Rhyd Y Carw Mill, Trefeglwys, Caersws, SY17 5PU

TAN15: Flood Consequence Assessment

For Straightforward Properties Ltd

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Rhyd Y Carw Mill, Trefeglwys, Caersws, SY17 5PU

Project	TAN15: Flood Risk Assessment
Client	Straightforward Properties Ltd
Status	Final
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EXECUTIVE SUMMARY

The proposed development would be expected to remain dry in all but the most extreme conditions. Providing the recommendations made in this FCA are instigated, flood risk from all sources would be minimised, the consequences of flooding are acceptable, and the development would be in accordance with the requirements of TAN15.

This FCA demonstrates that the proposed development would be operated with minimal risk from flooding, would not increase flood risk elsewhere and is compliant with the requirements of TAN15. The development should not therefore be precluded on the grounds of flood risk.

1.0 INTRODUCTION

1.1 Background

This Flood Consequence Assessment (FCA) has been prepared by KRS Environmental Limited to support a planning application for the proposed development at Rhyd Y Carw Mill, Trefeglwys, Caersws, SY17 5PU.

This FCA has been carried out in accordance with guidance contained in Technical Advice Note 15 Development and Flood Risk (TAN15) and associated Development Advice Maps. This FCA identifies and assesses the risks of all forms of flooding to and from the development and demonstrates how these flood risks will be managed so that the development remains safe throughout the lifetime, taking climate change into account.

It is recognised that developments which are designed without regard to flood risk may endanger lives, damage property, cause disruption to the wider community, damage the environment, be difficult to insure and require additional expense on remedial works. The development design should be such that future users will not have difficulty obtaining insurance or mortgage finance, or in selling all or part of the development, as a result of flood risk issues.

1.2 Technical Advice Note 15 (TAN15)

One of the key aims of TAN15 is to ensure that flood risk is taken into account at all stages of the planning process; to avoid inappropriate development in areas at risk of flooding and to direct development away from areas of highest risk.

It advises that where new development is exceptionally necessary in areas of higher risk, this should be safe, without increasing flood risk elsewhere, and where possible, reduce flood risk overall. A risk-based approach is adopted at stages of the planning process, applying a source pathway receptor model to planning and flood risk. To demonstrate this, an FCA is required and should include:

- whether a proposed development is likely to be affected by current or future flooding from all sources;
- whether it will increase flood risk elsewhere;
- whether the measures proposed to deal with these effects and risks are appropriate; and
- satisfy the justification test, including the acceptability of consequences.

1.3 Justification Test

The Justification Test sets out the details required to justify siting a new development in an area believed to be at risk of flooding and is defined in Section 6 of TAN15. The required criteria a site / development must fulfil are;

i) its location in zone C is necessary to assist, or be part of, a local authority regeneration initiative or a local authority strategy required to sustain an existing settlement; or

ii) its location in zone C is necessary to contribute to key employment objectives supported by the local authority, and other key partners, to sustain an existing settlement or region;

and

iii) it concurs with the aims of PPW and meets the definition of previously developed land; and,

iv) the potential consequences of a flooding event for the particular type of development have been considered, and in terms of the criteria contained in sections 5 and 7 and appendix 1 found to be acceptable.

1.4 Report Structure

This FCA has the following report structure:

- Section 2 describes the location area and the existing and proposed development;
- Section 3 outlines the flood risk to the existing and proposed development;
- Section 4 outlines mitigation measures used to reduce the overall level of flood risk;
- Section 5 provides justification of the proposed location of the development; and
- Section 6 presents a summary and conclusions.

2.0 LOCATION & DEVELOPMENT DESCRIPTION

2.1 Site Location

The site is located at Rhyd Y Carw Mill, Trefeglwys, Caersws, SY17 5PU (see Figure 1). The National Grid Reference (NGR) of the site is 295852, 290626.

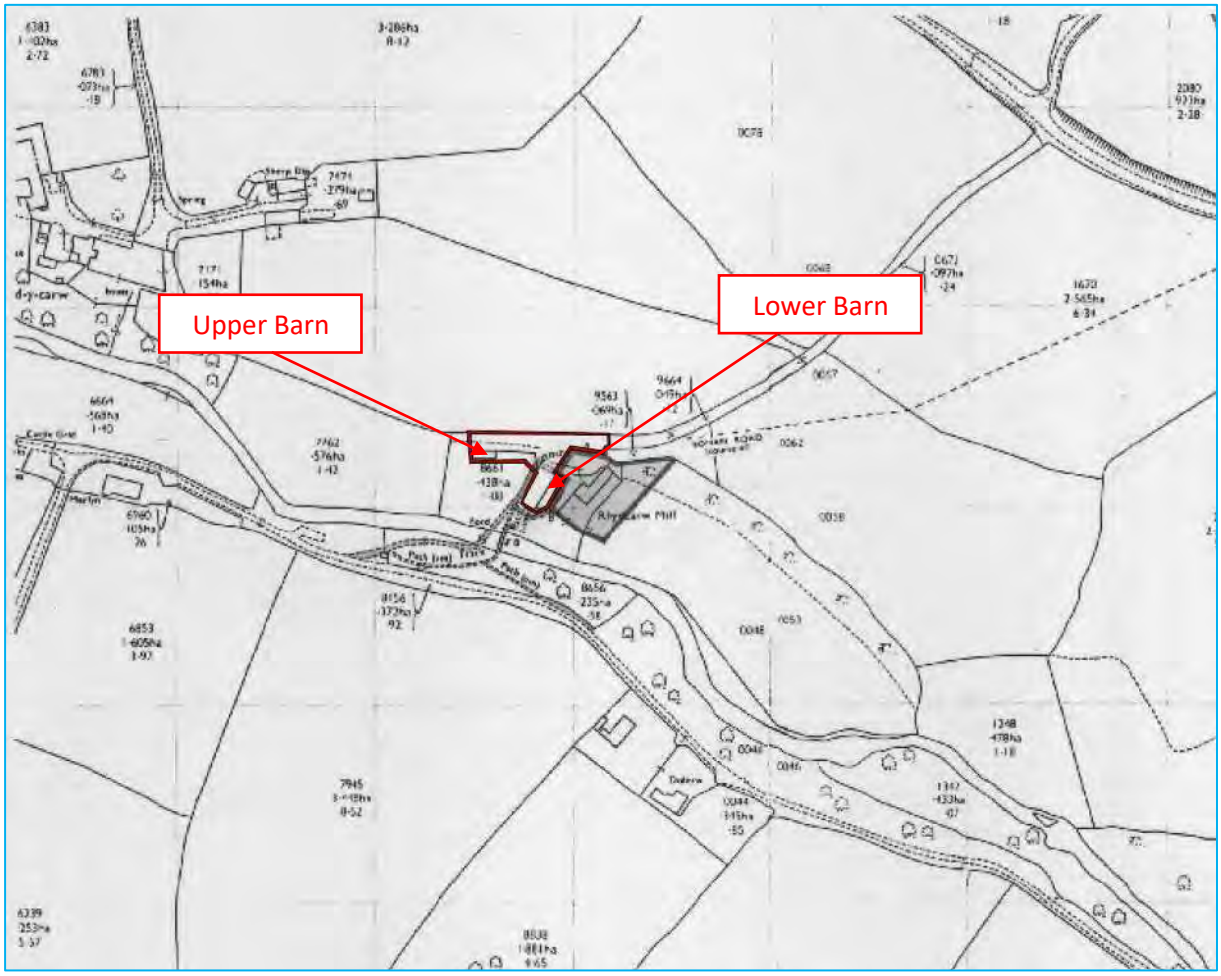


Figure 1 - Site Location

2.2 Existing Development

Located on the site are two barns, an upper barn and a lower barn (see Appendix 1). The upper barn is disused and the lower barn is used as kennels and for storage.

2.3 Proposed Development

The proposed development is for the conversion of the barns to a multifunctional corporate retreat/events development (see Appendix 2). The upper barn will be used for accommodation and the lower barn will be used as an events studio with storage and an office. Further details with regard to the proposed development can be found in the accompanying information submitted with the planning application.

2.4 Ground Levels

A topographical survey of the site and the River Trannon has recently been undertaken (see Appendix 3). The site ground level rises from the south to the north, the minimum ground level is 148.31 metres Above Ordnance Datum (mAOD) and the maximum ground level is 153.03mAOD.

The external ground level at the location of the upper barn is 149.76mAOD and the existing internal ground level of the upper barn is 149.74mAOD to 151.15mAOD. The external ground level at the location of the lower barn is 147.90mAOD and the existing finished floor level of the lower barn is 148.45mAOD.

2.5 Catchment Hydrology

The River Trannon (Afon Trannon) is located adjacent to the southern boundary of the site. The River Trannon is a tributary of the River Severn and flows into the River Severn approximately 6.50km downstream of the site just upstream of Caersws.

At this location, the River Trannon is approximately 5m wide and 0.50m to 1.00m deep (see Figure 2). Just downstream of the site is a footbridge across the River Trannon (see Figure 3), no other structures on the River Trannon are located within the vicinity of the site.

Figure 2 - River Trannon adjacent to the site looking Downstream

Figure 3 - Footbridge Adjacent to the Site Looking Downstream

2.6 Ground Conditions

The British Geological Survey (BGS) Map indicates that the bedrock underlying the site consists of the Caerau Mudstones Formation - mudstone and the Rhayader Mudstones Formation - mudstone. The superficial deposits consist of Glaciofluvial Deposits, Devensian - sand and gravel and Alluvium - gravel, sand, silt and clay.

3.0 FLOOD RISK

3.1 Sources of Flooding

All sources of flooding have been considered, these are: fluvial (river) flooding, tidal (coastal) flooding, groundwater flooding, surface water (pluvial) flooding, sewer flooding and flooding from artificial drainage systems/infrastructure failure.

3.2 Natural Resources Wales

Information regarding the current flood risk at the application site, local flood defences and flood water levels has been obtained from Natural Resources Wales. Natural Resources Wales has confirmed that they do not hold any modelled data for the site (see Appendix 4).

