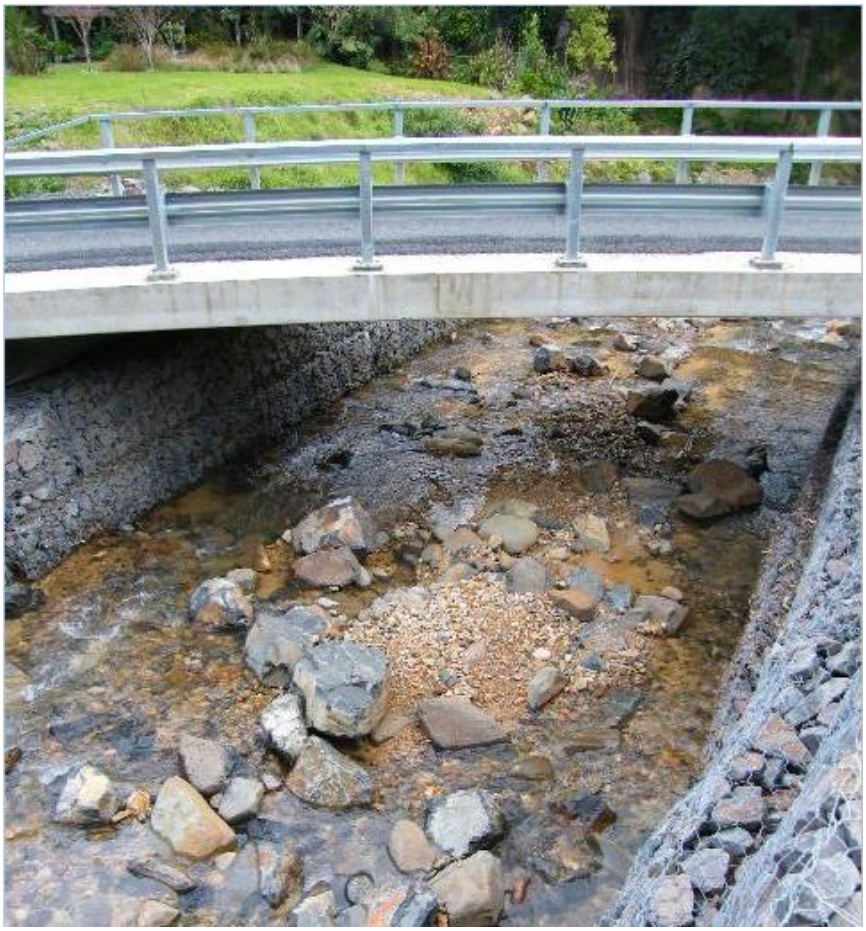
Waikato Regional Council Technical Report 2013/47

Pohue flood protection scheme design report



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Te Kaunihera ā Rohe o Waikato

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Executive summary

The Pohue community is located on the west coast of the Coromandel Peninsula, fourteen kilometres north of Thames on State Highway 25. In response to the severe floods generated by the "Weather Bomb 2002", Waikato Regional Council established the Peninsula Project to address river and catchment issues across the Peninsula through soil conservation, river management, animal pest control and flood protection measures. The work included risk assessment, technical investigations, a business case to Central Government, community consultation and establishment of a funding system to provide for undertaking flood mitigation works.

Pohue is one of the five priority communities identified as having a very high risk to life and property, requiring actions that address these risks. Since the introduction of the Peninsula Project in 2004, Waikato Regional Council and Thames Coromandel District Council, worked with the Pohue community to develop a flood mitigation strategy to address the Pohue Stream flood hazard. Interim flood mitigation works have been completed at Pohue, the details of which are provided in this Design Report.

For the success of this project it was essential that the community was involved with the development of the project. A flood working group was set up with members of the Pohue community and representation from TCDC, DOC and the local Iwi. The working group met at regular intervals to scope the issues, discuss options and to work together to implement the project.

Engineering investigations were undertaken by Waikato Regional Council to better understand the flood issues in Pohue, including a hydrological assessment of the Pohue catchment, a hydraulic assessment of Pohue Stream and the development of potential flood mitigation proposals. Several flooding issues were identified at Pohue, including the limited capacity of the stream channel and an undersized culvert causing blockages and overland flows during flood events.

Consultation was undertaken with the Pohue community with regard to preferred flood management options and over the period 2005 – 2008 a number of actions were agreed upon and implemented by Waikato Regional Council and Thames Coromandel District Council (TCDC), including the following:

- That annual channel maintenance work be undertaken to ensure blockages in the channel are cleared and sediment deposition on the stream bed is removed to maintain channel capacity.
- That the culvert under Pohue Creek Road be upgraded or replaced with a new culvert or bridge capable of carrying the bank full flow of the stream channel ($40m^3/s$ or the flow from the 5% Annual Exceedance Probability (AEP) event).
- Channel improvement works be undertaken including reshaping the Pohue Stream channel upstream of the bridge and partial bank protection.

The Pohue Creek Road culvert was identified as a significant restriction to flow and bed load movement. TCDC commissioned the upgrade of this culvert and a replacement bridge has been constructed. The new bridge is designed to have sufficient capacity to pass the existing 1% AEP flood flows ($67m^3/s$). The bridge design complies with Waikato Regional Council's design assessment.

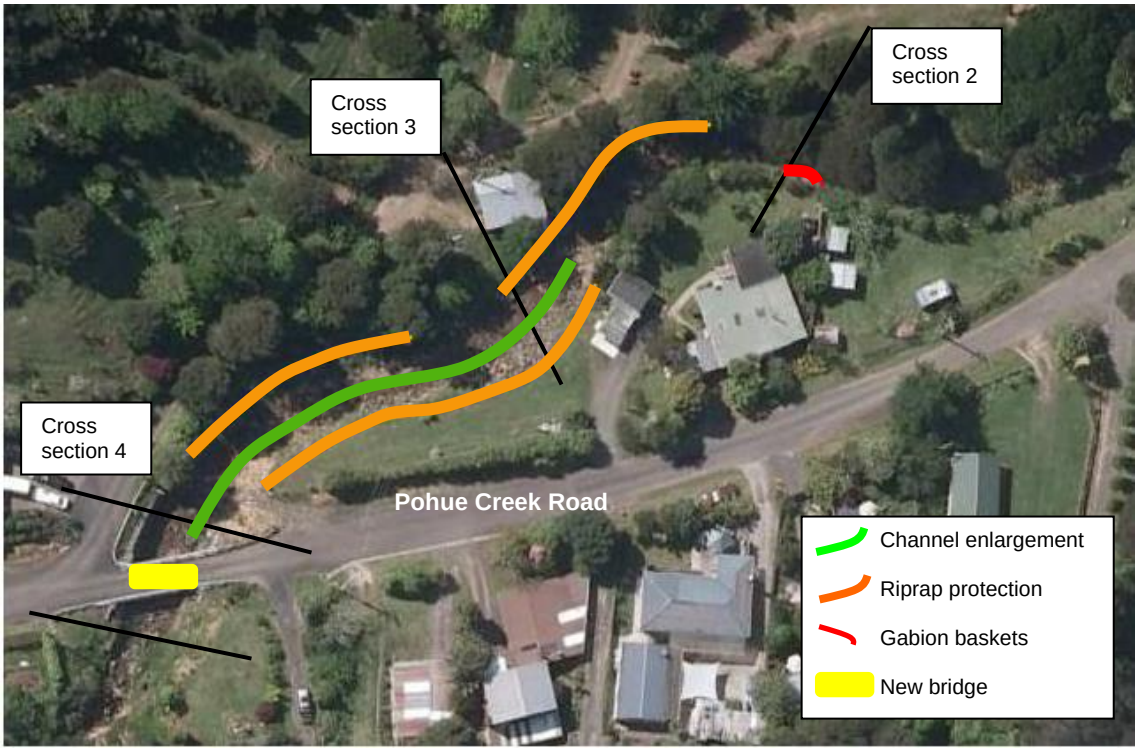
From initial assessments of the Pohue Stream channel, it was apparent that the capacity of the channel was inadequate for greater than the 5% AEP event. A hydraulic assessment was undertaken to design channel works, which along with the new bridge, would provide protection to the Pohue community for up to the 1% AEP event. To

improve the existing performance of the Pohue Stream channel the following works were recommended:

1. Channel enlargement from cross sections 1 to 4 inclusive (180m length).
2. Riprap protection (upper reach) on one side only from cross section 1 to a point approximately 20m upstream of cross section 3 (100m length).
3. Riprap protection (lower reach) on both sides of the channel from a point 20m upstream of cross section 3 to cross section 4 (80m length).

The indicative cost estimate for the full engineering works on the Pohue Stream was $179,500. Consultation was undertaken with the Pohue community and the community decided that it could only afford to pay for $50,000 worth of works. Council advised that the benefit of doing partial works would be limited, however the community wanted to progress on this basis.

Council assessed what works could be undertaken within this budgetary constraint and works were undertaken as a part of the Peninsula Project during the summer 07/08. The works focussed on the length of stream from the new bridge upward as far as the budget would extend. The works extended along approximate lengths illustrated in the figure below.



Completed engineering works at Pohue Stream

At this stage no further capital works are proposed for Pohue Stream. If at some point in the future the community decides it requires additional protection, and is able to fund the works, then council would look to extend the works further upstream. Subsequent stages of bank stabilisation and erosion protection works are to be undertaken over a longer term and on an as-required basis, using a consistent design approach.

The main channel of the Pohue Stream is monitored and periodically maintained by the Waikato Regional Council to remove accumulated sediment and debris. This work maintains the capacity of the Pohue Stream and reduces the risk to adjacent land that would otherwise be inundated more frequently.

‘Residual flood risk’ is a term used to describe a river flood risk that exists due to the potential for ‘greater than design’ flood events to occur. Residual flood risk applies to the Pohue community from factors such as the incomplete nature of the works, the greater than the design event, the impact of debris flow during a flood event and that the model excludes obstructions such as buildings and walls which may have localised effects.

Based on the flood hazard status of land in the community, TCDC has various planning controls in place via the Thames Coromandel District Plan, that restrict what land use activities can be undertaken. Refer to the Thames Coromandel District Plan and TCDC staff for details.

The flood mitigation scheme for Pohue community should be reviewed in accordance with the Coromandel Zone Management Plan. In addition if there are any significant changes in land use in the community the scheme would need to be reviewed. Due to funding constraints the full flood mitigation scheme was not constructed. If feedback from the community indicates that the community wants to increase their level of protection and are able to fund the works, then the scheme would be reviewed and completed if practicable.

1 Introduction

1.1 Background

The Pohue community is located on the west coast of the Coromandel Peninsula, fourteen kilometres north of Thames on State Highway 25. The Pohue community is located immediately adjacent, and to the north, of Waiomu. Although Pohue and Waiomu are located in two separate catchments they are generally regarded as one community, however for the purposes of this design report, Pohue is being dealt with separately to Waiomu.

In response to the severe floods generated by the "Weather Bomb 2002", Waikato Regional Council established the Peninsula Project to address river and catchment issues across the Peninsula through soil conservation, river management, animal pest control and flood protection measures.

Under the Peninsula Project WRC and Thames Coromandel District Council (TCDC) worked together on flood mitigation plans for five Thames Coast communities, including Waiomu/Pohue which are considered to represent one community. The work included risk assessments, technical investigations, development of risk mitigation options, development of a business case to central government for funding support and establishment of rating mechanisms. There was extensive community consultation on plans for these Thames Coast communities.

Since the introduction of the Peninsula Project in 2004, Waikato Regional Council and Thames Coromandel District Council, worked with the Pohue community to develop a flood mitigation strategy to address the Pohue Stream flood hazard. Works have been undertaken at Pohue to reduce the flood hazard from Pohue Stream, the details of which are provided in this Design Report.

1.2 Scope of report

The purpose of this Design Report is to provide a summary of the works that have been undertaken at Pohue to reduce the flood hazard from Pohue Stream, including the rationale behind the scheme development, the agreed levels of service, the design details, as built information, the operation and maintenance requirements of the scheme, the residual flood risk and the scheme review requirements.

The Design Report includes the following sections:

- Catchment overview
- Scheme design
- Flood mitigation scheme
- Agreed levels of service
- Operation and maintenance
- Residual flood risk
- Planning controls, and
- Scheme review.

2 Catchment overview

2.1 Catchment description

The Pohue community is located on the west coast of the Coromandel Peninsula, 14 kilometres north of Thames on State Highway 25 (refer to Figure 1).

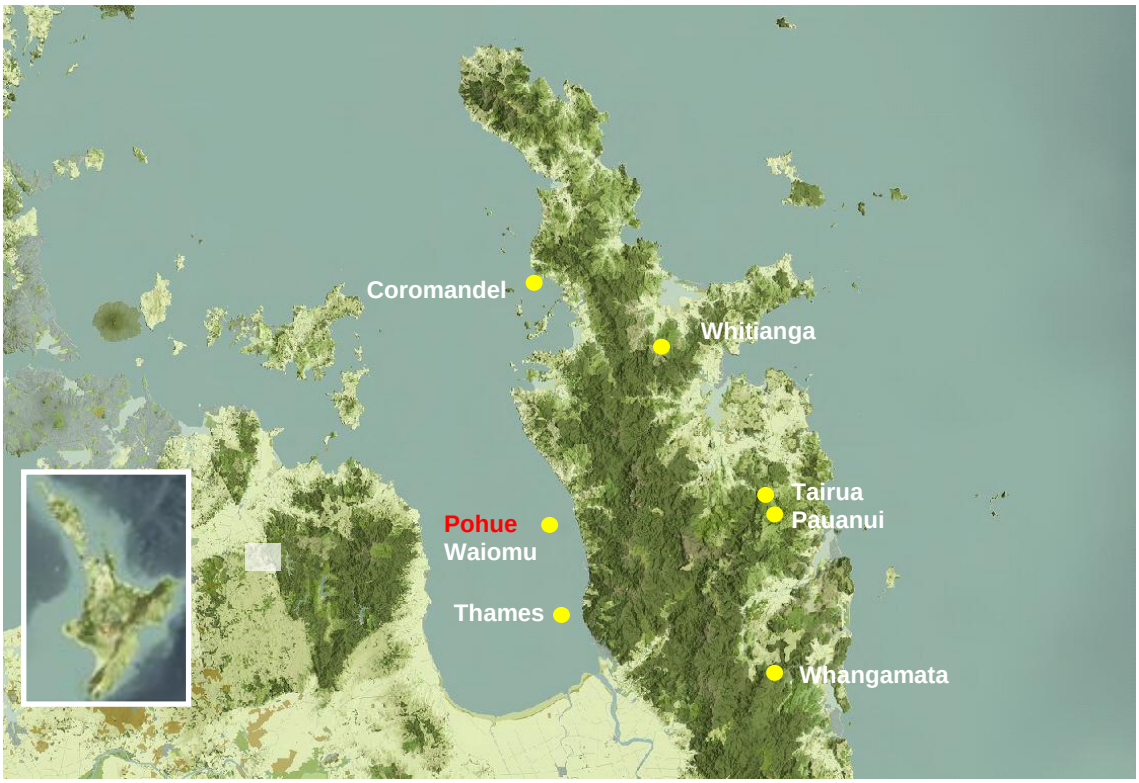


Figure 1 Thames-Coromandel district

The total area of the Pohue catchment equals 350 hectares (or 3.5 square kilometres). Around 96 percent of the catchment is covered by native forest while only 2.9 percent is in farmland. About 77 percent of the catchment is managed by the Department of Conservation (DOC). The urban area adjacent to the Pohue Stream makes up just 0.9 percent of the total catchment. Figure 2 below shows the boundary for the Pohue Stream catchment.

Figure 2 Pohue Stream catchment

2.2 Pohue Stream

The Pohue Stream flows out of the Coromandel Ranges and through the Pohue community before discharging to the Firth of Thames (refer to Figure 3). The Pohue Stream drains a very steep, hilly area, and the stream channel is deeply incised as a result. The stream is fed by approximately eight smaller tributary streams that are also deeply incised. During periods of heavy rain it takes about 30 minutes for water to get from the top of the catchment to the bottom.

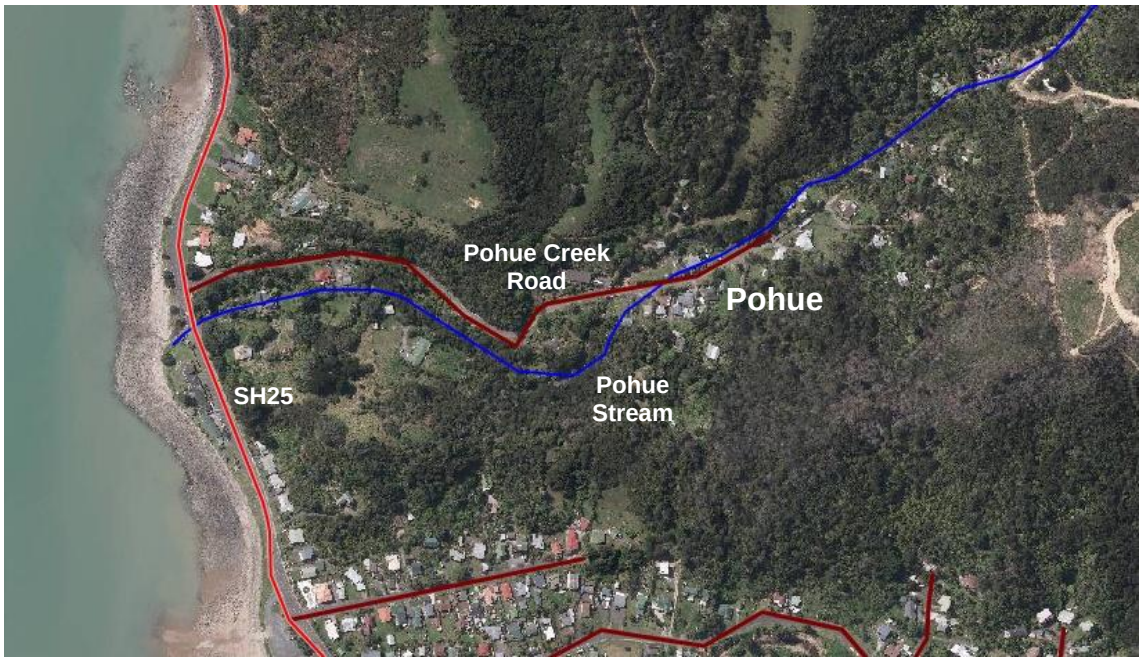


Figure 3 Pohue community

The existing channel performance prior to the scheme works being implemented was assessed to be the following for Pohue:

- Upstream of the culvert 5% AEP (20 year ARI) event
- Downstream of the culvert Not assessed

2.3 Flooding issues

The Pohue community is located within the valley created by the Pohue Stream. Residential development within the main portion of the community is located on the true left bank of the Pohue Stream, with many of the houses in the community located immediately adjacent to the stream. The Pohue catchment is susceptible to short duration but high intensity rainfall events causing flash flooding and debris flow in Pohue Stream with little or no warning.

During significant rain events the Pohue Stream breaks out of its banks and flows along Pohue Creek Road before re-entering the stream downstream of Pohue Creek Road crossing. A portion of the Pohue community is subject to a significant flood hazard from Pohue Stream. Figure 4 below illustrates the predominant flooding mechanism.

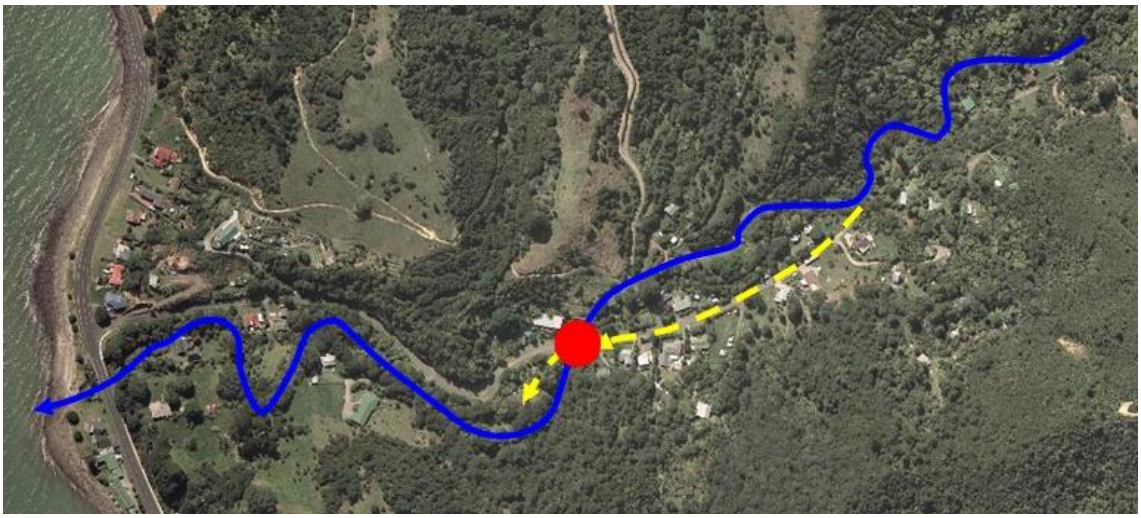


Figure 4 Predominant flooding mechanism at Pohue

The significance of the flood hazard to the Pohue community was demonstrated during the storm event that occurred on June 21, 2002 (also referred to as the 'Weather Bomb'). This event brought torrential rainfall to the Coromandel Peninsula (with unconfirmed intensities of up to 125 mm in 25 minutes) and caused widespread damage across the Thames-Coromandel and South Waikato Districts (Munro, 2002). The Pohue community sustained significant damage during this event.

