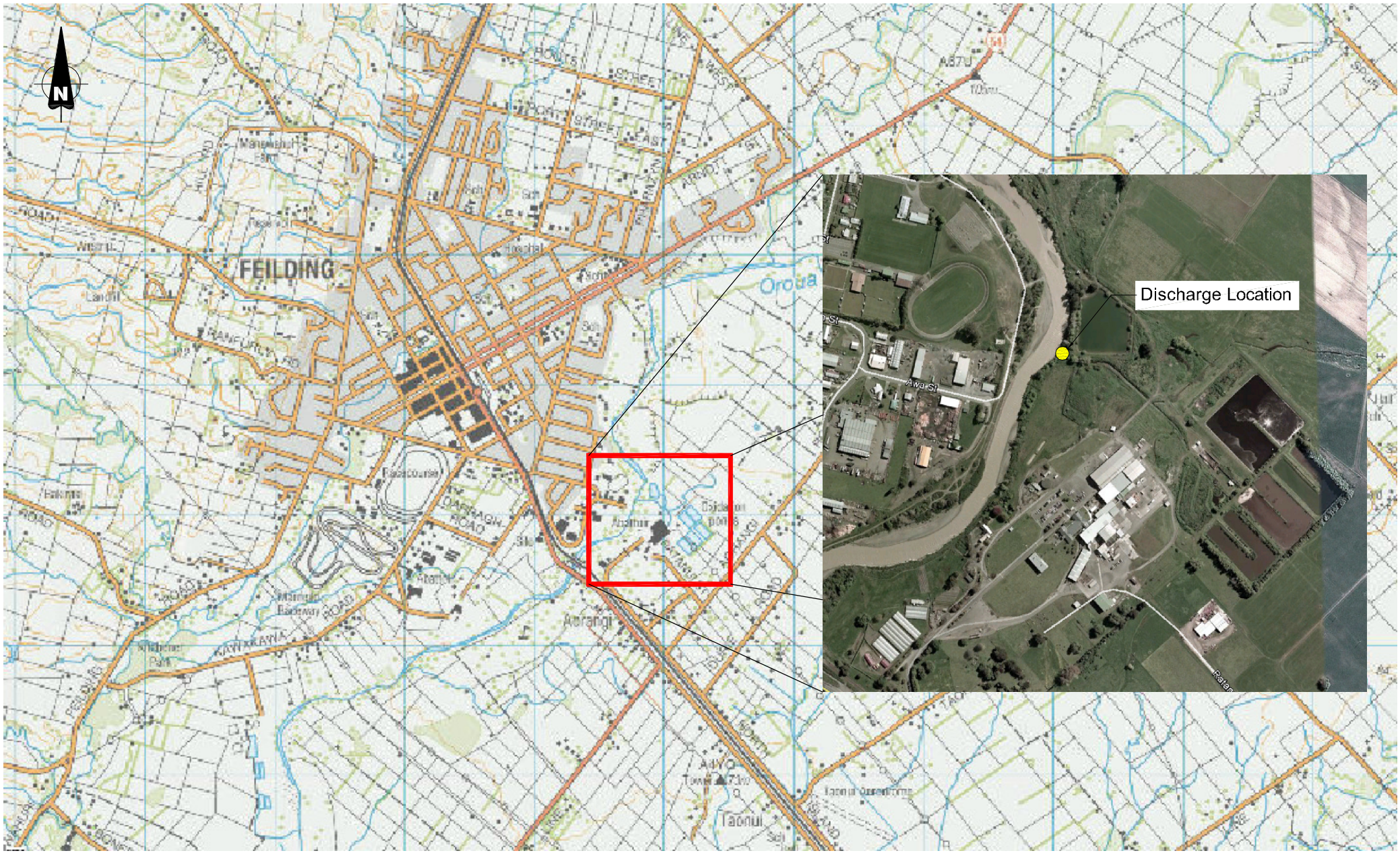
APPENDIX K

Riverbed Structures

Discharge Structure Figures:
Location
Aerial View
Plan
Cross Section

Report:
Treated Effluent Discharge Structure and Fish Friendly Stream Outlet



APPROVED	HL	23.05.14
CHECKED	–	–
DESIGNED	SC	23.05.14
DRAWN	PMJS	23.05.14

L O W E Environmental Impact

|T| [+64] 6 359 3099
|E| office@lei.co.nz
|W| www.lei.co.nz
|A| PO BOX 4667, PALMERSTON NORTH, 4442, NEW ZEALAND.

