8.0 MITIGATION MEASURES

Following the inclusion of a 20% climate change allowance within the hydraulic model produced as part of this assessment for the Camac Stream, the 1 in 100-year Mid-Range Future Scenario flood level is modelled to overtop the stream bank in the vicinity of the original Node 09CAMM01704. Consequently, a small portion of lands proposed for infilling now falls within a Flood Zone A (Mid-Range Future Scenario). In order to allow for the infilling of the proposed lands and to mitigate against any displacement of flood water under the 1% AEP, level for level compensation is proposed. This approach is described in Sections 8.1 and 8.2.

It is also acknowledged that the Local Authority's Water Services Section have requested that surface water run off rates should not be increased post the infilling works. Section 8.3 and 8.4 describes how the greenfield runoff will not increase post infilling.

8.1 Description of Level for Level Compensation Approach

The '*Guidelines*' describe the requirements which need to be adhered to when designing compensatory flood plain storage. Any loss of flood storage must be compensated for by the reduction in the level of nearby ground. This level for level compensation provides the same surface area at the same elevation before and after development. This ensures that the same volume of flood storage is available at all levels of flooding and that a direct replacement for lost storage volume is achieved.

The elevation over which the displacement is occurring is divided into flood 'slices' (i.e. horizontal sections of equal size). For each flood slice, the volume of floodplain lost through the development at that floodplain slice elevation must be calculated. The flood 'slices' methodology is used to ensure that the shaping of the compensation area mimics that of the original floodplain. For compensation areas to be deemed appropriately designed, they must comply with the following requirements:

100mm – 300mm horizontal flood slices to be used;

Cut volumes should be greater than or equal to the fill volume for each slice;

Should be hydraulically linked to flood zone; and

Should not be located within existing flood zone.

8.2 Proposed Compensatory Storage Mitigation

In order to ensure that greater flood storage is available post infilling works, the following mitigation measures are recommended:

- An area of compensatory storage should be developed within the western portion of the site. Figure 5 shows how this area is hydraulically linked to the existing 1 in 100-year flood plain and to what elevation, the ground should be lowered too. Whilst, Figure 6, details how level for level compensation can be achieved in this area. As is demonstrated on Figure 5, this proposed compensation area is outside of the 1% AEP (plus climate change allowance) Flood Zone. It is appropriate to partially position this compensation area within the 10m set back buffer zone as no infilling will occur and the area will still act as a buffer zone during the infilling activities.

Given that infilling is proposed to a maximum fluvial flood depth of 300mm, two flood 'slices' each 150mm in depth is sufficient. Table 6. outlines the volume of flood storage which would be lost through the proposed infilling works and the volume that can be achieved through the provision of level for level compensatory storage. As can be seen from Table x, >28m^3 of additional flood storage volume in excess of that lost during the 1 in 100-year event will be achieved following the implementation of this measure.

Table 6. Detail on Level for Level Compensation Storage Slices

Slice Elevation	Flood Volume Lost	Volume Gained by Compensatory Storage
135.59m – 135.74m AOD	9.15m^3	21.6m^3
135.75m – 135.89m AOD	5.175m^3	21.6m^3
Total	14.325m^3	43.2m^3

8.3 Onsite Infiltration Rate Assessment

In order to establish the infiltration rates onsite a soakaway test was carried out at four locations (TP01-TP04) in accordance with BRE Digest 365 Soakaways (BRE, 2016). TP01 was located within the lands mapped as containing TLPSsS – Sandstone and shale till (see Plate 9). TP02 and TP04 were excavated at either end of the band across the middle of the site mapped as consisting of GLs – Sands and gravels. While TP03 was excavated in the area mapped as containing A – Alluvium subsoils. A soil infiltration test was commenced within each trial pit on the 06th of September 2021 (see Photo Logs in Appendix 4). Each side of the trial pits were

Subsequent to the site visit, it was determined that twelve topographical cross sections and topographical data relating to the instream infrastructure was required to construct an accurate model of the watercourse. In total the model extent covers circa a 630m stretch of the Camac stream (i.e. including a sufficient distance upstream and downstream from the site). A summary of the cross-section locations and their justification for selection is described in Table 1. below.

Table 1. Description of the cross-section locations utilised in the HEC – RAS hydraulic model.

Cross Section No.	Description of Cross Section Location
Cross Section 1 (L-L)	170m upstream from the site under focus
Cross Section 2 (K-K)	105m upstream from the site under focus
Cross Section 3 (J-J)	Within the southern portion of the site
Cross Section 4 (I-I)	Within the southern portion of the site
Cross Section 5 (H-H)	Within the northern portion of the site
Cross Section 6 (G-G)	Within the northern portion of the site
Cross Section 7 (F-F)	Upstream of local roadway culvert
Cross Section 8 (E-E)	Downstream of local roadway culvert
Cross Section 9 (D-D)	Through Millbrook Manor Nursing Home
Cross Section 10 (C-C)	Upstream of Nursing Home lane culvert
Cross Section 11 (B-B)	Downstream of Nursing Home lane culvert
Cross Section 12 (A-A)	190m downstream of study site

All cross-section surveying was completed by Horizon Surveys Ltd in October 2021. This topographical data offers concise and highly accurate details of the top and bottom levels of the stream banks and the watercourse bed elevations. The cross profiles are included in Appendix 1. LIDAR data supplied by the Ordnance Survey Ireland (OSI), was utilised to define the floodplain extents. This topographical data was ground proofed using site elevation data taken by Coffey Construction Ltd and Horizon Surveys Ltd.

6.2 Peak Flow Estimation

6.2.1 Flood Studies Update (FSU) Flow Estimate

The Flood Studies Update (FSU) programme was undertaken by the Office of Public Works (OPW), to provide improved methods of extreme rainfall and flood estimation at both gauged and ungauged locations across the Republic of Ireland. The FSU web-based application portal facilitates the estimation of flood flows, extreme rainfall depths and other hydrological variables at river node points at 500m centres along the entire Irish river network.

At each node point, the Qmed value can be obtained from catchment descriptor data through the application of the following regression model:

$$Qmed_{rural} = 1.237x10^{-5} \times AREA^{0.937} \times BFIsoils^{0.922} \times SAAR^{1.306} \times FARL^{2.21} \times DRAIND^{0.341} \times S1085^{0.185} \times (1 + ARTDRAIN2)^{0.408}$$

Where:

AREA = Catchment area (km^2);

BFIsoils = Base flow index derived from soils data;

SAAR = Long term mean annual rainfall amount (mm);

FARL = Flood attenuation by reservoirs / lakes;

DRAIND = Drainage density;

S1085 = Slope of the main channel between 10% and 85% of its length (m/km);

ARTDRAIN2 = Percentage of the catchment river network included in Drainage schemes.

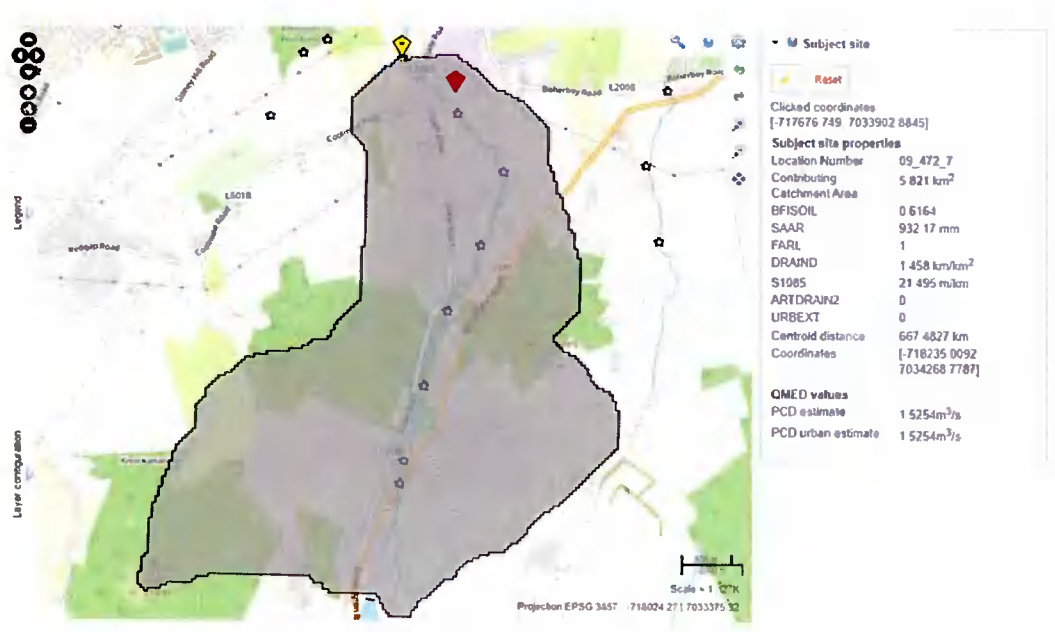


Plate 7. Output from the flood frequencies tool for gauged sites on the OPW FSU web portal.

The programme output for the subject site can be summarised as follows:

- Catchment Area: 5.821km^2
- SAAR: 932.17mm
- S1085: 21.495m/km

• Qmed: 1.525m^3/s

It is important to note that the use of the FSU Qmed is typically designed for catchments that are greater than 25km^2 in area. Caution should be exercised when using this methodology for smaller catchments. Given that the upgradient catchment area equates to 5.821km^2, it is imperative that other methodologies designed for use on smaller catchments are assessed and compared.

6.2.2 Flood Studies Supplementary Report 6

In the absence of sufficient flow records, one of the most appropriate methods for estimating ungauged design flood flows in Ireland is based on the Flood Studies Report (FSR) and subsequent modifications. The original 1975 Flood Studies Report (FSR) equation when tested showed that floods on small catchments were less well predicated than on large ones. The Flood Studies Supplementary Report (FSSR) No. 6 was introduced to overcome the shortcomings in the estimation of mean annual floods from small catchments through the use of the FSR. A total of 53 catchments with <20km^2 catchment area were used in the regression analysis during this study. The FSSR 6 Q_{BAR} equation for use on catchments of less than 20km^2 is:

$$Q_{BAR} = 0.00066 \times AREA^{0.92} \times SAAR^{1.22} \times SOIL^{2.0}$$

Using the FSSR 6 formula, the 1 in 1-year flow is as follows:

$$Q_{BAR} = 0.00066 \times 5.821^{0.92} \times 932.17^{1.22} \times 0.3^{2.0}$$

$$Q_{BAR} = 0.00066 \times 5.06 \times 4195.5 \times 0.09$$

$$Q_{BAR} = 1.26\ m^3/s$$

6.2.3 Institute of Hydrology (IH) 124

In 1994 the Institute of Hydrology carried out further regression studies on small catchments (areas <25km^2). A total of 87 catchments ranging from 0.9km^2 to 24.7km^2 were available. Seventy-one of these catchments were chosen as completely rural catchments having urban fractions of less than 0.025km^2. The following 3-variable equation was derived:

$$QBAR = 0.00108 \times AREA^{0.89} \times SAAR^{1.17} \times SOIL^{2.17}$$

This equation is widely used in Ireland to estimate flood flows and Greenfield runoff from small catchments (i.e. between 0.5km^2 and 25km^2).

Using the IH124 formula, the 1 in 1-year flow is as follows:

$$Q_{BAR} = 0.00108 \times 5.821^{0.89} \times 932.17^{1.17} \times 0.3^{2.17}$$

$$Q_{BAR} = 0.00108 \times 4.80 \times 2980.64 \times 0.073$$

$$Q_{BAR} = 1.13 \text{ m}^3/\text{s}$$

6.2.4 Flood Frequency Growth Curve for Ireland

Single-Site Flood Frequency Analysis is a statistical analysis of flood data for a particular gauged location and is only possible at locations where recorded time-series data exists. It is a method used to derive flood growth curves and frequency curves so that peak flows can be calculated from the Qmed. The appropriate growth curve for an ungauged catchment is estimated using a Pooled Analysis. This method uses catchment characteristics (PCDs) to identify a number of gauged catchments that are hydrologically similar to the catchment of the subject site. The observed flood data for the "similar" gauged catchments are then pooled to effectively create a longer time-series and used to estimate the peak flow at the ungauged subject site. In this way Pooled Analysis may also be used to supplement Single Site Analysis to improve the robustness of the design estimation particularly for long return period events. A Pooled Flood Frequency Analysis has been performed to derive the AEP growth factors outlined in Table 2 and Plate 8 using the FSU method. These growth factors have been applied to the design flows estimated using the FSU methodology. Conversely, it is possible using the standard growth factors set out in the FSR to calculate the 1 in 100-year design flows for the FSSR 6 and IH 124.

Table 2. Determination of flood flows for selected return periods

Peak Flow Estimation Method	QMED / Q_{BAR} Value (m^3/s)	Growth Factor (1 in 100 Years)	Growth Factor (1 in 1000 Years)	1 in 100 Year Predicted Flow (m^3/s)	1 in 1000 Year Predicted Flow (m^3/s)
FSU	1.53	2.59	3.46	3.96	5.29
FSSR 6	1.26	1.96	2.6	2.47	3.28
IH 124	1.13	1.96	2.6	2.21	2.94

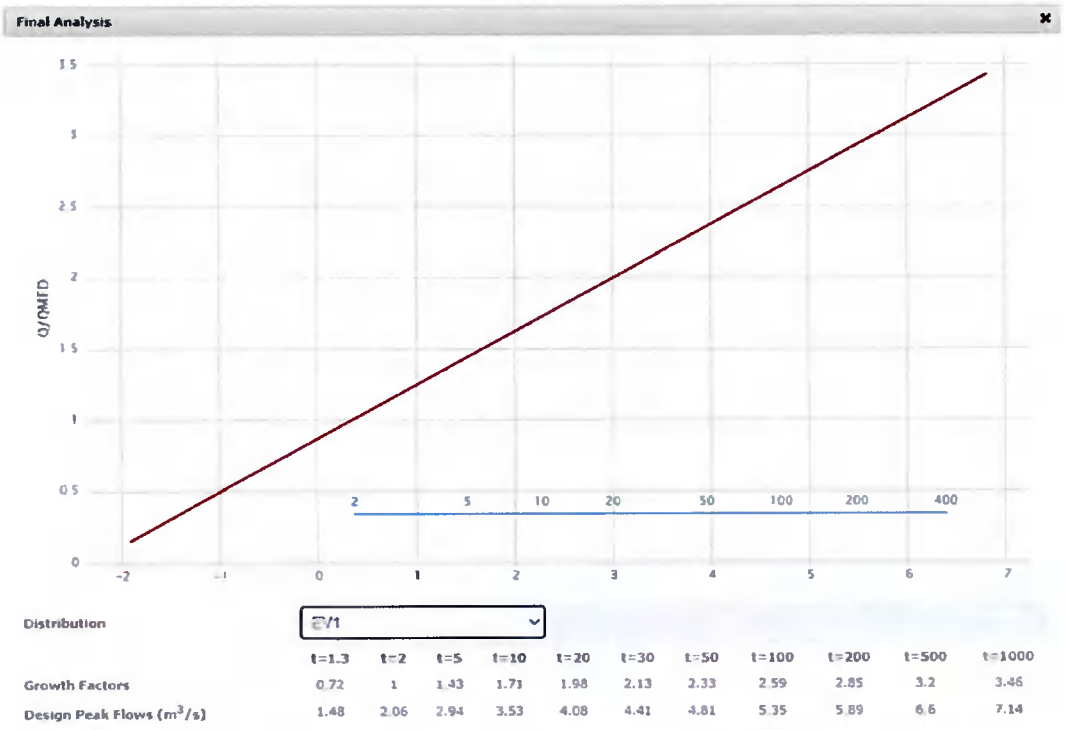


Plate 8. Pooled Flood Frequency Analysis derived from the OPW FSU web portal for the site.

6.2.6 Climate Change Allowance

It is proposed to apply a further growth factor of 1.2 to these estimated design year flows, in order to allow provision for predicted increased rainfall and associated run-off volumes over the coming century. The design flood flows (with allowance for climate change) are outlined in Table 3 below.

Table 3. Determination of flood flows for selected return periods

Peak Flow Estimation Method	1 in 100 Year Predicted Flow (m^3/s)	1 in 1000 Year Predicted Flow (m^3/s)	Growth Factor (Climate Change Allowance)	Plus Climate Change Allowance	
				1 in 100 Year Predicted Flow (m^3/s)	1 in 1000 Year Predicted Flow (m^3/s)
FSU	3.96	5.29	1.2	4.75	6.35
FSSR 6	2.47	3.28	1.2	2.96	3.94
IH 124	2.21	2.94	1.2	2.65	3.53

6.2.7 Recommended Design Flow

There was a relatively strong agreement between the design flows calculated using the FSSR 6 and IH 124 estimation methods. However, a more stringent 1 in 100-year design flow was estimated using the FSU methodology. Whilst not always utilised in catchments of <25km^2, in this instance this more rigorous design flow estimated from the FSU was used in the hydraulic model.

6.3 Hydraulic Modelling Assessment

In order to assess the extent of fluvial flooding in relation to the 1 in 1000-year flood event, a 1-Dimensional (1D) steady flow hydraulic model of the stream was constructed using the HEC-RAS hydraulic modelling software (latest version 5.0.7). The model was used to simulate the water level at different points along the stream under different flow regimes (see model outputs in Appendices 2 & 3). The model was compiled using the cross-sections surveyed on the 05th October 2021.

When constructing a 1D Steady Flow Hydraulic Model using HEC-RAS software, a number of user defined parameters are required to complete the computational procedure. This includes Manning's 'n-Values' (i.e. roughness coefficient) of the stream banks and channel at each cross-section. Contraction and expansion coefficients are also required to evaluate the amount of energy loss that occurs because of a flow contraction or expansion at each cross-section. The values used in the model are detailed in Table 4. The downgradient boundary condition of the model was determined using the 'Normal Depth' application of the software, whereby the channel slope was defined as 0.02m/m (i.e. relatively steep channel gradient). The 'Critical Depth' function was selected to model the upgradient boundary condition.

Table 4. Summary of roughness, contraction and expansion coefficients used in the hydraulic model

Cross Section No.	Roughness Coefficient (Manning's n Value)	Contraction Coefficient	Expansion Coefficient
Cross Section 1 (L-L) (RS = 212)	Left overbank – 0.035	0.1	0.3
	River channel – 0.033		
	Right overbank – 0.035		
Cross Section 2 (K-K) (RS = 211)	Left overbank – 0.035	0.1	0.3
	River channel – 0.033		
	Right overbank – 0.035		
Cross Section 3 (J-J) (RS = 210)	Left overbank – 0.035	0.1	0.3
	River channel – 0.033		
	Right overbank – 0.035		

Table 4 (Continued). Summary of roughness, contraction and expansion coefficients used in the hydraulic model

Cross Section No.	Roughness Coefficient (Manning's n Value)	Contraction Coefficient	Expansion Coefficient
Cross Section 4 (I-I) (RS = 209)	Left overbank – 0.035 River channel – 0.033 Right overbank – 0.035	0.1	0.3
Cross Section 5 (H-H) (RS = 208)	Left overbank – 0.035 River channel – 0.033 Right overbank – 0.035	0.1	0.3
Cross Section 6 (G-G) (RS = 207)	Left overbank – 0.035 River channel – 0.033 Right overbank – 0.035	0.3	0.5
Cross Section 7 (F-F) (RS = 206)	Left overbank – 0.035 River channel – 0.033 Right overbank – 0.035	0.3	0.5
Cross Section 8 (E-E) (RS = 205)	Left overbank – 0.035 River channel – 0.033 Right overbank – 0.035	0.3	0.5
Cross Section 9 (D-D) (RS = 204)	Left overbank – 0.035 River channel – 0.033 Right overbank – 0.035	0.3	0.5
Cross Section 10 (C-C) (RS = 203)	Left overbank – 0.035 River channel – 0.033 Right overbank – 0.035	0.3	0.5
Cross Section 11 (B-B) (RS = 202)	Left overbank – 0.035 River channel – 0.033 Right overbank – 0.035	0.3	0.5
Cross Section 12 (A-A) (RS = 201)	Left overbank – 0.035 River channel – 0.033 Right overbank – 0.035	0.3	0.5

Note: Manning's 'n-Values' derived from Chow, V.T., 1959 Open Channel Hydraulics, Mc Graw – Hill Book Company, N.Y

7.0 MODEL RESULTS

The conveyance capacity of each of the surveyed cross sections was assessed for suitability to transmit the Q100 flood flows within the Camac Stream. Each of the cross-sectional profiles including Q100 flood flows and Q100 flows plus climate change allowance are presented in Appendix 2 with the model data outputs for both flood events located in Appendix 3. Based on the hydraulic model produced for the watercourse, riverbank overtopping is not predicated to occur at the upgradient cross-section locations or at the cross sections within the northern portion of the site. Table 5. details the water levels predicated for the 1 in 100-year event (1% AEP) for each of the modelled cross sections.