Figure 5 below illustrates the damage sustained to properties in the Pohue community during the 'Weather Bomb'. Damage within the Pohue community is focused on those properties located on the true left bank of the Pohue Creek.

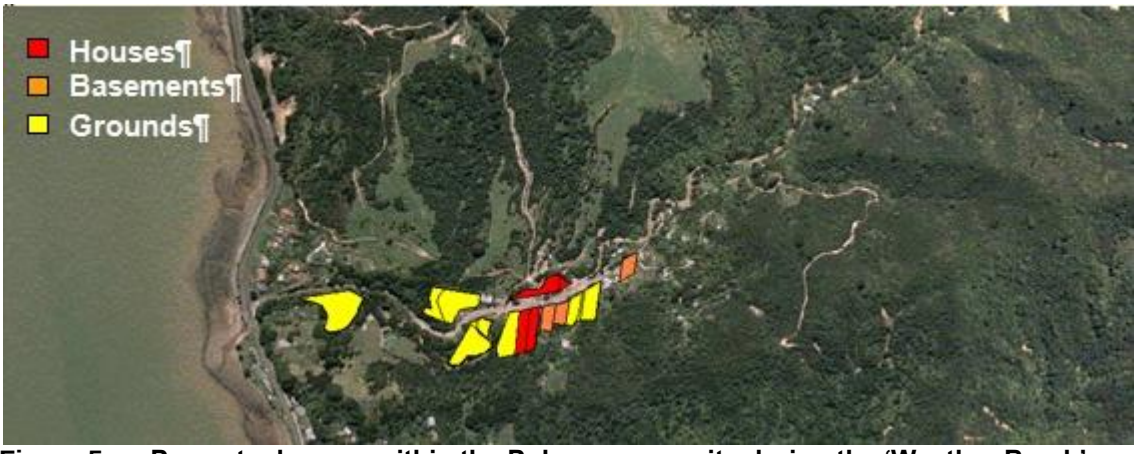


Figure 5 Property damage within the Pohue community during the 'Weather Bomb'

Following the 'Weather Bomb', the Waikato Regional Council and Thames Coromandel District Council initiated the Thames Coast Project to better understand the river flooding issues that affect the communities on the Thames Coast. This project also involved the identification of works to mitigate the impact of river flooding on people and property along the Thames Coast.

The Thames Coast Project focused on the five most vulnerable communities that were identified as being worst affected by both the weather bomb and historical flood events, which included the Pohue community.

2.4 Flood hazards

During the development of the Peninsula Project, WRC collected a significant amount of technical information covering the Pohue Stream catchment. This information is presented in WRC's Technical Report 2004/13 and includes:

- Historical research
- Catchment hydrology
- Lower channel hydraulics (1 dimensional)
- Floodplain hydraulics (2 dimensional)
- Flood hazard analysis (including extent and severity).

The main flooding issues identified in Pohue from these investigations are outlined below:

1. Pohue Stream channel capacity

The initial hydraulic assessment evaluated the bank full capacity of the Pohue Stream to be around 40m^3/s or the 5% Annual Exceedance Probability (AEP) event, hence the stream channel is overtopped in events greater than this, causing damage to some residential properties.

2. Channel stability

Bank stability and erosion have been identified along sections of the Pohue Stream. These sections require erosion protection works.

3. Capacity of the Pohue Road culvert

The Pohue Road culvert was evaluated as having a capacity of approximately 20m^3/s, which was significantly less than that of the stream channel. This reduced capacity lead to stream channel overtopping and contributed to flooding and associated property damage. This restriction also contributed to the accumulation of sediment within the

channel which further reduced the channel capacity and increased maintenance requirements.

4. Aggradation of the stream bed

Channel aggradations and channel blockages are an ongoing issue with the Pohue Stream that will require ongoing maintenance.

5. Catchment stability

While the majority of the catchment appears to be in indigenous forest/scrub vegetation, the under-storey vegetation is in poor condition due to pest animals (wild goats and possums).

Catchment management initiatives such as pest control, fencing and planting of stream banks have been proposed for this catchment and are currently being implemented to restore the catchment health and reduce the amount of soil erosion and slips. These catchment management measures are expected to reduce the amount of floating debris and soil erosion in the more frequent events (50% - 5% AEP events), however they are less effective for more significant events.

3 Scheme design

3.1 Technical information

During the development of the Thames Coast Project, Waikato Regional Council collected a significant amount of technical information covering the Pohue Stream catchment. This information is presented in WRC's Technical Report 2004/13 and includes:

- historical research
- catchment hydrology
- lower channel hydraulics (1 dimensional)
- floodplain hydraulics (2 dimensional)
- flood hazard analysis (including extent and severity).

Some of the key data sources and findings that have informed technical investigations are summarised below.

Table 1 Summary of technical reports covering flood events on the Thames coast

Flood Event	Technical reports
April 1981	HCB Report 109 and 123 (Sep 1981 and June 1982)
February 1985	HCB Report 190 (October 1985)
Cyclone Bola	No technical reports located
Cyclone Drena	No technical reports located
January 2002	No technical reports located
June 2002	EW Report 2002/10 (July 2002)

Table 2 Technical reports covering flood mitigation and management at Pohue

Community	Previously completed technical investigations
Pohue	No technical investigations previously completed

Table 3 Summary of completed flood mitigation works at Pohue

Community	Previously completed works
Pohue	No flood hazard mitigation works have been previously completed within the Pohue community other than periodic clearing of the channel.

3.2 Initial investigations

The performance of the Pohue Stream channel was initially assessed using Manning's equation for open channel flow.

This hydraulic assessment of the Pohue Stream derived the following facts:

- The bank full capacity of the Pohue Stream is around 40 m^3/s. This flow was assessed as the 5% AEP event.

- The Pohue Creek Road culvert had a capacity of 20 m^3/s. This represents a significant restriction in the Pohue Stream channel and has resulted in sediment accumulation upstream of the culvert.

3.3 Design principles

To address the flood issues present in Pohue, Waikato Regional Council undertook to develop a flood mitigation strategy for the community.

The main flood issues for Pohue included limited channel capacity, a collapsing culvert under Pohue Creek Road with insufficient capacity and channel stability issues. The Thames Coromandel District Council agreed to upgrade the culvert to a single lane bridge, and Waikato Regional Council agreed to undertake channel works to increase channel capacity and stability.

When undertaking the channel design for Pohue Stream, consideration was made of the natural processes which occur within a stream. The channel works have been designed for the purpose of reducing flooding; hence channel profiles have been designed to accommodate flows in the 1% Annual Exceedance Probability (AEP) events for existing climatic conditions.

While the less frequent and more significant events are important to consider for flood management purposes, the more frequent and less significant events, or "channel forming flows" (all flows up to the annual flood or 50% AEP event), should also be considered as these flows are responsible for defining the stream's velocity profile, carrying the majority of the sediment and for forming the natural stream channel. Channel forming flows will also have the greatest effect on the ecology and natural environment of the stream. When designing for channel forming flows an attempt to mimic the natural stream processes should be made. The design of a channel should include:

1. Retaining the natural velocity profile
This may be achieved by mimicking the natural cross section up to the annual flood water level. Where this is not possible a similar area to depth relationship should be retained. Also important is the gradient of the stream. This should not be altered from the natural system as aggradation and/or degradation may be accelerated. Gradient control structures may be necessary in some cases.

2. Retaining the native substrate
It may be necessary to excavate the bed to form a desired profile. Where the excavation causes an alteration to the bed material makeup, the surface layer of excavated material should be stockpiled and replaced to retain as much of the native substrate as possible.

3. Retaining natural features
Where natural features such as pools and overhangs exist, and these features are to be removed as a result of the works, consideration should be given to artificially reinstating these features.

Whilst the channel works have been designed for the purpose of reducing flooding; the design has also been developed to mimic the existing stream features, as outlined above, as much as possible.

Streams are complex systems that are constantly in a state of flux, hence while it is important to undertake the design so as to retain as many of the natural features as possible, it is likely that the natural stream processes will form the long term characteristics of the stream.

For small communities costs are always an important factor to be considered when

developing a flood mitigation strategy. The Pohue community is not large; hence the rating base cannot fund significant works. Based on feedback from the community, a maximum sum of money was agreed upon that could be financed by the community, it was then up to the Waikato Regional Council to assess what could be achieved within this budgetary constraint.

3.4 Hydrological assessment

To evaluate and design the channel capacity for the Pohue Stream it was necessary to undertake hydrological analysis to determine the likely flows in various events. A similar method of hydrological assessment was employed at Pohue Stream catchment as at other catchments along the Thames Coast. This used the Rational Method in conjunction with site specific rainfall data produced by the High Intensity Rainfall Design System (HIRDS) Version 2.0 (this was the most current version of HIRDS at the time of the design).

This rainfall-runoff methodology was validated by:

- Comparing the results with the rainfall intensities and peak flood flows observed during the significant event in October 2002 (the 'Weather Bomb').

- Comparing the results with the flood frequency analysis for the adjacent Kauaeranga River catchment which is a gauged river (Council's Smiths Recorder is located on the Kauaeranga River).

Using the Rational Method and using the physical characteristics as described above, a hydrological assessment was undertaken. A summary of the hydrological assessment completed for the Pohue Stream catchment is presented in the following figure.

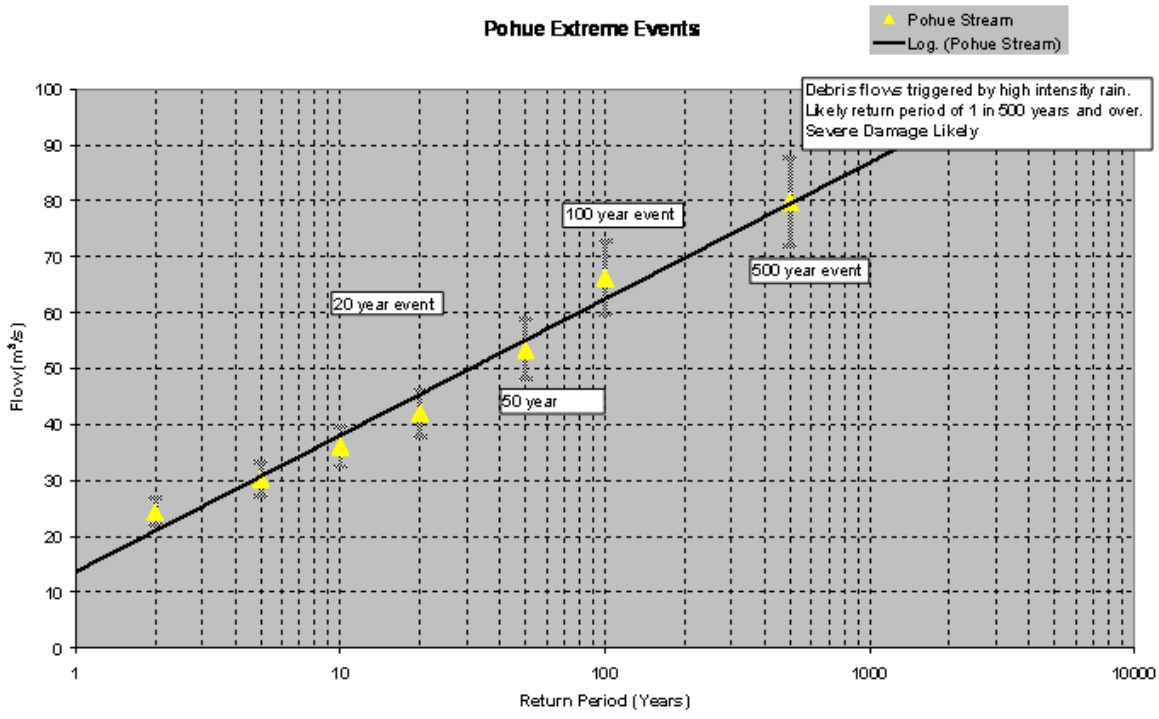


Figure 6 Pohue Stream flood frequency graph

This hydrological data was then used to inform the hydraulic assessment of the Pohue Stream.

3.5 Model development

A MIKE-11 one dimensional model was developed to represent the Pohue Stream using existing channel cross section information and the hydrological information discussed above.

The model inputs included:

- Cross section survey data was used to define the channel dimensions. The survey was undertaken by FW Millingtons Ltd in September 2004 (refer WRC DM# 2962965 for details). Cross sections were surveyed at nominal 50m intervals. These cross sections were input into the MIKE-11 model to define the channel capacity.

- Upstream flow hydrograph - representing the 1% AEP flow (existing) of 66m^3/s for the Pohue Stream.

- Downstream water level - a constant water level equating to the Mean High Water Spring in the Firth of Thames at chainage 259.63m in Pohue of RL19.0m.

- A Manning's n value of 0.06 was applied to the channel design.

The MIKE-11 hydraulic model is located on the WRC system in the following folder:

G:\RCS\Technical Services\Projects\Coromandel Zone\Pohue\Hydraulics\MIKE11\6. Proposed Design_Dec 07 (a readme file is located in this folder providing an explanation about the model files).

This hydraulic model was then used to develop a design for the channel works and associated design components.

4 Flood mitigation scheme

4.1 Overall objectives

The overall objectives for the flood protection scheme at Pohue included:

- Improvement of the performance of the Pohue Stream channel and floodway over the section that is within the Pohue urban area.

- Relieving the restriction created by the Pohue Creek Road culvert.

The key limitation to undertaking engineering works in the lower Pohue Stream was the limited number of properties that would directly benefit from any works.

The following sections outline the components of the flood protection works, including the upgrade of the Pohue Creek Road culvert, channel improvements and catchment management works.

4.2 Pohue Creek Road culvert upgrade

The Pohue Creek Road culvert was identified as a significant restriction to flow and bed load movement. TCDC commissioned the upgrade of this culvert and a replacement bridge has been constructed.

The new bridge is designed to have sufficient capacity to pass the 1% AEP flood flows ($67m^3/s$). Based on TCDC design drawings dated December 06 (refer Appendix 3 for details), the new bridge has been designed as follows:

- existing culverts excavated to bed level and riprap as directed
- 12.0m nominal span bridge
- proposed bed level RL5.75m (existing bed level RL7.16m)
- road design level RL8.86m
- bridge soffit approximately RL8.35m
- cross sectional area beneath bridge approximately $25m^2$
- 300mm reno mattress stream bed protection
- 1m x 1m gabion basket bank protection
- batters shaped to suit (1:1.5 nominal slope)

The bridge design complies with Waikato Regional Council's design assessment.

4.3 Channel improvements

From initial assessments of the Pohue Stream channel, it was apparent that the capacity of the channel was inadequate for greater than the 5% AEP event. Using the MIKE-11 hydraulic model discussed above, a hydraulic assessment was undertaken to design channel works, which along with the new bridge, would provide protection to the Pohue community for up to the 1% AEP event.

Channel excavation works were proposed upstream of the new bridge. The existing channel had sufficient capacity at Cross Section 5; hence only minor works were required at this location to tie the bridge structure into the stream channel. Figure 7 below illustrates the location of works.

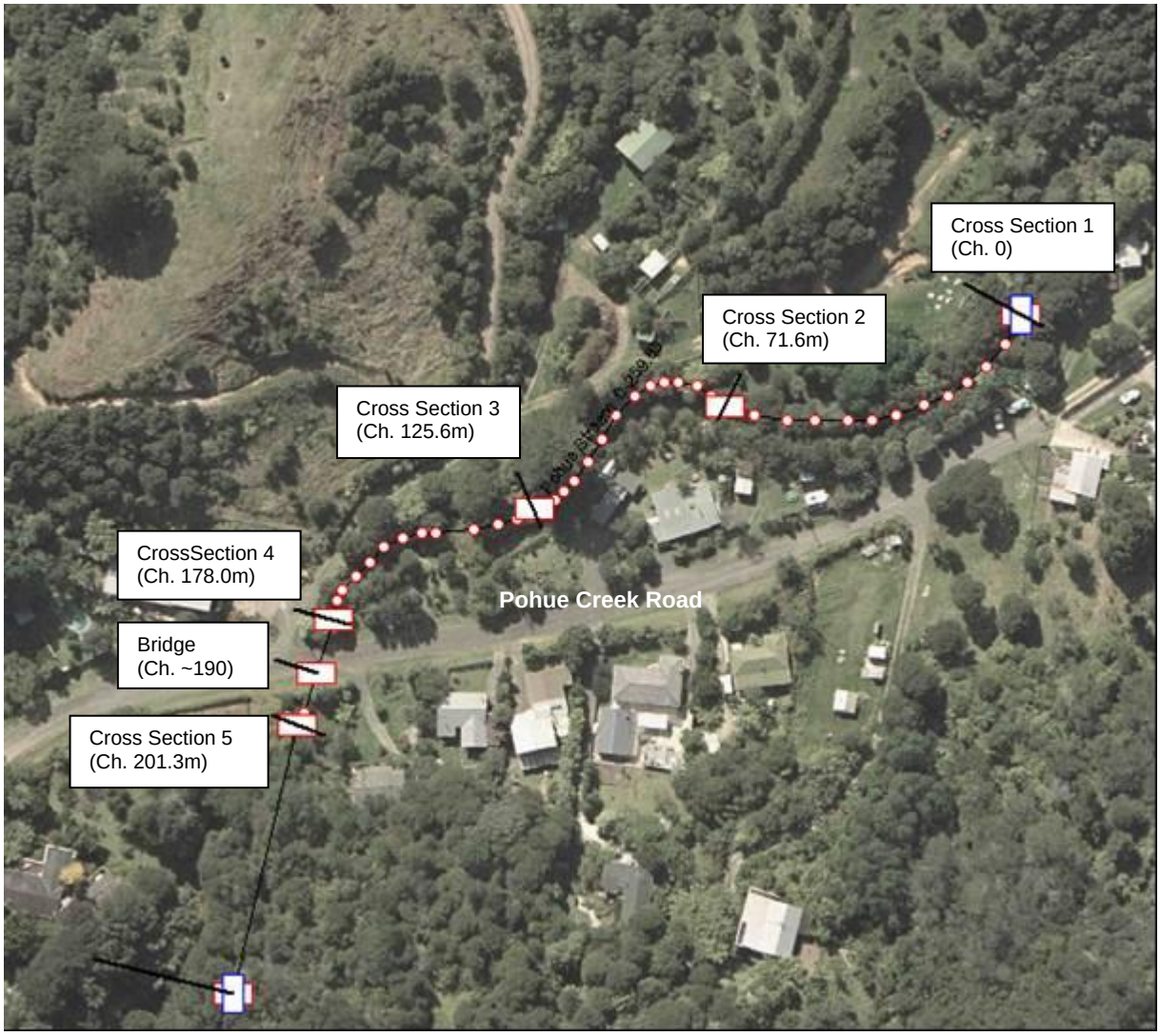


Figure 7 Location of works

The design of the channel excavation works was developed to:

- Increase the capacity of the channel so that it can pass the 1%AEP event (67 m^3/s) without spilling out of channel.
- Achieve a similar gradient to the existing channel (0.035m/m).
- Maintain a bed width of 4.0m and a bank slope of 1.25:1 to 1:1.
- Minimise the amount of excavation required to reduce the potential effects on the stream and surrounds and the associated costs.

To improve the existing performance of the Pohue Stream channel the following works were recommended:

1. Channel enlargement from cross sections 1 to 4 inclusive (180m length).
2. Riprap protection (upper reach) <u>one side only</u> from cross section 1 to a point approximately 20m upstream of cross section 3 (100m length).