CLIENT
AFFCO Manawatu Limited

DRAWING TITLE
Discharge Structure - Location

PROJECT
Discharge Modelling

SCALE
NTS (A4)

DATE
25 May 2014

DRAWING No.
10146-07

DRAWING STATUS
Consenting

REVISION
-

APPROVED	HL	23.05.14
CHECKED	–	–
DESIGNED	SC	23.05.14
DRAWN	PMJS	23.05.14

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|T| [+64] 6 359 3099
|E| office@lei.co.nz
|W| www.lei.co.nz
|A| PO BOX 4667, PALMERSTON NORTH, 4442, NEW ZEALAND.

CLIENT
AFFCO Manawatu Limited

DRAWING TITLE
Discharge Structure - Aerial View

PROJECT
Discharge Modelling

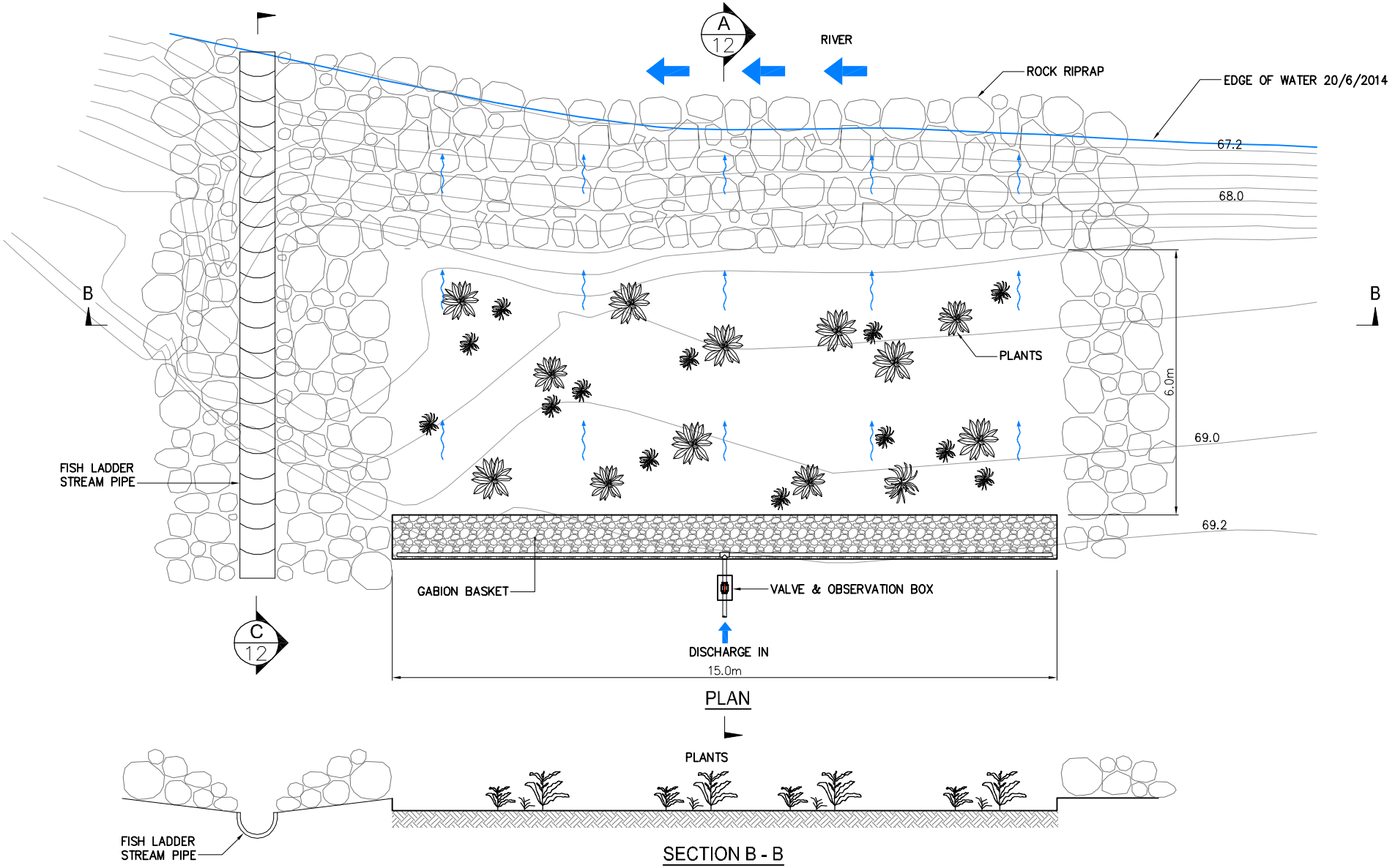
SCALE
1:500 (A4)
0 10m

DATE
05 Sep 2014

DRAWING No.
10146-10

DRAWING STATUS
Consenting

REVISION
-



APPROVED	HL	23.05.14
CHECKED	–	–
DESIGNED	SC	23.05.14
DRAWN	PMJS	23.05.14

L O W E Environmental Impact

|T| [+64] 6 359 3099
|E| office@lei.co.nz
|W| www.lei.co.nz
|A| PO BOX 4667, PALMERSTON NORTH, 4442, NEW ZEALAND.