3.3 Powys County Council

Powys County Council is the Local Panning Authority (LPA) and the Lead Local Flood Authority (LLFA) and has responsibilities for 'local flood risk', which includes surface runoff, groundwater and ordinary watercourses. Planning guidance written by Powys County Council regarding flood risk was consulted to assess the mitigation policies in place. In particular, the Powys County Council Strategic Flood Consequence Assessment (SFCA) has been reviewed.

3.4 Climate Change

Projections of future climate change, in the UK, indicate more frequent, short-duration, high intensity rainfall and more frequent periods of long duration rainfall. Guidance included within TAN15 recommends that the effects of climate change are incorporated into FCA. Recommended precautionary sensitivity ranges for peak rainfall intensities and peak river flows are outlined in the CL-03-16 - Climate change allowances for Planning purposes.

Table 1 show the peak river flow allowances by river basin district. There is reasonable level of certainty that the future impacts of climate change will lie somewhere between the central and upper allowances.

The 9th January 2014 Welsh Government letter to all Chief Planning Officers (CPO) in Wales and CL-03-16 - Climate change allowances for Planning purposes clarifies and refers to the Natural Resources Wales recommendations that the lifetime of development for residential development is 100 years, and for other development it is considered to be 75 years i.e. 2095.

Table 1 - Peak River Flow Allowances by River Basin District (use 1961 to 1990 baseline)

River Basin District	Allowance Category	Total Potential Change Anticipated by the 2020s	Total Potential Change Anticipated by the 2050s	Total Potential Change Anticipated by the 2080s
Severn	Upper end	+25%	+45%	+70%
	Central	+10%	+20%	+25%
	Lower end	+0%	+5%	+5%

3.5 Historic Flooding

The Natural Resource Wales historic flood outline map shows that the site has not historically flooded. The British Hydrological Society (BHS) "Chronology of British Hydrological Events[1]" has no information on flooding within the vicinity of the site. No other historical records of flooding for the site have been recorded.

The River Trannon does overtop its banks within the vicinity of the site but this does not result in flooding of the site, as shown in Figures 4 and 5.

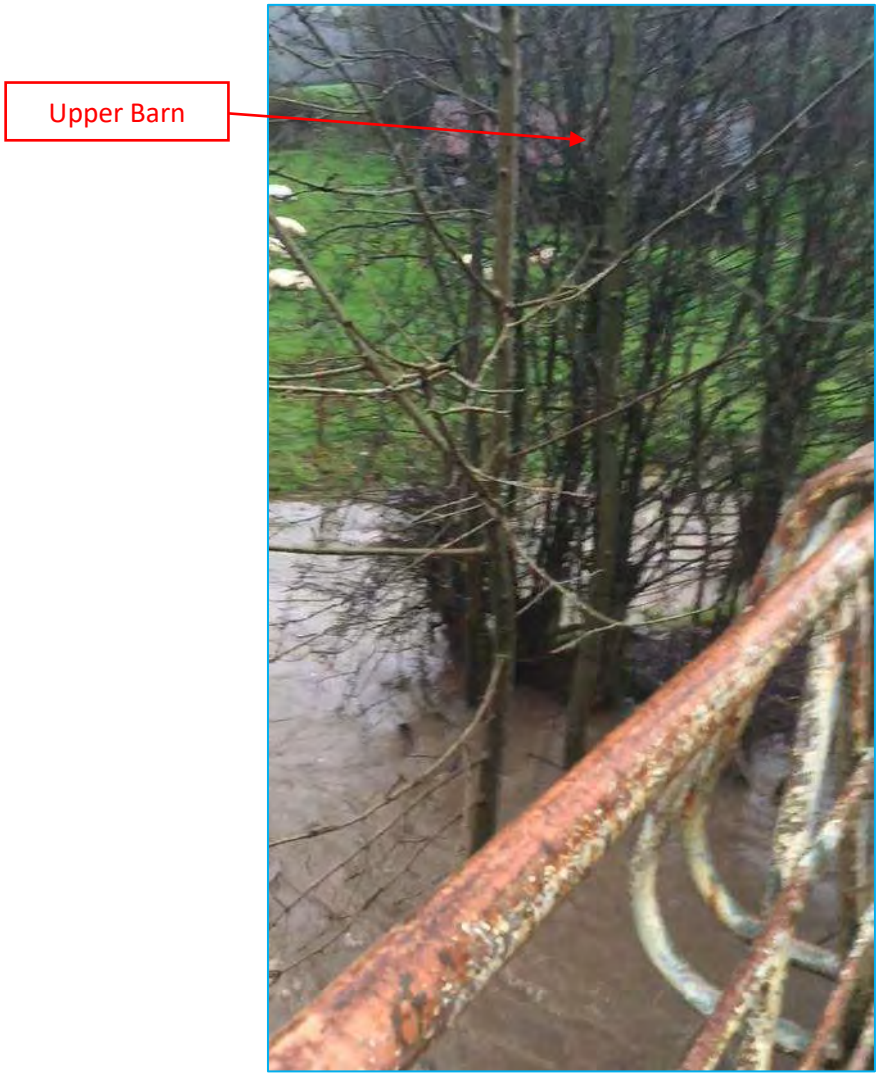


Figure 3 - Flooding on the 29/10/2020 from the Footbridge Looking at the Upper Barn

[1] http://www.dundee.ac.uk/geography/cbhe/

Figure 4 - Flooding on the 29/10/2020

3.6 Existing and Planned Flood Defence Measures

The site is not protected against flooding by existing flood defence measures. The flood risk will be further mitigated by using a number of risk management measures to manage and reduce the overall flood risk at the site, these are discussed in Section 4.0.

3.7 Development Advice Map

The Development Advice Map (DAM) which accompanies TAN15 shows that the site is located within C2 - Areas of the floodplain without significant flood defence infrastructure (see Figure 5).

Table 2 describes the composition and use of the TAN15 zones to control and manage development. Applying the Flood Risk Vulnerability Classification in Figure 2 of TAN15, the proposed development is classified as 'highly vulnerable'.

However, the lower barn will be used as an events studio with storage and an office and can be classified as 'less vulnerable'. It should also be taken into account that the existing use of the lower barn is a kennels and can be classified as 'less vulnerable' therefore, the proposed development of the lower barn will not change the vulnerability of the building.

Figure 5 - Development Advice Map

Table 2 - Development Advice Map Flood Zones

Description of Zone	Zone	Use within the precautionary Framework
Considered to be at little or no risk of fluvial or tidal/coastal flooding.	A	Used to indicate that justification test is not applicable and no need to consider flood risk further.
Areas known to have been flooded in the past evidenced by sedimentary deposits.	B	Used as part of a precautionary approach to indicate where site levels should be checked against the extreme (0.1%) flood level. If site levels are greater than the flood levels used to define adjacent extreme flood outline there is no need to consider flood risk further.
Based on Environment Agency extreme flood outline, equal to or greater than 0.1% (river, tidal or coastal)	C	Used to indicate that flooding issues should be considered as an integral part of decision making by the application of the justification test including assessment of consequences.
Areas of the floodplain which are developed and served by significant infrastructure, including flood defences.	C1	Used to indicate that development can take place subject to application of justification test, including acceptability of consequences.
Areas of the floodplain without significant flood defence infrastructure.	C2	Used to indicate that only less vulnerable development should be considered subject to application of justification test, including acceptability of consequences. Emergency services and highly vulnerable development should not be considered.

3.8 Natural Resources Wales Flood Risk Map

A review of the Natural Resources Wales Flood Risk Map indicates that the site is located within the high fluvial flood risk zone with a chance of flooding of greater than 1 in 30 (3.3%) years (see Figure 6). The upper barn is shown to be located within the very low fluvial flood risk zone with a chance of flooding of less than 1 in 1000 (<0.1%) years. The lower barn is located within the high fluvial flood risk zone with a chance of flooding of greater than 1 in 30 (3.3%) years.

The Flood Risk Map is the current best information on the extent of the extremes of flooding from rivers or the sea that would occur without the presence of flood defences, because these can be breached, overtopped and may not be in existence for the lifetime of the development. The Natural Resources Wales flood zones show the worst-case scenario.

Figure 6 - Natural Resources Wales Flood Risk Map

3.9 Fluvial (river) Flooding

The River Trannon poses the primary flood risk to the site. In extreme events the River Trannon may overtop its banks and inundate a small proportion of the site with floodwater. The local topography is such that floodwater could only possibly enter the site at one place, to the west of the site. In order to do so, water depth within the River Trannon would need to be greater than 1.50m to overtop the left hand river bank.

Hydrological Modelling

The topography of the floodplains within the vicinity of the site is constricted and the mechanisms of flooding are not complex. Any flooding would be of a minor nature due to the low flows and topography of the area. The flooding will only inundate the site to a relatively low water depth and water velocity, will only last a short period of time, in very extreme cases and will not have an impact on the whole of the proposed development site. The actual risk of flooding caused by overtopping of the riverbank during a fluvial flood event on the River Trannon will be reduced compared to the extent of flooding shown in the Natural Resources Wales flood outlines.

It is important to understand the hydrological nature of the River Trannon due to its implications on fluvial flood risk at the site. Such an investigation was undertaken using 'industry standard' techniques such as the Centre for Ecology and Hydrology (CEH) Flood Estimation Handbook (FEH) webservice, the FEH Statistical Method and the Revitalised Rainfall Runoff (ReFH)2 Method. These methods are based on robust hydrological modelling techniques and are described in the Flood Estimation Handbook (FEH). The FEH Calculation Record is shown as Appendix 5.

Catchment descriptors from the FEH webservice can be used to infer the physical nature of the catchment and its possible response to a rainfall event. Table 3 sets out the relevant catchment descriptors for the study catchment upstream of the site at National Grid Reference (NGR) 354950, 217400 (see Figure 7). To ensure the runoff from the entire catchment is taken into account and flood flows are not underestimated, it is intended to calculate peak flows for the full catchment to the

downstream limit of the site. A definition of each can be found at http:www.environment-agency.gov.uk/hiflows/97768.aspx.