3. Riprap protection (lower reach) both sides of the channel from a point 20m upstream of cross section 3 to cross section 4 (80m length).

The works are summarised in Figure 8 below. Further design details are provided in Appendix 1. Also refer to WRC DM#1073191 for design calculations.

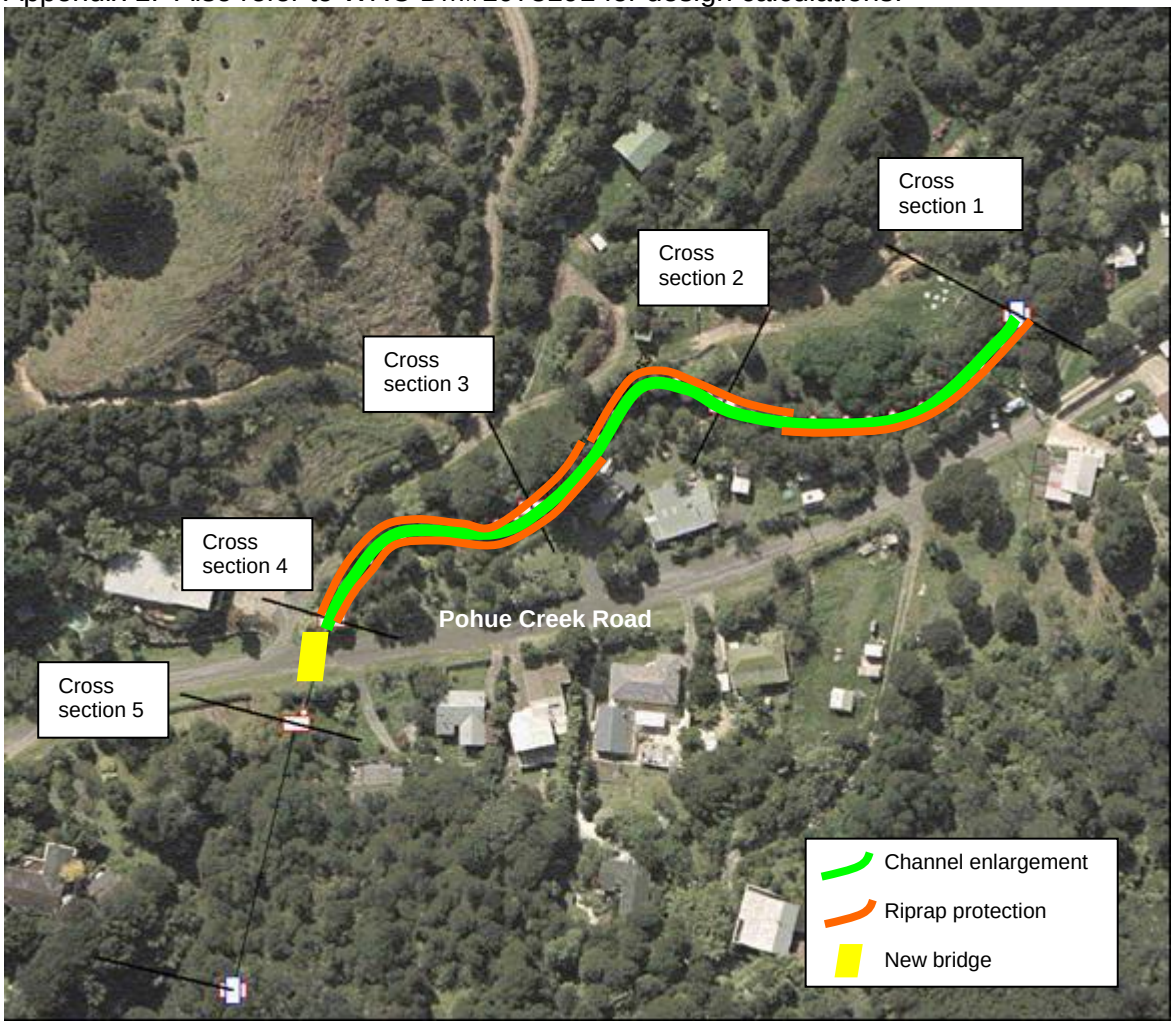


Figure 8 Proposed engineering works at Pohue Stream

A summary of the key dimensions of the existing and proposed channel profile is provided below.

Table 4 Existing and proposed channel profiles

	Existing			Proposed		
	Bed width (m)	**Top width (m)**	**Depth (m)**	**Bed width (m)**	**Top width (m)**	**Depth (m)**
XS1	3.34	7.11	1.12	4	8.78	1.87
XS2	2.89	5.81	1.06	4	7.39	1.81
XS3	3.63	6.06	1.67	4	9.41	2.54
XS4	3.22	8.67	2.03	4	11.07	2.59
XS5	3.48	12.21	4.25	3.48	12.21	4.25

Design cross sections were developed and then the design was checked using the MIKE-11 hydraulic model, to ensure the channel could pass the 1% AEP event (67 m^3/s).

A minimum freeboard of 300mm has been achieved at all cross sections except in the upper portion of the study area – in the vicinity of Cross Section 2. At this location it was proposed that the left bank would be re-shaped to form a small bund approximately 120m long (from Ch. 5 to Ch. 125) with a maximum height of 570mm, refer to the long section provided in Appendix 1 for details.

A gradient control structure was required at Cross Section 4 (Ch. 178m).

A low flow channel should be created in the base of the channel that meanders across the width depending on the alignment of the stream.

4.4 Channel stability

Excavation of the channel can lead to increased potential for bank instability. It would be preferable to have a bank slope of at least 1.5:1, however after site inspection it was apparent that there is insufficient space for this bank slope taking into account the proximity of residential dwellings to the stream. The bank slope has been increased to 1:1 for XS1 – XS3 (and steeper for XS2) and is 1.25:1 for XS4, hence bank armouring will be required to minimise bank instability, particularly on the outward side of bends. Bank armouring will involve the use of debris deposited along the stream bed and imported rock and the placement of this material along the stream banks at identified locations.

4.5 Completed works

The indicative cost estimate for the full engineering works on the Pohue Stream was $179,500 (a cost breakdown is provided in Appendix 2).

Consultation was undertaken with the Pohue community and the community decided that it could only afford to pay for $50,000 worth of works. Council advised that the benefit of doing partial works would be limited, however the community wanted to progress on this basis.

Council assessed what works could be undertaken within this budgetary constraint and works were undertaken as a part of the Peninsula Project during the summer 07/08. The works focussed on the length of stream from the new bridge upward as far as the budget would extend. Summer 2011/12, some gabion baskets were placed on the left bank of the stream in the vicinity of Cross section 2 to help provide bank stability. The works extended along approximate lengths illustrated in Figure 9 below.

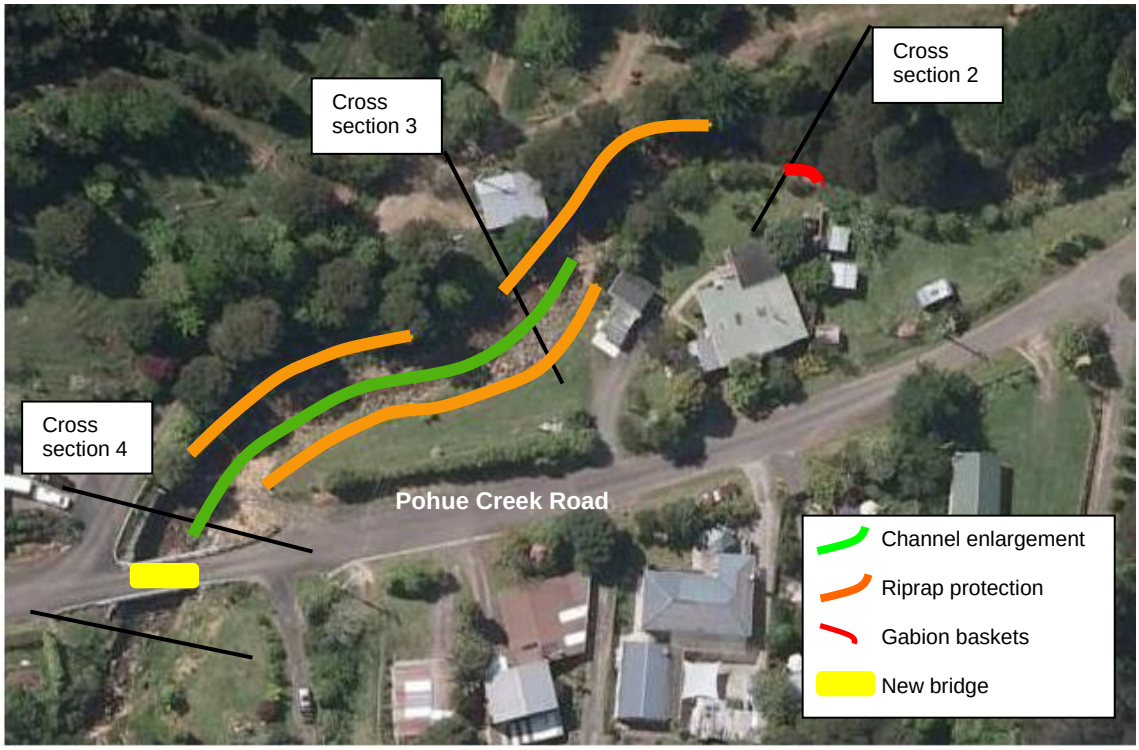


Figure 9 Completed engineering works at Pohue Stream

4.6 Catchment management works

Catchment management works have been undertaken within the Pohue Stream catchment covering the following areas:

- Protection of existing indigenous vegetation from livestock through retiring and fencing land.
- A continued goat and possum control programme.
- Removal of channel obstructions and accumulated sediment in the Pohue Stream and the tributaries to both (where appropriate access is available).
- Re-vegetation of areas prone to erosion (landslide material and riparian margins).

These works help to improve the health of the catchment and reduce the potential for erosion occurring in the upper catchment which can lead to increased debris flow in the stream.

4.7 Future works

To achieve the long term community outcomes of safe and healthy living environment, the flood mitigation strategy for the Pohue community includes the following:

1. The replacement of the culvert by a bridge, with a waterway capacity to accommodate the 1% AEP flow. This work has been completed.
2. Channel upgrade works to accommodate the 1% AEP flow; this work has been partially completed.
3. Stream bank stabilisation and erosion protection works to be undertaken in stages,

the first of which was undertaken in conjunction with the channel upgrade works, and was designed to address the protection of critical sections of the stream channel (in the vicinity of the new bridge and at the stream bends). The second stage of bank stabilisation and erosion protection works are to be undertaken over a longer term and on an as-required basis, using a consistent design approach.

At this stage no further capital works are proposed for Pohue Stream. If at some point in the future the community decides it requires additional protection, and is able to fund the works, then council would look to extend the works further upstream.

5 Agreed levels of service

The Coromandel Zone Management Plan (River and Catchment Services et al, 2011) outlines the agreed levels of service for the Coromandel. The agreed levels of service provided for the Coromandel zone were initially developed when the Peninsula Project was established in 2004. The current service levels were confirmed through an extensive consultation process initially undertaken in 2003/04, and subsequently updated by the LTP processes in 2006 and 2009.

In the Coromandel Zone Management Plan the Thames coast, including the Pohue catchment, is identified as a high priority area for flood protection schemes and for upper catchment protection through animal pest control (feral goats and possums). Additional works could focus on hill side erosion and stabilising erosion prone pastoral lands. The Thames Coast has a direct relationship to the Firth of Thames.

The flood protection scheme at Pohue is identified as needing to be maintained and managed to ensure the level of service for flood protection assets is maintained. The level of service provided by the Pohue scheme is detailed in Section 4 and in Appendix 1.

Routine river management is identified for high priority catchments to reduce the risks of localised flooding through removal of willow congestion and blockages and to provide long term environmental benefits through improved water quality, keeping stock out of stream and fencing and planting of stream banks to reduce stream bank erosion.

6 Operation and maintenance

The main channel of the Pohue Stream is monitored and periodically maintained by the Waikato Regional Council to remove accumulated sediment and debris (refer to Figure 10 for extent of maintenance). This work maintains the capacity of the Pohue Stream and reduces the risk to adjacent land that would otherwise be inundated more frequently, and also helps to maintain the performance of the flood protection scheme.

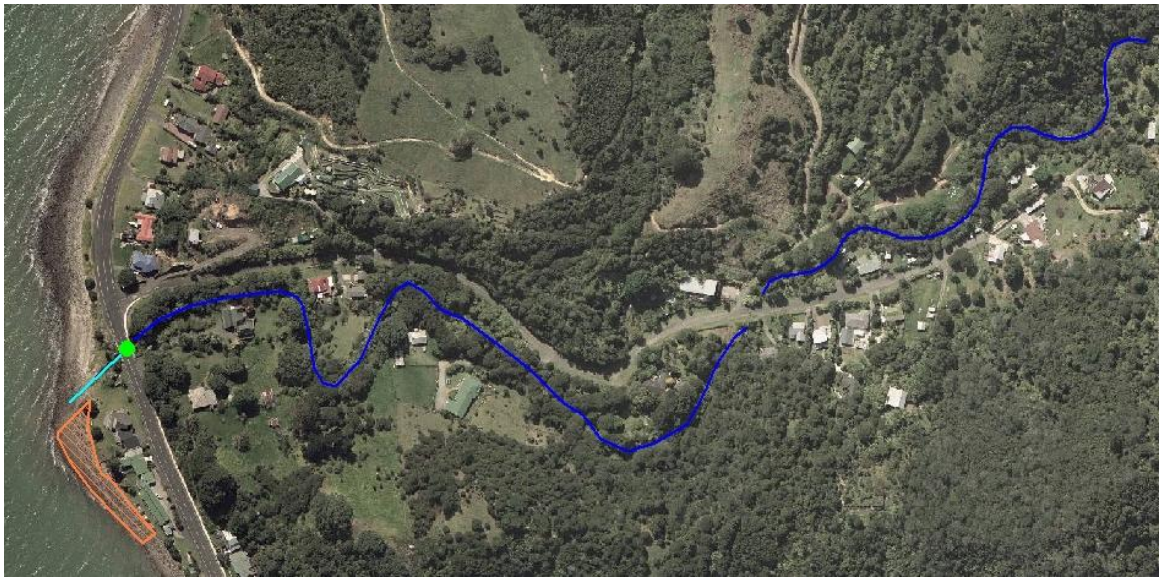


Figure 10 Extent of channel maintenance

The annual maintenance programme includes the removal of accumulating gravel and sediment in Pohue Stream, based on current cross sectional areas. These works are carried after annual inspection and monitoring of changes in the streams. The specific activities associated with this annual work programme include:

- The stream is walked over at least once a year to undertake a condition survey.
- Removal of accumulated gravel, sand and debris from a 560 m section of the Pohue Stream (refer to diagram for proposed extent).
- Some erosion has been repaired immediately downstream of the Pohue Creek Road Bridge.
- Pest plant spraying is the primary activity between the SH25 Bridge and the Pohue Creek Road Bridge, due to limited access.
- Above the SH25 Bridge, erosion repair work has been undertaken along the first 300m of the stream channel (several times in the past six years).
- Removal of accumulated gravel, sand, silt and debris from under the SH25 Bridge across the Pohue Stream.
- Removal of accumulated sand, silt and debris from the Pohue Stream between the SH25 Bridge and Firth of Thames (i.e. 40 m length of channel).
- Disposal of excavated gravel, sand and silt on the local foreshore below the high tide level.

- After rain events, access is gained to the section of stream upstream of the Pohue Creek Road Bridge to clear the channel and restack rocks along the bank.

The channel protection works are inspected annually for:

- Any movement of rock rip rap or associated channel erosion and scour and potential undermining channel protection works.

- Any necessary repair work is undertaken as required.

7 Residual flood risk

'Residual flood risk' is a term used to describe a river flood risk that exists due to the potential for 'greater than design' flood events to occur. The concept of residual flood risk is relatively new, but provides a more complete assessment of risk when compared with traditional approaches that rarely look beyond 'design conditions'.

The residual flood risks that affect the Pohue community are described as follows:

- The river flood model used to design the flood protection scheme is based on a 'design flood event'. There is however the potential for larger flood events to occur, resulting in wider, higher and faster flood waters.

- Due to the financial limitations on what works could be completed at Pohue, the works were only partially completed.

- The river flood model used to design the flood protection scheme is based on detailed ground level information, but excludes obstructions such as buildings and walls. These obstructions may result in wider, higher and faster flood waters.

- The river flood model used to design the flood protection scheme incorporates the impacts of sediment and debris. However, there may be instances where sediment and debris causes localised changes to the flood extent, depth and speed. This includes debris flow events that will produce significantly different flooding characteristics.

- This river flood model used to design the flood protection scheme is only relevant to flooding caused by the Pohue Stream. However, there is also the potential for flooding to occur in other waterways and due to the overwhelming (or lack) of local land drainage infrastructure.

- The river flood model is based on the existing condition of the Pohue Stream catchment. Any significant change to this condition will affect the river flood hazard that affects the Pohue community. For example, land use changes, deforestation and the intensification of development. Where significant changes do occur, this river flood model and associated flood protection scheme should be reviewed.

8 Planning controls

The proposed engineering works if completed in entirety, combined with river and catchment management activities, would protect most residential properties in Pohue against a 1%AEP event. Due to the incomplete nature of the works at Pohue, the community is generally still at risk from the 5% AEP event. There remains residual flood risk to the community as outlined in Section 7 above.

Based on the flood hazard status of land in the community, TCDC has various planning controls in place via the Thames Coromandel District Plan, that restrict what land use activities can be undertaken. The planning controls include measures such as:

- No development or re-development allowed in the floodway, and in residual high risk areas.
- Minimum floor level restrictions and construction requirements (e.g. flood proofing) for areas not protected by the works.
- For other protected areas within the present flood hazard areas, limited floor level restrictions would have to apply.

Refer to the Thames Coromandel District Plan and TCDC staff for details.

9 Scheme review

The Coromandel Zone Management Plan outlines agreed levels of service for the flood protection schemes on the Coromandel, including commentary on scheme reviews. It is stated that river and flood protection schemes will provide the standard of flood protection agreed with the community, and that this will be achieved by:

- Maintaining stopbanks to the design heights, achieving performance grade 3 or better.
- Responding to flood events by alerting communities prior to events, continuously monitoring river systems, undertaking emergency remedial works and reviewing system performance and maintenance requirements following flood events.
- Undertaking ongoing visual inspections of flood protection structures, reporting formally on an annual basis and following up on maintenance and repair requirements following flood events.
- Reporting annually to the subcommittee and Catchment Services Committee on flood protection performance measures.
- Undertaking flood protection works within consent conditions.
- Making the likelihood and consequences of greater-than-design flood events clear to communities and providing advice for communities on managing these risks (residual flood risks).
- Conducting all flood protection work in accordance with Council health and safety policies.

The following procedures will measure whether performance targets are achieved:

- Annual performance and condition inspections.
- Yearly performance measures reports to subcommittee and Catchment Services Committee.
- Assessing ongoing changes to catchments, and undertaking design flood level reviews once every 5 years as required.
- Annual health & safety audits.

The river flood model and hence the design of the flood mitigation scheme is based on the existing condition of the Pohue Stream catchment. Any significant change to this condition, for example land use intensification or deforestation, will affect the assumptions of the river flood model and hence compromise the basis of the scheme design. Where significant changes do occur, the river flood model and associated flood mitigation scheme should be reviewed.

Due to funding constraints the full flood mitigation scheme was not constructed. If feedback from the community indicates that the community wants to increase their level of protection and are able to fund the works, then the scheme would be reviewed and completed if practicable.