Table 5. Water levels predicted for the stream in relation to the proposed infill site

Cross Section No.	Water Level Predicted (1% AEP)	Water Level Predicted (1% AEP (plus C.C allowance)
CS 1 (L-L)	141.98m AOD	142.05m AOD
CS 2 (K-K)	141.01m AOD	141.08m AOD
CS 3 (J-J)	136.92m AOD	136.98m AOD
CS 4 (I-I)	136.70m AOD	136.75m AOD
CFRAM Node Location	135.84m AOD	135.89m AOD
CS 5 (H-H)	133.94m AOD	133.98m AOD
CS 6 (G-G)	132.43m AOD	132.48m AOD
CS 7 (F-F)	131.25m AOD	131.36m AOD
CS 8 (E-E)	130.50m AOD	130.55m AOD
CS 9 (D-D)	130.14m AOD	130.19m AOD
CS 10 (C-C)	129.50m AOD	129.61m AOD
Nursing Home Culvert	129.36m AOD	129.45m AOD
CS 11 (B-B)	129.45m AOD	129.54m AOD
CS 12 (A-A)	129.02m AOD	129.09m AOD

Like the model produced for the Camac Stream as part of the Eastern CFRAM, channel overtopping was predicated to occur at a location in vicinity of Node 09CAMM01704. As discussed previously a 1 in 100-year level of 135.81m AOD was estimated at this point during the CFRAM project. A 1 in 100-year level of 135.84m AOD was modelled as part of this project at this location, thus representing a strong agreement between models. Once a climate change allowance of 20% is factored in, a 1 in 100-year flood level of 135.89m AOD was predicted.

Consequently, the lands to the north of the infill area and a small portion of land within the proposed infill area, below an elevation of 135.89m AOD will be susceptible to fluvial flooding under the 1% AEP. Figure 4 outlines the right of bank flood extents predicated for the 1 in 100-year flood event for applicant's site.

trimmed square. The walls of the trial pits were found to be stable and therefore the use of granular fill material was not required. No subsidence of the trial pit walls was observed. The soils encountered in each soakaway trial pit included:

TP01

- 0 – 0.3m b.g.l: Topsoil;
- 0.3m – 1.2m b.g.l: Firm brown slightly sandy, gravelly CLAY;
- 1.2m – 1.4m b.g.l: Stiff brown gravelly CLAY with occasional cobbles. Cobbles are angular to subangular. TP01 was terminated at a depth of 1.4m b.g.l.

TP02

- 0 – 0.3m b.g.l: Topsoil;
- 0.3m – 0.6m b.g.l: Soft to Firm very dark brown CLAY;
- 0.6m – 1.1m b.g.l: Firm slightly sandy, very gravelly CLAY with frequent cobbles. Cobbles are angular to subangular. Mottling noted at 0.7m b.g.l. TP02 was terminated at a depth of 1.1m b.g.l as groundwater ingress was noted at base.

TP03

- 0 – 0.3m b.g.l: Topsoil;
- 0.3m – 0.7m b.g.l: Soft to Firm very dark brown CLAY;
- 0.7m – 1.3m b.g.l: Silty, sandy, GRAVEL with frequent to abundant cobbles. Cobbles are angular / subangular to subrounded. TP03 was terminated at a depth of 1.3m b.g.l as groundwater ingress was noted at base. Groundwater quickly filled to a depth of 0.8m b.g.l.

TP04

- 0 – 0.3m b.g.l: Topsoil;
- 0.3m – 0.7m b.g.l: Soft to Firm dark brown CLAY;

- 0.7m – 1.4m b.g.l: Soft to Firm slightly sandy, gravelly CLAY with frequent cobbles. Cobbles are angular to subangular. Mottling noted at 0.7m b.g.l. TP04 was terminated at a depth of 1.4m b.g.l due to groundwater intrusion at base.

Plate 9. Location of infiltration test holes onsite

Ground conditions within the areas categorised as TLPSsS – Sandstone and shale till and A – Alluvium subsoils were found to be consistent with the subsoil type and permeability classifications assigned by the GSI mapping. However, GLs – glaciofluvial sands and gravels were not encountered across the site. Instead, glacial till of a lower permeability was encountered. Given the presence of groundwater within TP02 and TP04 – no drop in water level in these trial pits was recorded after filling with water. The evidence of soil mottling at 0.7m b.g.l would suggest that groundwater levels rise to this depth. Hence it is not anticipated that under wet conditions, any subsoil infiltration will occur below 0.7m b.g.l. Similarly, no drop in water level was recorded within TP03. An infiltration rate of 50mm/hr was observed in TP01.

In order to assess the potential for subsoil permeability within the upper subsoil horizons of the land in the vicinity of TP03 (i.e. A – Alluvium subsoil) and TP04 (i.e soft to firm, glacial till CLAY), an infiltration test hole was dug to a depth below the topsoil level (i.e. 300mm b.g.l) in

the vicinity of the original trial pit locations (see Plate 9). No infiltration was recorded with TP03A. An infiltration rate of 155mm/hr was recorded in TP04A.

8.4 Proposed Design to Control Surface Water Runoff Rate

In order to mimic existing subsoil permeability / greenfield runoff rates onsite, post infilling works, it is proposed to deposit differing soil types within different areas of the infill site (see Figure 6). A minimum of 300mm of topsoil will be reinstated across the site once all infilling activities have ceased. This will compensate for any loss of infiltration / rainwater storage afforded by existing topsoil conditions.

The Ground Investigation completed Causeway Geotech in 2018 (Ref: 17-1375) for the neighbouring waterworks site, recorded glacial till (i.e. firm brown sandy gravelly CLAY) within the upper 1 – 2m horizons at a number of locations within the site. Stiffer glacial tills typically characterised as grey / black CLAY were encountered at lower depths in places. It is proposed that all infilling within the northern portion of the site (i.e. area categorised as TLPSsS subsoil of moderate permeability should consist of the shallower, firm brown sandy gravelly CLAYS (see Figure 6). Similarly, this type of material should be infilled at a depth of 0.3m - 0.7m b.g.l in the area where shallow subsoil infiltration will occur (i.e. area previously classified as GLs – sands and gravels but is now reclassified as glacial till). This material can be underlain with stiffer boulder CLAYs as groundwater levels likely found under wet conditions (i.e. evidence of mottled soil) hinders any further infiltration. Thus, no loss of subsoil storage will occur as a consequence of infilling this material. Similarly, stiff / very stiff boulder clays are suitable for infilling below the topsoil layer in the area of the site where alluvium subsoils are present. The infiltration tests completed onsite, confirm that no infiltration presently occurs within this area due to the soil conditions (see Figure 6).

9.0 VULNERABILITY & JUSTIFICTION TEST

Table 3.1 of the guidelines provides three vulnerability categories, based on the type of development that may be appropriate to each flood zone. In summary:

- **Zone A - High probability of flooding:** Most types of development would be considered inappropriate in this zone. Development in this zone should be avoided and/or only considered in exceptional circumstances, such as in city and town centres, or in the case of essential infrastructure that cannot be located elsewhere, and where the Justification Test has been applied. Only water-compatible development, such as docks and marinas, dockside activities that require a waterside location, amenity open space, outdoor sports and recreation, would be considered appropriate in this zone;

- **Zone B - Moderate probability of flooding:** Highly vulnerable development, such as hospitals, residential care homes, Garda, fire and ambulance stations, dwelling houses and primary strategic transport and utilities infrastructure, would generally be considered inappropriate in this zone, unless the requirements of the Justification Test can be met. Less vulnerable development, such as retail, commercial and industrial uses, sites used for short-let for caravans and camping and secondary strategic transport and utilities infrastructure, and water-compatible development might be considered appropriate in this zone;

- **Zone C - Low probability of flooding:** Development in this zone is appropriate from a flood risk perspective (subject to assessment of flood hazard from sources other than rivers and the coast) but would need to meet the normal range of other proper planning and sustainable development considerations

A Justification Test is an assessment of whether a development proposal within an area at risk of flooding meets specific criteria for proper planning and sustainable development and demonstrates that it will not be subject to unacceptable risk nor increase flood risk elsewhere. Table 3.2 of the guidelines illustrates those types of development that would be required to meet the Justification Test (see Plate 5). As a minimal amount of 1 in 100-year flooding (i.e. Flood Zone A) is predicted to occur within the footprint of the proposed infill area, a Development Management Justification Test was carried out in respect of the proposed project. This was completed in accordance with Section 5.15 of the Flood Risk Management Guidelines and incorporating the findings of this Site-Specific FRA. Table 7 presents the results of this test which conclude that the proposed development satisfies the criteria of the Justification test.

Table 7. Development Management Justification Test (Box 5.1 of the 'Guidelines')

Criterion	Response
5.1.1. The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.	The RU zoning objective of the application site, seeks to protect and improve rural amenity and to provide for the development of agriculture.
5.1.2 (i) The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk.	The Flood Risk Assessment shows that the development will be predominantly positioned outside of the modelled 'Flood Zone A'. A compensatory storage area will be provided to offset the minimal loss of 'Flood Zone A'. Consequently, the proposed development will not displace flood water to adjoining lands and thus will not increase flood risk in the vicinity of the site or wider environment.
5.1.2 (ii) The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible.	Given that no loss of floodplain storage will occur, a heightened risk of flood damage to surrounding properties or the local road infrastructure is not anticipated under the 1 in 100-year event. Additionally, the Flood Zone A takes account of climate change (i.e. Mid-Range Future Scenario).
5.1.2 (iii) The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access.	The proposed development does not impact on any existing flood protection measures and will not prevent any potential future flood risk management measures, as a sufficient buffer between the infill area and watercourse will exist. Similarly, the proposed development will not cause an obstruction to any future OPW arterial drainage works.
5.1.2 (iv) The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to development of good urban design and vibrant and active streetscapes.	The RU zoning objective of the application site, seeks to protect and improve rural amenity and to provide for the development of agriculture.

10.0 CONCLUSIONS & RECOMMENDATIONS

In consideration of the findings of this detailed site-specific flood risk assessment, the following conclusions and recommendations can be made:

- The OPW's CFRAM mapping / modelling indicates that a portion of the site is susceptible to fluvial flooding from the Camac Stream under the 1 in 100-year scenario;
- A hydraulic assessment of the Camac Stream, which was extended both upstream and downstream of the site was constructed by Hydrec Environmental Consulting in order to predict the 1 in 100-year flood event relative to the site and based on current river channel conditions / elevations (i.e. 2021);
- This model produced by Hydrec Environmental Consulting includes a 20% climate change allowance in relation to the Flood Zone A;
- Consequently, a small portion of the proposed infill area will fall within the 1% AEP (Mid-Range Future Scenario);
- To offset this loss, a compensation area which is currently outside of the 1% AEP Flood Zone but hydrologically linked to the existing flood plain has been proposed;
- Based on a level for level compensatory storage approach, a total of 43.2m^3 of compensatory storage volume can be achieved (i.e. once ground levels in the proposed 'Compensatory Storage Area' are reduced by 300mm). This represents an additional volume of 28.875m^3 to that of the quantify which will be displaced as a consequence of the infilling works;
- In order to mimic existing subsoil permeability / greenfield runoff rates onsite, it is proposed to deposit differing soil types as identified in the Causeway Geotech Ground Investigation within different areas of the infill site. These areas were selected as a consequence of the infiltration rates recorded (or lack of) during the site infiltration assessment completed on the 6th of September 2021 (see Figure 6).
- Given the nature of the project (i.e. Less Vulnerable Development) and its minimal positioning within a Flood Zone A, a Development Management Justification Test was carried out in accordance with Section 5.15 of the Flood Risk Management Guidelines. Table 7 presents the results of this test which conclude that the proposed development satisfies the criteria of the Justification test;

- **To conclude the project subject to the specified mitigation measures being implemented, will not be at risk from flooding nor will it exacerbate flooding in the immediate vicinity or wider area.**

Signed:

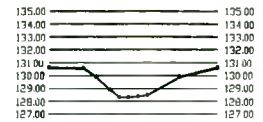
Patrick McCabe

Patrick McCabe B.Sc., M.Sc.

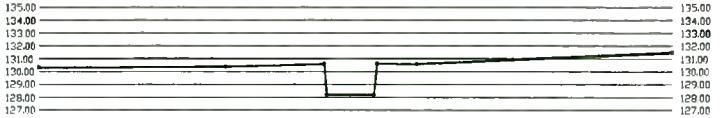
Hydrec Environmental Consulting

APPENDIX 1

HORIZON SURVEYS LTD – TOPOGRAPHICAL CROSS SECTIONS



Section A-A



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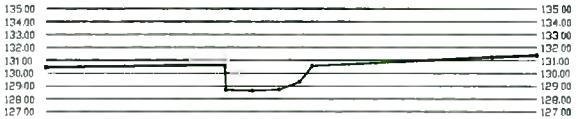

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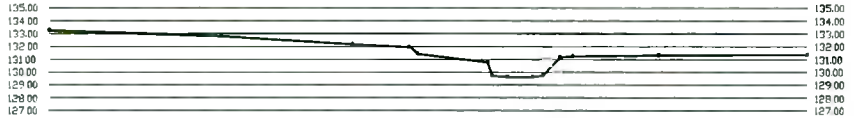

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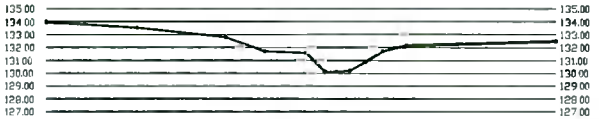

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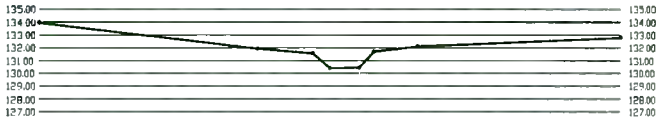

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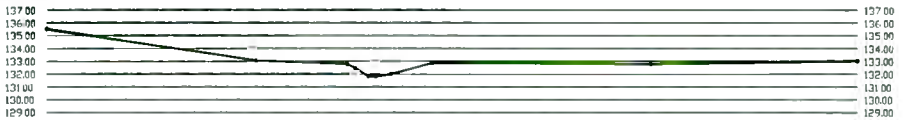

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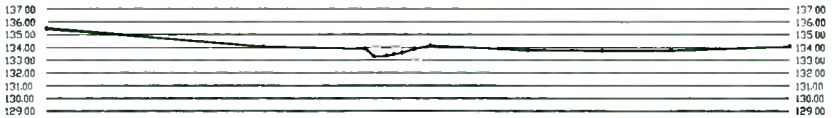


Section H-H

NOTES:
1. All levels are relative to Ordnance Datum Malin Head
2. 50m sq grid relative to Irish Transverse Mercator Co-ordinate reference system
3. Contours are at .25m intervals

LINE TYPE LEGEND

	Bog		Electricity Box
	Downpipe		Fire Hydrant
EP	Electricity Pole		Flow Station
GAS	Gate		Inspection Cover
	Gully		Invert Level
	Gas Valve		Lamp Post
	Gas Cover		Manhole
	Finished Floor Level	OR/ST	Post
	Electricity Cover		Pillar
	Manhole Cover		Telegraph pole
	Ridge		Telecom Cover
	Spot Level		Tree
	Sign		Water Meter

LINE TYPE LEGEND

	Boundary		Surface Change
	Building		Step
	Bank Top		Vegetation Line
	Bank Bottom		Verge
	Channel		Telecom Cover
	Fence		Wall
	Kerb		Railing
	Path		Verge
	Overhead Electricity Line		Road Edge

REVISIONS

No.	Date	Description

Market Square, Castleblayney, Monaghan, Ireland
Tel 042 9740871 Mobile 087 6640837 / 087 7830026
Website www.horizon.group.ie

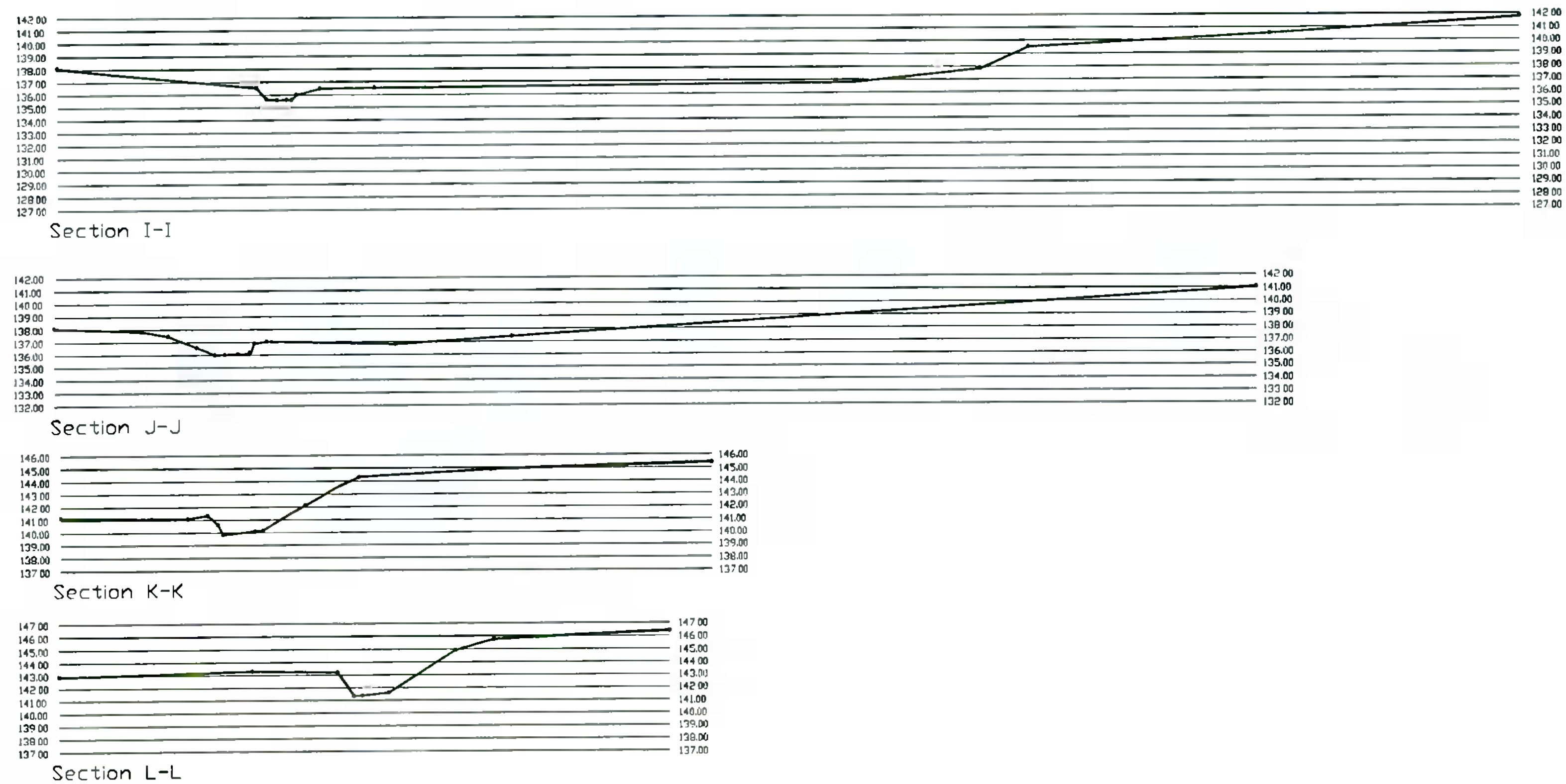
Client
XX

Professional
Hydrec

Project Title
River Survey at Saggart

Drawn	TD	Dwg No	01/001
Scale	1:200	Date	XX

A1



NOTES:
1. All levels are relative to Ordnance Datum Malin Head
2. 50m sq grid relative to Irish Transverse Mercator Co-ordinate reference system
3. Contours are at .25m intervals