Table 3 - FEH Catchment Descriptors

Catchment Descriptor	Value
NGR	295900, 290600
Area	29.58 km²
Altbar	358 m
Aspbar	147 degrees
Aspvar	0.16
Bfihost	0.410
Bfihost19	0.364
CentroidEasting	291,961 m
CentroidNorthing	292,449 m
Dplbar	6.59 km
Dpsbar	145.00 m/km
Farl	1.0000
Fpext	0.0360
Fpdbar	0.398 cm
Fploc	1.190
Ldp	12.94 km
Propwet	0.660
Rmed1H	10.9 mm
Rmed1D	50.4 mm
Rmed2D	62.8 mm
Saar6190	1,559 mm
Saar4170	1,492 mm
Sprhost	44.95 %
Urbconc1990	
Urbext1990	0.0001
Urbloc1990	
Urbconc2000	
Urbext2000	0.0000
Urbloc2000	
CatchmentRainC	-0.027
CatchmentRainD1	0.483
CatchmentRainD2	0.392
CatchmentRainD3	0.378
CatchmentRainE	0.293
CatchmentRainF	2.466
GridRainD1	0.479
GridRainD2	0.377
GridRainD3	0.383

The catchment boundary has been checked against the OS mapping and no changes are necessary. Qualitative checks on FARL using mapping and BFIHOST checked using soil maps was undertaken. The

soil catchment details were checked by using soil maps the catchment location. A visual assessment using Google Maps and the FEH Webservice Map was used to check the URBEXT2000 value and FARL. With a low URBEXT value, it was not necessary to consider any updating. These values were consistent with the maps. No catchment descriptors were altered from the initial FEH catchment descriptors.

The catchment area is small at 29.58km^2, the SPRHOST value (Standard Percentage Runoff) is 44.95% and indicates a low permeable catchment. Approximately 44.95% of the rainfall will contribute to direct runoff rather than be stored and reflects the low permeability of the underlying geology. The BFIHOST value (Baseflow Index) is low at 0.410.

The descriptors BFIHOST and SPRHOST are representative of the permeability of catchment soils and geology, a high BFIHOST and a low SPRHOST value indicate a very permeable catchment, whilst a low BFIHOST and high SPRHOST indicate a very impermeable catchment. Based on the relatively broad scale data sets that inform the catchment descriptors, the catchment descriptors values indicate a reasonably impermeable catchment.

The SAAR6190 (Standard Average Annual Rainfall) value is high at 1559. The URBEXT2000 value is 0.00 and therefore, the catchment is essentially rural. The catchment descriptors were used to calculate the design flow on River Trannon, using the FEH Statistical Method and the ReFH2 method.

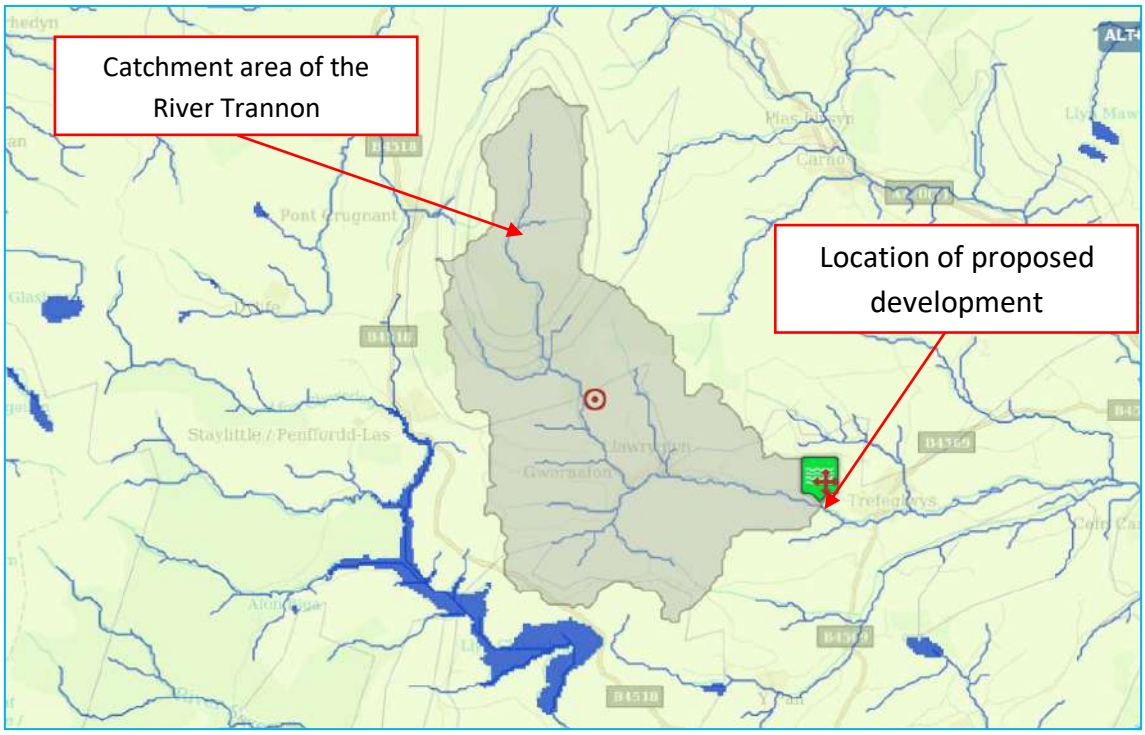


Figure 7 - River Trannon Upstream Catchment as shown on the FEH webservice

FEH Statistical Method

The statistical method is based on an Index Flood, which is the mean annual flood (QMED – with a return period of 2 years) from catchment descriptors and then improving this using data from an appropriate gauging station. The standard output from the method is presented in Appendix 6. Changes have been made to the QMED adjustment process in WINFAP-FEH3.0.003 updated with Version 7 of the NRFA Peak Flow Dataset, which improves upon the previous method. The value of QMED calculated from the catchment descriptors using the FEH Statistical Method is 0.95m^3/s.

It is common practice to adjust QMED using gauged data from so-called donor catchments. The search area was restricted to 20km because the effect that the new data transfer method has on QMED adjustment becomes negligible when the distance between catchment centroids is greater than 10km.

Recent research has shown that the use of distant donor catchments is not the most accurate way to calibrate the QMED equation. As an alternative, sites should be chosen to minimise the geographical distance between the centroids of the target and donor catchments. This is based on a Guidance Note issued by the Environment Agency in July 2008 (from SC050050/SR Report and incorporated in WINFAP-FEH v3).

No suitable donors could be located for the site. They were either too distant (with centroids greater than 10km away) or too large and therefore of potentially contrasting hydrological regime (see Table 5).

Table 5 - Candidate Donor Sites for QMED

Station	QMED Donor	Centroid Distance (km)	Area	SAAR	BFIHOST
gb 295900, 290600 (subject site	--	--	29.58	1559	0.410
54014 (Severn @ Abermule)	26.039	8.64	574.66	1256	0.449
54091 (Severn @ Hafren Flume)	23.095	9.47	3.44	2514	0.303
54022 (Severn @ Plynlimon Flume)	24.906	9.75	8.69	2483	0.323

Growth factors can be estimated from site records, if available, but should only be used for return periods of up to half the length of record, so determination of the 1 in 100 year event would require 200 years of recorded data. For longer return periods, the so-called pooled analysis is recommended. This method derives a growth curve from weighted parameters of catchments with similar hydrological characteristics. Data from the HiFlows-UK database has been used in deriving the Pooling Group. In addition, following guidance issued by the Environment Agency in 2009, pooling groups should use at least 500 station years of data, irrespective of the return period of interest.

WINFAP-FEH initially found 19 sites with catchment descriptors similar to those at the site that could be used for the pooling group. The WINFAP-FEH software indicated that the pooling group is acceptably homogeneous and a review of the pooling group is not required.

However, a review of the pooling was undertaken. The Standard Test of H2 is 094. FARL values were all above 0.94 and were considered appropriate and no stations were shown to have a high level of discordance. The years of data from all the stations totalled above 500 years. Table 6 shows the pooling group used, with the number of years totalling 524.

The pooling group sites which are ranked are satisfactory in terms of hydrological similarity with the subject site and the pooling group distribution provides an acceptable statistical fit. The FEH states that a significant proportion of pooling groups remain heterogenous, even after a review of discordancy, heterogeneity and adapting a heterogenous pooling group to make it homogeneous is not advised. Consequently, the pooling group is considered acceptable.

After the pooling group was reviewed, the goodness of fit (absolute Z value) was accessed. The Generalised Logistic (GL) provides a Z value of 0.0077 and the Generalised Extreme Value (GE) provides a Z value of 1.5488. The GL distribution was used to calculate growth factors and is the preferred distribution in view of its dominant role in FEH and since it gives a more conservative (higher) estimate,

this distribution typically provides the best fit for use in deriving growth curve factors and flood frequency estimates. WINFAP-FEH was then used to obtain a pooled growth curve to be used in estimating the flood flows. WINFAP-FEH was then used to define the QMED value as detailed above and create a flood frequency curve for the specified return periods by fitting the pooled growth curve created to the GL distribution.