10 References

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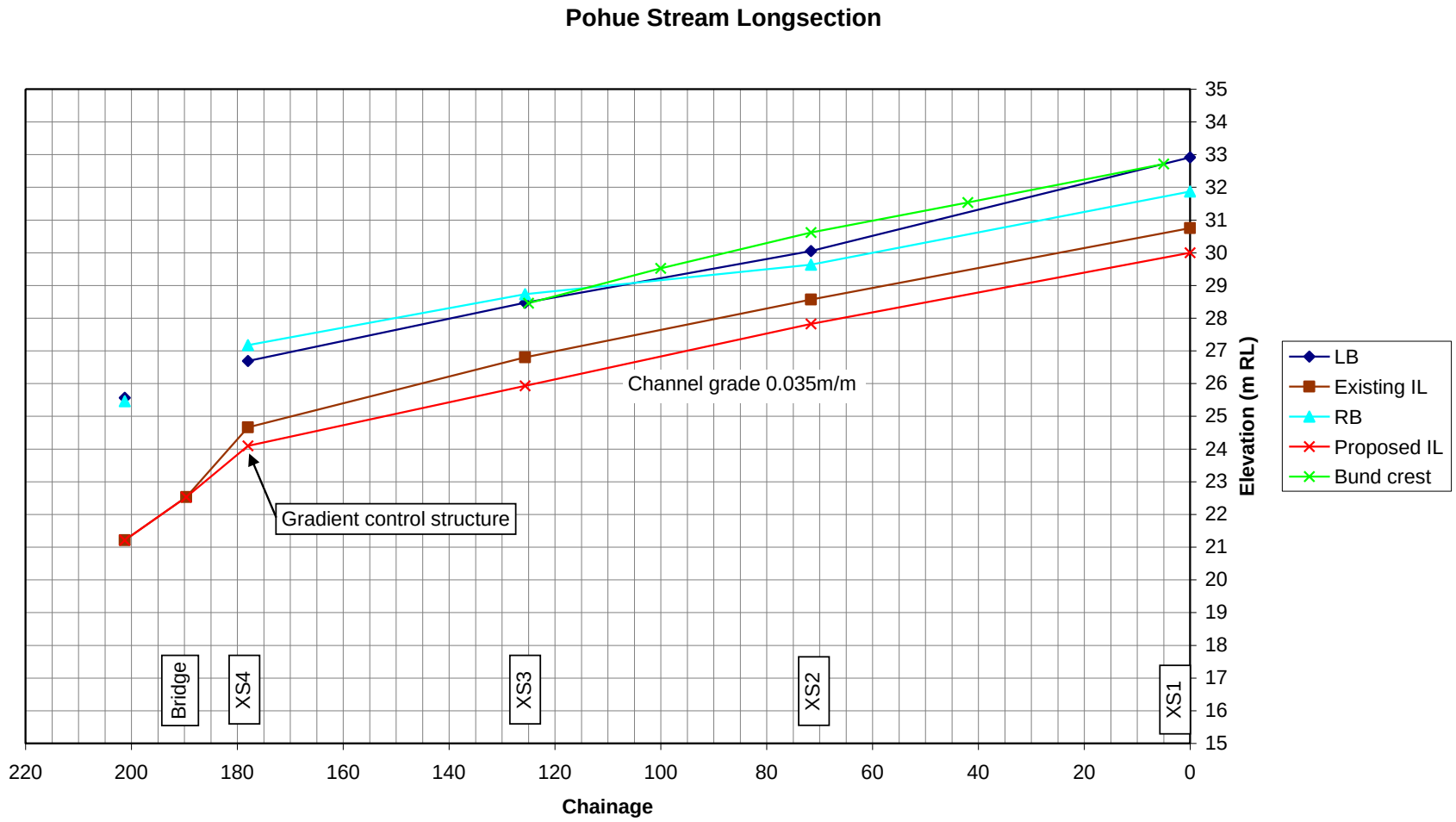
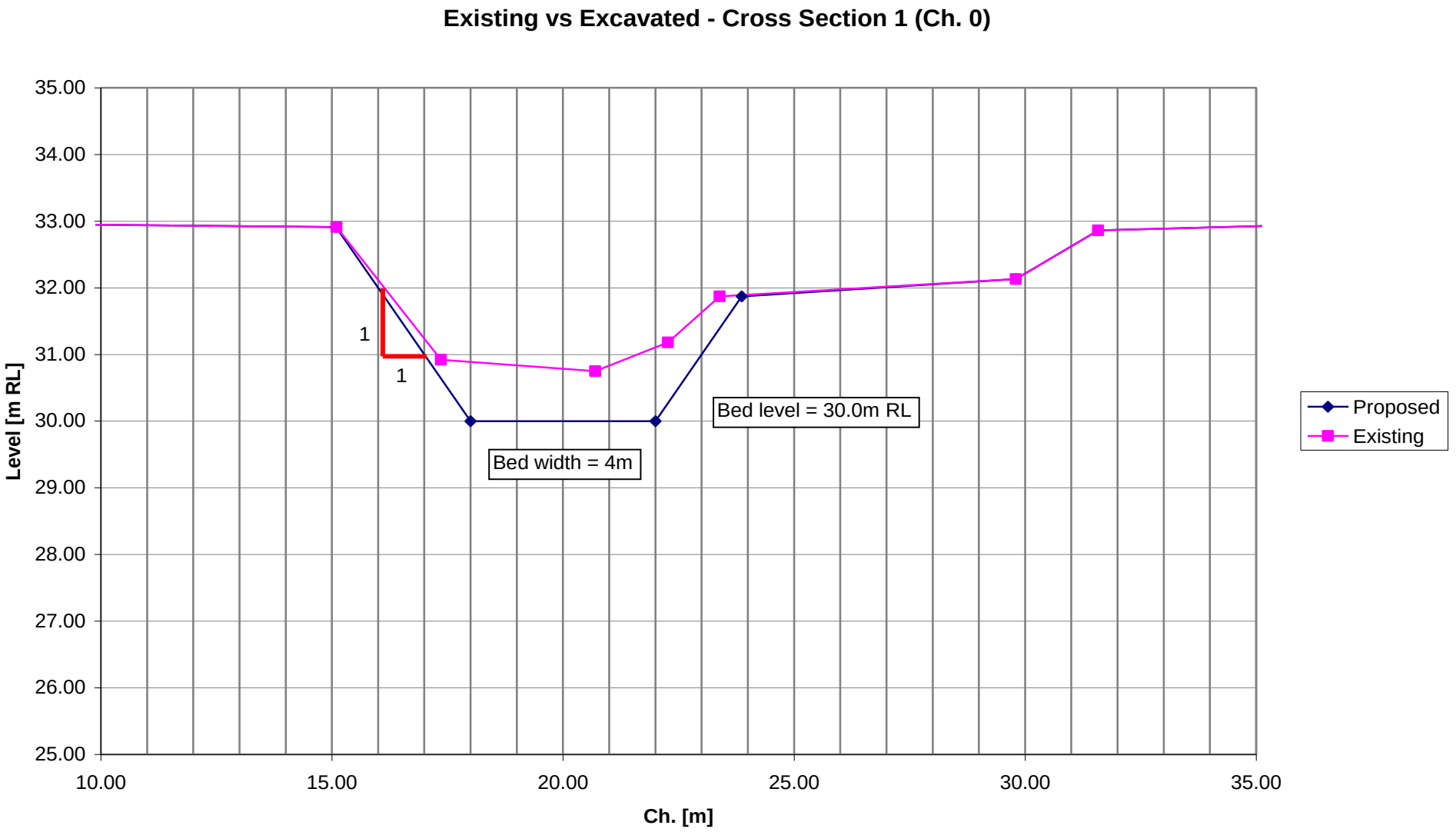
Appendix 1 Design information

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27.00
26.00
25.00
10.00
15.00
20.00
25.00
30.00
35.00
Ch. [m]
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1
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Bed level = 30.0m RL
Proposed
Existing

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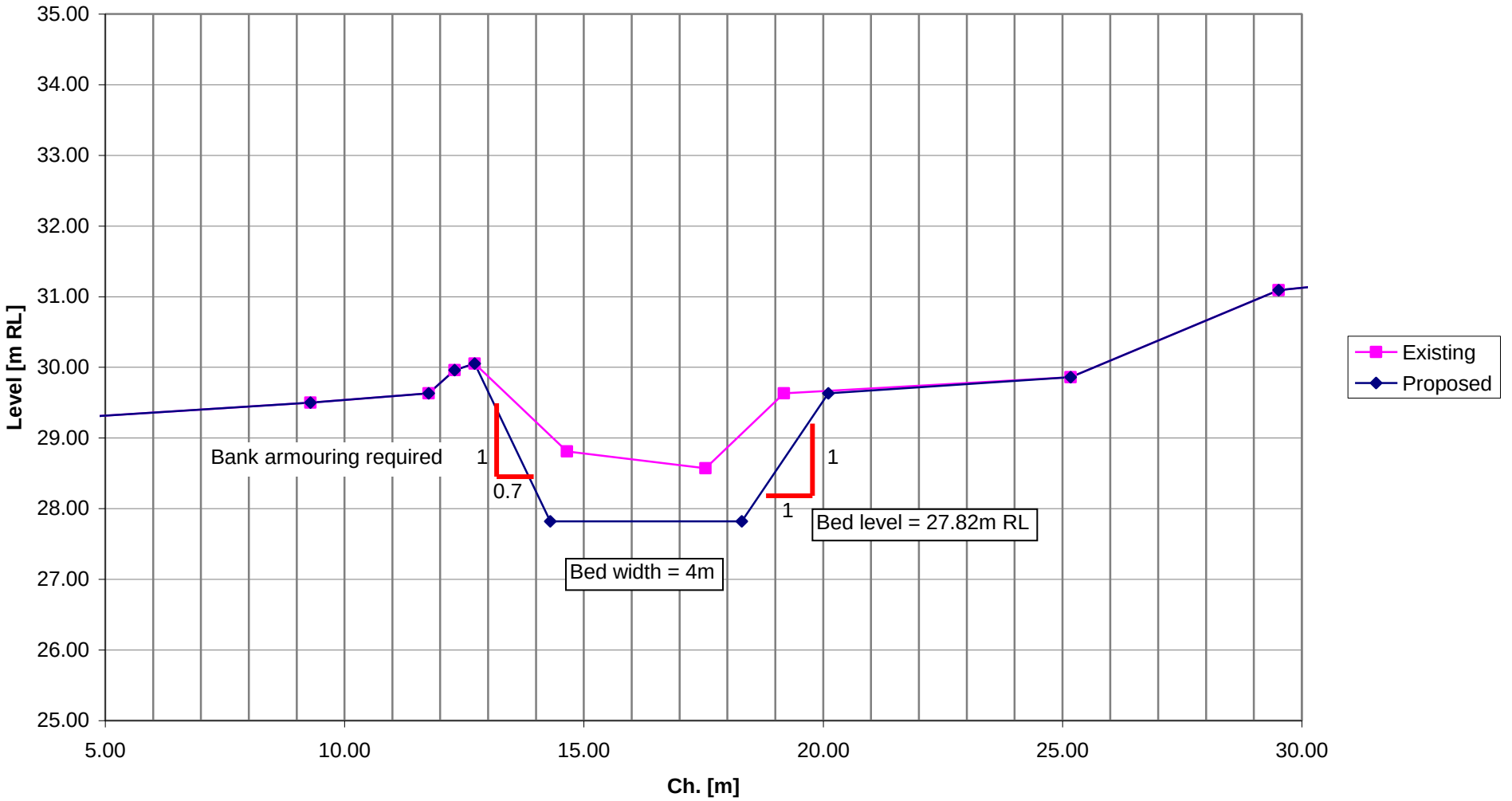

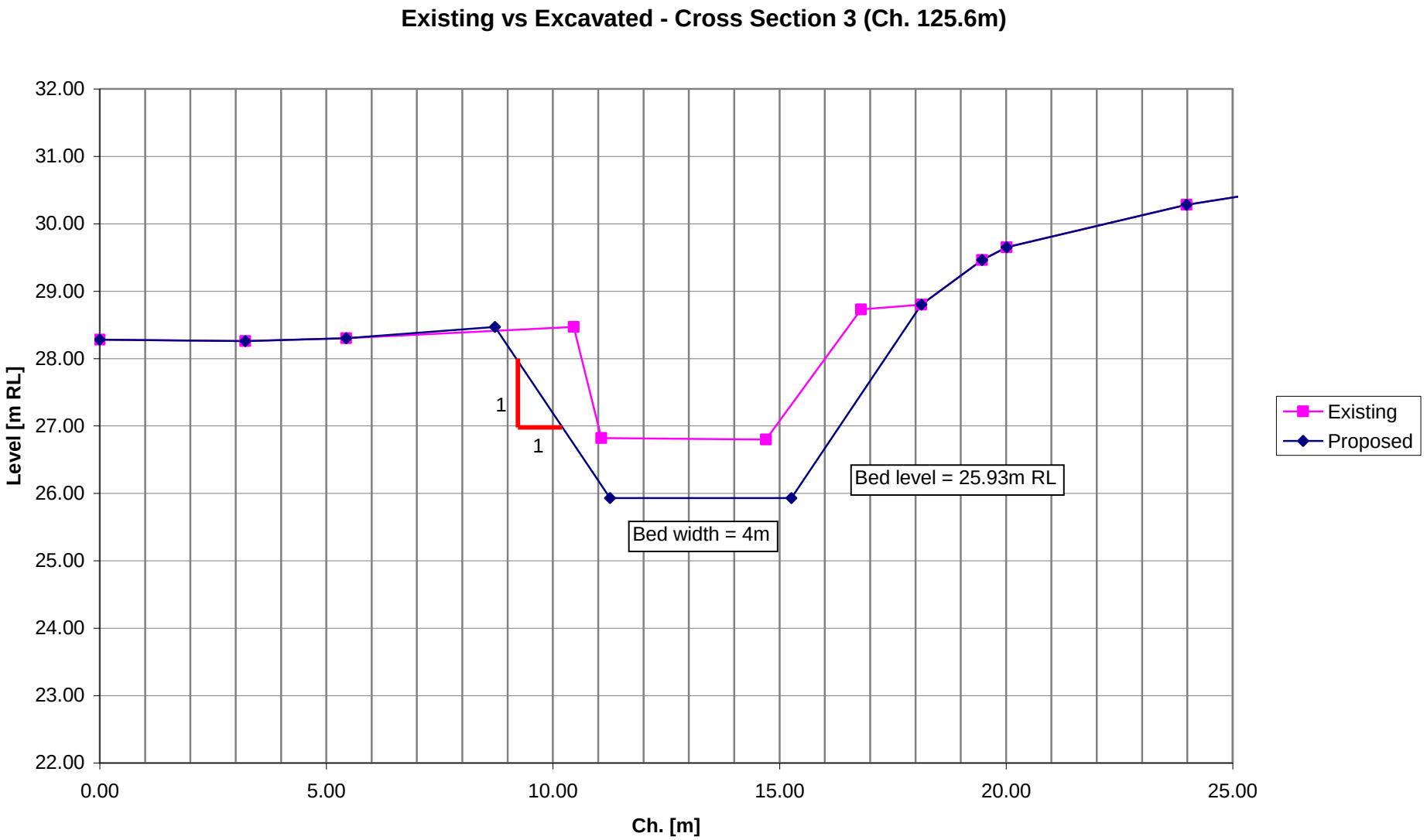
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1
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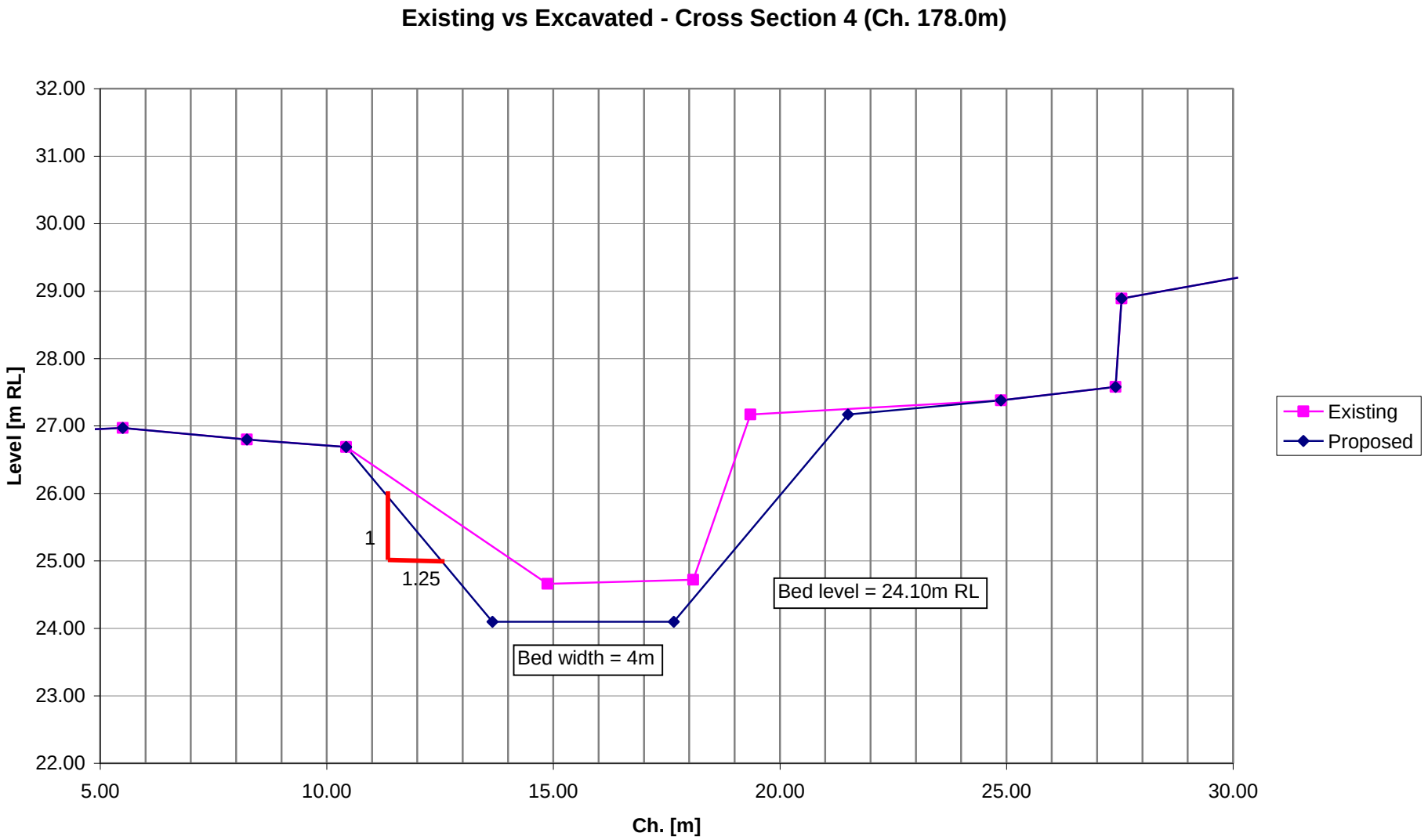
Existing
Proposed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1.25
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Bed level = 24.10m RL
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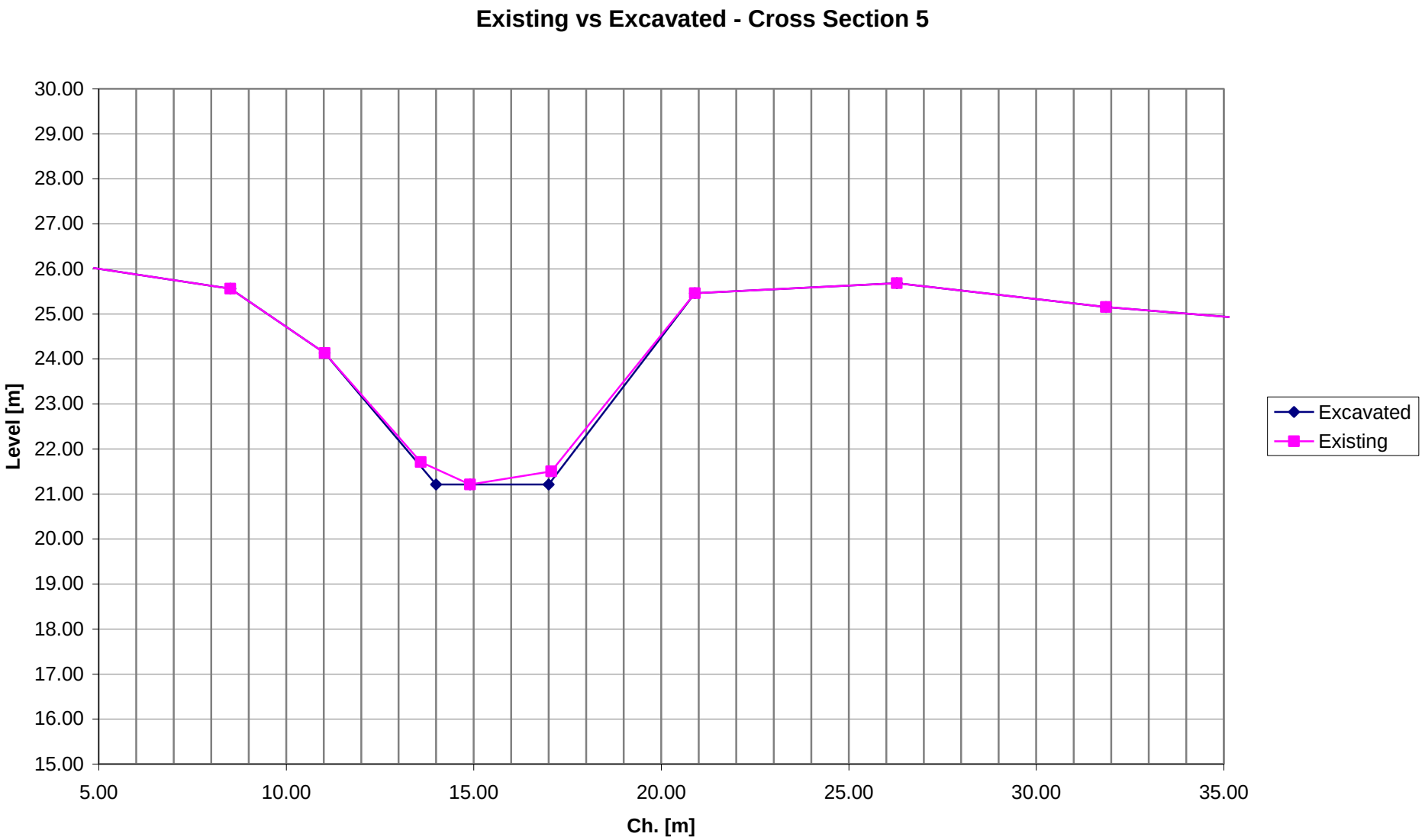
Proposed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Excavated
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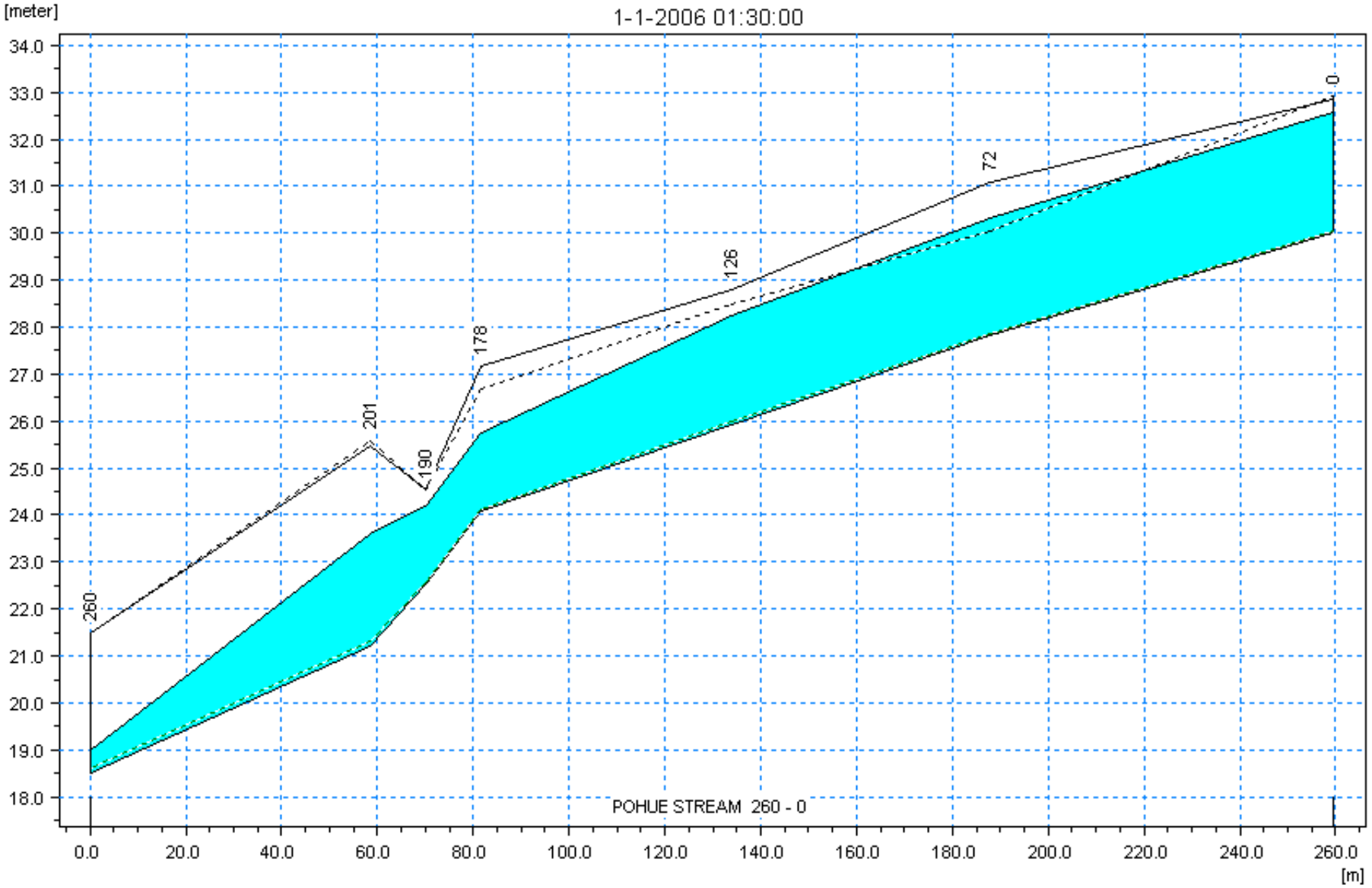
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POHUE STREAM 260 - 0
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140.0
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180.0
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[m]