LINE TYPE LEGEND

LINE TYPE LEGEND

REVISIONS

No.	Date	Description

Horizon Group

Client: XX

Professional: Hydrec

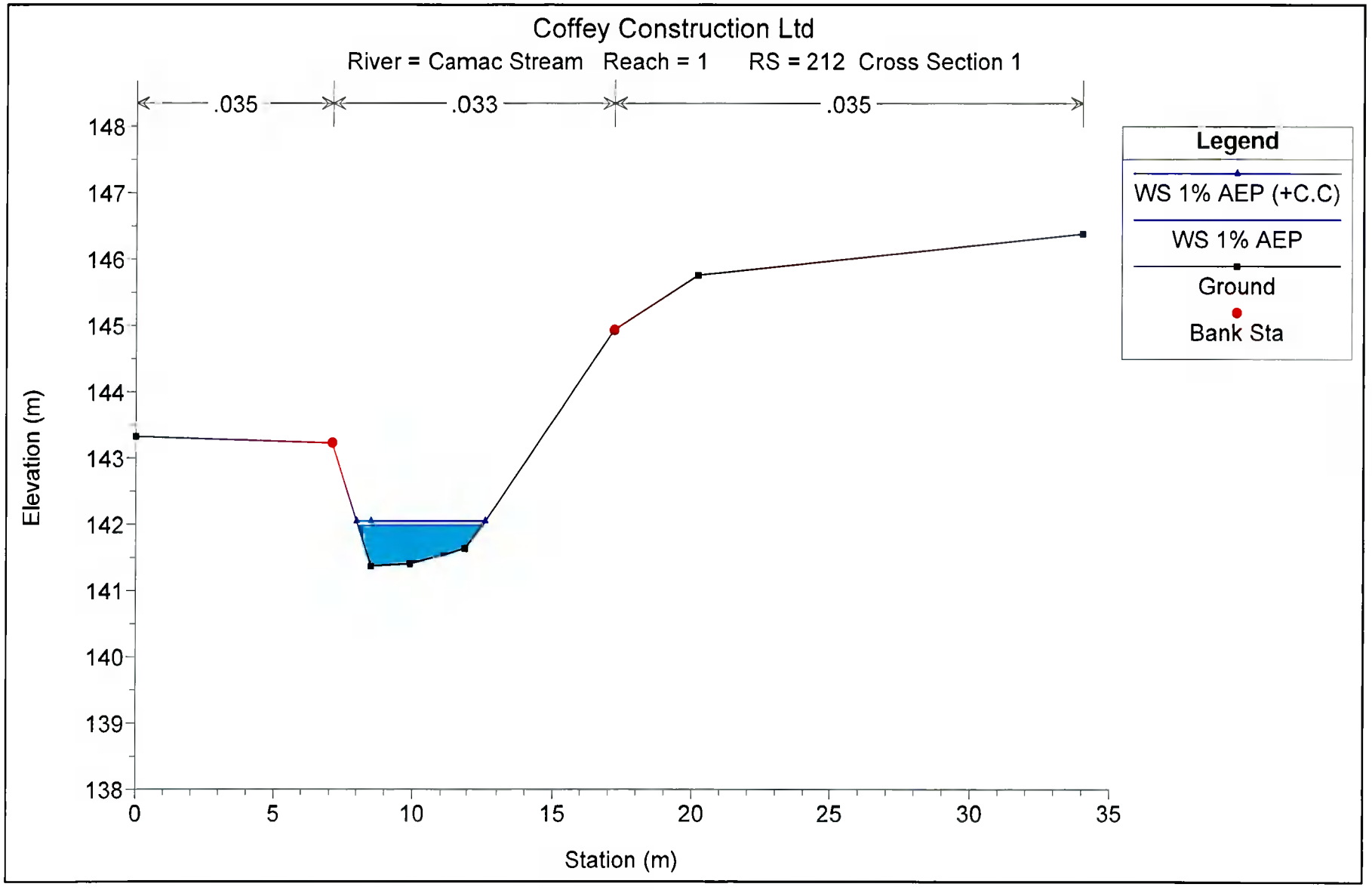
Project Title: River Survey at Saggart

Drawn	TD	Dwg No	01/001
Scale	1/200	Date	XX

A1

APPENDIX 2

HEC-RAS CROSS SECTION PROFILES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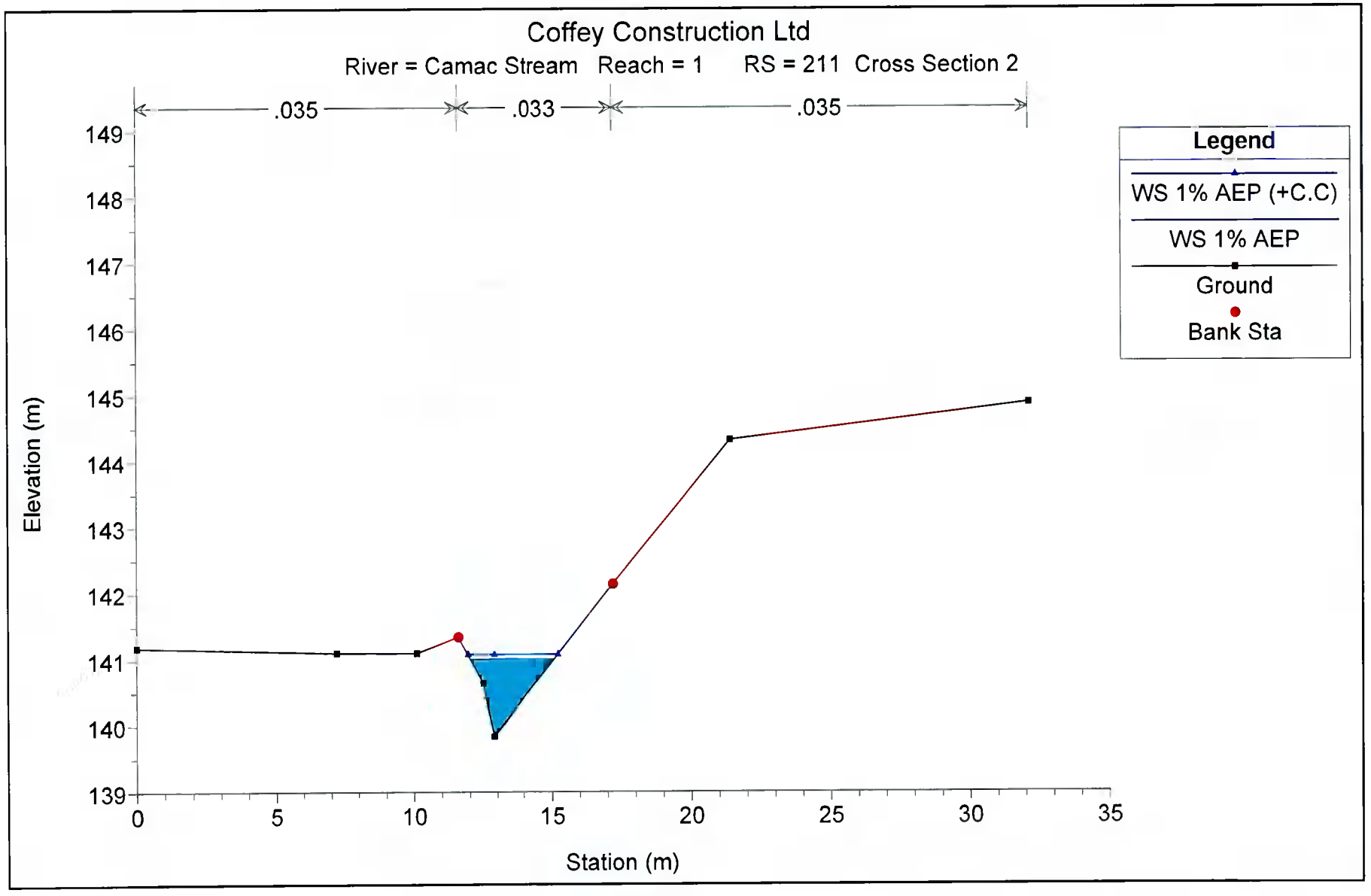
.035
.033
.035
148
147
146
145
144
143
142
141
140
139
138
Elevation (m)
0
5
10
15
20
25
30
35
Station (m)
Legend
WS 1% AEP (+C.C)
WS 1% AEP
Ground
Bank Sta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.033
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Legend
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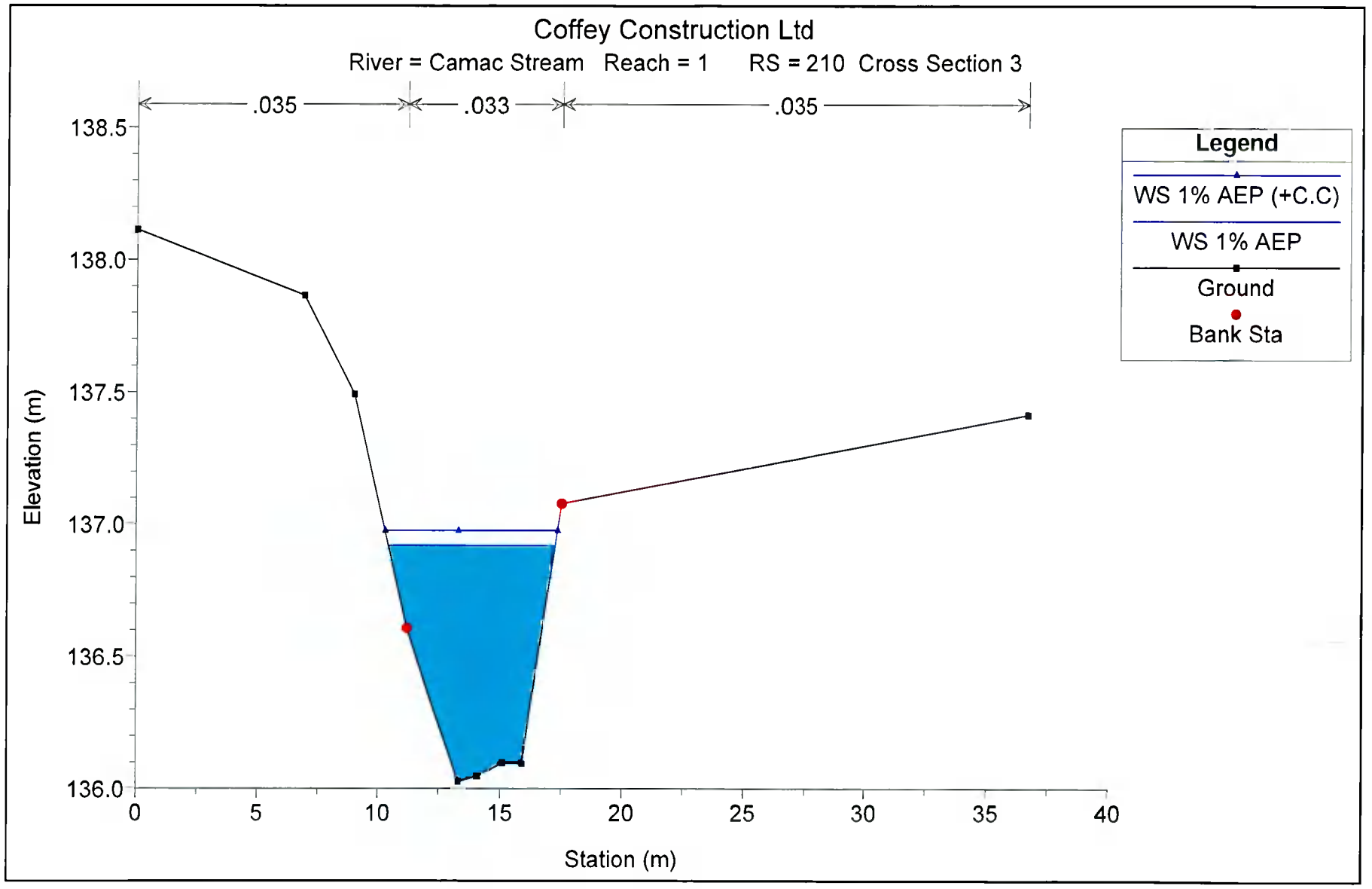
WS 1% AEP
Ground
Bank Sta
Elevation (m)
149
148
147
146
145
144
143
142
141
140
139
0
5
10
15
20
25
30
35
Station (m)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River = Camac Stream Reach = 1 RS = 210 Cross Section 3
.035
.033
.035
138.5
138.0
137.5
137.0
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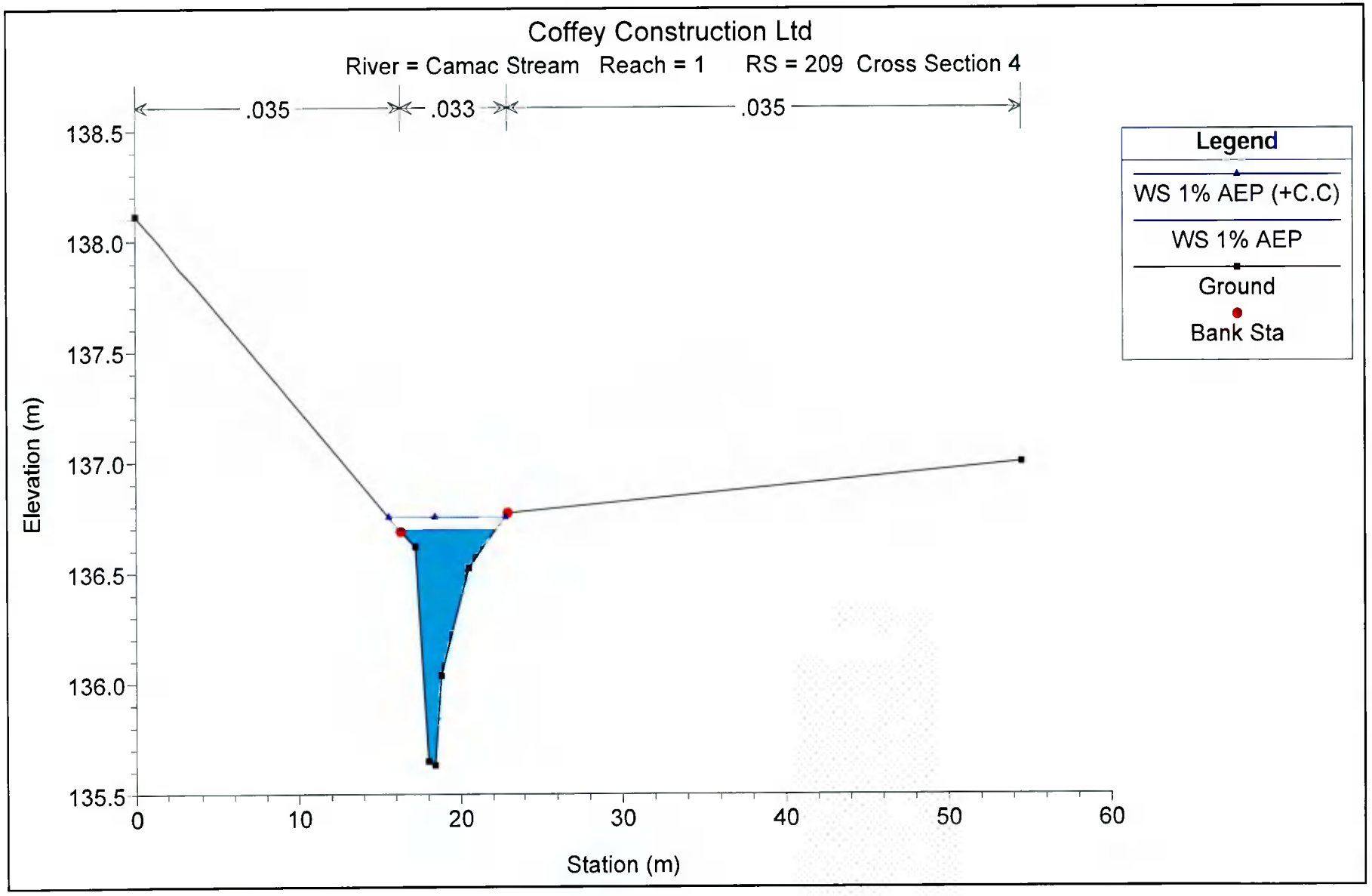
Elevation (m)
0
5
10
15
20
25
30
35
40
Station (m)
Legend
WS 1% AEP (+C.C)
WS 1% AEP
Ground
Bank Sta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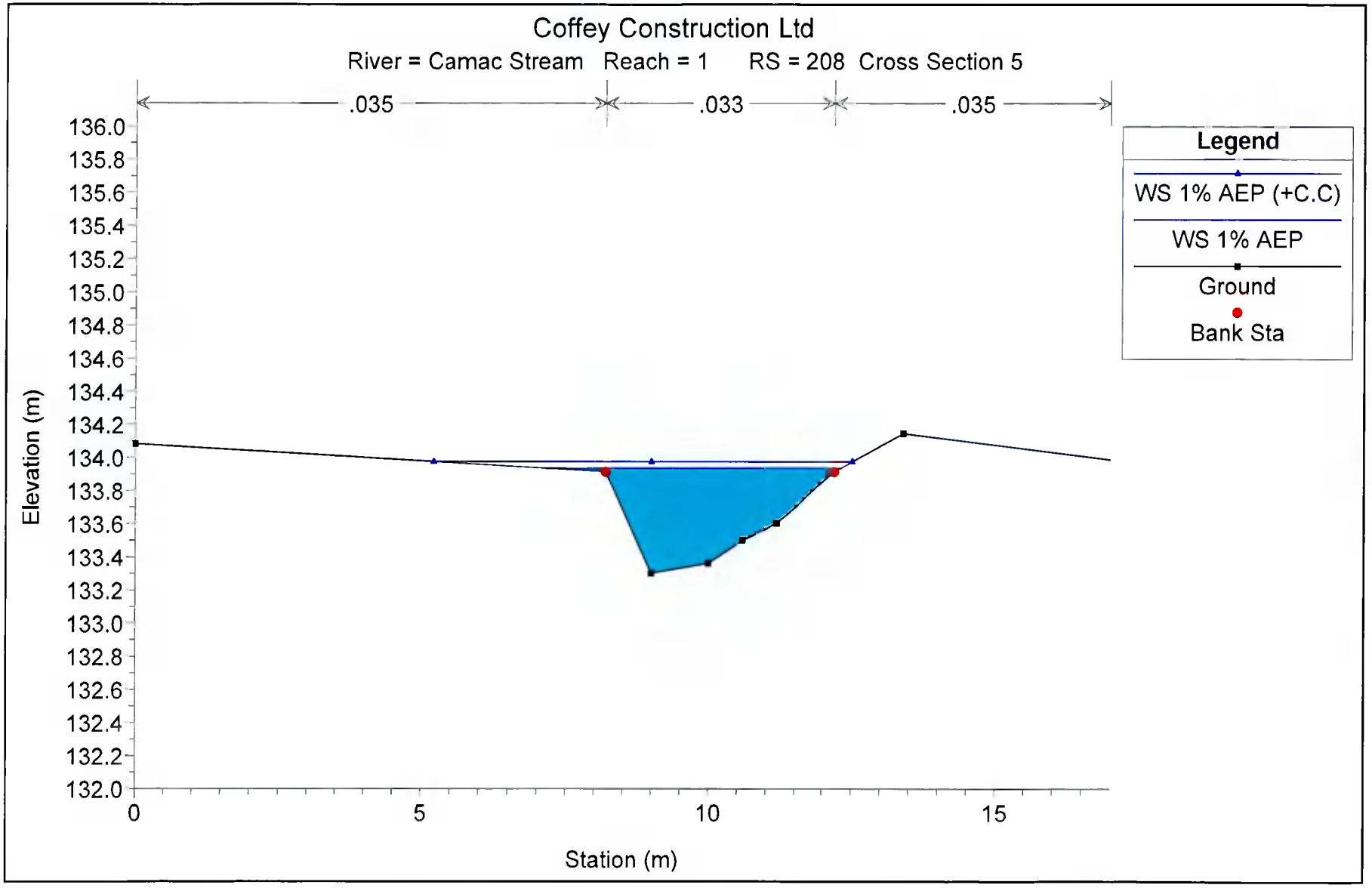
.033
.035
Legend
WS 1% AEP (+C.C)
WS 1% AEP
Ground
Bank Sta
Elevation (m)
138.5
138.0
137.5
137.0
136.5
136.0
135.5
0
10
20
30
40
50
60
Station (m)