Table 6 - Final Pooling Group

No.	Station	Distance	Years of data	QMED AM	L-CV	L-SKEW	Discordancy
1	55017 (Chwefru @ Carreg-y-wen)	0.144	7	21.421	0.428	0.535	2.314
2	61003 (Gwaun @ Cilrhedyn Bridge)	0.167	39	20.679	0.157	0.030	0.915
3	21029 (Tweed @ Glenbreck)	0.269	9	37.765	0.069	0.138	2.384
4	48004 (Warleggan @ Trengoffe)	0.299	39	9.565	0.244	0.207	0.234
5	25012 (Harwood Beck @ Harwood)	0.308	39	31.368	0.176	0.264	0.572
6	60004 (Dewi Fawr @ Glasfryn Ford)	0.325	34	17.911	0.053	-0.097	1.809
7	67013 (Hirnant @ Plas Rhiwedog)	0.329	12	24.081	0.200	-0.026	2.375
8	72007 (Brock @ U/s a6)	0.337	30	29.438	0.194	0.273	2.025
9	48009 (st Neot @ Craigshill Wood)	0.409	12	8.469	0.246	0.372	0.426
10	48801 (Cober @ Trenear Intake)	0.454	21	2.591	0.265	0.252	0.309
11	27032 (Hebden Beck @ Hebden)	0.465	42	3.910	0.222	0.267	0.173
12	76811 (Dacre Beck @ Dacre Bridge)	0.481	9	34.576	0.250	0.345	2.185
13	21017 (Ettrick Water @ Brockhoperig)	0.504	41	60.364	0.203	0.276	0.167
14	48001 (Fowey @ Trekeivesteps)	0.512	39	16.858	0.220	0.300	0.169
15	48010 (Seaton @ Trebrownbridge)	0.517	36	6.470	0.236	0.254	0.262
16	55015 (Honddu @ Tafolog)	0.521	29	16.682	0.337	0.355	0.920
17	47009 (Tiddy @ Tideford)	0.522	39	5.916	0.175	0.133	0.617
18	72013 (Borrowbeck @ Borrow Bridge Weir)	0.528	5	73.779	0.255	0.426	0.950
19	49003 (de Lank @ de Lank)	0.543	42	12.994	0.223	0.250	0.194
	Total		524				

The pooling group growth curves are shown in Figure 8. They show minor wide scatter, as would be expected for such a pooling group. A brief review was undertaken no reason could be found to justify

their exclusion of the stations. In any case, their retention leads to higher flood estimates which is considered to be a precautionary and thus conservative.

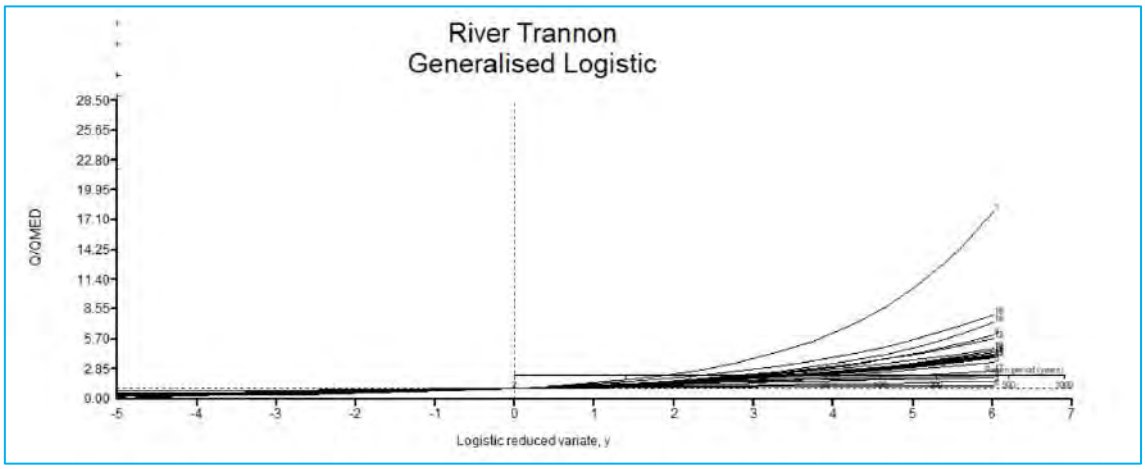


Figure 8 - Pooling Group Generalised Logistic Flood Frequency Curve

Revitalised Rainfall Runoff Method 2

The rainfall runoff modelling approach of ReFH2 has been used to ascertain the flood flows for the site, version 3.1 has been used. This method was released in 2015 and uses catchment descriptors to produce peak rates of runoff for both rural and urban catchments. The standard output from the method is presented in Appendix 7. The application of the ReFH2 method calculates a critical duration for the storm based on the catchment descriptors.

For the River Trannon the time to peak has been calculated as 1.87 hours. The seasonality of the annual maximum flood has been re-visited as part of recent research2. This concluded that the default Seasonality should be based on urban extent and BFIHOST within ReFH 2. Based on this analysis the following default rules are applied within the ReFH model:

- Summer storms are selected by default if:
    - URBEXT2000 is ≥ 0.30, or
    - 0.15 ≤ URBEXT2000 < 0.30 and BFIHOST19 is ≥ 0.65.
- Winter storms are selected by default in all other cases.

Therefore, in this case a winter storm has been selected.

Peak Flows

The peak flows calculated using the FEH Statistical Method and the ReFH2 method have been compared (see Table 7). It is expected that results using the different methods will vary.

- The ReFH2 Method yielded more conservative results than the FEH Statistical Method. Although in this case they are very similar and suggests that either method can be used on this occasion for a permeable catchment.

[2] Environment Agency. Estimating flood peaks and hydrographs for small catchments: Phase 2.

- Guidance confirms that flood estimates for the FEH Statistical 1 in 1000 year event should be obtained by applying a scaling factor to the 1 in 100 year event. The scaling factor is obtained by dividing the 1 in 1000 year event by the 1 in 100 year estimate from the ReFH2 method.

- Climate change allowances must be taken into account over the whole lifetime of the development (see Table 1). Therefore, the peak river flows for the 1 in 100 year event have been increased by 5%, 25% and 70% to account for the effects of climate change in accordance with TAN15.

- The GL was preferred in view of its dominant role in FEH and since it had the lowest Z value.

- Estimates obtained using FEH Statistical method and the ReFH2 method consistently match.

- It had already been established that there were no grounds for adjusting the QMED on the basis of nearby donors.

- There is no clear evidence of flooding of the land at the site in recent years. Whilst the absence of serious flooding on the land does not validate any flood assessment it is consistent with the observations of the owner.

- The FEH Statistical method is the preferred method as a larger dataset of gauged data was used in the calibration of the method and it has been more directly calibrated to reproduce flood frequency on UK catchments.

Table 7 - Peak Flows for the River Trannon

Return Period (yrs)	Peak Discharge (m^3/s)	
	FEH Statistical Method	ReFH2 Method
2	26.58	25.32
20	49.78	50.21
50	60.91	62.29
100	70.80	72.91
100 +5%	74.34	76.56
100 +25%	88.50	91.14
100 +70%	120.36	123.95
1000	116.46*	119.93

Note: * Calculated using the ration between the ReFH method 1000/100 return period peak flows.

Hydraulic Modelling

Hydraulic modelling is used to convert the hydrological modelling outputs in flow and water levels within a river. A steady state HEC-RAS (version 5.0.7) model of the River Trannon has been developed from the topographical survey in steady state mode. In steady state model HEC-RAS calculates water levels iteratively for a constant discharge through the reach and is therefore conservative, as they do not allow any attenuation of the design discharge. The model has been run using a mixed flow regime.

The ReFH Method peak flows shown in Table 7 have been used as the upstream inflows. Given the short length of the River Trannon that passes through the site only one inflow location in the model has been included, a short distance upstream of the site.

Model Cross Sections

Figure 9 and Appendix 3 shows the cross sections used within the HEC-RAS model. The cross sections are representative of the channel in the reach adjacent, upstream and downstream of the site. The HEC-RAS model comprises of a single reach of the River Trannon reach 001. The distance between the cross sections was kept to a minimum under the circumstances, the majority of the cross section are less than 50m apart with the maximum spacing being 100m. It was not possible to safely locate the cross sections closer together at some locations.

A schematic of the HEC-RAS model is shown in Figure 10 which shows the naming convention of the HEC-RAS model. This extends from 296149, 290428 (downstream extent) to 295379, 290746 (upstream extent). The total model length is 874m.

The numbering system must be consistent in that HEC-RAS assumes that higher river cross sections are upstream and lower river cross sections are downstream. Cross section 0000 is located at the downstream limit of the model of cross section 0874 is located at the upstream limited of the model and is based on the chainage along the River Trannon.