Appendix 2 Cost estimate

The following are preliminary cost estimates.

Parameters used:

- Channel enlargement from cross section 1 to 4 inclusive.
- Riprap protection on one side only from cross section 1 to a point approximately 20 m u/s of cross section 3. (100 metres long).
- Riprap protection on both sides of the channel from the point 20 m u/s of cross section 3 to cross section 4. (80 metres long).

1 Riprap protection upper reach

Bank height av 1.5 m – length 100 metres
Volume = 3 m^3/m x 100 m
= 300 m^3 solid
= say 400 m^3 truck
= 600 tonne riprap

Supply and cart rock 600 tonne @ $45	27,000
Place rock 2 days digger	2,000
	$29,000

2 Riprap protection lower reach

Bank height av 2.0 m – length 80 metres
Volume = 10 m^3/m x 80
= 800 m^3 solid
= 1000 m^3 truck
= 1500 tonne riprap

Supply and cart rock 1500 tonne @ $45	67,500
Place rock 5 days digger	5,000
	$72,500

3 Channel Enlargement

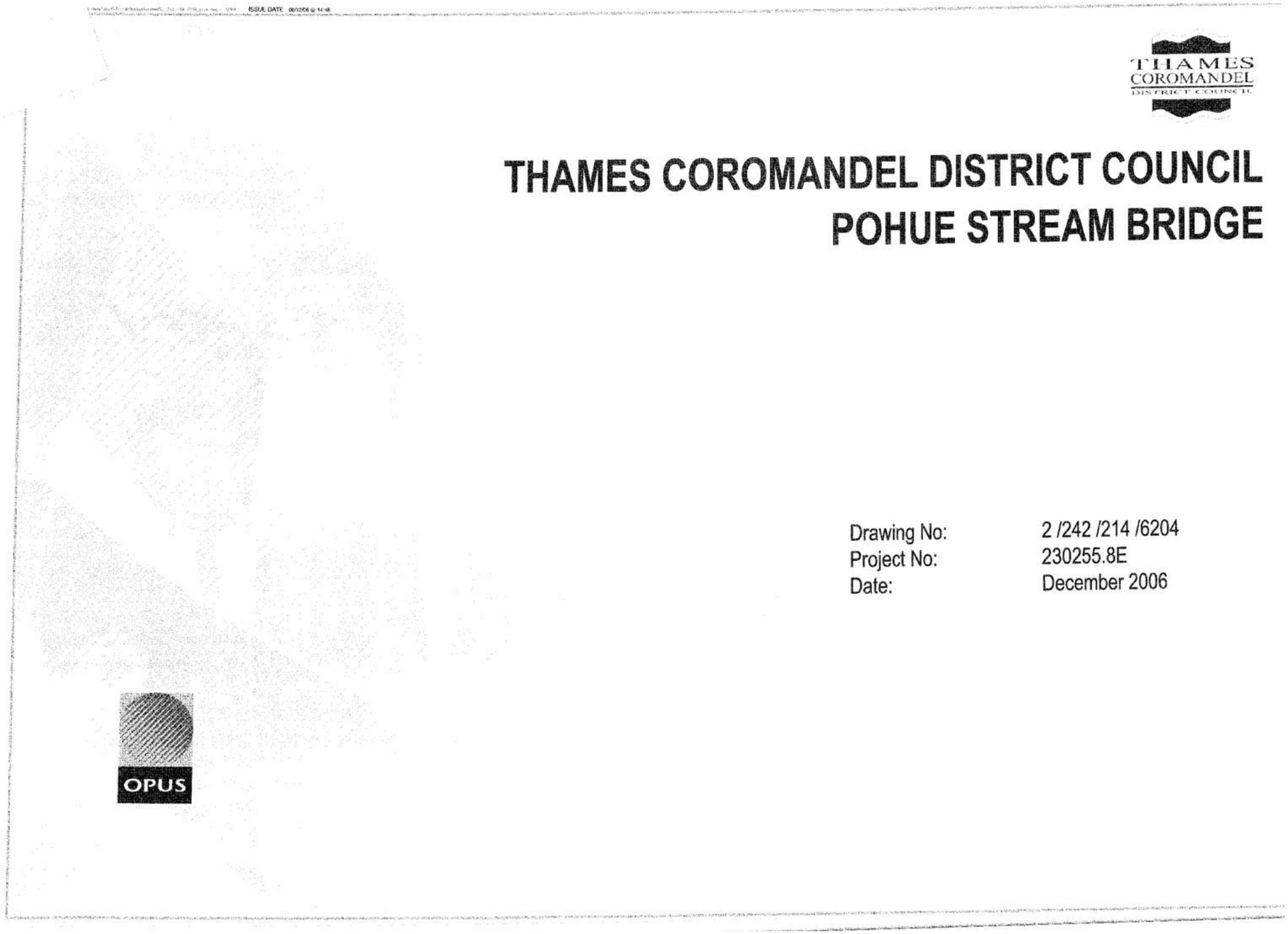
Amon's volume for channel enlargement =	1900m^3	
Add total volume of riprap displacement	1100m^3	
		3000m^3
Allow 3 days digger, dozer and 3 trucks		
Excavation cost 3 x $5000		$15000

4 Summary of costs

Supply and cart 2100 tonne riprap @ $45	94,500
Place rock	7,000
Enlarge channel and excavator for riprap	15,000
Filter cloth	5,000
Construct small clay bund	2,000
Subtotal	123,500
Consent	20,000
Design/supervision	19,000
Archaeology	5,000
Contingency	12,000
	179,500
	Say 180,000

Note No allowance for protection downstream of the road crossing.

Appendix 3 Bridge design details



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PROJECT No. 2-30255.8E
SHEET No. 00

DRAWING ISSUE REGISTER

DATE OF ISSUE

PROJECT TITLE:
THAMES COROMANDEL DISTRICT COUNCIL
POHUE STREAM BRIDGE

DAY 21
MONTH 12
YEAR 06
CHKD DN

DRAWING No.	SIZE	DRAWING TITLE	REVISION
2/242/214/7204/00	A1	Index	R0
2/242/214/7204/1	A1	General Arrangement	R0
2/242/214/7204/2	A1	Setting Out and Pile Details	R0
2/242/214/7204/3	A1	Abutment: Dimensions and Reinforcement	R0
2/242/214/7204/4	A1	Abutment: Typical Section and Shear Key Details	R0
2/242/214/7204/5	A1	Beams: Castin Details and Unit Data	R0
2/242/214/7204/6	A1	Beams: Precast/Pretensioned DHC Unit Details	R0
2/242/214/7204/7	A1	Beams: Connection and Linkage Details	R0
2/242/214/7204/8	A1	Guardrail: Layout and Details	R0
2/242/214/7204/9	A1	Guardrail: Handrail Fixing and Assembly Details	R0
2/242/214/7204/10	A1	Gabion Bank Protection: Elevations	R0

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D Drawing(s) on Disk
E Drawing(s) Emailed
F Drawing(s) Faxed
H Drawing(s) By Hand

ISSUE STATUS
PRELIMINARY
REVIEW
Building Consent

AMENDMENT	APP'D	DATE

	BY	CHECKED	DATE
DESIGN	D.Nair	S.Devey	Nov06
DRAWN	G.Bentley	T.Brace	Nov06
APPROVED	G.A.Bentley		Dec06

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TITLE: THAMES COROMANDEL DISTRICT COUNCIL
POHUE STREAM BRIDGE
Index

STATUS Building Consent
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PLOT DATE 21/12/06 @ 12:30
FEATURE IDENTIFIER 2/242/214
CODE 6204
SHEET 0
REVISION R0

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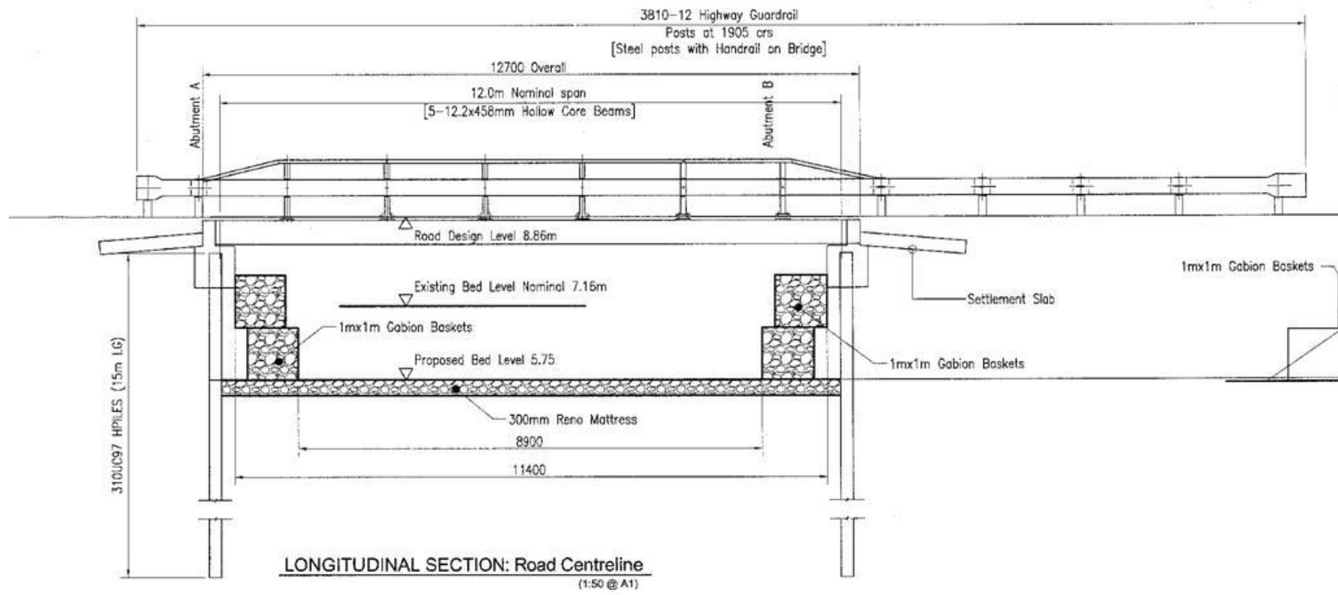

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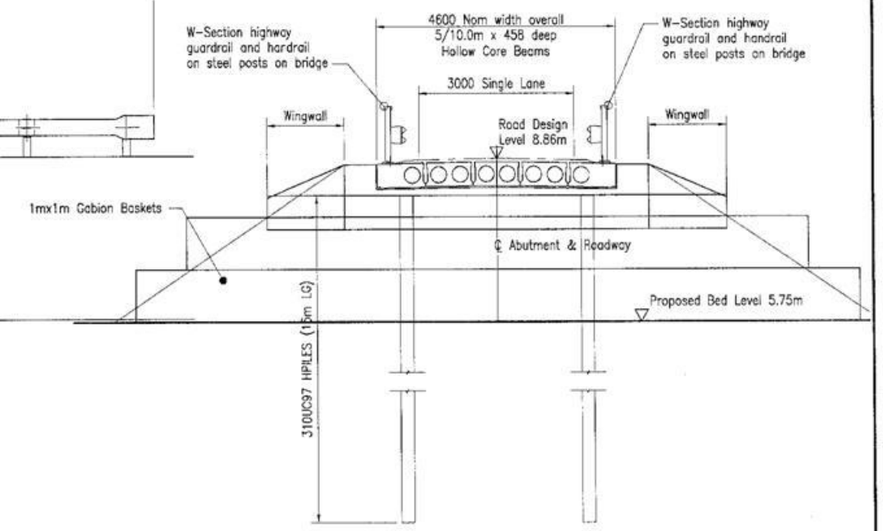

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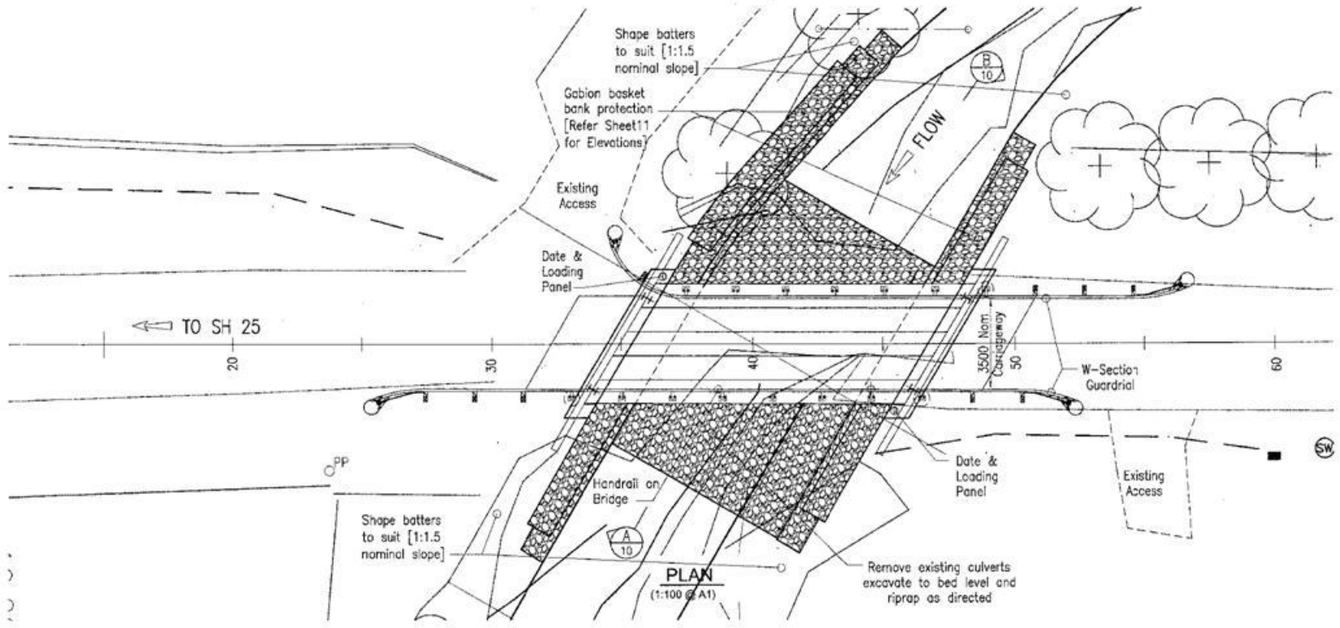

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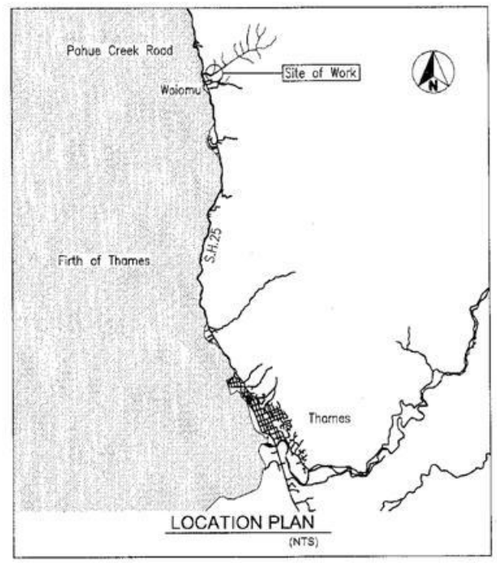