Coffey Construction Ltd
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.033
.035
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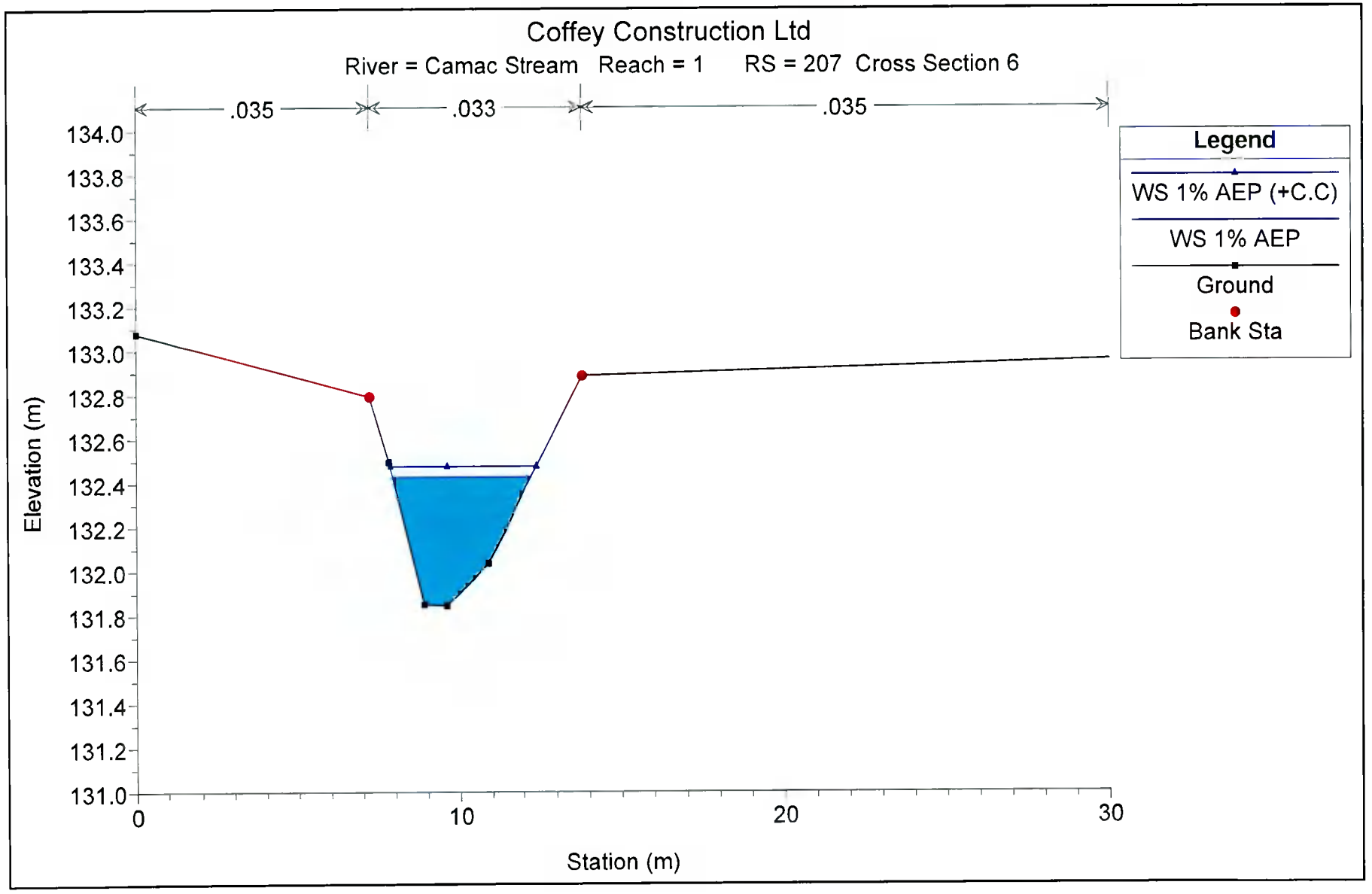
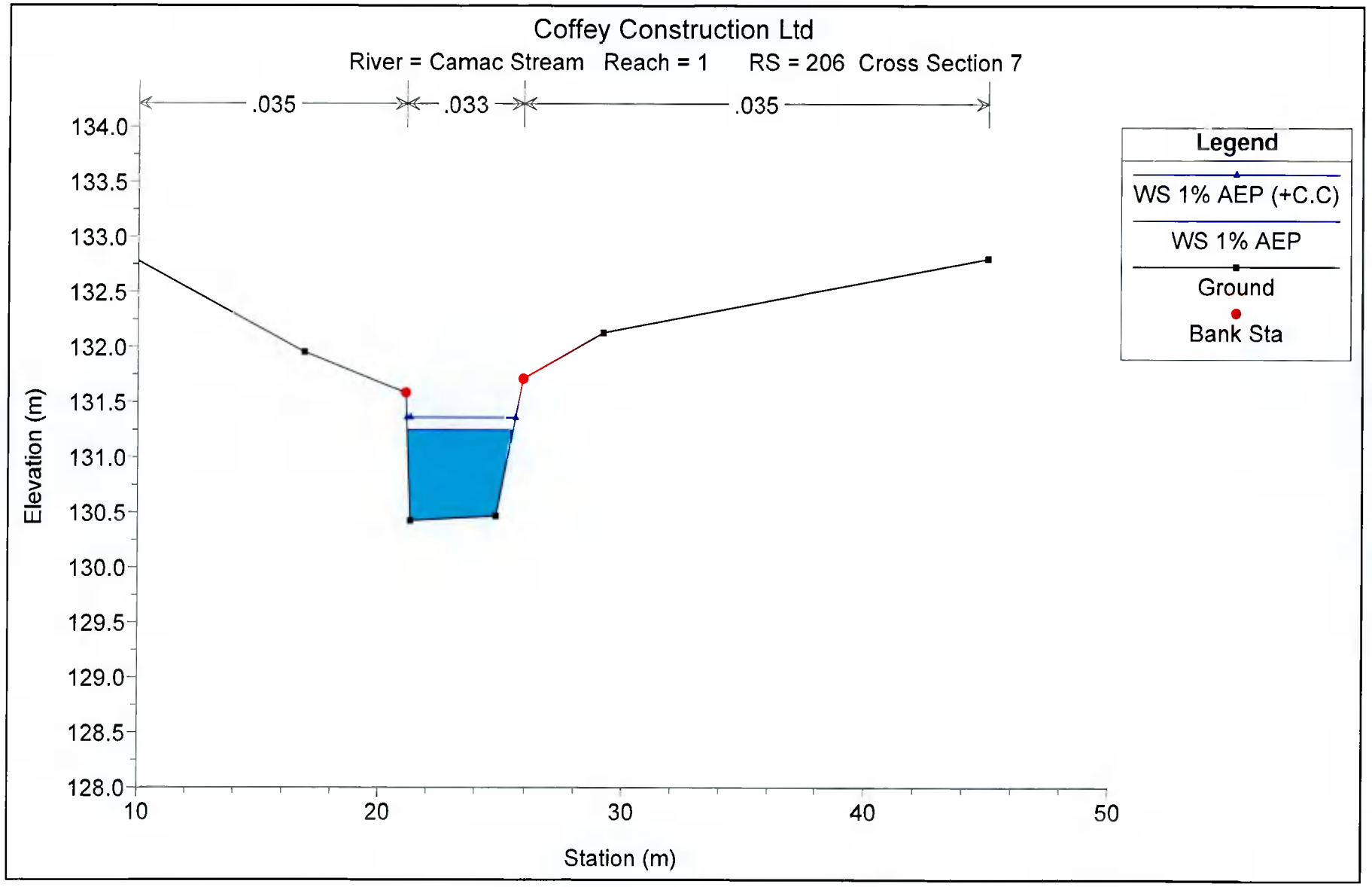
135.8
135.6
135.4
135.2
135.0
134.8
134.6
134.4
134.2
134.0
133.8
133.6
133.4
133.2
133.0
132.8
132.6
132.4
132.2
132.0
Elevation (m)
0
5
10
15
Station (m)
Legend
WS 1% AEP (+C.C)
WS 1% AEP
Ground
Bank Sta


Coffey Construction Ltd
River = Camac Stream Reach = 1 RS = 207 Cross Section 6
.035
.033
.035
Legend
WS 1% AEP (+C.C)
WS 1% AEP
Ground
Bank Sta
Elevation (m)
134.0
133.8
133.6
133.4
133.2
133.0
132.8
132.6
132.4
132.2
132.0
131.8
131.6
131.4
131.2
131.0
0
10
20
30
Station (m)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.033
.035
134.0
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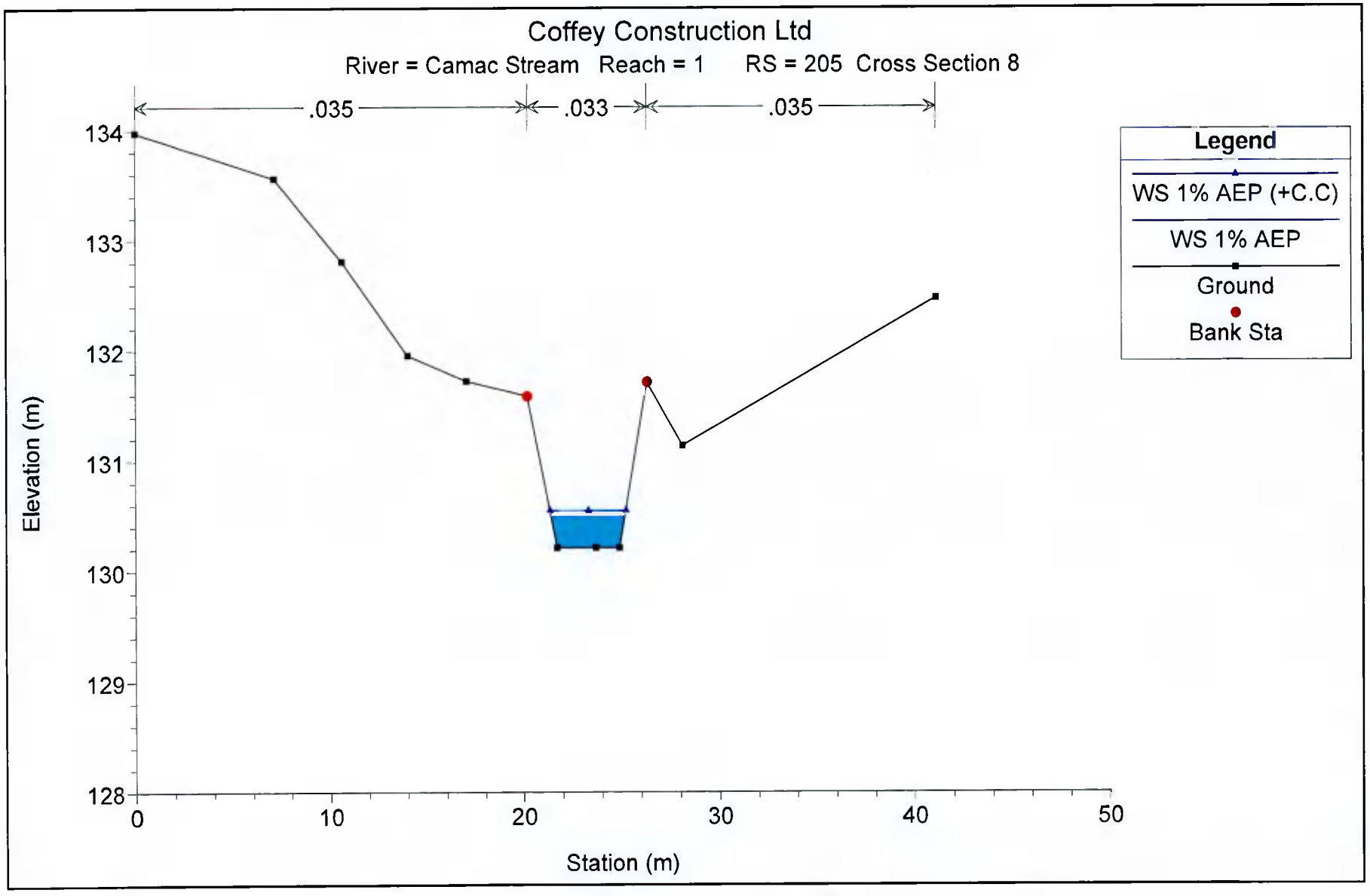
133.0
132.5
132.0
131.5
131.0
130.5
130.0
129.5
129.0
128.5
128.0
Elevation (m)
10
20
30
40
50
Station (m)
Legend
WS 1% AEP (+C.C)
WS 1% AEP
Ground
Bank Sta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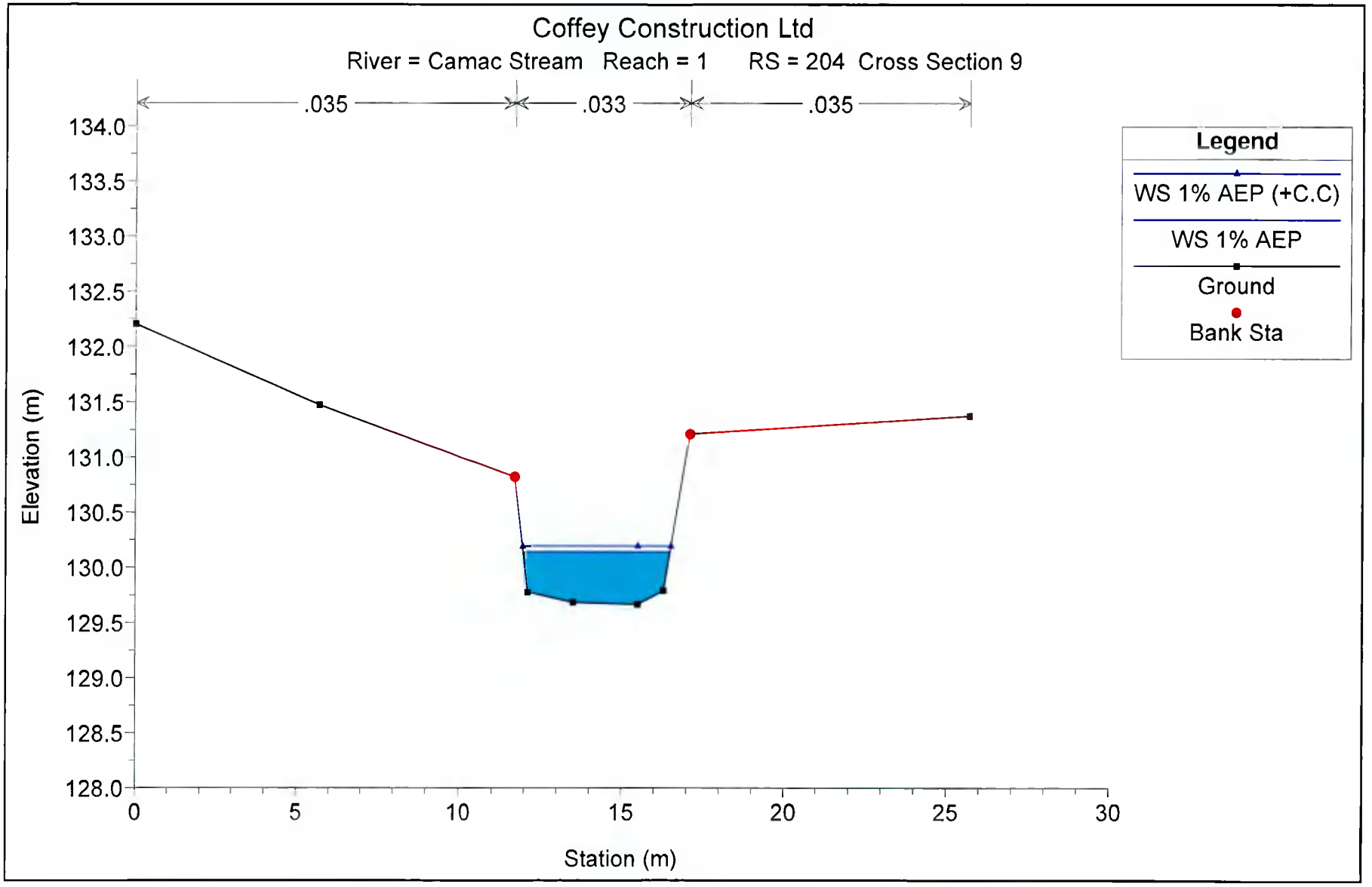
.033
.035
Legend
WS 1% AEP (+C.C)
WS 1% AEP
Ground
Bank Sta
Elevation (m)
134
133
132
131
130
129
128
0
10
20
30
40
50
Station (m)