CLIENT
AFFCO Manawatu Limited

DRAWING TITLE
Discharge Structure - Plan

PROJECT
Resource Consenting

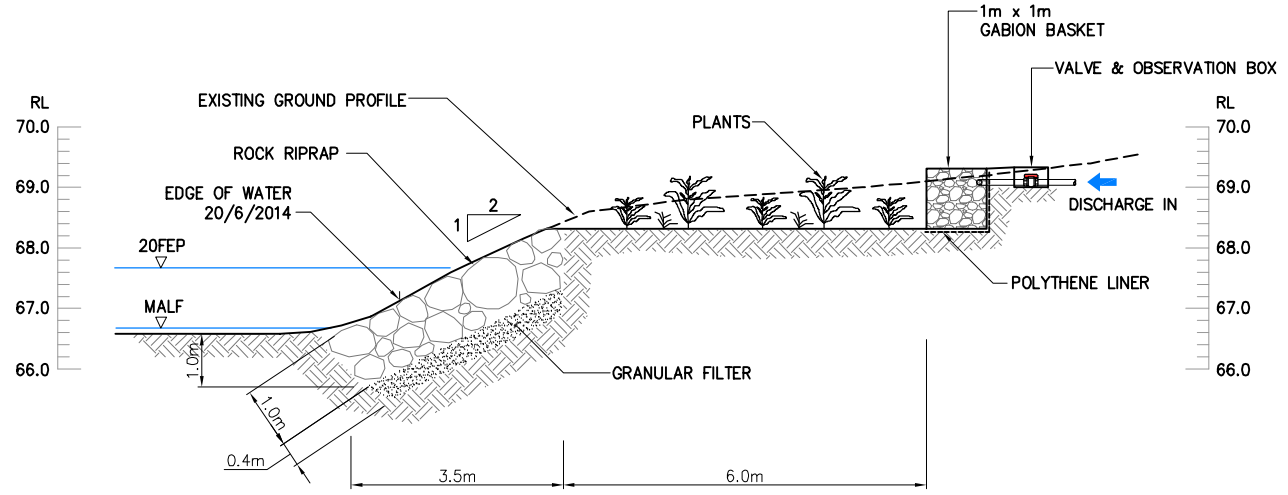
SCALE
1:125 (A4)
0 3m

DATE
05 Sep 2014

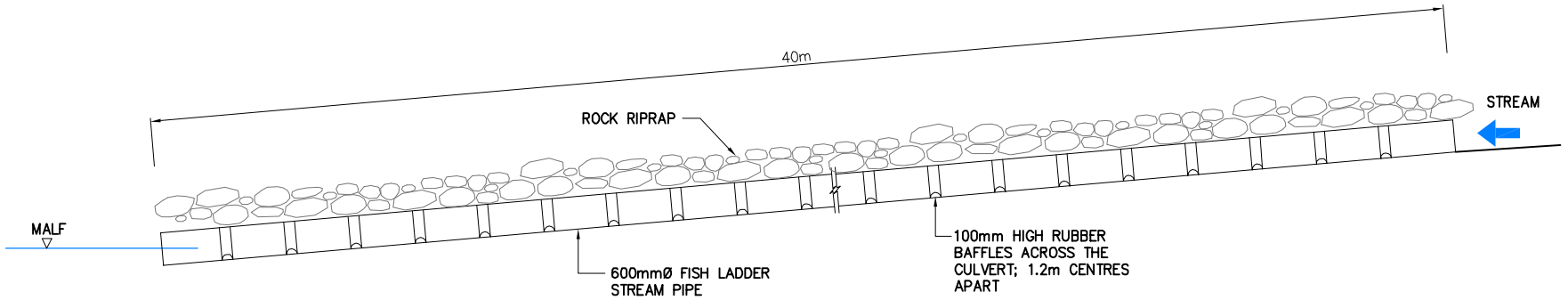
DRAWING No.
10146-11

DRAWING STATUS
Consenting

REVISION
-



A 11 CROSS SECTION



C 11 CROSS SECTION

APPROVED	HL	23.05.14
CHECKED	–	–
DESIGNED	SC	23.05.14
DRAWN	PMJS	23.05.14

L O W E Environmental Impact

|T| [+64] 6 359 3099
|E| office@lei.co.nz
|W| www.lei.co.nz
|A| PO BOX 4667, PALMERSTON NORTH, 4442, NEW ZEALAND.

CLIENT
AFFCO Manawatu Limited

DRAWING TITLE
Discharge Structure - Cross Section

PROJECT
Resource Consenting

SCALE
1:125 (A4)
0 3m

DATE
05 Sep 2014

DRAWING No.
10146-12

DRAWING STATUS
Consenting

REVISION
-

AFFCO Feilding – Treated Effluent Discharge Structure and Fish Friendly Stream Outlet

Introduction

Lowe Environmental Impact have proposed that a rock riprap discharge ramp would be constructed on the Oroua River bank over which to discharge treated effluent from the AFFCO site into the Oroua River approximately 840m upstream of the Aorangi Road Bridge.

The effluent currently discharges to a modified natural stream channel that drops over a small terrace and into the river a short distance downstream from the proposed new discharge site. The effluent will be piped to a rock filled Gabion Basket discharge structure and over a vegetated berm area before spilling into the river over a 20m length of rock riprapped river bank.

Removing the effluent from the natural stream channel and forming a fish friendly structure that connects the stream channel to the river channel will enable fish to access the rehabilitated natural stream channel.

Rock Riprap Discharge Ramp

The rock riprap discharge ramp will be constructed along the existing bank of the Oroua River in a similar way to a normal rock riprap lining installed to control river bank erosion.