LOCATION PLAN
(NTS)

	BY	CHECKED	DATE
DESIGN	D.Nair	S.Devoy	Nov06
DRAWN	G.Beardley	T.Bruce	Nov06
APPROVED	G.Riordan		Dec06

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AMENDMENT | APP'D | DATE

GRAPHIC SCALES

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TITLE: THAMES COROMANDEL DISTRICT COUNCIL
POHUE STREAM BRIDGE

General Arrangement

STATUS	FILE				
Building Consent	230255_BE				
SCALE	PLOT DATE	FEATURE IDENTIFIER	CODE	SHEET	REVISION
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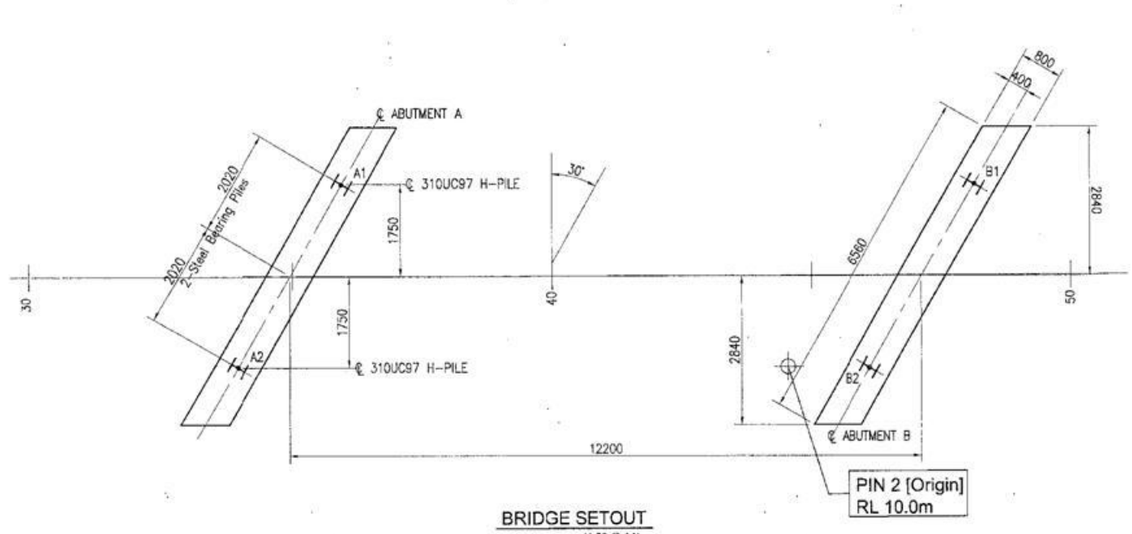

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IS 3	300007.62	700020.01	9.8
IS 4	300043.61	700017.5	11.29
IS 5	300064.97	700041.16	10.98
IS 6	300097.06	700038.37	13.08
IS 7	300122.61	700034.9	14.16
IS 8	300146.54	700045.9	14.79
IS 9	300157.16	700065.39	16.04
IS 10	300168.4	700083.34	15.42
IS 11	300199.77	700081.59	16.37
IS 12	300228.33	700072.08	18.22

COORDINATES & LEVELS ARE ASSUMED [ORIGIN PIN 2]
CONTROL POINTS ARE PIN 2 & IS 1,3 & 4

PILE SETOUT				
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A2	299989.89	699998.48	8.150	-6.85
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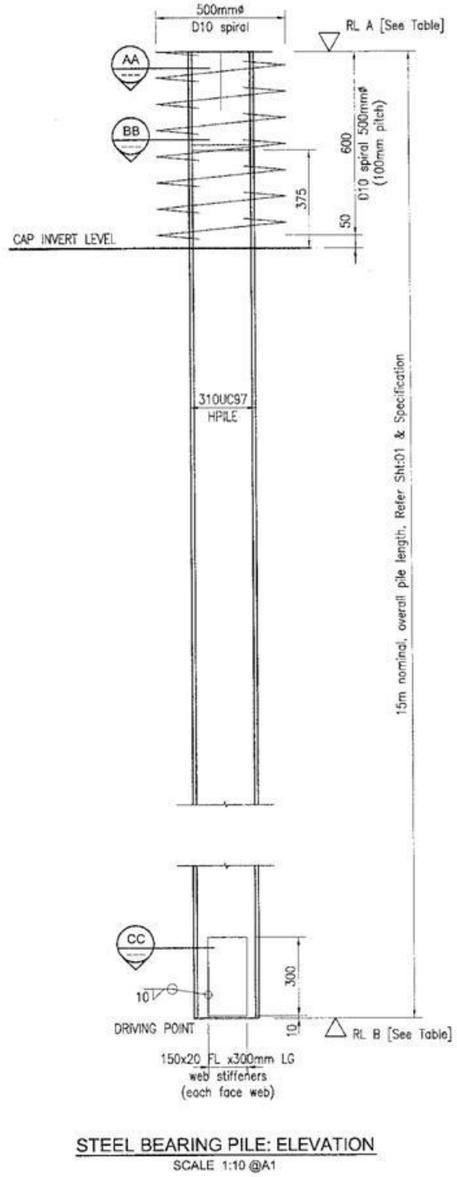

STEEL BEARING PILE: ELEVATION
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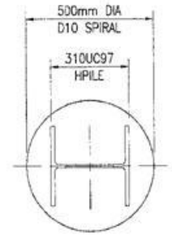

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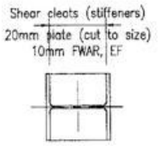

SECT: B-B

SECT: C-C

NOTES

1. Materials & Workmanship shall be in accordance with specification T-CES 404.
2. Pile steel to be Gr.350 to AS:NZS 3679. Shear cleats, stiffeners etc Gr.430 to BS 4360 or Gr.250 to AS 3678.
3. Piles to be 15m nom length. Where longer piles are required to achieve bearing capacity, additional lengths shall be splice welded together. Pile splice welds to be avoided in the 2.5m below cap soffit level.
4. Piles to achieve Ultimate Bearing Load (min): 1400kN.
5. Pile positioning is to be within 50mm of true top position. deviation from vertical shall be no more than 1:50 distance from pile tip to be marked @2000mm intervals along its length.
6. Welds: shall be in accordance with T-CES 301
7. Once driven, piles shall be cut to correct length

AMENDMENT	APP'D	DATE

	BY	CHECKED	DATE
DESIGN	D.Nair	S.Devoy	Nov06
DRAWN	G.Bentley	T.Brace	Nov06
APPROVED	G.M. Kogan		Dec06

THAMES COROMANDEL DISTRICT COUNCIL

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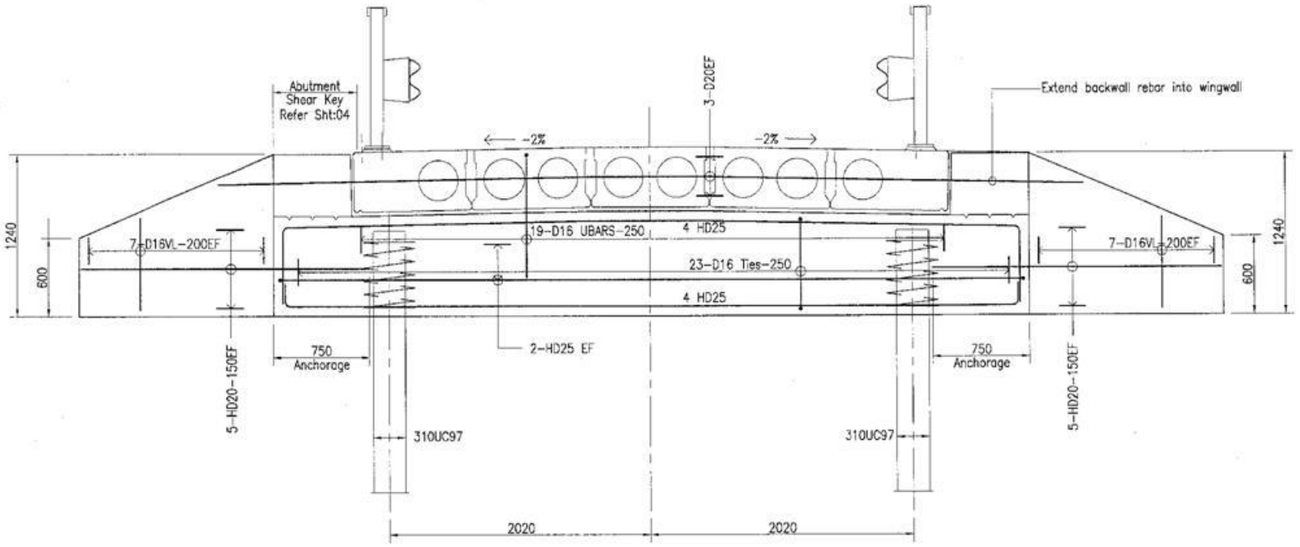
TITLE: THAMES COROMANDEL DISTRICT COUNCIL
POHUE STREAM BRIDGE

Setting Out and Pile Details

STATUS	FILE				
Building Consent	230255_8E				
SCALE	PLOT DATE	FEATURE IDENTIFIER	CODE	SHEET	REVISION
As Shown [A1]	21/12/06 @ 12:30	2/242/214	6204	2	R0

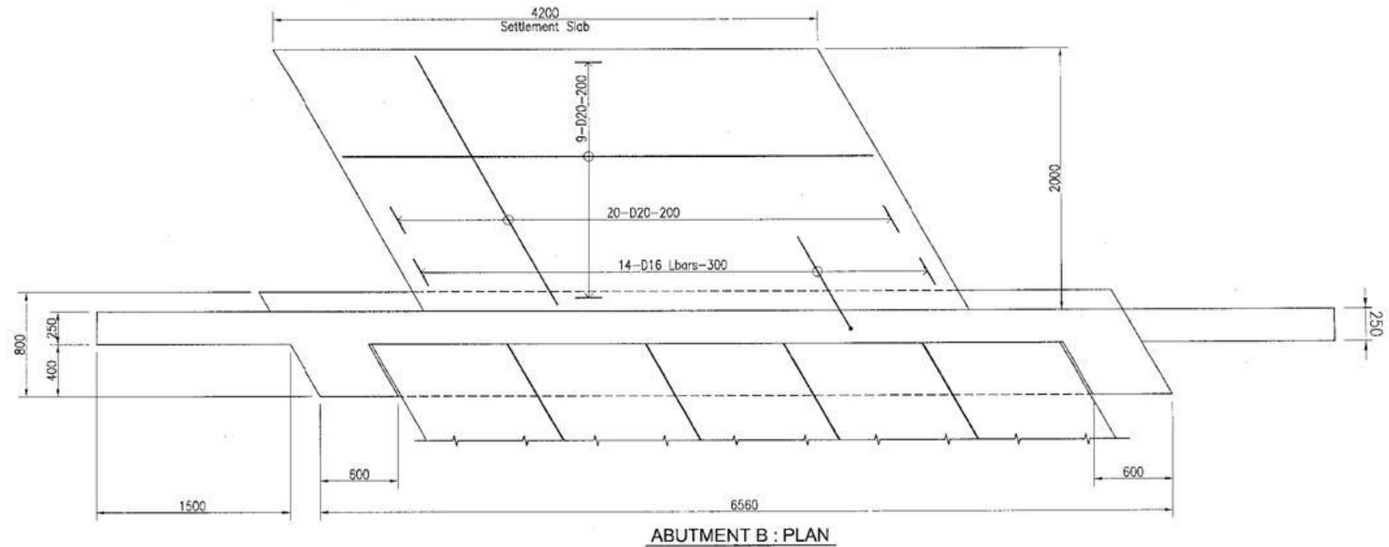
g:\230000\30255_81_pohue creek\acad\7-construction\current\2_242_214_7204_01-10.dwg - 2R0 ORIGINAL SHEET SIZE A1 [840x594]

GRAPHIC SCALES



ABUTMENT B : ELEVATION
(1:20 @ A1)

ABUTMENT A SIMILAR [HANDED]



ABUTMENT B : PLAN
(1:20 @ A1)

	BY	CHECKED	DATE
DESIGN	D.Nair	S.Devoy	Nov06
DRAWN	G.Bentley	L.Droce	Nov06
APPROVED	C.A.Reade		Dec06

AMENDMENT | APP'D | DATE

THAMES COROMANDEL DISTRICT COUNCIL

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TITLE: THAMES COROMANDEL DISTRICT COUNCIL
POHUE STREAM BRIDGE

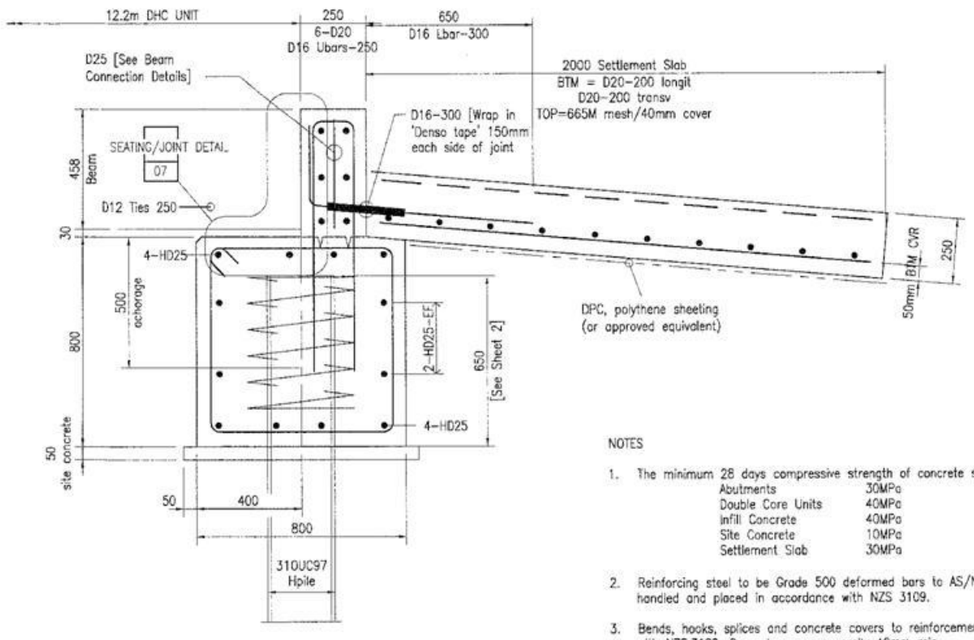
Abutment: Dimensions and Reinforcement Details

STATUS	FILE				
Building Consent	230255_8E				
SCALE	PLOT DATE	FEATURE IDENTIFIER	CODE	SHEET	REVISION
As Shown [A1]	21/12/06 @ 12:30	2/242/214	6204	3	R0

GRAPHIC SCALES

21/12/2006 12:42

g:\230000\30255_81_pohue creek\acad\7-construction\current\2_242_214_7204_01-10.dwg - 3R0 ORIGINAL SHEET SIZE A1 [840x594]



ABUTMENTS A & B - TYPICAL SECTION
SCALE 1:10 @A1

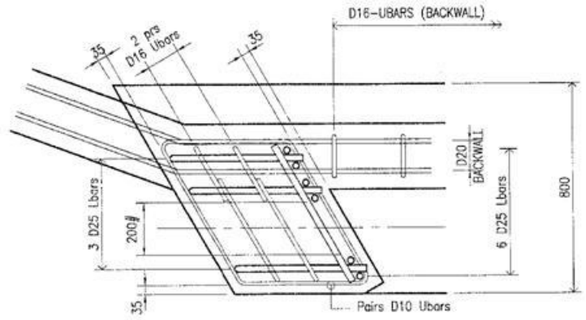
NOTES

1. The minimum 28 days compressive strength of concrete shall be :

Abutments	30MPa
Double Core Units	40MPa
Infill Concrete	40MPa
Site Concrete	10MPa
Settlement Slab	30MPa

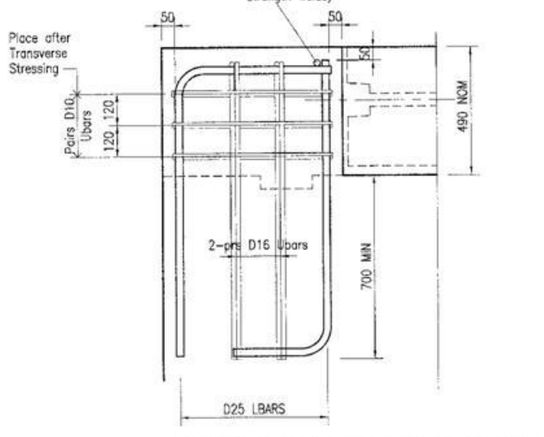
2. Reinforcing steel to be Grade 500 deformed bars to AS/NZS4671, supplied, handled and placed in accordance with NZS 3109.
3. Bends, hooks, splices and concrete covers to reinforcement shall comply with NZS:3109. Concrete cover generally 40mm min.
4. Concrete finishes shall comply with NZS 3114.
   Surfaces hidden – Type F2
   Surfaces wholly or partially exposed – Type F5
5. Exposed corners to have 25x25 chamfers or fillets.
6. Construction joints to be Type'B' to NZS 3109.
7. Form work construction and erection to be in accordance with T-CES101.

Shear key reinforcement arranged to allow for a clear opening of 200mm about duct for jack access during transverse stressing operation. main abutment reinforcement arranged to suit.



MAIN ABUTMENT REINFORCING NOT SHOWN FOR CLARITY

PLAN: ABUTMENT SHEAR KEY
SCALE 1:10 @A1



MAIN ABUTMENT REINFORCING NOT SHOWN FOR CLARITY

ELEVATION: SHEAR KEY DETAIL

	BY	CHECKED	DATE
DESIGN	D.Noir	S.Devoy	Nov06
DRAWN	G.Bentley	T.Brace	Nov06
APPROVED	G.J.Hogan		Dec06

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AMENDMENT | APP'D | DATE

THAMES COROMANDEL DISTRICT COUNCIL

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TITLE: THAMES COROMANDEL DISTRICT COUNCIL
POHUE STREAM BRIDGE
Abutment: Typical Section and Shear Key Details

STATUS	FILE				
Building Consent	230255_8E				
SCALE	PLOT DATE	FEATURE IDENTIFIER	CODE	SHEET	REVISION
As Shown [A1]	21/12/06 @ 12:30	2/242/214	6204	4	R0

g:\230000\30255_81_ponoa creek\acad\7-construction\current\2_242_214_7204_01-10.dwg - 400 ORIGINAL SHEET SIZE A1 [840x594]

GRAPHIC SCALES

1. PRESTRESSING FORCE AT INITIAL TENSIONING

Total Longitudinal Force Per Unit (kN) OUTER BEAM =2955kN, INNER BEAMS =2552kN
12.5mm Super 7 wire strand stressed to 73% of minimum
breaking load (184kN per strand) in accordance with AS 1311

2. CONCRETE STRENGTH

Minimum compressive strength @ transfer =30MPa.
Specified compressive strength @28 days =40MPa

3. SURFACE FINISH

a) Top Surface: Broom Finish as specified to T-CES:201
b) Side and Underside Surface =Smooth Finish
c) Shear Key =Chequer Plate Finish

4. VOID FORMERS

Surfaces of voids are to be rendered impermeable to water penetration for at least 28 days, either by surface treatment or use of hollow lightweight solid void formers of suitable material.
Proposed method shall be to the Engineers consent.
Tolerance on void formers ±6mm Maximum weight of void formers =6kg/m

5. CONCRETE COVER

Cover to all prestressing components =40mm minimum.
Cover to reinforcement =30mm (or as shown)
Cover to adjacent void formers =20mm minimum

6. HANDLING

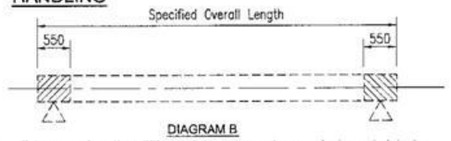


DIAGRAM B

Extremes of vertical lifting points or ground support shown hatched.
Keep unit as horizontal as possible when handling or storing.

7. UNIT DETAILS

Unit Depth =458mm
Unit Overall Length =12.2m
Concrete (volume per unit):
Inner Units =3.26 Cu.m, Outer Units =4.17 Cu.m
Handling Mass (tonnes per unit):
Inner Units =8.5 tonnes, Outer Units =10.8tonnes

8. TOLERANCES

5.1 Dimensions at time of erection: Actual overall length and squareness. The unit end surfaces shall lie within the 'tolerance boxes' shown in Diagram A.