Coffey Construction Ltd
River = Camac Stream Reach = 1 RS = 204 Cross Section 9
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.033
.035
Legend
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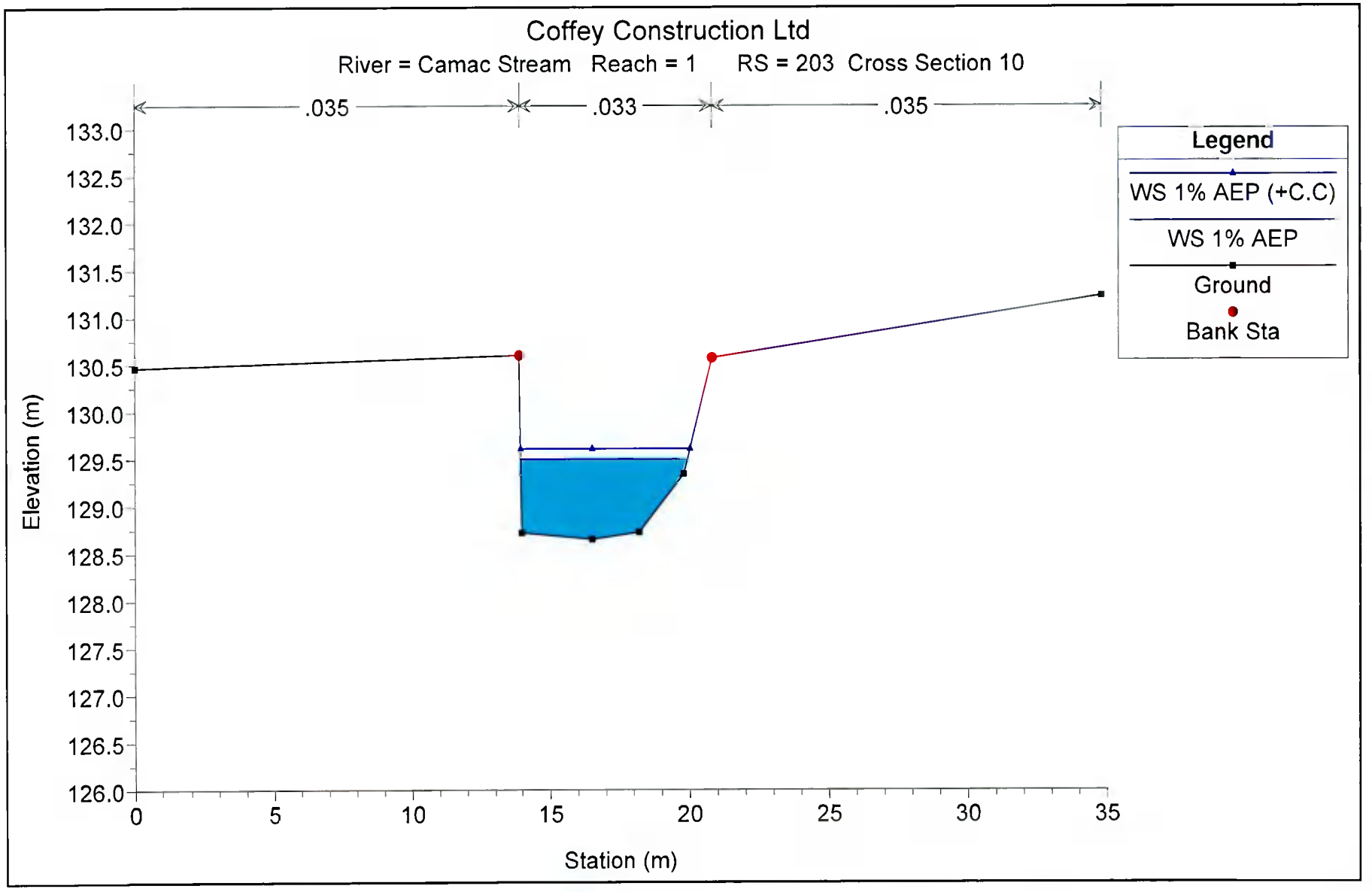
WS 1% AEP
Ground
Bank Sta
Elevation (m)
134.0
133.5
133.0
132.5
132.0
131.5
131.0
130.5
130.0
129.5
129.0
128.5
128.0
0
5
10
15
20
25
30
Station (m)


Coffey Construction Ltd
River = Camac Stream Reach = 1 RS = 203 Cross Section 10
.035
.033
.035
Legend
WS 1% AEP (+C.C)
WS 1% AEP
Ground
Bank Sta
Elevation (m)
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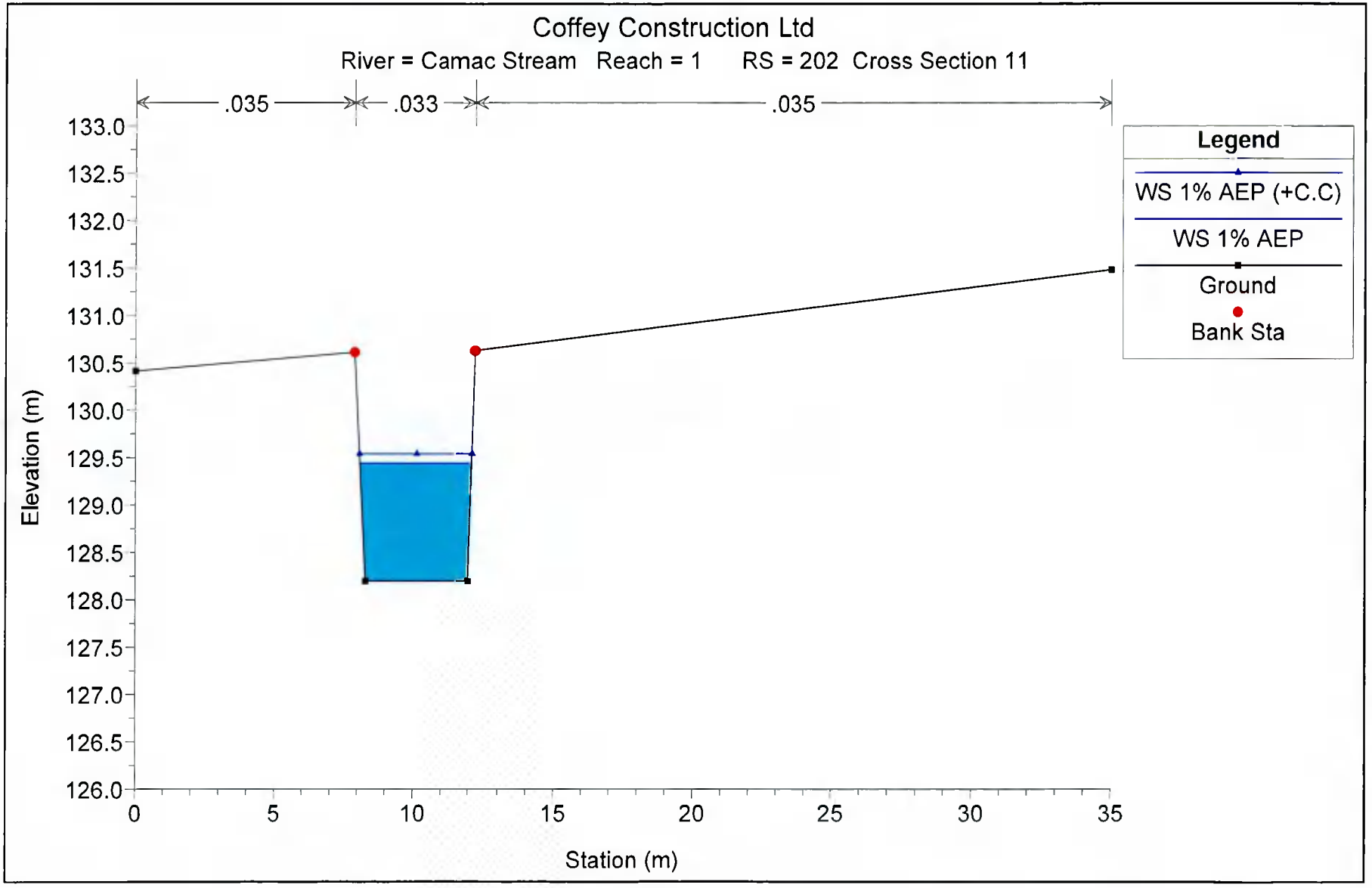
131.5
131.0
130.5
130.0
129.5
129.0
128.5
128.0
127.5
127.0
126.5
126.0
0
5
10
15
20
25
30
35
Station (m)


Coffey Construction Ltd
River = Camac Stream Reach = 1 RS = 202 Cross Section 11
.035
.033
.035
Legend
WS 1% AEP (+C.C)
WS 1% AEP
Ground
Bank Sta
Elevation (m)
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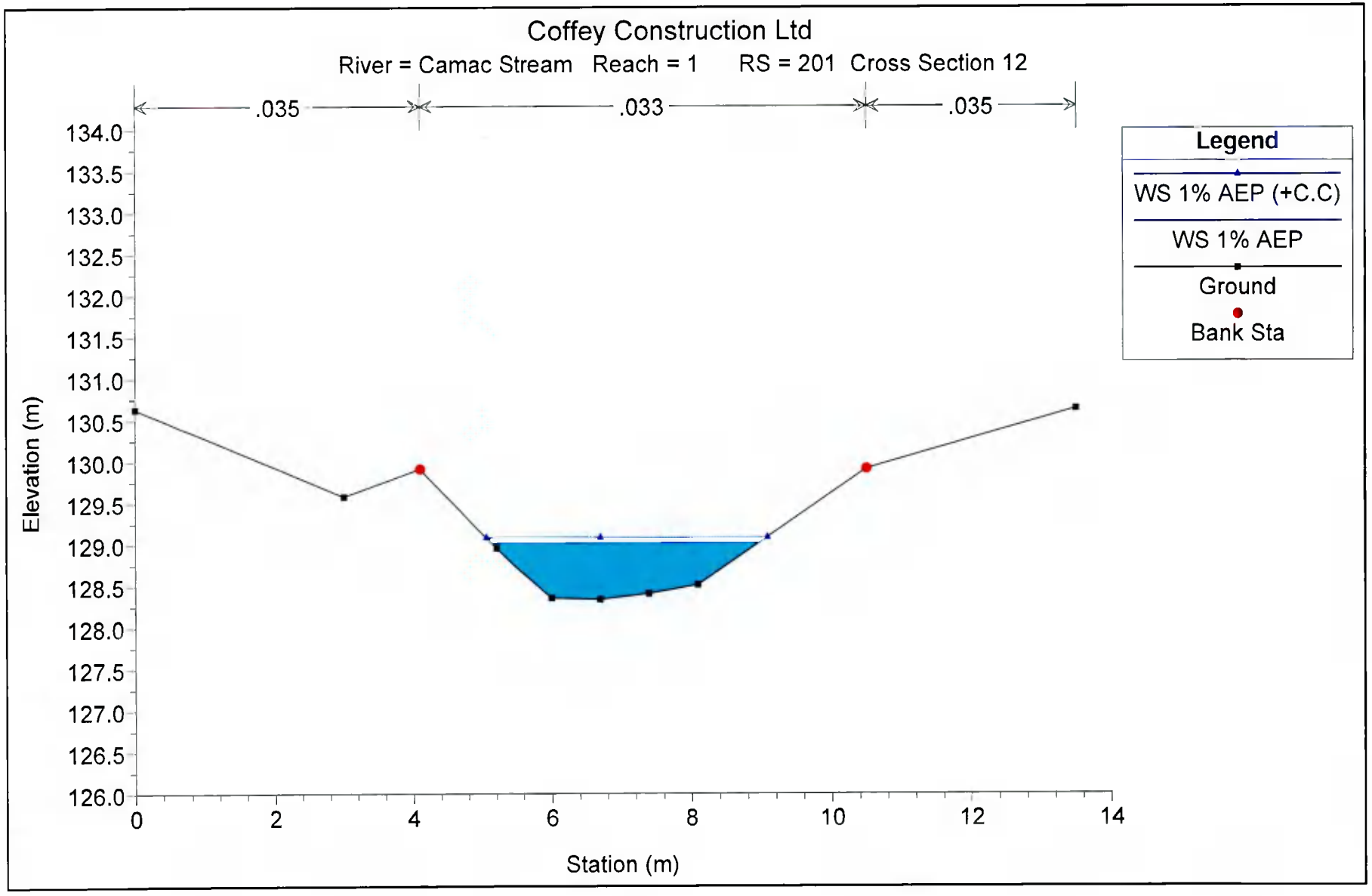
131.5
131.0
130.5
130.0
129.5
129.0
128.5
128.0
127.5
127.0
126.5
126.0
0
5
10
15
20
25
30
35
Station (m)


Coffey Construction Ltd
River = Camac Stream Reach = 1 RS = 201 Cross Section 12
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.033
.035
Legend
WS 1% AEP (+C.C)
WS 1% AEP
Ground
Bank Sta
Elevation (m)
134.0
133.5
133.0
132.5
132.0
131.5
131.0
130.5
130.0
129.5
129.0
128.5
128.0
127.5
127.0
126.5
126.0
0
2
4
6
8
10
12
14
Station (m)

APPENDIX 3

HEC-RAS HYDRAULIC MODEL OUTPUTS

Plan: Plan 02 Camac Stream 1 RS: 212 Profile: 1% AEP

E.G. Elev (m)	142.18	Element	Left OB	Channel	Right OB
Vel Head (m)	0.20	Wt. n-Val.		0.033	
W.S. Elev (m)	141.98	Reach Len. (m)	1.73	1.73	1.73
Crit W.S. (m)	141.96	Flow Area (m2)		2.02	
E.G. Slope (m/m)	0.013411	Area (m2)		2.02	
Q Total (m3/s)	3.96	Flow (m3/s)		3.96	
Top Width (m)	4.43	Top Width (m)		4.43	
Vel Total (m/s)	1.96	Avg. Vel. (m/s)		1.96	
Max Chl Dpth (m)	0.62	Hydr. Depth (m)		0.46	
Conv. Total (m3/s)	34.2	Conv. (m3/s)		34.2	
Length Wtd. (m)	1.73	Wetted Per. (m)		4.86	
Min Ch El (m)	141.37	Shear (N/m2)		54.78	
Alpha	1.00	Stream Power (N/m s)		107.23	
Frctn Loss (m)	0.02	Cum Volume (1000 m3)	0.00	1.26	0.00
C & E Loss (m)	0.00	Cum SA (1000 m2)	0.05	2.71	0.09

Plan: Plan 02 Camac Stream 1 RS: 212 Profile: 1% AEP (+C.C)

E.G. Elev (m)	142.26	Element	Left OB	Channel	Right OB
Vel Head (m)	0.22	Wt. n-Val.		0.033	
W.S. Elev (m)	142.05	Reach Len. (m)	1.73	1.73	1.73
Crit W.S. (m)	142.02	Flow Area (m2)		2.31	
E.G. Slope (m/m)	0.013076	Area (m2)		2.31	
Q Total (m3/s)	4.75	Flow (m3/s)		4.75	
Top Width (m)	4.58	Top Width (m)		4.58	
Vel Total (m/s)	2.06	Avg. Vel. (m/s)		2.06	
Max Chl Dpth (m)	0.68	Hydr. Depth (m)		0.50	
Conv. Total (m3/s)	41.5	Conv. (m3/s)		41.5	
Length Wtd. (m)	1.73	Wetted Per. (m)		5.06	
Min Ch El (m)	141.37	Shear (N/m2)		58.59	
Alpha	1.00	Stream Power (N/m s)		120.44	
Frctn Loss (m)	0.02	Cum Volume (1000 m3)	0.01	1.43	0.01
C & E Loss (m)	0.00	Cum SA (1000 m2)	0.19	2.83	0.25

Plan: Plan 02 Camac Stream 1 RS: 211 Profile: 1% AEP

E.G. Elev (m)	141.30	Element	Left OB	Channel	Right OB
Vel Head (m)	0.29	Wt. n-Val.		0.033	
W.S. Elev (m)	141.01	Reach Len. (m)	1.74	1.74	1.74
Crit W.S. (m)	141.01	Flow Area (m2)		1.67	
E.G. Slope (m/m)	0.019438	Area (m2)		1.67	
Q Total (m3/s)	3.96	Flow (m3/s)		3.96	
Top Width (m)	3.06	Top Width (m)		3.06	
Vel Total (m/s)	2.37	Avg. Vel. (m/s)		2.37	
Max Chl Dpth (m)	1.17	Hydr. Depth (m)		0.55	
Conv. Total (m3/s)	28.4	Conv. (m3/s)		28.4	
Length Wtd. (m)	1.74	Wetted Per. (m)		3.97	
Min Ch El (m)	139.84	Shear (N/m2)		80.16	
Alpha	1.00	Stream Power (N/m s)		190.07	
Frctn Loss (m)	0.04	Cum Volume (1000 m3)	0.00	1.13	0.00
C & E Loss (m)	0.01	Cum SA (1000 m2)	0.05	2.47	0.09

Plan: Plan 02 Camac Stream 1 RS: 211 Profile: 1% AEP (+C.C)

E.G. Elev (m)	141.40	Element	Left OB	Channel	Right OB
Vel Head (m)	0.32	Wt. n-Val.		0.033	
W.S. Elev (m)	141.08	Reach Len. (m)	1.74	1.74	1.74
Crit W.S. (m)	141.23	Flow Area (m2)		1.89	
E.G. Slope (m/m)	0.020281	Area (m2)		1.89	
Q Total (m3/s)	4.75	Flow (m3/s)		4.75	

Plan: Plan 02 Camac Stream 1 RS: 211 Profile: 1% AEP (+C.C) (Continued)

Top Width (m)	3.27	Top Width (m)		3.27	
Vel Total (m/s)	2.52	Avg. Vel. (m/s)		2.52	
Max Chl Dpth (m)	1.24	Hydr. Depth (m)		0.58	
Conv. Total (m3/s)	33.4	Conv. (m3/s)		33.4	
Length Wtd. (m)	1.74	Wetted Per. (m)		4.23	
Min Ch El (m)	139.84	Shear (N/m2)		88.71	
Alpha	1.00	Stream Power (N/m s)		223.50	
Frctn Loss (m)	0.04	Cum Volume (1000 m3)	0.01	1.28	0.01
C & E Loss (m)	0.00	Cum SA (1000 m2)	0.16	2.57	0.25

Plan: Plan 02 Camac Stream 1 RS: 210 Profile: 1% AEP

E.G. Elev (m)	136.97	Element	Left OB	Channel	Right OB
Vel Head (m)	0.05	Wt. n-Val.	0.035	0.033	
W.S. Elev (m)	136.92	Reach Len. (m)	1.67	1.67	1.67
Crit W.S. (m)		Flow Area (m2)	0.12	4.04	
E.G. Slope (m/m)	0.001876	Area (m2)	0.12	4.04	
Q Total (m3/s)	3.96	Flow (m3/s)	0.04	3.92	
Top Width (m)	6.82	Top Width (m)	0.78	6.04	
Vel Total (m/s)	0.95	Avg. Vel. (m/s)	0.34	0.97	
Max Chl Dpth (m)	0.90	Hydr. Depth (m)	0.16	0.67	
Conv. Total (m3/s)	91.4	Conv. (m3/s)	1.0	90.5	
Length Wtd. (m)	1.67	Wetted Per. (m)	0.84	6.36	
Min Ch El (m)	136.02	Shear (N/m2)	2.69	11.69	
Alpha	1.03	Stream Power (N/m s)	0.92	11.34	
Frctn Loss (m)	0.00	Cum Volume (1000 m3)	0.00	0.87	0.00
C & E Loss (m)	0.00	Cum SA (1000 m2)	0.05	1.84	0.09