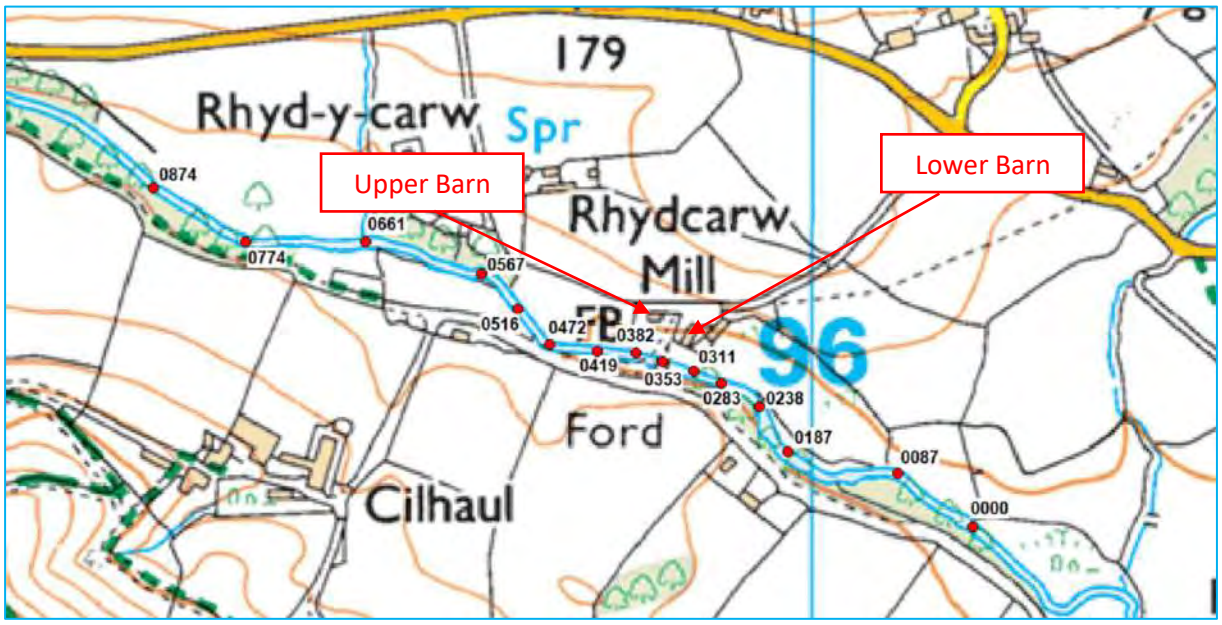


Figure 9 - Model Cross Section Locations

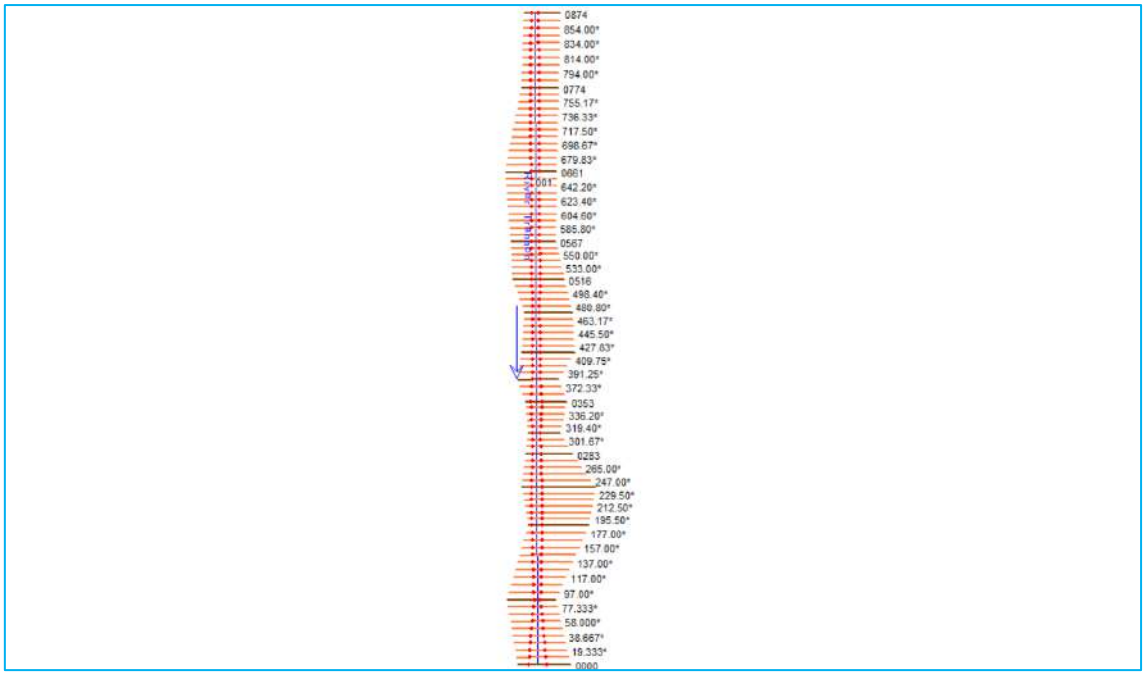


Figure 10 - HEC-RAS Model Schematic

The geometry of a natural channel is irregular and cannot be characterised by simple mathematical relationships. Therefore, representation in mathematical models requires that the stream geometry, in the form of discrete cross sections, be taken transversely at key locations in the watercourse. The in-bank survey described previously is sufficient to estimate water levels provided the flows remain within the confines of the main channel. In order to account for conveyance when flow overtops the main channel banks, the in-bank cross sections should be extended across the full width of the floodplain. Therefore, the cross sections have been extended across the site. The topographical survey and a 1m resolution LiDAR data Digital Terran Model (DTM) and the site topographical survey have been used to extend the cross sections further into the floodplain.

In total 15 surveyed cross sections have been used to develop the model as shown in Table 8. The errors, warning and notes that HEC-RAS produces when the model is run where reviewed and where required interpolated sections were used to remove these errors. Interpolated cross sections have been used to improve the energy, conveyance and head loss calculations in the model. It was not possible to remove all the errors, warning and notes, however, the majority were removed, and no major errors remain and therefore, would have little impact on the flood risk posed to the site.

Structure Data

No hydraulically significant structure have been identified on the River Trannon within the study reach. The footbridge adjacent to the site is not considered to be hydraulically significant, as shown in Figure 3.

Table 8 - HEC-RAS Model Cross Sections

Model Cross Section	Survey Cross Section	Eastings	Northings	Extended
0000	1.016	296149	290428	Left bank
0087	1.015	296079	290478	Right bank
0187	1.014	295976	290498	Left bank
0238	1.013	295949	290541	Left bank
0283	1.012	295913	290563	Left bank
0311	1.011	295887	290574	Left bank
0353	1.009	295858	290583	Left bank
0382	1.008	295833	290591	Left bank
0419	1.007	295796	290592	Left bank
0472	1.006	295752	290599	Left bank
0516	1.005	295722	290632	Both banks
0567	1.004	295688	290666	Right bank
0661	1.003	295579	290696	Right bank
0774	1.002	295466	290696	----
0847	1.001	295379	290746	----

Boundary Conditions

The flow regime within the HEC-RAS model has been set both subcritical and supercritical flow conditions (i.e. mixed mode within the plan file). Due to the nature of the watercourse sub-critical flow conditions will be expected; therefore, a normal depth downstream boundary condition has been used with a slope of 0.006m/m for the upstream boundary and a slope of 0.0003m/m for the downstream boundary within HEC-RAS. With no data available at the site, this method of calculating the downstream boundary gives a reasonable estimation of the downstream water level.

Errors or assumptions in the estimation of the downstream boundary can impact on upstream calculated water levels and subsequent flood outlines. Therefore, the backwater length equation was calculated. The equation ensures that any errors in the downstream boundary estimation do not adversely affect modelled water levels at critical sections of the reach (i.e. those adjacent to the site).

The downstream boundary is located 382m downstream of the area of interest. Therefore, it has been calculated that the downstream boundary is far enough away from the area of interest so as to not affect the results.

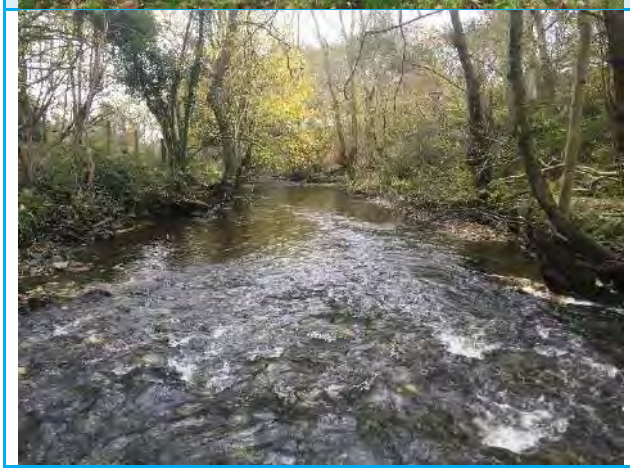
Hydraulic Roughness

Hydraulic roughness represents the conveyance capacity of vegetation growth, bed and bank material, channel, sinuosity and structures on the floodplain. Within HEC-RAS, the hydraulic roughness is defined using the Manning's 'n' roughness coefficient values. Manning's 'n' roughness values were assigned by using site knowledge, photographs, modelling judgement and with industry standard literature including Chow[3], Hicks & Mason[4] and USGS[5]. Chow (1959) contains reference tables to match observed bed conditions with a value for Manning's 'n'. These reference tables are the most widely used method in 1D hydraulic modelling study.

[3] Open Channel Hydraulics, Chow V.T., McGraw-Hill, Singapore 1959.
[4] Hicks, D.M. and Mason, P.D. (1998) 'Roughness Characteristics of New Zealand Rivers' National Institute of Water and Atmospheric Research Ltd, New Zealand.
[5] US Geological Society (2001) 'Verified Roughness Characteristics of Natural Channels', Water Resources of the Western United States.

Table 9 details the Manning's 'n' roughness coefficient values and description of the river reaches characterised by similar floodplain and channel bank roughness conditions. A Manning's 'n' roughness coefficient value of 0.035 has been used for the river channel and a value of 0.035 has been used for the floodplain. The sensitivity of the model results to the Manning's 'n' roughness coefficient values has been explored in detail.

Table 9 - Manning's 'n' roughness coefficient values

Photograph	Cross Section Reference	Manning's 'n'	Description
	Floodplain	0.035	Pasture, farmland, light brush
	River Channel	0.035	Clean, straight, full, no rifts or deep pools, with some stones and weeds

Model Coefficients

Flow contraction and expansion coefficients were determined using the HEC-RAS User's Manual. Contraction and expansion coefficients are used by the hydraulic model computations to determine the transition losses due to the expansion and constriction of flow, between two adjacent cross sections. The manual suggests that values of 0.10 (contraction) and 0.30 (expansion) are typical for a gradual transition along an open channel. In this instance, coefficients of 0.10 and 0.30 have been applied to the contraction and expansion for the open channel sections.

Assumptions & Limitations of the Model

The representation of any complex system by simple model requires a number of assumptions to be made. In the case of a simple 1D hydraulic model of a river system, it must be assumed that:

- The cross sections accurately represent the river;
- The hydrological analysis based on the gauged data (where available) can be extrapolated to other parts of the system; and

- The design flows are an accurate representation of flows for a given return period.

Owing to the lack of gauged data for local watercourse during flood events in this part of the catchment, the model has not been calibrated against observed flood levels. Instead, careful consideration has been given to the selection of roughness, structure discharge coefficients and ineffective flow boundaries. The theory of these is well understood and the model may be considered appropriate for flows up to bank full capacity and simple flow on the floodplain.

Results

Table 10 shows that the maximum modelled water levels for the River Trannon, model cross sections 0382 to 0311 are most applicable to the site (see Appendix 8).