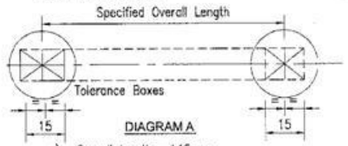
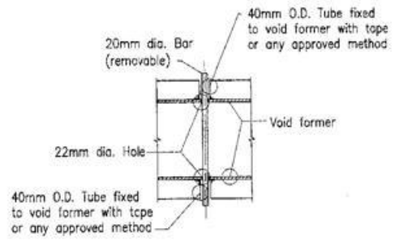


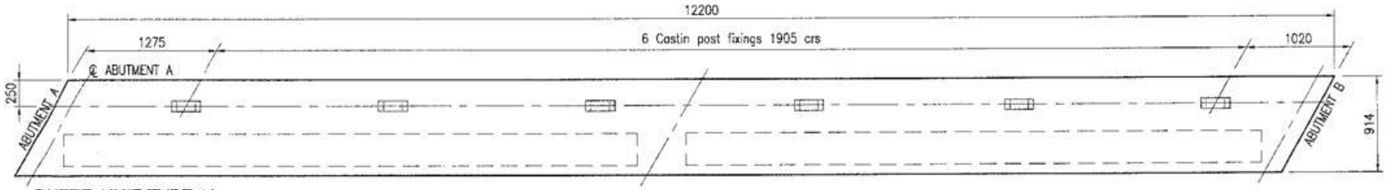
DIAGRAM A

a) Overall length =±15mm
b) Plane surface, deviation from 1.5m straight edge =6mm
c) Cross sectional dimensions (overall) =+6mm-0mm
d) Difference in level of top surface between adjacent units in place =12mm
e) Horizontal deviation (see specification) =6mm
f) Smallest web thickness =+6mm
g) Smallest flange thickness =+6mm, -4mm
h) Diaphragm thickness =±6mm
i) Hogging variation (see specification) =±12mm

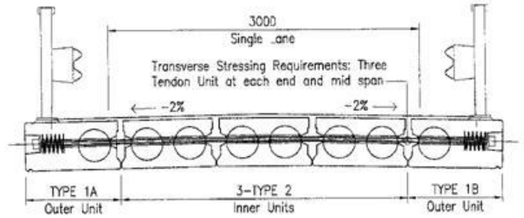
5.2 Location of steel and cast-in items.
a) Prestressing strands in any direction =±3mm
b) Location of an item in relation to any other within its group =±10mm
c) Transverse duct position =± 6mm



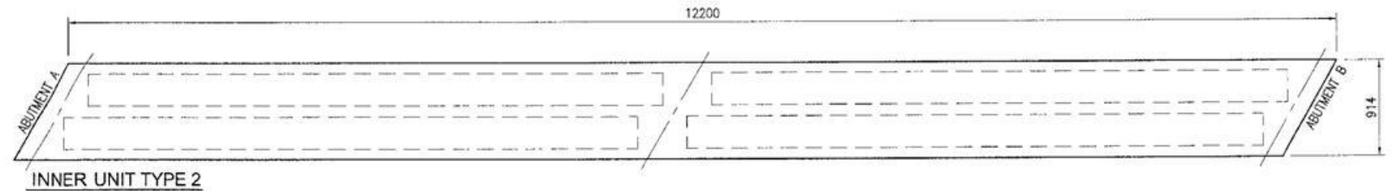
INSPECTION AND DRAINAGE HOLE DETAILS



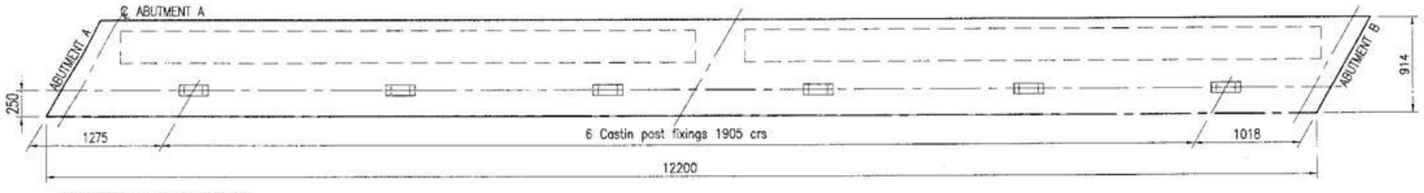
OUTER UNIT TYPE 1A



TYPICAL SECTION - BEAM LAYOUT
SCALE 1:25@A1

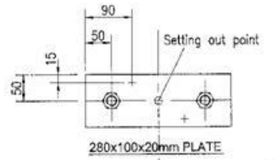


INNER UNIT TYPE 2

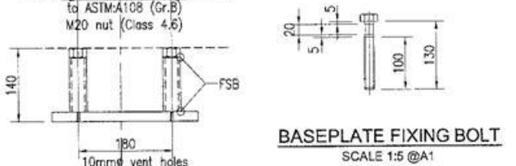


OUTER UNIT TYPE 1B

BEAM TYPES
SCALE 1:25@A1



M20 (Class 4.6) galv bolt, with neck turned down to give a failure load @ 90kN (±5kN) in tension. two bolts required per bridge post.



CASTIN BRACKET DETAIL

BASEPLATE FIXING BOLT
SCALE 1:5 @A1

	BY	CHECKED	DATE
DESIGN	D.Nair	S.Devey	Nov06
DRAWN	G.Bentley	T.Brace	Nov06
APPROVED	G.E.Hogan		Dec06

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AMENDMENT | APP'D | DATE

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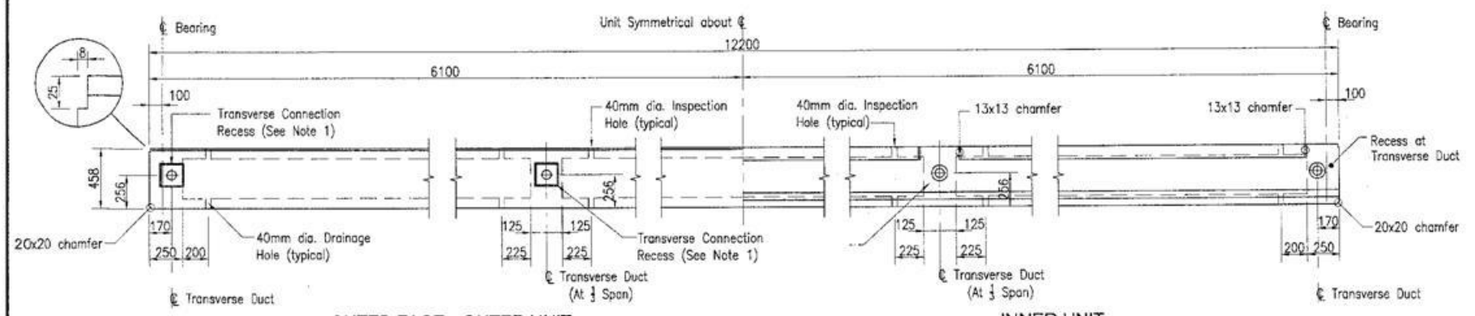
TITLE: THAMES COROMANDEL DISTRICT COUNCIL
POHUE STREAM BRIDGE

Beams: Castin Details and Unit Data

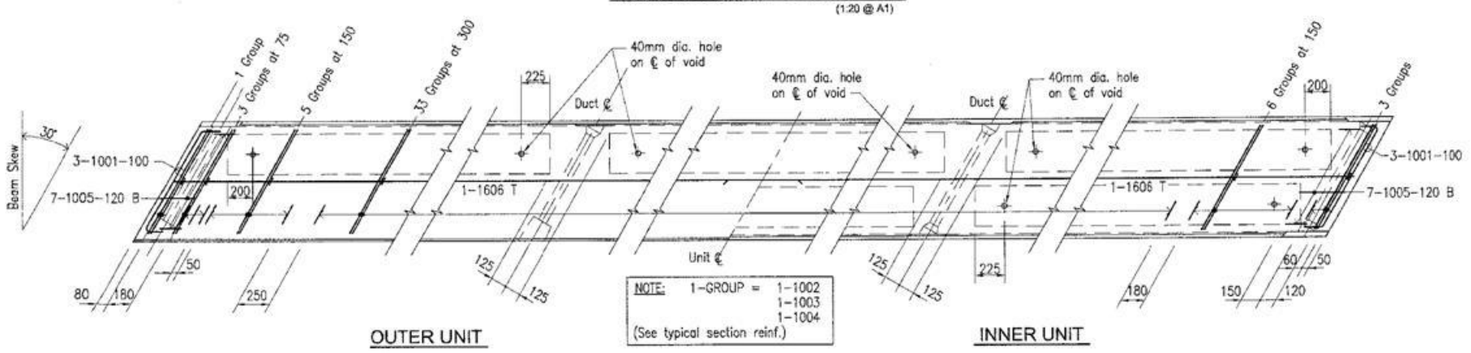
STATUS	FILE				
Building Consent	230255_8E				
SCALE	PLOT DATE	FEATURE IDENTIFIER	CODE	SHEET	REVISION
As Shown [A1]	21/12/06 @ 12:30	2/242/214	6204	5	R0

p:\230000\30255_81_pohue creek\acad\7-construction\current\2_242_214_7204_01-10.dwg - SRO ORIGINAL SHEET SIZE A1 [840x594]

GRAPHIC SCALES

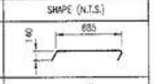
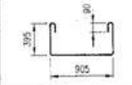
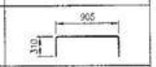
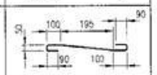
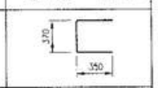
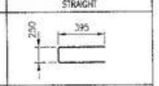


PART ELEVATION - DIMENSIONS
(1:20 @ A1)



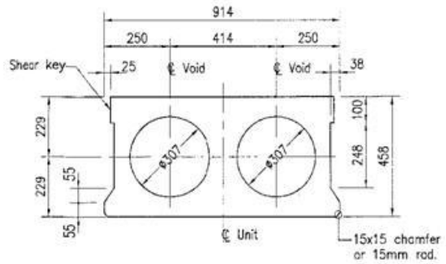
PART PLAN - REINFORCEMENT - [30° SKEW]
(1:20 @ A1)

REINFORCEMENT SCHEDULE (FOR ONE UNIT)

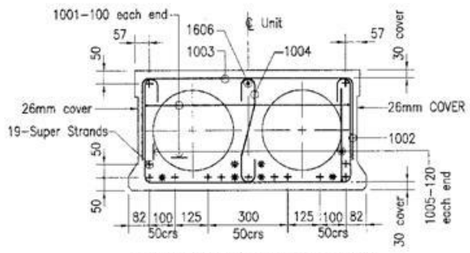
MARK	No. OFF	LENGTH	SHAPE (N.T.S.)
1001	6	1135	
1002	51	1850	
1003	51	1495	
1004	51	575	
1005	14	1020	
1606	2	5370	STRAIGHT
1207	6 PER BRACKET	990	
1208	2 PER BRACKET	750	STRAIGHT

NOTES:
1. Mark designation of bars. ie. 1001
   10 = diameter in mm
   01 = 1st bar mark in unit.
2. All bends shall comply with NZS 3109.
3. All dimensions are from outside to outside unless otherwise shown.
4. All bars shall be deformed.
5. All reinforcement for DHC beams to be 500E.

NOTES
1. Recess for transverse connection in outer unit shall be dimensioned to suit the type of connection system adopted.
2. Strands shall be released slowly and after release shall be cut and ground flush with the concrete at the end of the unit. A thick coating of coal tar epoxy shall be applied after grinding before the unit leaves the casting yard.
3. Inspection Holes shall extend to the void formers only and shall be mortared after final inspection of the units. Drainage Holes shall extend through the void formers and into the void.
4. For locations of castin Brackets for Guardrail Posts see Unit Layout. Material for cast in brackets to be stee Gr.S275 to NZS 3415:1995 or Gr.250 to AS/NZS 3678. All welds to be in accordance with Opus Specification T-CES 301.
5. Cast in brackets for Guardrails to be hot dip galvanised after fabrication to Opus Specification T-CES 306.



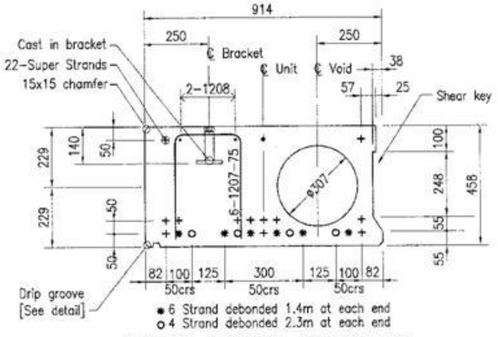
TYPICAL SECTION - INNER UNIT
DIMENSIONS
(1:10@A1)



• Strand debonded 600mm at each end

Reinforcement symmetrical about ℄ unit

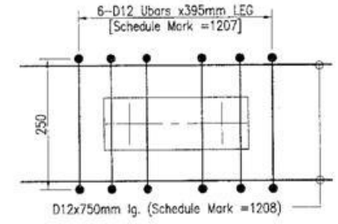
TYPICAL SECTION - INNER UNIT
REINFORCEMENT AND STRAND LAYOUT
(1:10@A1)



• 6 Strand debonded 1.4m at each end
○ 4 Strand debonded 2.3m at each end

TYPICAL SECTION - OUTER UNIT
STRAND LAYOUT
AND GUARDRAIL CASTIN BRACKET
(1:10@A1)

NOTE: Typical reinforcement omitted. See typical section (inner unit) for details.



CASTIN BRACKET ADDITIONAL REBAR TIES
(1:5 @ A1)

DRIP GROOVE DETAIL
(1:2@A1)

	BY	CHECKED	DATE
DESIGN	D.Nair	S.Devoy	Nov06
DRAWN	C.Bentley	T.Broce	Nov06
APPROVED	G.J.Hogan		Dec06

AMENDMENT | APP'D | DATE

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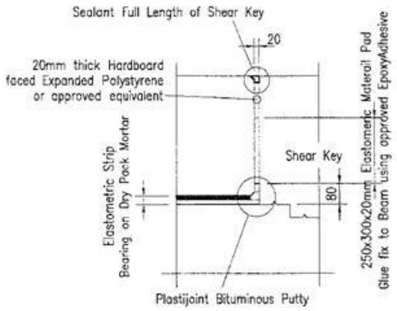
TITLE: THAMES COROMANDEL DISTRICT COUNCIL
POHUE STREAM BRIDGE

Precast/Pretensioned D.H.C. Beam Details

STATUS	FILE				
Building Consent	230255_8E				
SCALE	PLOT DATE	FEATURE IDENTIFIER	CODE	SHEET	REVISION
As Shown [A1]	21/12/06 @ 12:30	2/242/214	6204	6	R0

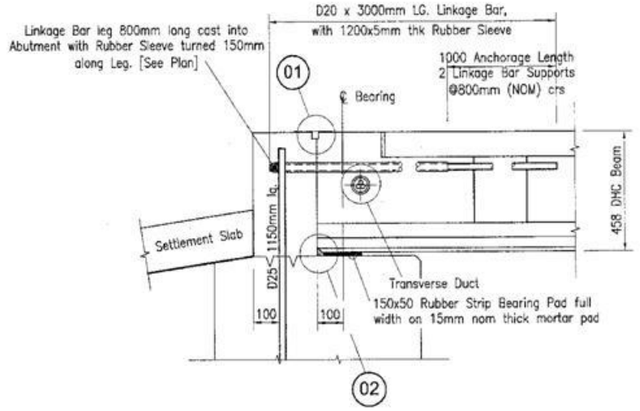
g:\230000\30255_81_pohue creek\cad\7-construction\current\2_242_214_7204_01-10.dwg - 6R0 ORIGINAL SHEET SIZE A1 [840x594]

GRAPHIC SCALES



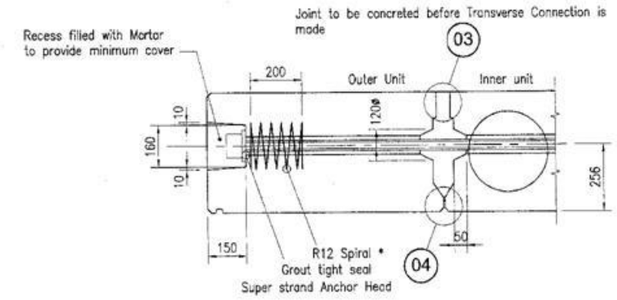
SECTION [A]

SCALE 1:10@A1



ABUTMENT: LONGITUDINAL LINKAGE BAR PLACEMENT

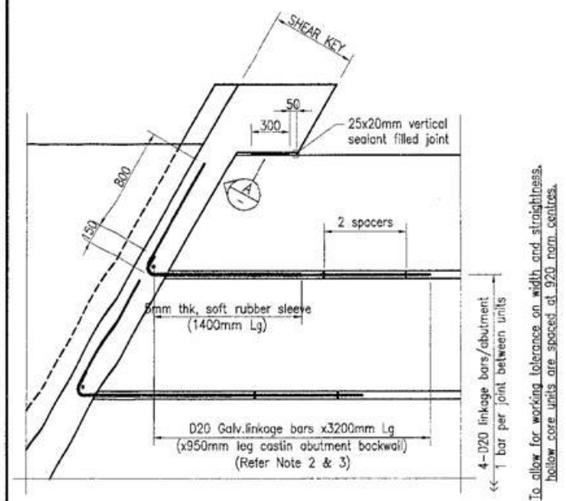
SCALE 1:10@A1



TRANSVERSE CONNECTION REQUIREMENTS:
* Refer to table of transverse stressing requirements

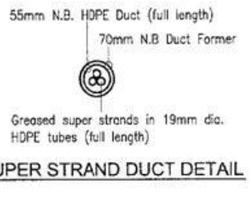
TRANSVERSE TIE DETAILS

SCALE 1:10@A1

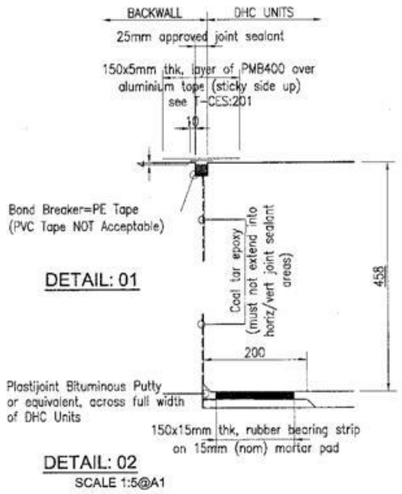


TRANSVERSE SHEAR KEY BEAM CONNECTION DETAIL

SCALE 1:20 @A1



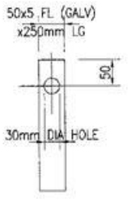
SUPER STRAND DUCT DETAIL



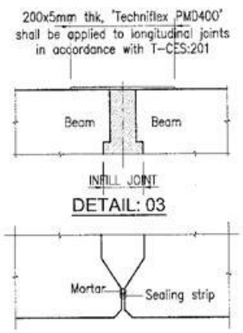
DETAIL: 01

DETAIL: 02

SCALE 1:5@A1



LINKAGE BAR SUPPORT



DETAIL: 03

DETAIL: 04

* TRANSVERSE STRESSING REQUIREMENTS						
	Span (m)	Number of transverse tendons	No. of 12.7mm super strands per tendon	Stressing* per strand	Anchor confining steel	
					Spirals	Stirrups
Flexible barrier	12.2	4	3	60% UTS	R12/175mm dia./ 40mm pitch	not required

1. Transverse Strand stressed to 60% of min. breaking load (184kN/strand)–330kN total/tendon.
2. Linkage Bars at Abutments to be manufactured from Gr.300E deformed MS bars to AS/NZS 4671 and to be Hot Dip Galvanised to AS/NZS 4680 after fabrication but before fitting of sleeves. Bend and place to NZS 3109.
3. Soft Rubber Linkage Bar Sleeves may be replaced with an alternative Bond breaking material of equivalent thickness as approved by the Engineer. (e.g. 'DENSO' or 'PROTECTO' tape).
4. Elastomeric material indicated to comply with BS 1154/Type Z50.
5. Infil concrete shall attain 40MPa compressive strength @ 28 days, along full length of beam. Concrete infil to have an approved non-shrink additive and shall be a minimum of two days old before stressing strands.
6. This drawing shall be read in conjunction with the current Opus Specification T-CES 201.