Plan: Plan 02 Camac Stream 1 RS: 210 Profile: 1% AEP (+C.C)

E.G. Elev (m)	137.03	Element	Left OB	Channel	Right OB
Vel Head (m)	0.06	Wt. n-Val.	0.035	0.033	
W.S. Elev (m)	136.98	Reach Len. (m)	1.67	1.67	1.67
Crit W.S. (m)		Flow Area (m2)	0.17	4.38	
E.G. Slope (m/m)	0.002087	Area (m2)	0.17	4.38	
Q Total (m3/s)	4.75	Flow (m3/s)	0.07	4.68	
Top Width (m)	7.06	Top Width (m)	0.92	6.13	
Vel Total (m/s)	1.04	Avg. Vel. (m/s)	0.40	1.07	
Max Chl Dpth (m)	0.95	Hydr. Depth (m)	0.19	0.71	
Conv. Total (m3/s)	104.0	Conv. (m3/s)	1.5	102.5	
Length Wtd. (m)	1.67	Wetted Per. (m)	0.99	6.46	
Min Ch El (m)	136.02	Shear (N/m2)	3.53	13.87	
Alpha	1.04	Stream Power (N/m s)	1.42	14.82	
Frctn Loss (m)	0.00	Cum Volume (1000 m3)	0.01	0.99	0.01
C & E Loss (m)	0.00	Cum SA (1000 m2)	0.16	1.91	0.25

Plan: Plan 02 Camac Stream 1 RS: 209 Profile: 1% AEP

E.G. Elev (m)	136.87	Element	Left OB	Channel	Right OB
Vel Head (m)	0.18	Wt. n-Val.	0.035	0.033	
W.S. Elev (m)	136.70	Reach Len. (m)	11.29	11.29	11.29
Crit W.S. (m)	136.70	Flow Area (m2)	0.00	2.11	
E.G. Slope (m/m)	0.017503	Area (m2)	0.00	2.11	
Q Total (m3/s)	3.96	Flow (m3/s)	0.00	3.96	
Top Width (m)	5.98	Top Width (m)	0.11	5.88	
Vel Total (m/s)	1.88	Avg. Vel. (m/s)	0.10	1.88	
Max Chl Dpth (m)	1.07	Hydr. Depth (m)	0.00	0.36	
Conv. Total (m3/s)	29.9	Conv. (m3/s)	0.0	29.9	
Length Wtd. (m)	11.29	Wetted Per. (m)	0.11	6.59	
Min Ch El (m)	135.63	Shear (N/m2)	0.79	54.99	

Plan: Plan 02 Camac Stream 1 RS: 209 Profile: 1% AEP (Continued)

Alpha	1.00	Stream Power (N/m s)	0.08	103.21	
Frctn Loss (m)	0.24	Cum Volume (1000 m3)	0.00	0.80	0.00
C & E Loss (m)	0.01	Cum SA (1000 m2)	0.03	1.72	0.09

Plan: Plan 02 Camac Stream 1 RS: 209 Profile: 1% AEP (+C.C)

E.G. Elev (m)	136.94	Element	Left OB	Channel	Right OB
Vel Head (m)	0.19	Wt. n-Val.	0.035	0.033	
W.S. Elev (m)	136.75	Reach Len. (m)	11.29	11.29	11.29
Crit W.S. (m)	136.75	Flow Area (m2)	0.03	2.46	
E.G. Slope (m/m)	0.016728	Area (m2)	0.03	2.46	
Q Total (m3/s)	4.75	Flow (m3/s)	0.01	4.74	
Top Width (m)	7.19	Top Width (m)	0.76	6.43	
Vel Total (m/s)	1.91	Avg. Vel. (m/s)	0.38	1.93	
Max Chl Dpth (m)	1.12	Hydr. Depth (m)	0.03	0.38	
Conv. Total (m3/s)	36.7	Conv. (m3/s)	0.1	36.7	
Length Wtd. (m)	11.29	Wetted Per. (m)	0.76	7.14	
Min Ch El (m)	135.63	Shear (N/m2)	5.41	56.53	
Alpha	1.01	Stream Power (N/m s)	2.06	108.90	
Frctn Loss (m)	0.24	Cum Volume (1000 m3)	0.00	0.91	0.01
C & E Loss (m)	0.01	Cum SA (1000 m2)	0.13	1.79	0.20

Plan: Plan 02 Camac Stream 1 RS: 208 Profile: 1% AEP

E.G. Elev (m)	134.23	Element	Left OB	Channel	Right OB
Vel Head (m)	0.29	Wt. n-Val.	0.035	0.033	0.035
W.S. Elev (m)	133.94	Reach Len. (m)	1.71	1.71	1.71
Crit W.S. (m)	134.06	Flow Area (m2)	0.01	1.59	0.17
E.G. Slope (m/m)	0.024013	Area (m2)	0.01	1.59	0.17
Q Total (m3/s)	3.96	Flow (m3/s)	0.00	3.85	0.11
Top Width (m)	7.95	Top Width (m)	1.09	4.00	2.86
Vel Total (m/s)	2.24	Avg. Vel. (m/s)	0.22	2.42	0.66
Max Chl Dpth (m)	0.64	Hydr. Depth (m)	0.01	0.40	0.06
Conv. Total (m3/s)	25.6	Conv. (m3/s)	0.0	24.8	0.7
Length Wtd. (m)	1.71	Wetted Per. (m)	1.09	4.28	2.98
Min Ch El (m)	133.30	Shear (N/m2)	2.61	87.29	13.09
Alpha	1.14	Stream Power (N/m s)	0.57	211.52	8.59
Frctn Loss (m)	0.04	Cum Volume (1000 m3)	0.00	0.60	0.00
C & E Loss (m)	0.00	Cum SA (1000 m2)	0.00	1.16	0.02

Plan: Plan 02 Camac Stream 1 RS: 208 Profile: 1% AEP (+C.C)

E.G. Elev (m)	134.30	Element	Left OB	Channel	Right OB
Vel Head (m)	0.32	Wt. n-Val.	0.035	0.033	0.035
W.S. Elev (m)	133.98	Reach Len. (m)	1.71	1.71	1.71
Crit W.S. (m)	134.10	Flow Area (m2)	0.09	1.74	0.30
E.G. Slope (m/m)	0.023930	Area (m2)	0.09	1.74	0.30
Q Total (m3/s)	4.75	Flow (m3/s)	0.04	4.48	0.23
Top Width (m)	10.93	Top Width (m)	2.99	4.00	3.94
Vel Total (m/s)	2.23	Avg. Vel. (m/s)	0.43	2.57	0.78
Max Chl Dpth (m)	0.68	Hydr. Depth (m)	0.03	0.44	0.08
Conv. Total (m3/s)	30.7	Conv. (m3/s)	0.3	29.0	1.5
Length Wtd. (m)	1.71	Wetted Per. (m)	2.99	4.28	4.11
Min Ch El (m)	133.30	Shear (N/m2)	7.10	95.39	16.94
Alpha	1.26	Stream Power (N/m s)	3.05	245.38	13.21
Frctn Loss (m)	0.04	Cum Volume (1000 m3)	0.00	0.68	0.00
C & E Loss (m)	0.00	Cum SA (1000 m2)	0.02	1.20	0.04

Plan: Plan 02 Camac Stream 1 RS: 207 Profile: 1% AEP

E.G. Elev (m)	132.74	Element	Left OB	Channel	Right OB
Vel Head (m)	0.32	Wt. n-Val.		0.033	
W.S. Elev (m)	132.43	Reach Len. (m)	1.73	1.73	1.73
Crit W.S. (m)	132.51	Flow Area (m2)		1.59	
E.G. Slope (m/m)	0.027653	Area (m2)		1.59	
Q Total (m3/s)	3.96	Flow (m3/s)		3.96	
Top Width (m)	4.31	Top Width (m)		4.31	
Vel Total (m/s)	2.50	Avg. Vel. (m/s)		2.50	
Max Chl Dpth (m)	0.58	Hydr. Depth (m)		0.37	
Conv. Total (m3/s)	23.8	Conv. (m3/s)		23.8	
Length Wtd. (m)	1.73	Wetted Per. (m)		4.54	
Min Ch El (m)	131.84	Shear (N/m2)		94.64	
Alpha	1.00	Stream Power (N/m s)		236.38	
Frctn Loss (m)	0.04	Cum Volume (1000 m3)		0.52	
C & E Loss (m)	0.05	Cum SA (1000 m2)		0.93	

Plan: Plan 02 Camac Stream 1 RS: 207 Profile: 1% AEP (+C.C)

E.G. Elev (m)	132.83	Element	Left OB	Channel	Right OB
Vel Head (m)	0.35	Wt. n-Val.		0.033	
W.S. Elev (m)	132.48	Reach Len. (m)	1.73	1.73	1.73
Crit W.S. (m)	132.57	Flow Area (m2)		1.81	
E.G. Slope (m/m)	0.027907	Area (m2)		1.81	
Q Total (m3/s)	4.75	Flow (m3/s)		4.75	
Top Width (m)	4.57	Top Width (m)		4.57	
Vel Total (m/s)	2.63	Avg. Vel. (m/s)		2.63	
Max Chl Dpth (m)	0.63	Hydr. Depth (m)		0.40	
Conv. Total (m3/s)	28.4	Conv. (m3/s)		28.4	
Length Wtd. (m)	1.73	Wetted Per. (m)		4.82	
Min Ch El (m)	131.84	Shear (N/m2)		102.57	
Alpha	1.00	Stream Power (N/m s)		269.91	
Frctn Loss (m)	0.03	Cum Volume (1000 m3)		0.58	
C & E Loss (m)	0.07	Cum SA (1000 m2)		0.96	

Plan: Plan 02 Camac Stream 1 RS: 206 Profile: 1% AEP

E.G. Elev (m)	131.33	Element	Left OB	Channel	Right OB
Vel Head (m)	0.08	Wt. n-Val.		0.033	
W.S. Elev (m)	131.25	Reach Len. (m)	13.00	13.00	13.00
Crit W.S. (m)	130.94	Flow Area (m2)		3.13	
E.G. Slope (m/m)	0.003573	Area (m2)		3.13	
Q Total (m3/s)	3.96	Flow (m3/s)		3.96	
Top Width (m)	4.33	Top Width (m)		4.33	
Vel Total (m/s)	1.26	Avg. Vel. (m/s)		1.26	
Max Chl Dpth (m)	0.82	Hydr. Depth (m)		0.72	
Conv. Total (m3/s)	66.2	Conv. (m3/s)		66.2	
Length Wtd. (m)	13.00	Wetted Per. (m)		5.38	
Min Ch El (m)	130.42	Shear (N/m2)		20.42	
Alpha	1.00	Stream Power (N/m s)		25.81	
Frctn Loss (m)		Cum Volume (1000 m3)		0.41	
C & E Loss (m)		Cum SA (1000 m2)		0.67	

Plan: Plan 02 Camac Stream 1 RS: 206 Profile: 1% AEP (+C.C)

E.G. Elev (m)	131.45	Element	Left OB	Channel	Right OB
Vel Head (m)	0.09	Wt. n-Val.		0.033	
W.S. Elev (m)	131.36	Reach Len. (m)	13.00	13.00	13.00
Crit W.S. (m)	131.00	Flow Area (m2)		3.63	
E.G. Slope (m/m)	0.003353	Area (m2)		3.63	
Q Total (m3/s)	4.75	Flow (m3/s)		4.75	

Plan: Plan 02 Camac Stream 1 RS: 206 Profile: 1% AEP (+C.C) (Continued)

Top Width (m)	4.45	Top Width (m)		4.45	
Vel Total (m/s)	1.31	Avg. Vel. (m/s)		1.31	
Max Chl Dpth (m)	0.94	Hydr. Depth (m)		0.82	
Conv. Total (m3/s)	82.0	Conv. (m3/s)		82.0	
Length Wtd. (m)	13.00	Wetted Per. (m)		5.64	
Min Ch El (m)	130.42	Shear (N/m2)		21.16	
Alpha	1.00	Stream Power (N/m s)		27.68	
Frctn Loss (m)		Cum Volume (1000 m3)		0.46	
C & E Loss (m)		Cum SA (1000 m2)		0.69	

Plan: Plan 02 Camac Stream 1 RS: 205 Profile: 1% AEP

E.G. Elev (m)	131.28	Element	Left OB	Channel	Right OB
Vel Head (m)	0.78	Wt. n-Val.		0.033	
W.S. Elev (m)	130.50	Reach Len. (m)	1.72	1.72	1.72
Crit W.S. (m)	130.72	Flow Area (m2)		1.01	
E.G. Slope (m/m)	0.105747	Area (m2)		1.01	
Q Total (m3/s)	3.96	Flow (m3/s)		3.96	
Top Width (m)	3.78	Top Width (m)		3.78	
Vel Total (m/s)	3.92	Avg. Vel. (m/s)		3.92	
Max Chl Dpth (m)	0.29	Hydr. Depth (m)		0.27	
Conv. Total (m3/s)	12.2	Conv. (m3/s)		12.2	
Length Wtd. (m)	1.72	Wetted Per. (m)		4.02	
Min Ch El (m)	130.21	Shear (N/m2)		260.31	
Alpha	1.00	Stream Power (N/m s)		1020.74	
Frctn Loss (m)	0.11	Cum Volume (1000 m3)		0.37	
C & E Loss (m)	0.18	Cum SA (1000 m2)		0.62	

Plan: Plan 02 Camac Stream 1 RS: 205 Profile: 1% AEP (+C.C)

E.G. Elev (m)	131.35	Element	Left OB	Channel	Right OB
Vel Head (m)	0.80	Wt. n-Val.		0.033	
W.S. Elev (m)	130.55	Reach Len. (m)	1.72	1.72	1.72
Crit W.S. (m)	130.78	Flow Area (m2)		1.20	
E.G. Slope (m/m)	0.089347	Area (m2)		1.20	
Q Total (m3/s)	4.75	Flow (m3/s)		4.75	
Top Width (m)	3.89	Top Width (m)		3.89	
Vel Total (m/s)	3.95	Avg. Vel. (m/s)		3.95	
Max Chl Dpth (m)	0.34	Hydr. Depth (m)		0.31	
Conv. Total (m3/s)	15.9	Conv. (m3/s)		15.9	
Length Wtd. (m)	1.72	Wetted Per. (m)		4.17	
Min Ch El (m)	130.21	Shear (N/m2)		252.71	
Alpha	1.00	Stream Power (N/m s)		999.21	
Frctn Loss (m)	0.09	Cum Volume (1000 m3)		0.42	
C & E Loss (m)	0.18	Cum SA (1000 m2)		0.64	

Plan: Plan 02 Camac Stream 1 RS: 204 Profile: 1% AEP

E.G. Elev (m)	130.36	Element	Left OB	Channel	Right OB
Vel Head (m)	0.22	Wt. n-Val.		0.033	
W.S. Elev (m)	130.14	Reach Len. (m)	1.68	1.68	1.68
Crit W.S. (m)	130.14	Flow Area (m2)		1.91	
E.G. Slope (m/m)	0.016998	Area (m2)		1.91	
Q Total (m3/s)	3.96	Flow (m3/s)		3.96	
Top Width (m)	4.54	Top Width (m)		4.54	
Vel Total (m/s)	2.08	Avg. Vel. (m/s)		2.08	
Max Chl Dpth (m)	0.48	Hydr. Depth (m)		0.42	
Conv. Total (m3/s)	30.4	Conv. (m3/s)		30.4	
Length Wtd. (m)	1.68	Wetted Per. (m)		5.01	
Min Ch El (m)	129.66	Shear (N/m2)		63.50	

Plan: Plan 02 Camac Stream 1 RS: 204 Profile: 1% AEP (Continued)

Alpha	1.00	Stream Power (N/m s)		131.84	
Frctn Loss (m)	0.03	Cum Volume (1000 m3)		0.31	
C & E Loss (m)	0.01	Cum SA (1000 m2)		0.48	

Plan: Plan 02 Camac Stream 1 RS: 204 Profile: 1% AEP (+C.C)

E.G. Elev (m)	130.44	Element	Left OB	Channel	Right OB
Vel Head (m)	0.25	Wt. n-Val.		0.033	
W.S. Elev (m)	130.19	Reach Len. (m)	1.68	1.68	1.68
Crit W.S. (m)	130.20	Flow Area (m2)		2.14	
E.G. Slope (m/m)	0.017162	Area (m2)		2.14	
Q Total (m3/s)	4.75	Flow (m3/s)		4.75	
Top Width (m)	4.59	Top Width (m)		4.59	
Vel Total (m/s)	2.22	Avg. Vel. (m/s)		2.22	
Max Chl Dpth (m)	0.53	Hydr. Depth (m)		0.47	
Conv. Total (m3/s)	36.3	Conv. (m3/s)		36.3	
Length Wtd. (m)	1.68	Wetted Per. (m)		5.12	
Min Ch El (m)	129.66	Shear (N/m2)		70.35	
Alpha	1.00	Stream Power (N/m s)		156.13	
Frctn Loss (m)	0.03	Cum Volume (1000 m3)		0.35	
C & E Loss (m)	0.01	Cum SA (1000 m2)		0.49	

Plan: Plan 02 Camac Stream 1 RS: 203 Profile: 1% AEP

E.G. Elev (m)	129.55	Element	Left OB	Channel	Right OB
Vel Head (m)	0.05	Wt. n-Val.		0.033	
W.S. Elev (m)	129.50	Reach Len. (m)	21.00	21.00	21.00
Crit W.S. (m)	129.12	Flow Area (m2)		4.17	
E.G. Slope (m/m)	0.001916	Area (m2)		4.17	
Q Total (m3/s)	3.96	Flow (m3/s)		3.96	
Top Width (m)	5.97	Top Width (m)		5.97	
Vel Total (m/s)	0.95	Avg. Vel. (m/s)		0.95	
Max Chl Dpth (m)	0.85	Hydr. Depth (m)		0.70	
Conv. Total (m3/s)	90.5	Conv. (m3/s)		90.5	
Length Wtd. (m)	21.00	Wetted Per. (m)		6.90	
Min Ch El (m)	128.65	Shear (N/m2)		11.37	
Alpha	1.00	Stream Power (N/m s)		10.79	
Frctn Loss (m)		Cum Volume (1000 m3)		0.24	
C & E Loss (m)		Cum SA (1000 m2)		0.32	

Plan: Plan 02 Camac Stream 1 RS: 203 Profile: 1% AEP (+C.C)

E.G. Elev (m)	129.66	Element	Left OB	Channel	Right OB
Vel Head (m)	0.05	Wt. n-Val.		0.033	
W.S. Elev (m)	129.61	Reach Len. (m)	21.00	21.00	21.00
Crit W.S. (m)	129.17	Flow Area (m2)		4.82	
E.G. Slope (m/m)	0.001781	Area (m2)		4.82	
Q Total (m3/s)	4.75	Flow (m3/s)		4.75	
Top Width (m)	6.06	Top Width (m)		6.06	
Vel Total (m/s)	0.98	Avg. Vel. (m/s)		0.98	
Max Chl Dpth (m)	0.95	Hydr. Depth (m)		0.80	
Conv. Total (m3/s)	112.5	Conv. (m3/s)		112.5	
Length Wtd. (m)	21.00	Wetted Per. (m)		7.14	
Min Ch El (m)	128.65	Shear (N/m2)		11.80	
Alpha	1.00	Stream Power (N/m s)		11.61	
Frctn Loss (m)		Cum Volume (1000 m3)		0.27	
C & E Loss (m)		Cum SA (1000 m2)		0.33	