Table 11 - Modelled Water Levels for the River Trannon (mAOD)

Model Cross Section	Survey Cross Section	100	100 +5%	100 +25%	100 +70%	1000
0000	1.016	146.64	146.71	146.94	147.38	147.33
0087	1.015	146.64	146.71	146.94	147.38	147.33
0187	1.014	147.23	147.34	147.63	147.97	147.93
0238	1.013	147.68	147.76	147.92	148.26	148.22
0283	1.012	147.80	147.87	147.80	148.07	148.05
0311	1.011	148.17	148.21	148.37	148.67	148.64
0353	1.009	148.58	148.62	148.80	149.14	149.11
0382	1.008	148.85	148.89	149.03	149.30	149.27
0419	1.007	148.97	149.01	149.16	149.45	149.42
0472	1.006	149.11	149.14	149.25	149.47	149.45
0516	1.005	149.65	149.68	149.84	150.07	150.05
0567	1.004	149.77	149.80	149.93	150.16	150.14
0661	1.003	150.30	150.32	150.53	150.73	150.71
0774	1.002	151.07	151.10	151.23	151.50	151.46
0847	1.001	151.63	151.67	151.81	152.09	152.06

Sensitivity Analysis

The results of the sensitivity analyses give an indication of the level of confidence that can be placed in the water level estimates obtained from computational hydraulic modelling. This is most important in circumstances where it has not been possible to calibrate the model for observed events, as in this case. The sensitivity analyses also give an indication of how the results may vary due to seasonal changes in vegetative growth, variations in the estimate of peak flows and variations in the coefficients of hydraulic structures. The following parameters were varied one at a time to assess their sensitivity on the water levels.

- Design flows +5%, +25% and +70% are assessed in the climate change scenario.
- Manning's 'n' roughness coefficient values +/- 20%.

Sensitivity to Flow

Water levels along the River Trannon are sensitive to flow rate as would be expected. When the 100 year flows are increased by 25%, there is a maximum increase in water levels of 0.40m at cross section 0187 and an average increase of 0.21m. These results show that the model is behaving normally and therefore shows confidence in the model results.

Sensitivity to Hydraulic Roughness

The sensitivity of the model water levels to channel and floodplain roughness was checked by varying the adopted Manning's 'n' roughness values. Manning's 'n' roughness values were uniformly increased by 20% for the first run and uniformly decreased by 20% for the second run (see Table 12).

A 20% increase in Manning's 'n' roughness values resulted in an increase in water levels on average throughout the study reach of 0.13m during the 1 in 100 year (+25%) event (see Appendix 9). Conversely, a 20% decrease in Manning's 'n' roughness values resulted in a decrease in water levels on average throughout the study reach of 0.21m during the 1 in 100 year (+25%) event (see Appendix 10).

These results show that the model is behaving normally and therefore shows confidence in the model results. The largest changes in water level due to changes in Manning's 'n' are located downstream or upstream from the site and will have limited impact on flood risk at the site.

Table 12 - Manning's n Sensitivity Analysis Modelled Water Levels for the River Trannon (mAOD)

Model Cross Section	Survey Cross Section	100			100 +25%		
		Baseline	+20%	-20%	Baseline	+20%	-20%
0000	1.016	146.64	146.88	146.36	146.94	147.19	146.64
0087	1.015	146.64	146.90	145.57	146.94	147.21	145.73
0187	1.014	147.23	147.43	147.15	147.63	147.72	147.58
0238	1.013	147.68	147.81	147.55	147.92	148.03	147.88
0283	1.012	147.80	147.99	147.14	147.80	148.19	147.60
0311	1.011	148.17	148.17	148.17	148.37	148.37	148.37
0353	1.009	148.58	148.69	148.45	148.80	148.91	148.69
0382	1.008	148.85	148.92	148.81	149.03	149.10	148.98
0419	1.007	148.97	149.05	148.90	149.16	149.25	149.09
0472	1.006	149.11	149.20	149.15	149.25	149.38	149.22
0516	1.005	149.65	149.69	149.63	149.84	149.87	149.81
0567	1.004	149.77	149.86	149.41	149.93	150.02	149.53
0661	1.003	150.30	150.42	150.23	150.53	150.58	150.31
0774	1.002	151.07	151.18	151.01	151.23	151.33	151.06
0847	1.001	151.63	151.78	151.49	151.81	151.97	151.62

1 in 100 Year Event

Appendix 11 shows the model cross sections and long sections during the 1 in 100 year event. Appendix 12 shows that during the 1 in 100 year event the majority of the flow will be contained within the banks of the River Trannon. Table 11 shows the maximum water level within the River Trannon adjacent to the site, at cross section 0382 would be 148.85mAOD.

The external ground level at the location of the building is 149.76mAOD and the existing internal ground level of the building is 149.74mAOD to 151.15mAOD. The upper barn internal ground level has a minimum freeboard of 0.89m above the 1 in 100 year water level. Therefore, the upper barn will not be inundated with floodwater during the 1 in 100 year event, the upper barn would be flood free during the 1 in 100 year event.

The external ground level at the location of the lower barn is 147.90mAOD and the existing finished floor level of the lower barn is 148.45mAOD. Therefore, the lower barn may be inundated with floodwater during the 1 in 100 year event, to an internal depth of 0.40m.

1 in 100 Year (+25%) Event

Appendix 11 shows the model cross sections during the 1 in 100 year (+25%) event. Appendix 12 shows that during the 1 in 100 year (+25%) event the majority of the flow will be contained within the banks of the River Trannon. Table 11 shows the maximum water level within the River Trannon adjacent to the site, at cross section 0382 would be 149.03mAOD.

The external ground level at the location of the building is 149.76mAOD and the existing internal ground level of the building is 149.74mAOD to 151.15mAOD. The upper barn internal ground level has a minimum freeboard of 0.71m above the 1 in 100 year (+25%) water level. Therefore, the upper barn will not be inundated with floodwater during the 1 in 100 year (+25%) event, the upper barn would be flood free during the 1 in 100 year (+25%) event.

The external ground level at the location of the lower barn is 147.90mAOD and the existing finished floor level of the lower barn is 148.45mAOD. Therefore, the lower barn may be inundated with floodwater during the 1 in 100 year (+25%) event, to an internal depth of 0.58m.

1 in 1000 Year Event

Appendix 11 shows the model cross sections during the 1 in 1000 year event. Appendix 12 shows that during the 1 in 1000 year event the majority of the flow will be contained within the banks of the River Trannon. Table 11 shows the maximum water level within the River Trannon adjacent to the site, at cross section 0382 would be 149.27mAOD.

The external ground level at the location of the building is 149.76mAOD and the existing internal ground level of the building is 149.74mAOD to 151.15mAOD. The upper barn internal ground level has a minimum freeboard of 0.47m above the 1 in 100 year water level. Therefore, the upper barn will not be inundated with floodwater during the 1 in 1000 year event, the upper barn would be flood free during the 1 in 1000 year event.

The external ground level at the location of the lower barn is 147.90mAOD and the existing finished floor level of the lower barn is 148.45mAOD. Therefore, the lower barn may be inundated with floodwater during the 1 in 1000 year event, to an internal depth of 0.82m.

Summary

These results are a more accurate representation of the flood outlines compared to the DAM outline shown in Figure 5 which can only be taken as a rough guide and compare favourably with the Natural Resources Wales Flood Risk Map shown in Figure 6.

The site is one of the last places in the area to flood and remains flood free when other areas close by are flooded. The site is at such a ground level that it would only flood in the most extreme flood events; the site will remain flood free for the vast majority of flood events during the lifetime of the proposed development.

Flood risk to the site from the River Trannon can be considered to be limited. Any overbank flow would follow the contours of the surrounding area and would flow directly to the east rather than flowing towards the site. The flood risk can also be considered to be limited due to the difference in elevations. The ground levels of the site are located a minimum of 3.00m above the normal water level of the River Trannon.

Any flooding would be of a minor nature due to the low flows and topography of the area. The flooding will only inundate the site to a relatively low water depth and water velocity, will only last a short period of time, in very extreme cases and will not have an impact on the whole of the proposed development site.

Given the scale and nature of the proposed development it has been concluded that fluvial flooding poses a low flood risk to the site. Therefore, the risk of fluvial flooding is considered to be of **medium significance**. The risk of fluvial flooding will be further managed and mitigated by using a number of property level protection measures to manage and reduce the overall flood risk at the site (see Section 4.0).

3.10 Tidal (coastal) Flooding

The site is not located within the vicinity of tidal flooding sources and the risk of tidal flooding is considered to be **not significant**.

3.11 Groundwater Flooding

Groundwater flooding is defined as the emergence of groundwater at the ground surface or the rising of groundwater into man-made ground under conditions where the normal range of groundwater levels is exceeded.

Groundwater flooding tends to occur sporadically in both location and time. When groundwater flooding does occur, it tends to mostly affect low-lying areas, below surface infrastructure and buildings (for example, tunnels, basements and car parks) underlain by permeable rocks (aquifers).

Site conditions suggest a low probability of groundwater flooding. The local geology is not considered to yield significant volumes of groundwater. No below surface infrastructure and buildings are located or are proposed for the site. The risk of flooding from groundwater flooding is considered to be **not significant**.

3.12 Surface Water (pluvial) Flooding

The site is not situated near to large areas of poor permeability or areas with the geology and/or topography which may result in surface water flooding. The soil conditions at the site and within the vicinity of the site indicate that the site may be at risk of surface water flooding.

The Natural Resources Wales Surface Water flood map shows that the site has a very low risk of surface water flooding (see Figure 13) with a chance of surface water flooding of less than 1 in 1000 (0.1%) years. Therefore, the risk of flooding from surface water flooding is considered to be **not significant**.