	BY	CHECKED	DATE
DESIGN	D.Nair	S.Devoy	Nov06
DRAWN	C.Bentley	T.Brace	Nov06
APPROVED	G.A.Ragan		Dec06

AMENDMENT | APP'D | DATE

THAMES COROMANDEL DISTRICT COUNCIL

OPUS

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TITLE: THAMES COROMANDEL DISTRICT COUNCIL
POHUE STREAM BRIDGE

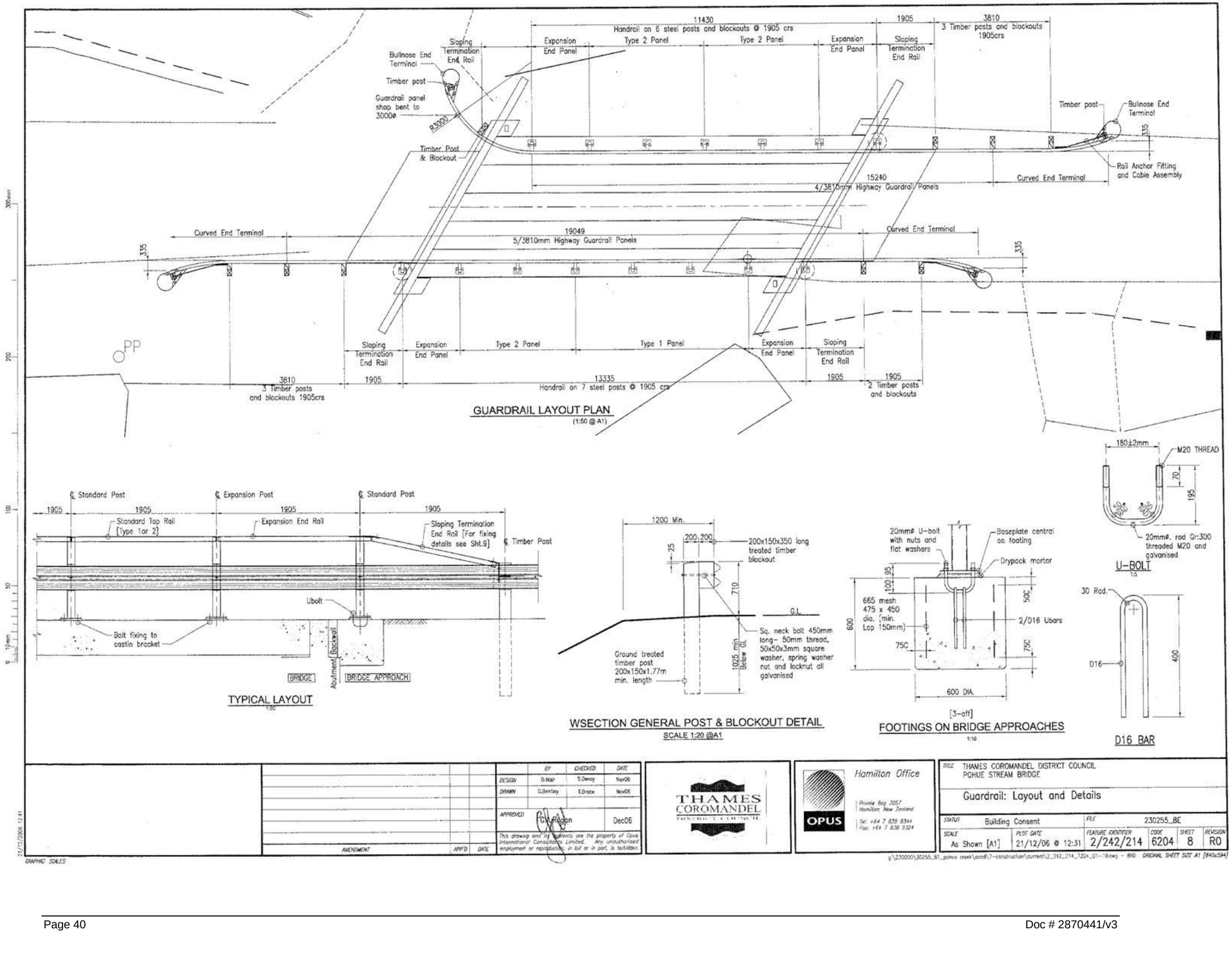
Beam Connection and Linkage Details

STATUS		FILE			
Building Consent		230255_BE			
SCALE	PLOT DATE	FEATURE IDENTIFIER	CODE	SHEET	REVISION
As Shown [A1]	21/12/06 @ 12:30	2/242/214	6204	7	R0

g:\230000\30255_81_pohue creek\acad\7-construction\current\2_242_214_7204_01-10.dwg – PRO ORIGINAL SHEET SIZE A1 [840x594]

GRAPHIC SCALES

21/12/2006 12:41


11430
Handrail on 6 steel posts and blockouts @ 1905 crs
1905
3810
3 Timber posts and blockouts 1905crs
Sloping Termination End Rail
Expansion End Panel
Type 2 Panel
Type 2 Panel
Expansion End Panel
Sloping Termination End Rail
Bullnose End Terminal
Timber post
Guardrail panel shop bent to 3000ø
R3000
Timber Post & Blockout
Timber post
Bullnose End Terminal
335
Rail Anchor Fitting and Cable Assembly
15240
4/3810mm Highway Guardrail Panels
Curved End Terminal
Curved End Terminal
19049
5/3810mm Highway Guardrail Panels
Curved End Terminal
335
335
PP
Sloping Termination End Rail
Expansion End Panel
Type 2 Panel
Type 1 Panel
Expansion End Panel
Sloping Termination End Rail
3810
3 Timber posts and blockouts 1905crs
1905
13335
Handrail on 7 steel posts @ 1905 crs
1905
1905
2 Timber posts and blockouts
GUARDRAIL LAYOUT PLAN
(1:50 @ A1)
300mm
200
100
50
0
19mm
Standard Post
Expansion Post
Standard Post
1905
1905
1905
1905
Standard Top Rail [Type 1or 2]
Expansion End Rail
Sloping Termination End Rail [For fixing details see Sht.9]
Timber Post
Ubolt
Bolt fixing to castin bracket
Backwall
Abutment
BRIDGE
BRIDGE APPROACH
TYPICAL LAYOUT
1:50
1200 Min.
200
200
25
200x150x350 long treated timber blockout
710
G.L
Sq. neck bolt 450mm long- 50mm thread, 50x50x3mm square washer, spring washer nut and locknut all galvanised
1025 min Below GL
Ground treated timber post 200x150x1.77m min. length
WSECTION GENERAL POST & BLOCKOUT DETAIL
SCALE 1:20 @A1
20mmø U-bolt with nuts and flat washers
Baseplate central on footing
Drypack mortar
100
95
665 mesh 475 x 450 dia. (min. Lap 150mm)
600
50C
2/D16 Ubars
75C
75C
600 DIA.
[3-off]
FOOTINGS ON BRIDGE APPROACHES
1:10
180±2mm
M20 THREAD
70
195
20mmø. rod Gr:300 threaded M20 and galvanised
U-BOLT
1:5
30 Rad.
D16
400
D16 BAR
DESIGN D.Nair S.Davey Nov06
DRAWN G.Bentley T.Brace Nov06
APPROVED G.Regan Dec06
AMENDMENT APP'D DATE
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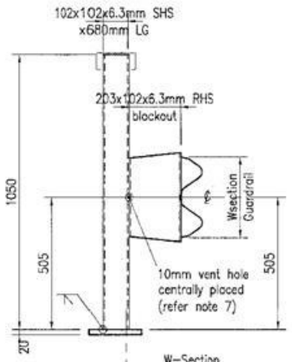
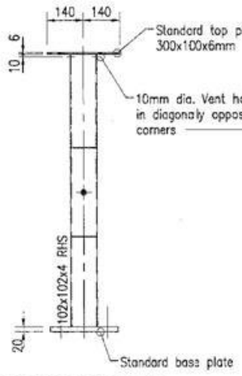
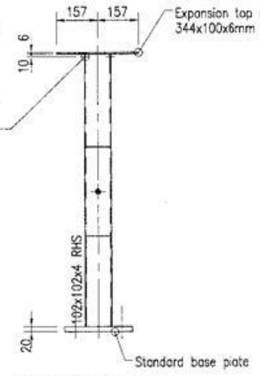
THAMES COROMANDEL DISTRICT COUNCIL
Hamilton Office
Private Bag 3057 Hamilton New Zealand
Tel. +64 7 838 9344 Fax. +64 7 838 9324
TITLE: THAMES COROMANDEL DISTRICT COUNCIL POHUE STREAM BRIDGE
Guardrail: Layout and Details
STATUS: Building Consent
FILE: 230255_8E
SCALE: As Shown [A1]
PLOT DATE: 21/12/06 @ 12:31
FEATURE IDENTIFIER: 2/242/214
CODE: 6204
SHEET: 8
REVISION: R0
g:\230000\30255_81_pohue creek\acad\7-construction\current\2_242_214_7204_01-10.dwg - Bill ORIGINAL SHEET SIZE A1 [840x594]
GRAPHIC SCALES
21/12/2006 12:41

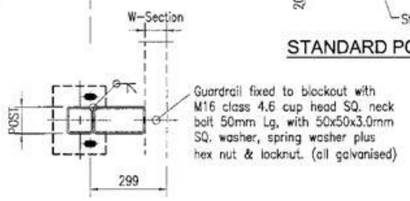




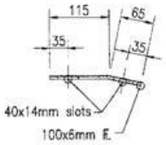
STANDARD POST



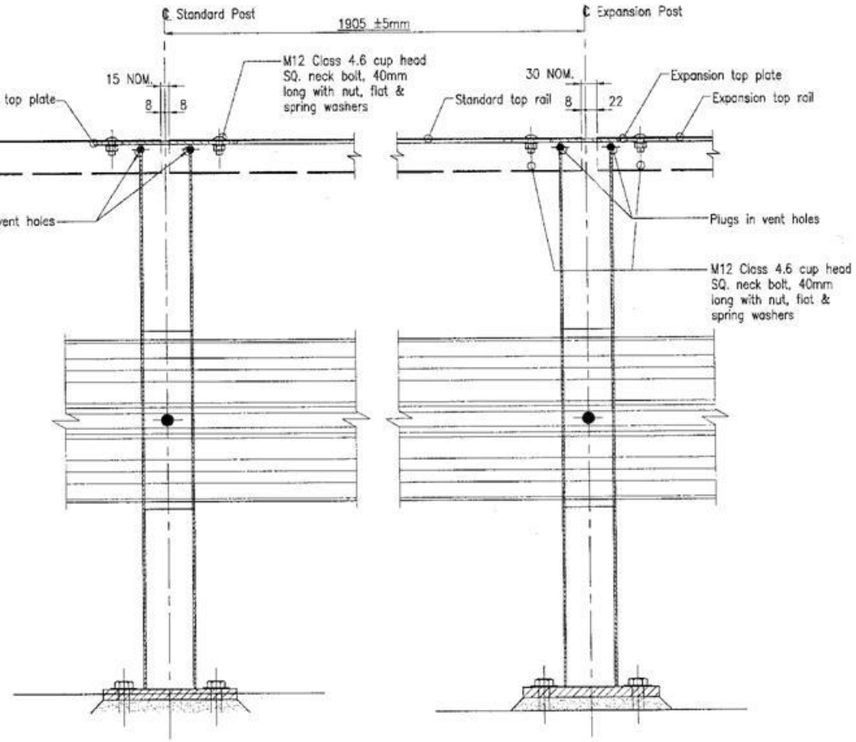
EXPANSION POST



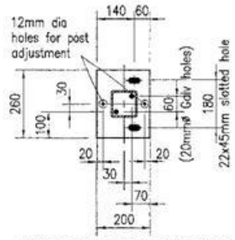
HANDRAIL POSTS
1:10



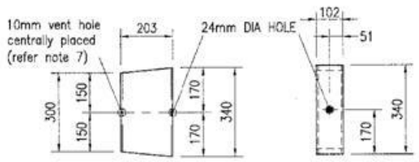
SLOPING HANDRAIL
FIXING BRACKET



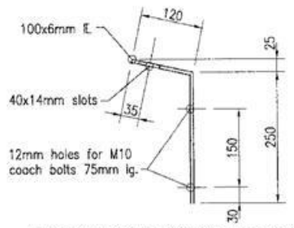
SECTIONAL ELEVATION



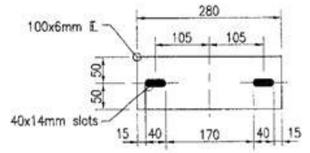
BASEPLATE: Ex 20mm THK PLATE



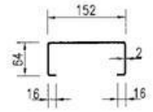
203x102x6.3mm RHS BLOCKOUT
STANDARD BLOCKOUT PIECE



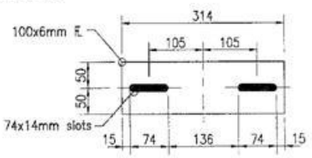
TIMBER POST FIXING BRACKET



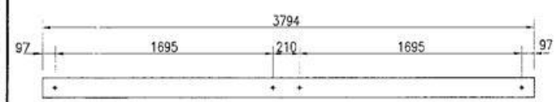
STANDARD TOP PLATE



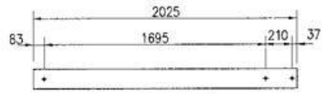
LITESPAN LC 150/16 PURLIN SECTION
1:5



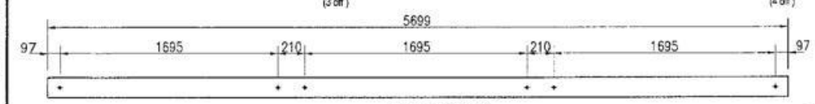
EXPANSION TOP PLATE



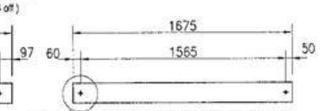
TYPE 2 TOP RAIL
(3 off)



EXPANSION END RAIL
(4 off)



TYPE 1 TOP RAIL
(1 off)



SLOPING TERMINATION END RAIL
(4 off)

All bolt holes are
18mmø and on
longitudinal ℄

STANDARD TOP RAILS
(1:20 @ A1)

NOTE: Top rails shall be fabricated from ungalvanised 'Litespan LC 150/16 purlin section or approved equivalent and galvanised after fabrication. (See Note 2)

1. Steelwork to be hot dip galvanised after fabrication to AS 1650 & straightened after fabrication as required.
2. Steelwork shall be GR.250 complying with AS 3678/3679, or an approved equivalent.
3. RHS squares and rectangles shall be GR.350 complying with AS 1163.
4. Exposed sharp edges and corners to be slightly rounded by grinding before galvanising.
5. W-Section guardrail fabrication and erection shall be in accordance with AS/NZS 3845
6. Welds to be in accordance with NZS 4701
7. Nuts for M16 guardrail/post fixing bolts to be tightened finger tight, plus 1/4 turn then locked with locking nut, this to allow for bridge movement.
8. Vent & drain holes in guardrail posts shall be effectively sealed (to prevent ingress of water) with an approved sealant (Expandite 'Silaflex C' or similar) alternatively an approved plug.
9. Drypack mortar to be in accordance with NZS 3109.
10. Guardrail posts are to be placed vertically in the transverse bridge direction & normal to the grade in the longitudinal bridge direction or as otherwise indicated.
11. Timber posts & blockouts shall be pinus radiata no1 framing to NZS 3631, H4 treated after cutting & drilling.

AMENDMENT	APP'D	DATE

	BY	CHECKED	DATE
DESIGN	D.Nair	S.Devay	Nov06
DRAWN	G.Bentley	T.Brace	Nov06
APPROVED	G.K.Regan		Dec06

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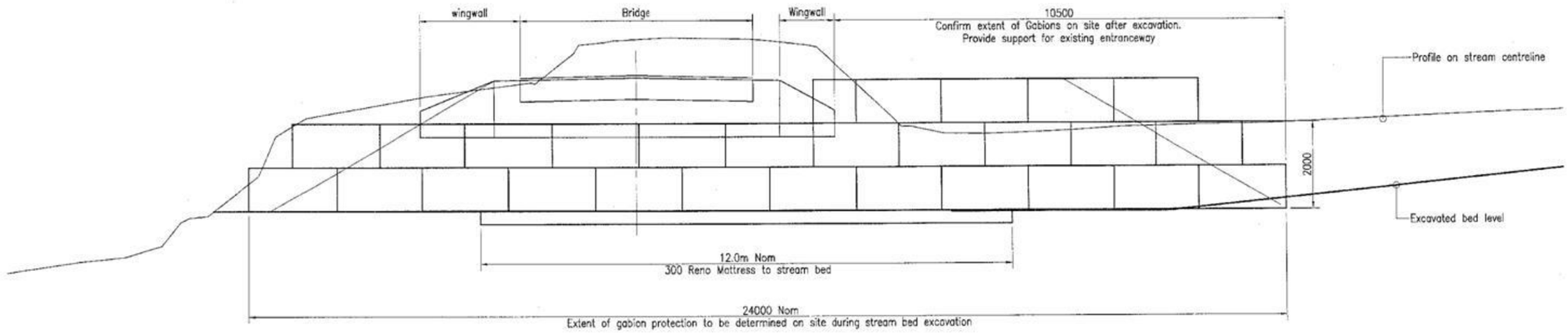
TITLE: THAMES COROMANDEL DISTRICT COUNCIL
POHUE STREAM BRIDGE

Guardrail: Handrail Fixing and Assembly Details

STATUS		FILE				
Building Consent		230255_BE				
SCALE	PLOT DATE	FEATURE IDENTIFIER	CODE	SHEET	REVISION
As Shown [A1]	21/12/06 @ 12:31	2/242/214	6204	9	R0

GRAPHIC SCALES

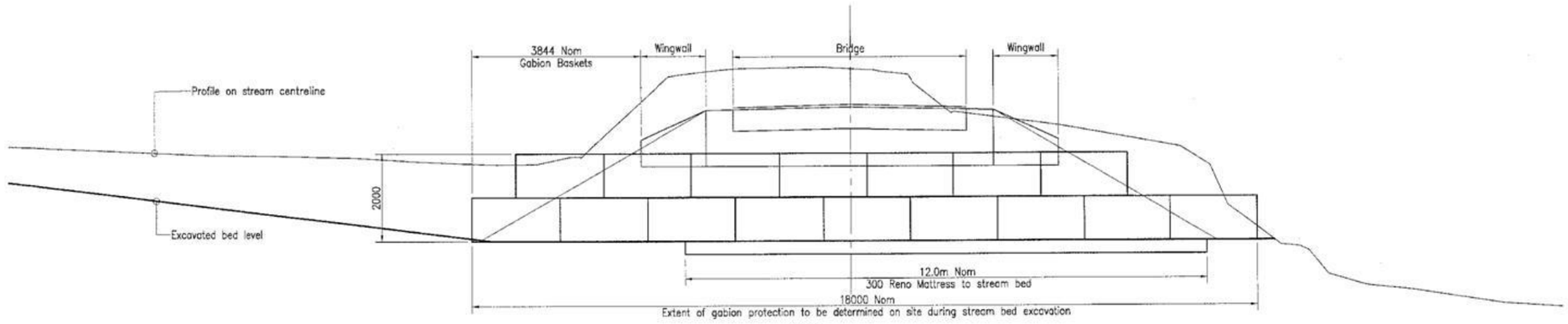
g:\230000\30255_81_pohue creek\acad\7-construction\current\2_242_214_7204_01-10.dwg - 9/10 ORIGINAL SHEET SIZE A1 [840x594]



ELEVATION A/1

ELEVATION: ABUTMENT A

(1:50 @ A1)



ELEVATION B/1

ELEVATION: ABUTMENT B

(1:50 @ A1)

AMENDMENT	APP'D	DATE

	BY	CHECKED	DATE
DESIGN	D.Nolr	S.Devoy	Nov05
DRAWN	G.Bentley	T.Broce	Nov05
APPROVED	G.A.Radder		Dec06

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TITLE: THAMES COROMANDEL DISTRICT COUNCIL
POHUE STREAM BRIDGE

Gabion Bank Protection: Elevations

STATUS	FILE				
Building Consent	230255_8E				
SCALE	PLOT DATE	FEATURE IDENTIFIER	CODE	SHEET	REVISION
As Shown [A1]	21/12/06 @ 12:30	2/242/214	6204	10	R0

c:\230000\30255_81_pohue creek\pcad\7-construction\current\2_242_214_7204_01-10.dwg - 10R0 ORIGINAL SHEET SIZE A1 [840x594]

GRAPHIC SCALES