Plan: Plan 02 Camac Stream 1 RS: 202 Profile: 1% AEP

E.G. Elev (m)	129.48	Element	Left OB	Channel	Right OB
Vel Head (m)	0.03	Wt. n-Val.		0.033	
W.S. Elev (m)	129.45	Reach Len. (m)	1.74	1.74	1.74
Crit W.S. (m)		Flow Area (m2)		4.81	
E.G. Slope (m/m)	0.001039	Area (m2)		4.81	
Q Total (m3/s)	3.96	Flow (m3/s)		3.96	
Top Width (m)	4.01	Top Width (m)		4.01	
Vel Total (m/s)	0.82	Avg. Vel. (m/s)		0.82	
Max Chl Dpth (m)	1.25	Hydr. Depth (m)		1.20	
Conv. Total (m3/s)	122.9	Conv. (m3/s)		122.9	
Length Wtd. (m)	1.74	Wetted Per. (m)		6.22	
Min Ch El (m)	128.20	Shear (N/m2)		7.88	
Alpha	1.00	Stream Power (N/m s)		6.49	
Frctn Loss (m)	0.00	Cum Volume (1000 m3)		0.18	
C & E Loss (m)	0.00	Cum SA (1000 m2)		0.22	

Plan: Plan 02 Camac Stream 1 RS: 202 Profile: 1% AEP (+C.C)

E.G. Elev (m)	129.59	Element	Left OB	Channel	Right OB
Vel Head (m)	0.04	Wt. n-Val.		0.033	
W.S. Elev (m)	129.54	Reach Len. (m)	1.74	1.74	1.74
Crit W.S. (m)		Flow Area (m2)		5.20	
E.G. Slope (m/m)	0.001203	Area (m2)		5.20	
Q Total (m3/s)	4.75	Flow (m3/s)		4.75	
Top Width (m)	4.03	Top Width (m)		4.03	
Vel Total (m/s)	0.91	Avg. Vel. (m/s)		0.91	
Max Chl Dpth (m)	1.34	Hydr. Depth (m)		1.29	
Conv. Total (m3/s)	137.0	Conv. (m3/s)		137.0	
Length Wtd. (m)	1.74	Wetted Per. (m)		6.41	
Min Ch El (m)	128.20	Shear (N/m2)		9.56	
Alpha	1.00	Stream Power (N/m s)		8.74	
Frctn Loss (m)	0.00	Cum Volume (1000 m3)		0.20	
C & E Loss (m)	0.00	Cum SA (1000 m2)		0.22	

Plan: Plan 02 Camac Stream 1 RS: 201 Profile: 1% AEP

E.G. Elev (m)	129.26	Element	Left OB	Channel	Right OB
Vel Head (m)	0.24	Wt. n-Val.		0.033	
W.S. Elev (m)	129.02	Reach Len. (m)			
Crit W.S. (m)	129.02	Flow Area (m2)		1.82	
E.G. Slope (m/m)	0.015727	Area (m2)		1.82	
Q Total (m3/s)	3.96	Flow (m3/s)		3.96	
Top Width (m)	3.84	Top Width (m)		3.84	
Vel Total (m/s)	2.17	Avg. Vel. (m/s)		2.17	
Max Chl Dpth (m)	0.68	Hydr. Depth (m)		0.47	
Conv. Total (m3/s)	31.6	Conv. (m3/s)		31.6	
Length Wtd. (m)		Wetted Per. (m)		4.21	
Min Ch El (m)	128.34	Shear (N/m2)		66.75	
Alpha	1.00	Stream Power (N/m s)		145.13	
Frctn Loss (m)		Cum Volume (1000 m3)			
C & E Loss (m)		Cum SA (1000 m2)			

Plan: Plan 02 Camac Stream 1 RS: 201 Profile: 1% AEP (+C.C)

E.G. Elev (m)	129.35	Element	Left OB	Channel	Right OB
Vel Head (m)	0.26	Wt. n-Val.		0.033	
W.S. Elev (m)	129.09	Reach Len. (m)			
Crit W.S. (m)	129.09	Flow Area (m2)		2.09	
E.G. Slope (m/m)	0.015411	Area (m2)		2.09	
Q Total (m3/s)	4.75	Flow (m3/s)		4.75	

Plan: Plan 02 Camac Stream 1 RS: 201 Profile: 1% AEP (+C.C) (Continued)

Top Width (m)	4.03	Top Width (m)		4.03	
Vel Total (m/s)	2.27	Avg. Vel. (m/s)		2.27	
Max Chl Dpth (m)	0.75	Hydr. Depth (m)		0.52	
Conv. Total (m3/s)	38.3	Conv. (m3/s)		38.3	
Length Wtd. (m)		Wetted Per. (m)		4.45	
Min Ch El (m)	128.34	Shear (N/m2)		71.00	
Alpha	1.00	Stream Power (N/m s)		161.41	
Frctn Loss (m)		Cum Volume (1000 m3)			
C & E Loss (m)		Cum SA (1000 m2)			

Plan: Plan 02 Camac Stream 1 RS: 205.5 Culv Group: Culvert #1 Profile: 1% AEP

Q Culv Group (m3/s)	3.96	Culv Full Len (m)	
# Barrels	1	Culv Vel US (m/s)	2.27
Q Barrel (m3/s)	3.96	Culv Vel DS (m/s)	3.53
E.G. US. (m)	131.33	Culv Inv El Up (m)	130.42
W.S. US. (m)	131.25	Culv Inv El Dn (m)	130.17
E.G. DS (m)	130.96	Culv Frctn Ls (m)	0.06
W.S. DS (m)	130.81	Culv Exit Loss (m)	0.17
Delta EG (m)	0.36	Culv Entr Loss (m)	0.13
Delta WS (m)	0.43	Q Weir (m3/s)	
E.G. IC (m)	131.17	Weir Sta Lft (m)	
E.G. OC (m)	131.33	Weir Sta Rgt (m)	
Culvert Control	Outlet	Weir Submerg	
Culv WS Inlet (m)	130.93	Weir Max Depth (m)	
Culv WS Outlet (m)	130.50	Weir Avg Depth (m)	
Culv Nml Depth (m)	0.24	Weir Flow Area (m2)	
Culv Crt Depth (m)	0.51	Min El Weir Flow (m)	132.06

Plan: Plan 02 Camac Stream 1 RS: 205.5 Culv Group: Culvert #1 Profile: 1% AEP (+C.C)

Q Culv Group (m3/s)	4.75	Culv Full Len (m)	
# Barrels	1	Culv Vel US (m/s)	2.41
Q Barrel (m3/s)	4.75	Culv Vel DS (m/s)	3.68
E.G. US. (m)	131.45	Culv Inv El Up (m)	130.42
W.S. US. (m)	131.36	Culv Inv El Dn (m)	130.17
E.G. DS (m)	131.05	Culv Frctn Ls (m)	0.06
W.S. DS (m)	130.89	Culv Exit Loss (m)	0.19
Delta EG (m)	0.39	Culv Entr Loss (m)	0.15
Delta WS (m)	0.47	Q Weir (m3/s)	
E.G. IC (m)	131.28	Weir Sta Lft (m)	
E.G. OC (m)	131.45	Weir Sta Rgt (m)	
Culvert Control	Outlet	Weir Submerg	
Culv WS Inlet (m)	131.00	Weir Max Depth (m)	
Culv WS Outlet (m)	130.55	Weir Avg Depth (m)	
Culv Nml Depth (m)	0.26	Weir Flow Area (m2)	
Culv Crt Depth (m)	0.58	Min El Weir Flow (m)	132.06

Plan: Plan 02 Camac Stream 1 RS: 202.5 Culv Group: Culvert #1 Profile: 1% AEP

Q Culv Group (m3/s)	3.96	Culv Full Len (m)	
# Barrels	1	Culv Vel US (m/s)	1.55
Q Barrel (m3/s)	3.96	Culv Vel DS (m/s)	0.83
E.G. US. (m)	129.55	Culv Inv El Up (m)	128.70
W.S. US. (m)	129.50	Culv Inv El Dn (m)	128.20
E.G. DS (m)	129.48	Culv Frctn Ls (m)	0.00
W.S. DS (m)	129.45	Culv Exit Loss (m)	0.00
Delta EG (m)	0.07	Culv Entr Loss (m)	0.06
Delta WS (m)	0.05	Q Weir (m3/s)	
E.G. IC (m)	129.43	Weir Sta Lft (m)	
E.G. OC (m)	129.55	Weir Sta Rgt (m)	
Culvert Control	Outlet	Weir Submerg	
Culv WS Inlet (m)	129.36	Weir Max Depth (m)	
Culv WS Outlet (m)	129.45	Weir Avg Depth (m)	
Culv Nml Depth (m)	0.20	Weir Flow Area (m2)	
Culv Crt Depth (m)	0.48	Min El Weir Flow (m)	130.47

Plan: Plan 02 Camac Stream 1 RS: 202.5 Culv Group: Culvert #1 Profile: 1% AEP (+C.C)

Q Culv Group (m3/s)	4.75	Culv Full Len (m)	
# Barrels	1	Culv Vel US (m/s)	1.64
Q Barrel (m3/s)	4.75	Culv Vel DS (m/s)	0.92
E.G. US. (m)	129.66	Culv Inv El Up (m)	128.70
W.S. US. (m)	129.61	Culv Inv El Dn (m)	128.20
E.G. DS (m)	129.59	Culv Frctn Ls (m)	0.00
W.S. DS (m)	129.54	Culv Exit Loss (m)	0.00
Delta EG (m)	0.07	Culv Entr Loss (m)	0.07
Delta WS (m)	0.06	Q Weir (m3/s)	
E.G. IC (m)	129.53	Weir Sta Lft (m)	
E.G. OC (m)	129.66	Weir Sta Rgt (m)	
Culvert Control	Outlet	Weir Submerg	
Culv WS Inlet (m)	129.45	Weir Max Depth (m)	
Culv WS Outlet (m)	129.54	Weir Avg Depth (m)	
Culv Nml Depth (m)	0.23	Weir Flow Area (m2)	
Culv Crt Depth (m)	0.54	Min El Weir Flow (m)	130.47

APPENDIX 4

PHOTO LOGS OF INFILTRATION TESTS

Plate A4.1 – TP01

Plate A4.2 – Location of TP02

Plate A4.3 – TP04

Plate A4.4 – TP03A

Plate A4.5 – TP04A

Appendix 4: Construction Environmental Management Plan

Rowan

Construction Environmental Management Plan

Coffey Construction Ltd

September 2021

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Report Sign Off

REVISION	DATE	ORIGNATOR	REVIEWER
FOR ISSUE	15/10/2021	EOB	EG

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1. Introduction

Rowan Engineering Consultants (ROWAN) Ltd were requested by Coffey Construction Ireland Ltd to draft a Construction Environmental Management Plan (CEMP) for land contouring works at Slade, Saggart Co. Dublin.

1.1 Overview of the proposed project

The principal activities associated with the proposed development are;

- Land recontouring works on c 16,000m2 of a folio size of c 2.4 ha (allowing buffers).
- The volume of material to be placed on the site is c 35,000m3 with an average fill level of c. 3.5 m above existing. Refer to planning drawing numbered LH.001 submitted as part of the planning application for full details.

There is no planned removal of hedge line vegetation on the perimeter of the site.

An infill free buffer zone of at least 10m will be established around much of the perimeter of the site

1.2 Purpose and Scope of the CEMP

The scope of the CEMP covers the activities relating to the proposed infill at the proposed development in Slade, Saggart, County Dublin.

The CEMP is developed with the objective of avoiding adverse impacts. The Camac River flows along the south-western site boundary.

The CEMP is applicable to the Client, the appointed construction contractor and also any sub-contractor's site staff during the construction phase of the proposed works.

2. Location of the Proposed Development

2.1 Site Location and Site Layout

The Proposed project is located in the townland of Slade, Co. Dublin. The nearest village to the site is Saggart, which is located c.600m north east of the proposed site. The proposed site is c.2.4ha. The site is bounded to the north by the Irish Water construction site, to the west by an ESB sub-station, to the south by the Camac River and to the east by a yard.

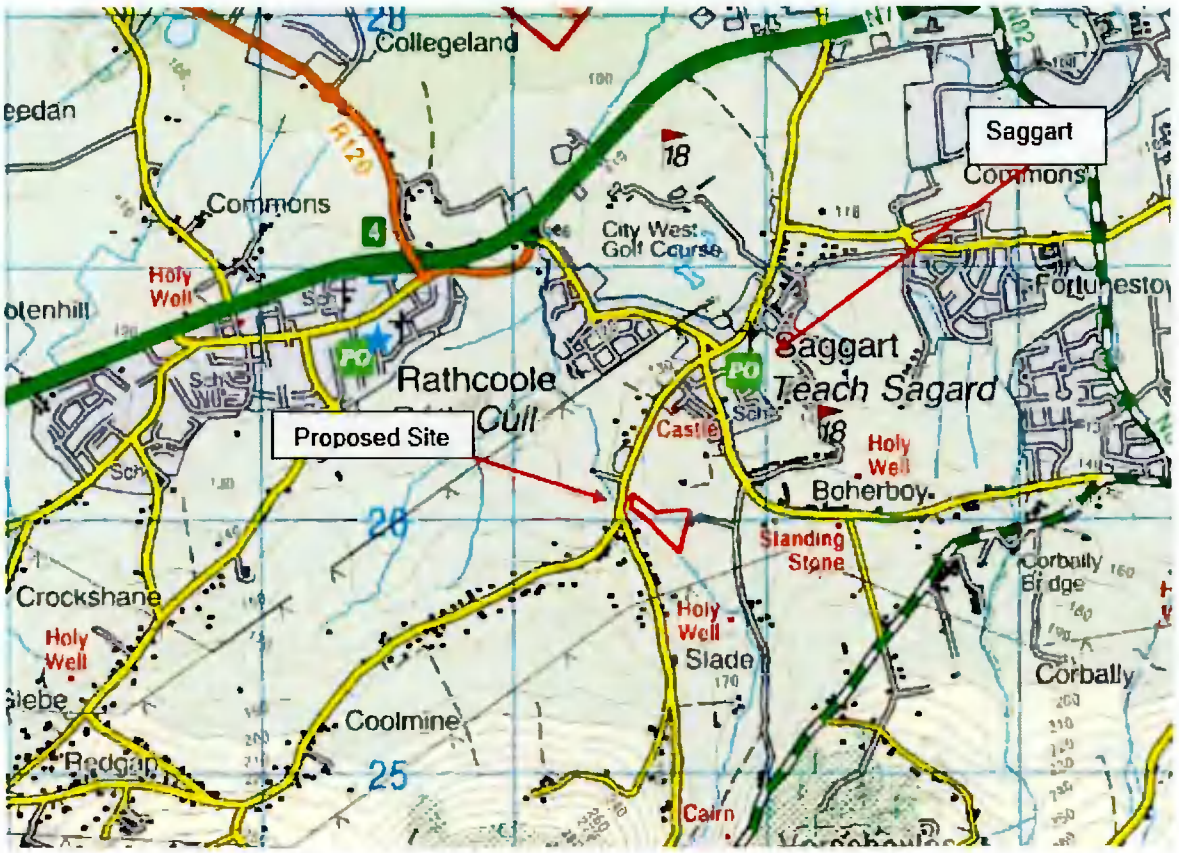

Figure 2.1: Site Location (outlined in red)

The site area of the proposed project is c.2.4 ha. The proposed site layout is shown below in Figure 2.3.

Figure 2.2 Site Location Aerial View (outlined in red).

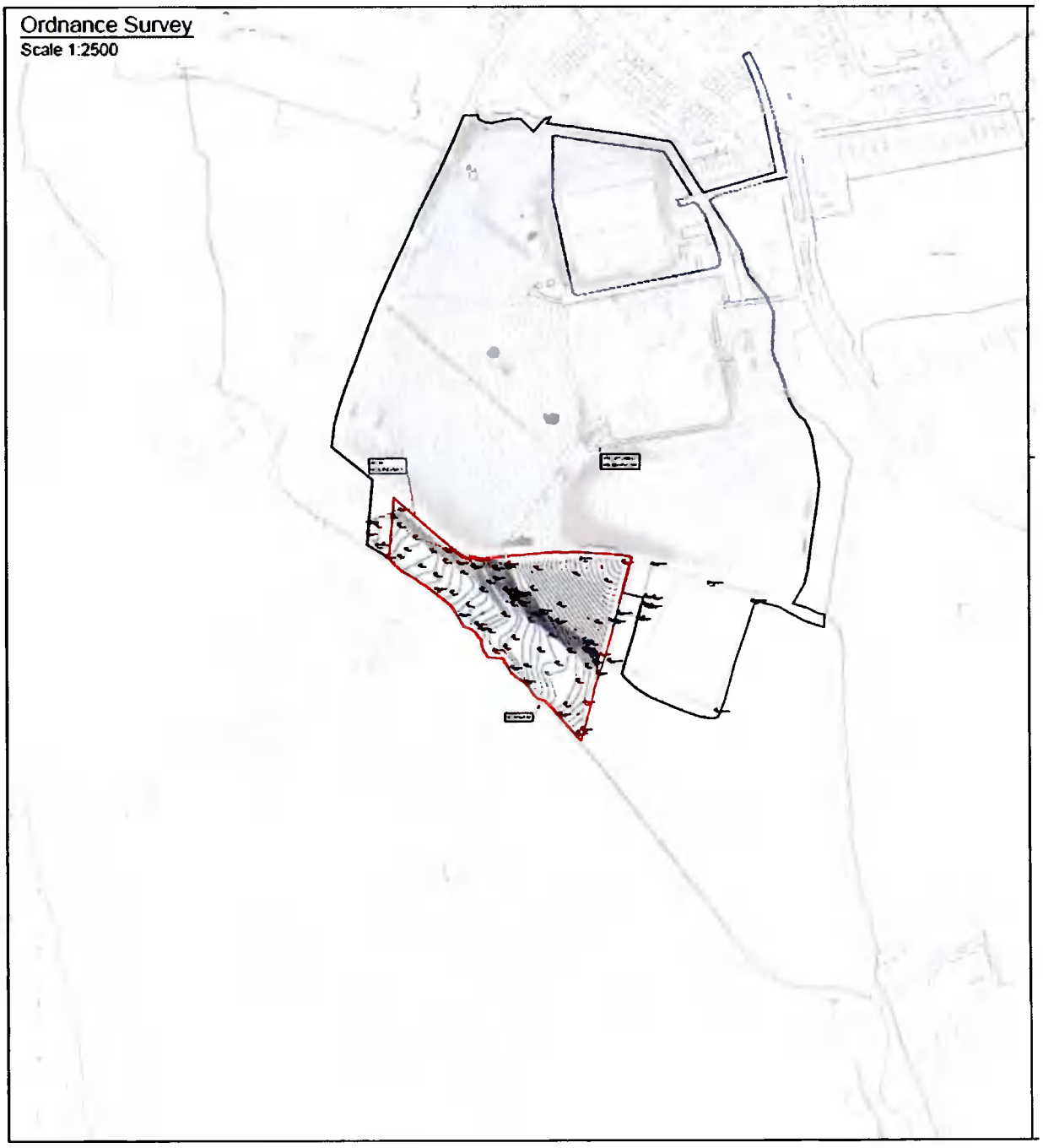

Figure 2.3: Site Location Plan and Site Plan with Proposed Development Boundary

2.2 Site Access

The soil and stone would be transported through an existing linkage between both land parcels using site machinery. Truck movements would be avoided on the local road network.