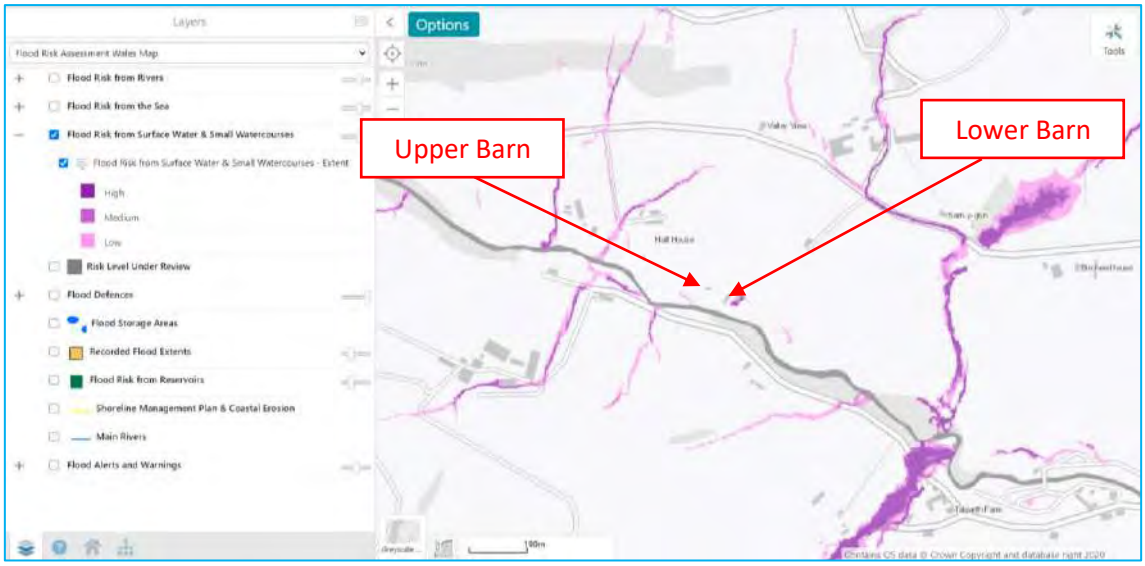


Figure 13 - Natural Resources Wales Surface Water Flood Map

3.13 Sewer Flooding

Sewer flooding occurs when urban drainage networks become overwhelmed and maximum capacity is reached. This can occur if there is a blockage in the network causing water to back up behind it or if the sheer volume of water draining into the system is too great to be handled. Sewer flooding tends to occur sporadically in both location and time such flood flows would tend to be confined to the streets around the development.

Any sewers will inevitably have a limited capacity so in extreme conditions there would be surcharges, which may in turn cause flooding. Flood flows could also be generated by burst water mains, but these would tend to be of a restricted and much lower volume than weather generated events and so can be discounted for the purposes of this assessment.

Given the design parameters normally used for drainage design in recent times and allowing for some deterioration in the performance of the installed systems, which are likely to have been in place for many years, an appropriate flood risk probability from this source could be assumed to have a return period in the order of 1 in 10 to 1 in 20 years. The provision of adequate level difference between the ground floors and adjacent ground level would reduce the annual probability of damage to property from this source to 1 in 100 years or less. The risk of flooding from sewer flooding is considered to be **not significant**.

3.14 Flooding from Artificial Drainage Systems/Infrastructure Failure

There are no nearby artificial water bodies, water channels, reservoirs and artificial drainage systems that could be considered a flood risk to the property. The Natural Resources Wales Reservoir flood map shows that the site is not at risk of reservoir flooding (see Figure 14). The risk of flooding from artificial drainage systems/infrastructure failure is considered to be **not significant.**

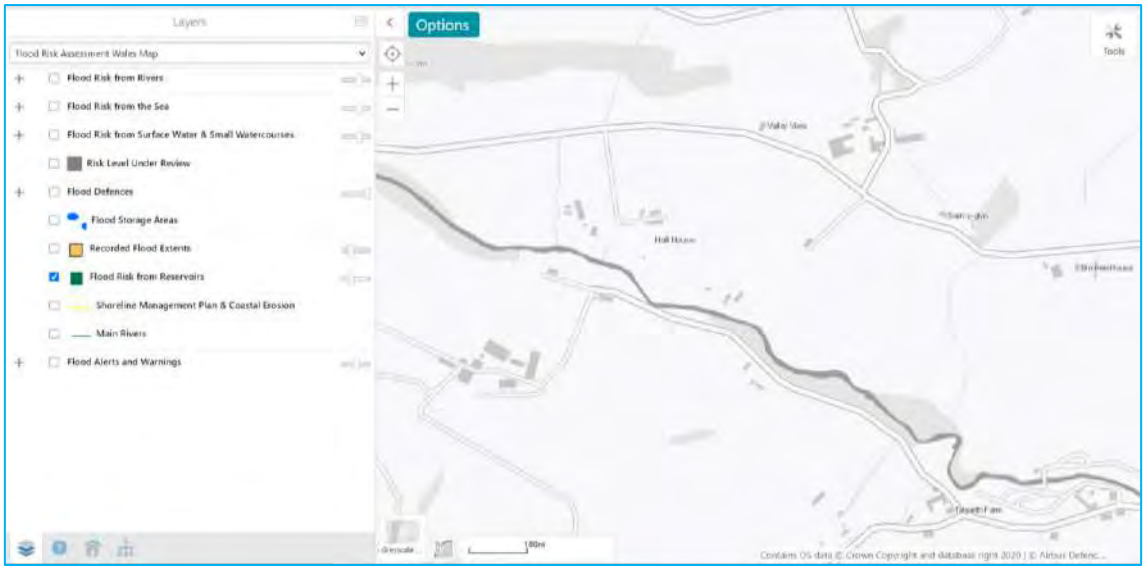


Figure 14 - Natural Resources Wales Reservoir Flood Map

3.15 Effect of the Development on Flood Risk

The buildings are existing therefore, the proposed development will have no impact on the movement of floodwater across the site. This will ensure no detriment to the flood storage capacity of the site. The overall direction of the movement of water will be maintained within the developed site and surrounding area. The conveyance routes (flow paths) will not be blocked or obstructed. There will be no increase in the flood water levels due to the proposed development. There will be no loss in flood storage capacity and no change in the on-site and off-site flood risk.

3.16 Summary of Site Specific Flood Consequence Assessment

A summary of the sources of flooding and a review of the risk posed by each source at the site is shown in Table 5.

Table 5 - Risk Posed by Flooding Sources

Sources of Flooding	Potential Flood Risk	Potential Source	Probability/Significance
Fluvial Flooding	Yes	River Trannon	Medium
Tidal Flooding	No	None Reported	None
Groundwater Flooding	No	None Reported	None
Surface Water Flooding	No	None Reported	None
Sewer Flooding	No	None Reported	None
Flooding from Artificial Drainage Systems/Infrastructure Failure	No	None Reported	None

The site is unlikely to flood except in extreme conditions. The primary, but unlikely, flood risk posed to the site is from fluvial flooding from the River Trannon. The DAM shows that the site is located within C2 - Areas of the floodplain without significant flood defence infrastructure.

A review of the Natural Resources Wales Flood Risk Map indicates that the upper barn is shown to be located within the very low fluvial flood risk zone with a chance of flooding of less than 1 in 1000

(<0.1%) years. The lower barn is located within the high fluvial flood risk zone with a chance of flooding of greater than 1 in 30 (3.3%) years.

Hydraulic modelling shows that the upper barn will not be inundated with floodwater during the 1 in 100 year (+25%) and 1 in 1000 year events, the upper barn would be flood free during the 1 in 100 year (+25%) and 1 in 1000 year events.

The lower barn may be inundated with floodwater to a depth of 0.40m during the 1 in 100 year event, to a depth of 0.58m during the 1 in 100 year (+25%) and to a depth of 0.82m during the 1 in 1000 year event.

These results are a more accurate representation of the flood outlines compared to the DAM outline shown in Figure 5 which can only be taken as a rough guide and compare favourably with the Natural Resources Wales Flood Risk Map shown in Figure 6.

Given the scale and nature of the proposed development and the size and location of the fluvial flooding sources it has been concluded that tidal flooding poses a low flood risk to the site therefore, the risk of flooding from fluvial flooding is considered to of **medium significance**.

The proposed development is classified as 'highly vulnerable'. However, the lower barn will be used as an events studio with storage and an office and can be classified as 'less vulnerable'. It should also be taken into account that the existing use of the lower barn is a kennels and can be classified as 'less vulnerable' therefore, the proposed development of the lower barn will not change the vulnerability of the building. The more flood-compatible uses the events studio, storage and office being situated in the lower part of the site at a higher risk of flooding.

The buildings are existing therefore, the proposed development will have no impact on the movement of floodwater across the site. This will ensure no detriment to the flood storage capacity of the site. The overall direction of the movement of water will be maintained within the developed site and surrounding area. The conveyance routes (flow paths) will not be blocked or obstructed. There will be no increase in the flood water levels due to the proposed development. There will be no loss in flood storage capacity and no change in the on-site and off-site flood risk.

4.0 RISK MANAGEMENT

4.1 Introduction

In this flood zone, developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area through the layout and form of the development and the use of flood mitigation measures.

A number of techniques and mitigation strategies to manage and reduce the overall flood risk in the area will be used. This will ensure the development will be safe and there is:

- Minimal risk to life;
- Minimal disruption to people living and working in the area;
- Minimal potential damage to property;
- Minimal impact of the proposed development on flood risk generally; and;
- Minimal disruption to natural heritage.

The flood risk at the site will be reduced by using a number of risk management measures to manage and reduce the overall flood risk at the site.

4.2 Sequential Approach

The sequential approach has been applied within the site by locating the most vulnerable elements of the development in the lowest risk areas. The most vulnerable use, the accommodation classified as 'highly vulnerable', is situated within the upper barn on the higher part of the site at a lower risk of flooding within the upper barn.

The upper barn is shown to be located within the very low fluvial flood risk zone with a chance of flooding of less than 1 in 1000 (<0.1%) years and is shown to be situated above the 1 in 100 year (+25%) and 1 in 1000 year modelled flood outlines.

The more flood-compatible uses the events studio, storage and office (i.e. 'less vulnerable') will be situated in the lower part of the site, within the lower barn, at a higher risk of flooding. It should also be taken into account that the existing use of the lower barn is a kennels and can be classified as 'less vulnerable' therefore, the proposed development of the lower barn will not change the vulnerability of the building.