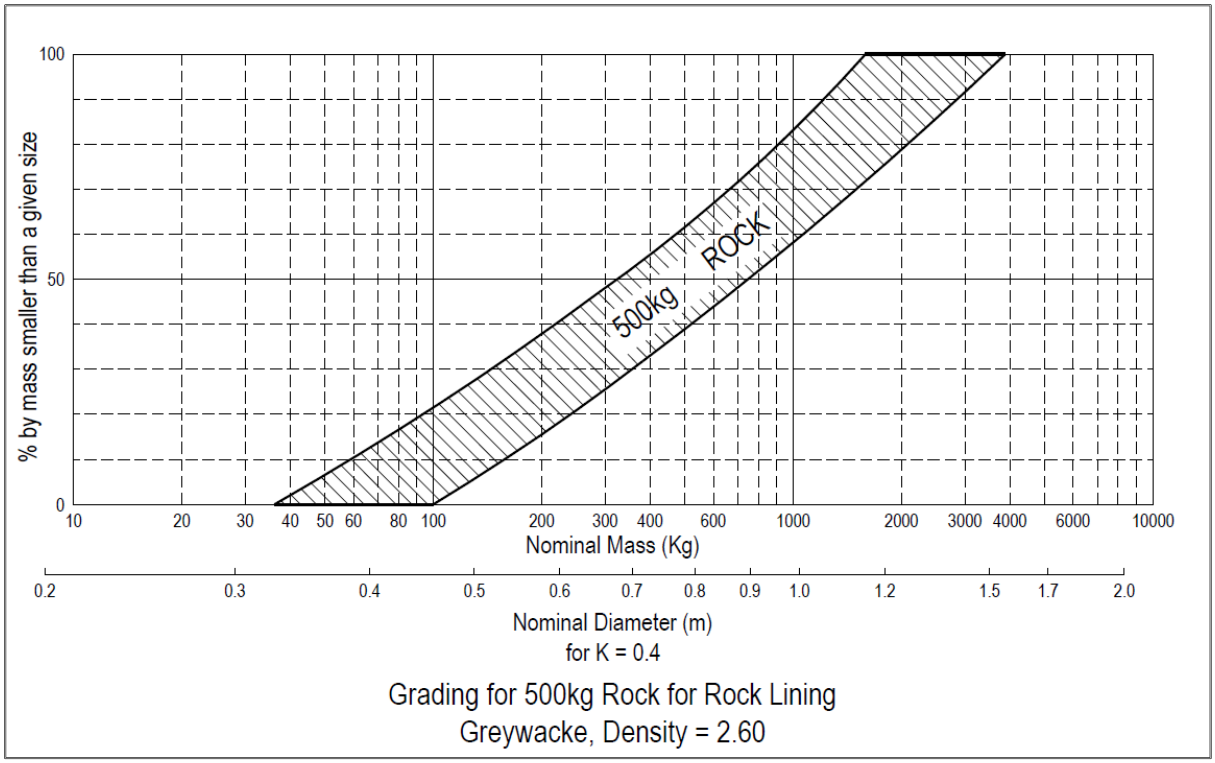
Flood flow and velocity information has been obtained from Horizons Regional Council (HRC). The 100 year flood flow and velocity are 620 cumecs and 3m/s respectively.

To form a stable riverbank lining that would withstand 100 year flood events in the river the rock would need to meet the following specification:

- Rock Grading: as per the following grading curve
- Batter slope: no stepper than 2:1
- Rock layer thickness: at least 1.0 m
- Foundation depth: at least 1 m below river bed level (see section below)
- The rock would need to be tied into the river bank by at least 2m at the upstream and downstream end of the rock lining.
- The outer face of the rock riprap shall be in the line of the upstream and downstream riverbanks.
- A 400mm layer of granular filter material must be place between the natural riverbank material and the rock riprap.

  The filter material shall meet as far as practicable the following specifications:

Size (mm)					
D_0	D_{15}	D_{30}	D_{50}	D_{85}	D_{100}
6-15	15-40	30-80	60-170	150-350	200-450



Grading for 500kg Rock for Rock Lining
Greywacke, Density = 2.60

River bed level

Cross sections of the river have been obtained from HRC. They have a cross sections 185m and 135m upstream and downstream of the proposed rock riprap outlet structure respectively. Interpolating between these cross sections taking into consideration the channel configuration changes over this reach, I estimate that the bed level at the proposed works site is at RL 66.5m.