The main site will be accessed via an entrance along the northern site boundary, which leads to the construction site of the new Saggart Irish Water Reservoir that is under construction. Refer to **Figure 2.4.** and attached drawing J1387-CCL-10-SL-DR-001.

Figure 2.4: Site Access for the Main Water Reservoir Site.

2.3 Decommissioning of the proposed project

At the end of its operational life, the following will be implemented.

- The infilled areas will be levelled, and suitable reseed mix will be sown which will be beneficial for agricultural proposes.

As the equipment used in the infilling and levelling processes 'belong' to the adjacent main site, these will be returned to compounds when not in use.

2.4 Environmental Constraints of Note at the Site

2.4.1 Site Habitats

The land-use surrounding the site is predominantly agricultural and improved agricultural grassland is the dominant habitat in the lands that surround the site. Other habitats represented locally include small areas of woodland and scrub, hedgerows and tree lines.

2.4.2 Water Features

The Camac River flows along the south-western site boundary.

The Camac River (IE-EA_09C020100) (to the south west of the proposed site) and the proposed site are located within the Liffey Catchment. The proposed site is located in the (Liffey_SC_090) sub catchment.

Under the WFD, all water bodies are required to meet good status within a certain time period. Ireland is now in the second cycle of the WFD and therefore good status should be achieved in all water bodies by the end of this current cycle, i.e., 2021. If a waterbody is unlikely to achieve this status, then it is deemed to be *At Risk*. The Camac River is described as being *Not At Risk* and of *Good Status*.

Figure 2.5: Surface water features relevant to the development site.

2.4.3 Soils, Geology & Hydrogeology Environment

Groundwater Aspects: There are no Source Protection Zones, Karst Features or Boreholes located in the immediate area of the proposed site.

Aquifer Vulnerability: The dataviewer for the Geological Survey of Ireland (GSI) described the site as being located in an area of Poor Aquifer - Bedrock which is Generally Unproductive except for Local Zones. The vulnerability rating for the proposed site is classed as low for the majority of the site, high down through the middle of the site and moderate in a section northeast of the site. Refer to **Figure 2.6.**

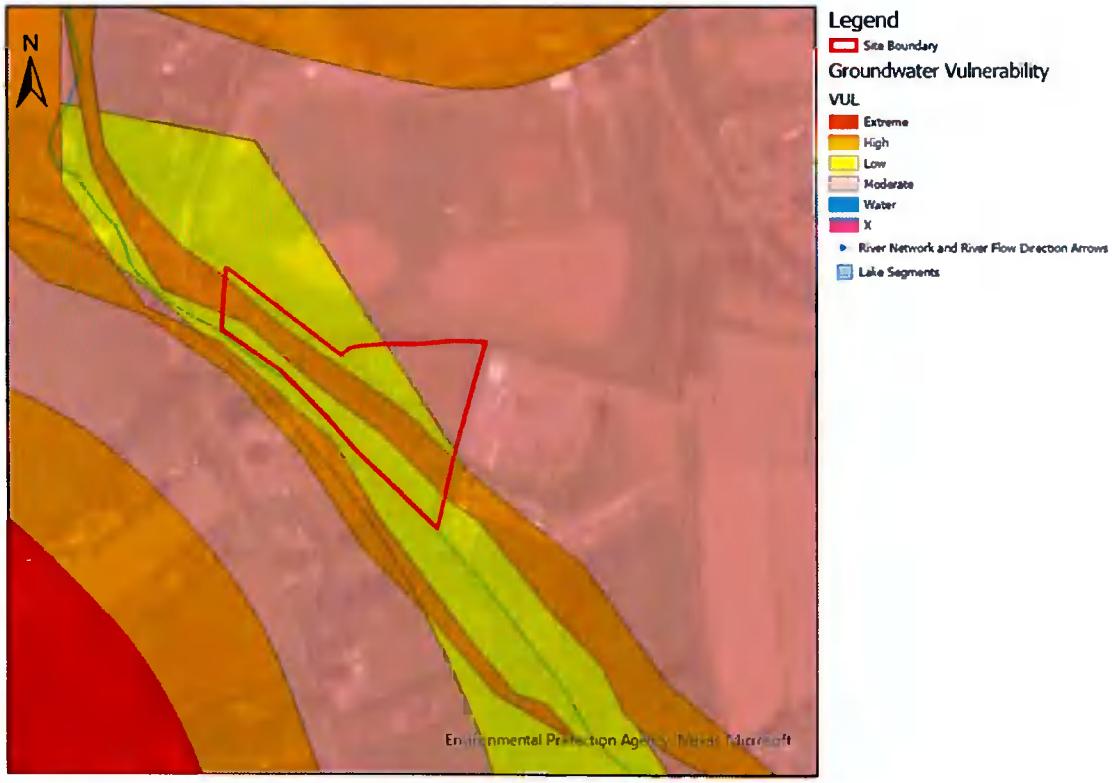

Figure 2.5: Groundwater Vulnerability at the Proposed site.

3. Construction Environmental Management Plan

3.1 Construction Environmental Mitigation

Construction environmental mitigation will be expected to follow best practice and any specific measures required in the planning conditions. The objective of this mitigation is to avoid/reduce the potential for environmental impacts during the (infill) phase.

This mitigation will be implemented by the construction contractor and is detailed in Table 3.1 below.

Table 3.1: Construction Environmental Mitigation

Aspect	Potential Environmental Impact	Description
Traffic and Transport	Impacts on road safety / traffic flows	The proposed site will have a positive impact on the surrounding traffic network as it would remove the need for considerable amount of off-site disposal as the soil and stone would be transported through an existing linkage between both land parcels using site machinery – c3500 truck movements would be avoided on the local road network. No traffic will be generated as the soil and stone would be transported through an existing linkage between both land parcels using site machinery. However, the following is noted: • Delivery times are to be limited to the specified working hours, 07:30-18:00, Monday to Friday and 08:00-14:00 on Saturday.
Population and Human Health	Impacts on population and human health	• All HGV's leaving the site will directed through a wheelwash in order to prevent mud and other wastes being tracked onto public roads; • During prolonged dry or windy periods, any areas with the potential to generate dust will be watered and; • Public roads will be inspected regularly for cleanliness and cleaned as necessary.
Noise	Impacts on noise sensitive locations	The mitigation measures that will be implemented on site to minimise environmental impacts relating to noise, will include All vehicle engines will be switched off when not in use; • Restricted speed limits will be implemented on site to reduce the generation of noise from moving HGV's within the site; • Working hours will be limited during which site activities are permitted to 07:00-18:00 Monday to Friday, and 08:00-13:00 on Saturdays; • A site representative responsible for matters relating to noise will be appointed to liaise with client and residents.

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ENVIRONMENTAL INSPECTION CHECKLIST

Aspect	Potential Environmental Impact	Description
Soils, Geology, Hydrology and Hydrogeology	Pollution event on local soils. geology surface and groundwaters	A buffer zone along the River Camac shall be maintained at all times during the construction period. Mitigation measures that will be implemented on site during the construction phase shall include: • No construction activities will be undertaken within the buffer zone of the River Camac. In the event, the sedimentation / erosion of soils occurs on site, strict controls will be implemented by the construction contractor to confirm that there will be no release of sediment into the River Camac during the construction phase. • All soil materials will be visually inspected for signs of potential contamination. Should any contamination be identified, the relevant soils will be stored separately, sampled and disposed of by a licensed waste contractor (as required). • There will be no oils, fuels, greases, and hydraulic fluids stored onsite. • There will be no refuelling taking place onsite
Air Quality and Climate	Nuisance Dust & resulting impact on local residents	Impacts to air quality during the construction phase are not considered to be significant. Mitigation measures that will be implemented on site during the construction phase shall include: • Hard surfaces will be swept to remove any mud or aggregate build up; • All HGV's leaving the main site will be directed through a wheel wash in order to prevent mud and other wastes being tracked onto the public roads; • Soil handling and movement will only take place when the soils are in the optimum condition. This optimum soil condition may be described as moist but friable. • No soils will be moved when they are too dry or when there are unusually windy weather conditions; • With regard to exhaust emissions and GHG emissions: o Vehicles on the site will be not left idling for more than a few minutes; o Energy consumption & emissions data will be considered in the purchasing new plant and vehicles.

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ENVIRONMENTAL INSPECTION CHECKLIST

Aspect	Potential Environmental Impact	Description
Biodiversity/ Ecology	Impacts on Ecological Features	Mitigation measures that will be implemented on site during the construction phase shall include: • All site development works shall adhere to best practice. • The work areas must be kept to the minimum area required to carry out the proposed works and the area should be clearly marked out and cordoned off in advance of work commencement. • Prior to the commencement of the infill on site, the site manager and the contractors should be made aware of the ecological sensitivity of the site, both in terms of the protection of surface water and groundwater. • All site works must follow those specified in the Construction Management Plan. • Efficient construction practices and sequences shall be employed on site, and this will minimise soil erosion and potential pollution of local watercourses with soil and sediment. Unnecessary clearance of vegetation shall be avoided. Works within the site shall be avoided during periods of heavy rainfall. • In order to protect water quality in The River Camac, all site preparation and construction works shall conform to all guidelines within the document Inland Fisheries Ireland Requirements for the Protection of Fisheries Habitats during Construction and Development Works and River Sites (www.fisheriesireland.ie) and the updated guidelines entitled Guidelines on Protection of Fisheries During Construction Works in And Adjacent to Waters (2016). Guidelines in the CIRIA (Construction Industry Research and Information Association) Publications including C532 – Control of Water Pollution from Construction, guidance for Consultants and Contractors should also be followed. • A buffer zone between construction works and the river shall be maintained at all phases of construction and operation. There must be no deposition of soil within this buffer strip. • Hydrocarbon / fluid management measures shall include: o Fuels, oils, greases and hydraulic fluids will not be stored onsite. o No refuelling or lubrication of equipment shall take place
Waste Management	Ineffective waste management	No waste will be generated as a result of this project. The project in itself is reducing waste and using a by-product for beneficial re-use in line with EPA Article 27 Guidance.

4. Emergency Response Procedure

The purpose of the emergency response procedure (ERP) is to address an emergency situation which may originate on-site. The main scenario's which were considered to potentially occur on site were associated with:

- A spill or leakage;
- A fire; and

4.1 Emergency Spill/Leakage Protocol

The procedure for dealing with spillages and/or leakages on site is as follows:

- The site operator shall be notified of a spill/leakage immediately by site staff;
- Where there is any indication that environmental pollution (releases to the environment) has, or may have, taken place, then The site operator will liaise with the appropriate Authority as deemed required;
- If possible, the type & nature of the spilled material and the volume shall be confirmed. Any risks to human health and/or the environment shall be determined;
- Stop the source and contain the spillage;
- Limit the spillage effected area by blocking, diverting or confining the spillage;
- Smaller leaks/spillages shall be contained using a spill kit, where absorbent product will be applied to the spill and removed as soon as it has absorbed all the material. All contaminated spill kit material shall be put into a suitable waste container and labelled as to the contents, prior to collection by a licenced waste contractor;
- If a bigger spillage occurs, access to any surface water features is to be blocked off to stop potential discharges. Then, staff shall clear up the spillage and dispose of the spill material to an authorised waste facility;
- If a spillage results in discharges to a surface water feature or there is potential for adverse impact on the environment, the site operator shall report to the appropriate authority (eg Wicklow County Council / Irish Water, Inland Fisheries Ireland) and agree a course of action;
- A record of the spill/leakage incident shall be retained on-site.

4.2 Fire

In the event of a fire, persons near the outbreak of the fire shall alert the site operator. In an emergency situation, the appropriate services will be notified.

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ENVIRONMENTAL INSPECTION CHECKLIST

The following information will be provided:

1. The name of the company

2. Address

Slade, Saggart, Co. Dublin.

3. Details of the Fire

Emergency contact details are:

Local Garda Station: Rathcoole: 016667900

Local Fire Station: Tallaght: 016734000

Dialling 999/112 will connect the caller with any of the emergency services.

If a fire on-site has an adverse impact on the environment, South Dublin County Council, Irish Water and Inland Fisheries Ireland (as relevant) will be notified and they shall agree a course of action.

4.3 Chemicals/Oils/Fuels On-Site

No volumes of oil/fuels/chemicals are expected to be stored on site and refueling will not take place on the site. The following controls shall be implemented by the construction contractor in relation to the leakages of mobile equipment.

- Appropriate and sufficient spill control materials will be installed at strategic locations within the site. Spills kits for immediate use will be kept in the cab of mobile equipment.
- Spill kits will be stored in the site compound with easy access for delivery to site in the case of an emergency. A minimum stock of spill kits will be maintained at all times and site vehicles will carry spill kits at all times. Spill kits must include suitable spill control materials to deal with the type of spillage that may occur and where it may occur. Typical contents of an on-site spill kit will include the following as a minimum
    - Absorbent granules.
    - Absorbent mats/cushions.
    - Absorbent booms.
- Spill kits will contain gloves to handle contaminated materials and sealable disposal sacks.
- Fuel, oils, greases and hydraulic fluids will not be stored onsite.
- Re-fuelling of construction vehicles will not take place onsite.
- The contractor will ensure that no hazardous or noxious materials enters a watercourse/drain. Should this situation arise emergency procedures will be activated.

5. Silt Fencing for the River Camac.

There shall be no discharges of contaminated waters to ground or surface waters from the infill phase. In order to avoid indirect sedimentation impacts on The River Camac, there will be a buffer of c.10m and the installation of silt fence around the perimeter of the infilled area.

A silt fence will remove the potential for sediment movement during wet weather events. This is particularly important along the River Camac. The silt fence will be a permeable geotextile barrier installed vertically on support posts and entrenched in the ground. **Figure 6.1** below illustrates a silt fence in operation and attached drawing J1387-CCL-10-SL-DR-001 shows its proposed layout on the site.

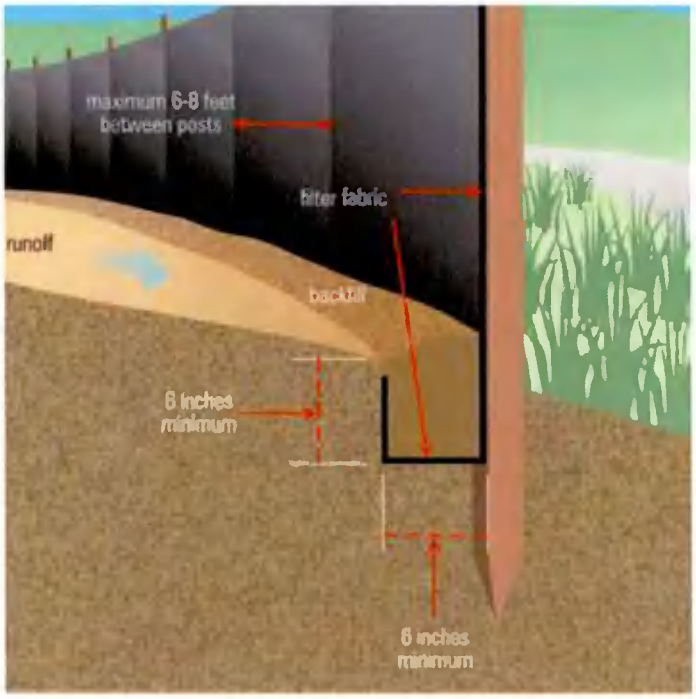

Figure 6.1: Silt fencing arrangements for vulnerable section along the River Camac.

6. Site Inspection Procedure and Checklist

Regular site assessments will be undertaken to confirm that the CEMP is being followed. These will include.

- Daily and weekly site walkovers using prescribed check lists
- Environmental Toolbox talks;
- Visual checking and recording of mechanical plant for leaks and mechanical issues in order to minimise leakage and breakdowns on site. The purpose is to identify any need for pre-emptive maintenance, so as to avoid any accidental spillage of hydrocarbons.

The checklists proposed for use are appended to this CEMP.

Attachment 1 – Environmental Checklist

Introduction & Scope

This environmental inspection procedure outlines the requirements for the conduct of regular visual inspections at the site, Slade Saggart, Co. Dublin.

Regular visual inspections are performed to ensure a clean working environment.

The inspections also aim to identify potential environmental hazards in the work area and to minimise associated risks.

Responsibilities

The site operator

- Undertake regular visual inspections of the Site;
- Undertake and record the Weekly Check inspections (per checklist attached); and
- Implement and adhere to any required corrective actions/ control measures.

Inspection Procedure

1. Review the Weekly Checklist Form;
2. Conduct the inspection by walking around the work environment;
3. Identify any hazards and areas of non compliance against the checklist;
4. Record all findings, ensuring the Form is signed and dated and includes details of the personnel conducting the environmental inspection;

Environmental Inspection Checklist

Date: _____

Person: _____

Weather condition (precipitation, sun, wind- speed and direction)

Environmental Inspection Checklist	Comments	Corrective Actions Needed (Y/N)
GENERAL		
Site clean and tidy – no litter, good housekeeping?		
Are there any leaks or mechanical issues with plant and equipment on-site?		
Do any corrective action records remain open?		
DUST EMISSIONS		
Are site activities sprayed to minimise dust generation?		
Are dusty sections of the site sprayed with water?		
Are speed control measures being complied with		
WATER ENVIRONMENT		
Are emission values at the monitoring points being met?		
Are vehicles cleaned before leaving the main site?		
Are wheel washing facilities at the main site properly maintained		
Is sand and silt in the wheel washing bay regularly removed?		
Is the site entrance and surrounding public road		

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ENVIRONMENTAL INSPECTION CHECKLIST

Environmental Inspection Checklist	Comments	Corrective Actions Needed (Y/N)
kept clean and free of mud?		
Is wastewater regularly removed off-site		
Is water recycled where possible for dust suppression/ wheelwash etc?		
NOISE		
Is the site operating within the agreed working hours?		
Is idle equipment turned off?		
Any noise mitigation measures adopted?		
WASTE MANAGEMENT		
Are wastes regularly removed off-site for recycling/ appropriate disposal?		
Are all wastes collected and disposed of by licensed contractors		
Are waste containers appropriately & clearly labelled?		

APPENDIX 5: Landscape Visual Impact Assessment

LEGEND

Site Boundary

Fluvial flood extent
(1% AEP + 20% C.C)

Stream / River

HYDREC
ENVIRONMENTAL CONSULTING

PROJECT:

Flood Risk Assessment -
Coffey Construction Ltd. -
Slade, Saggart, Co. Dublin

TITLE:

Extent of fluvial flooding under the 1-100 year event, to right of stream channel and within applicant's land

SCALE:	DRAWN BY:
1:1,000@A3	PMcC
DRAWING NO:	**REV.**
Figure 4.	0

LEGEND

- Site Boundary
- Fluvial flood extent
- Proposed Infill Area
- Compensatory Storage Area

HYDREC ENVIRONMENTAL CONSULTING

PROJECT:

Flood Risk Assessment
- Coffey Construction Ltd -
Slade, Saggart, Co. Dublin

TITLE:

Area proposed for infilling and compensatory storage onsite

SCALE:	DRAWN BY:
1:800@A3	PMcC
DRAWING NO:	**REV.**
Figure 5.	0