The rock riprap must be founded 1.0m below the bed level but for estimating purposes, I have taken foundation depth to be RL 65.5

Estimated rock quantities and cost

Rock discharge ramp	120 m^3		
Upstream and downstream of planted area	12 m^3		
Filter layer	50 m^3		
Estimated cost			$ 30,000

Estimated culvert cost

40m of 600mm concrete pipe laid with upstream headwall	$15,000	
Rubber baffles	$ 2,500	
Rock protection 40 m^3	$ 8,000	
Total culvert cost		$25,500

Fish Friendly Stream Channel Reinstatement

The stream channel into which the effluent from the storage ponds is currently discharged has been significantly modified over the years both in its cross section and alignment.

The stream has its headwaters approximately 3 km (channel length) to the north east of where it discharges to the river. The stream has a catchment area of approximately 75 hectares and a potential 100 year flood flow of 2 m^3/s. A flow this large is unlikely to ever reach the river however owing to a large number of culverts and ponded sections along its 3km course.

Approximately 200m upstream of its confluence with the Oroua River, the stream passes through two sets of culverts with the upstream culvert being a 600mm diameter concrete culvert with its invert 1.5m below the surrounding ground level. This culvert has a maximum discharge capacity of 0.9 m^3/s.

The stream channel has been cleared and reshaped over a 300m length centred roughly on this culvert and now has a bed width of 1 to 1.5m and 1:1 batter slopes.
The downstream end of the stream channel has been modified and currently flows in a shallow concrete channel to the edge of the terrace where it has a free outfall onto concrete rubble before flowing through an area of overgrown vegetation to the Oroua River channel. The end of the concrete channel is approximately 2.5m above the bed of the low flow level in the Oroua River.
AFFCO have agreed with local iwi to fully reinstate the stream channel and reconnect it to the river in a manner that will facilitate upstream fish passage.

Fish friendly ramp options.

Whilst a simple rock riprapped channel to the river would appear to be an option, such a channel leaves no spaces for the fish to move upstream through the rock and as a minimum such a ramp would need to have a concrete base with the rocks strategically embedded into the surface.
At a point directly downstream of the outer face of the Gabion Basket discharge structure, such a channel would be over 1 meter deep and during flood events the channel would cause significant turbulence that wold very likely result in significant erosion of the riverbank making such a structure difficult to maintain.
A more secure structure is therefore proposed involving a 40m long 600mm diameter reinforced concrete culvert laid on a uniform grade with its upstream invert slightly lower than the invert of the upstream channel and its outlet slightly below the low flow water level in the river.
The culvert trench would be backfilled and the ground surface protected with a layer of rock riprap to prevent damage during large floods in the river and from overflows from the upstream channel. The outlet would be surrounded by an extension of the upstream discharge structure.
To provide for fish passage up the culvert, it is proposed that 100mm high rubber baffles supplied by ATS-Environmental will be attached to the culvert invert at 1.2 m centres.
The following hyperlink shows how these baffles provide for fish passage up the culvert. https://www.youtube.com/watch?v=n8VrU93jaks

Stream bed refurbishment

The existing old concrete channel would need to be removed and disposed of off-site before the new culvert was installed and the section of this channel upstream of the new outlet culvert would need to be reformed to tie into the upstream channel.
The bed of the upstream reshaped sections of channel is very uniform and does not provide good fish habitat. It is also unlikely to remain stable in a flood event. A full flow discharging from the 600mm culverts would cause scour of the downstream channel and may cause a free outfall to form that would restrict fish passage during periods of low flow.
The habitat in the channel could be improved significantly by lining the invert of the channel with a course river-run gravel and by placing larger rocks (150 - 200mm diameter) randomly in the bed.
A section of the stream bed extending 1 m downstream of the culverts should be lined with 200mm rocks pressed in to the bed but with their tops surfaces at least 50mm above the culvert invert. This will prevent erosion at the culvert outlet and encourage a natural bed to form within the culvert.

Oroua River flood levels

Whilst my brief was not to design the level and position of the Gabion Basket structure or the vegetated berm area, the design level of the Gabions and berm may be influenced by the level of major flood flows.
The level of the 100-year flood flow at the outlet structure has been obtained from HRC. The flood level would be 69.69 m but HRC would add at least 450mm to that to provide freeboard.

John Philpott
22 August 2014