4.3 Finished Floor Levels

The finished floor levels of the buildings will be set no lower than the existing levels. The upper barn internal ground level has a minimum freeboard of 0.71m above the 1 in 100 year (+25%) water level. Therefore, the upper barn will not be inundated with floodwater during the 1 in 100 year (+25%) event, the upper barn would be flood free during the 1 in 100 year (+25%) event.

It is recognised however that owing to limited headroom constraints, massing, planning policy and Building Regulations it is considered impractical to raise the finished floor levels further. Therefore, in order to mitigate against this, it is recommended that the occupants of the building sign up to receive flood warnings from Natural Resources Wales and implement a flood evacuation plan to a safe area away from the buildings during times of flood. It is also proposed that flood protection measures are employed within the building design to reduce the overall risk to the occupants.

A combination of resistance (proofing) and resilience measures will be included to provide further protection. This is discussed below.

4.4 First Floor Accommodation

Accommodation will be located on the first floor as well as the ground floor of the upper barn. This will allow occupants to retreat to higher floor levels if needed. The levels of the first floor are located a minimum of 2.50m above the ground floor finished floor level well above any floodwater levels.

This provides a 'safe haven' above any floodwater levels. This will enable rapid escape should flooding occur which is unlikely. The upper floors are accessed via internal stairs and are sufficient in size to safely house all occupants of the building. The 'safe haven' will only be required in very extreme events or if a flood warning has not been received.

4.5 Flood Resilience and Resistance

The development of the layout should always consider that the site is potentially at risk from an extreme event and as such the implementation of flood resilience and resistance methods should be assessed. Flood resilient and resistant measures will be used, including:

- The walls of the buildings will be thick.
- Sealant will be used around external doors and windows.
- All external doors and windows will be constructed from hard wearing materials with flood seals.
- Solid ground floors in preference to suspended floors with under voids.
- Any new cavity walls with polyisocyanurate (PIR) rigid closed-cell insulation that retains structural integrity and have low moisture take will be used.
- Mortar joints will be thoroughly filled to reduce the risk of water penetration.
- If frogged bricks are used, they will be laid frog up so that filling becomes easier and coverage more certain.
- Bricks manufactured with perforations will not be used. Low-water-absorbing blocks/bricks and mortar mixes will be used up to the predicted 1 in 100 year flood level, plus one course of blocks/bricks to provide freeboard (up to a maximum depth of 600 mm above floor level). This increases resistance to water penetration.
- Fixings will be galvanized/stainless steel/copper (no mild steel to be used - cause rust/staining or walls).
- Hardcore and binding will have good compaction to reduce the risk of settlement and consequential cracking.
- A proprietary damp-proof membrane system will be used that is bonded to the slab rather than below the insulation and installed in accordance with the manufacturer's requirements

will be used. Care should be taken not to stretch the membrane in order to retain a waterproof layer.

- All electrics wiring, switches, sockets, socket outlets etc. to be located a minimum of 450mm above the finished floor level which provides a further freeboard above the 1 in 100 year (+25%) water level.

- Ensure that external paving's slope away from the building and not towards them.

- All other below ground service penetrations will be sealed.

4.6 Flood Warning and Evacuation

The site is located in a flood risk area therefore; the site will participate in Natural Resources Wales flood warning telephone service. The site will register contact details with the Natural Resources Wales Flood Warning Service in order to receive Flood Alerts. Natural Resources Wales operate a free flood warning service providing alerts by phone, text or email when flooding is anticipated providing an opportunity for owners to take necessary precautions, giving enough time for the building to be safely evacuated and mitigation measures to be put in place.

All occupants of the site will be made aware of the Natural Resources Wales Floodline telephone number and the Flood Warning Codes and their meaning. The owner of the properties will carry out the role of Flood Warden for the site and ensure they have an understanding of the flood mechanisms of the site and will ensure that the safety of the occupants and visitors will not be compromised.

Natural Resources Wales uses Flood Warnings Codes. They can be issued in any order, usually ending with an 'all clear'. They are issued by Natural Resources Wales through their website and issue Flood Alerts for this area. The flood warning will be passed onto the occupiers and visitors of the site verbally, by telephone and/or in person. It will be ensured that everyone receives the flood warnings when required.

4.7 Flood Plan

A Flood Plan outlining the precautions and actions you should take when a flood event is anticipated to help reduce the impact and damage flooding may cause will be developed. Sensible precautions would include raising electrical items, irreplaceable items and sentimental items off the ground or where possible moving them to a higher floor, rolling up carpets and rugs and turning off utilities. In addition, consider what actions you would take should the property need to be evacuated including access and egress routes and preparing a flood kit in advance containing warm clothing, medication, a torch, food and wellingtons.

The Flood Plan is a 'living' document and therefore should be periodically reviewed and updated to provide advice and guidance to occupants in the event of an extreme flood. The Flood Plan will therefore reduce the vulnerability of the occupants to flooding and makes them aware of the mechanisms of flooding at the site. If required a 'safe haven' can also be maintained and may be required in very extreme events if a flood warning has not been received.

4.8 Safe Access and Egress Route

Access routes should be such that occupants can safely access and exit their buildings in design flood conditions. These routes must also provide the emergency services with access to the development during a flood event and enable flood defence authorities to carry out any necessary duties during the

period of flood. A safe access and egress route, including emergency access can be maintained for vehicles and/or by foot by the access road to the north.

The Safe Access and Egress Route shown in Figure 15 indicates the exit route that all people (i.e. occupants and visitors) on site should follow once a flood warning has been received. People should make their way to areas outside of the flood zone.

Given that the site is located within a flood warning area, site users would be aware of the flood risk and should have more than sufficient time to evacuate the site before flooding of the access road would be expected. Therefore, the lead time of the flooding will provide site users with more than ample time to evacuate the site and seek safe refuge outside the floodplain. In the event of a flood warning, vital belongings, including waterproof clothing, necessary medication and essentials for infants and children will be collected. It should be ensured that all occupiers and visitors to the site are accounted for, and then exit the site.

In the event of a flood warning, vital belongings, including waterproof clothing, necessary medication and essentials for infants and children will be collected. It should be ensured that all occupiers and visitors to the site are accounted for, and then exit the site using the routes shown in Figure 15.

Therefore, safe access and egress from the site will be possible. The above factors would, therefore, allow safe access and egress as per TAN15 and Natural Resources Wales guidance. In the event of a flood warning, vital belongings, including waterproof clothing, necessary medication will be collected. It should be ensured that all occupiers and visitors to the site are accounted for, and then exit the site.

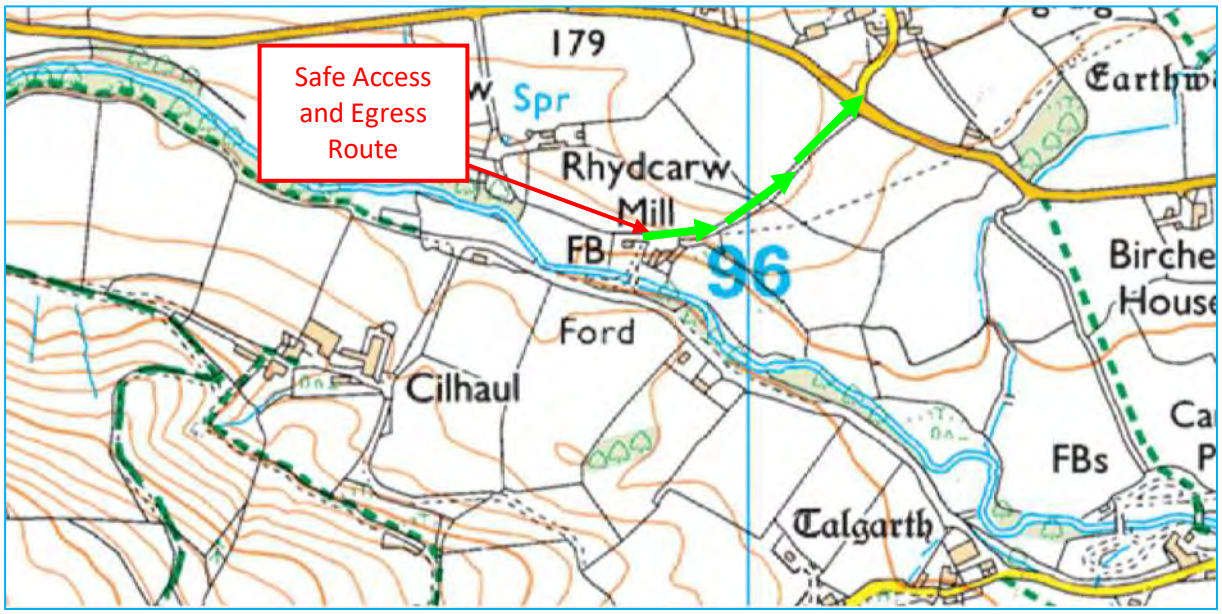


Figure 15 - Safe Access and Egress Route

4.9 Flooding Consequences

The proposed development of the site will provide betterment compared to the existing situation due to the proposed mitigation measures as discussed above, the change from a single storey building to two storey buildings and the fact that the proposed development is for office and warehousing compared to the existing use of the site as a children's day nursery.

The site can be justified in accordance with TAN15 as it can be demonstrated that the consequences of flooding can be managed down to a level which is acceptable for the nature and type of site. The

mitigation measures detailed above show that the flood risk can be effectively managed and therefore the consequences of flooding are acceptable.

5.0 JUSTIFYING THE LOCATION OF THE DEVELOPMENT

5.1 Justification Test

The Justification Test sets out the details required to justify siting a new development in an area believed to be at risk of flooding and is defined in Section 6 of TAN15. The required criteria a site / development must fulfil are:

i) its location in zone C is necessary to assist, or be part of, a local authority regeneration initiative or a local authority strategy required to sustain an existing settlement; or

ii) its location in zone C is necessary to contribute to key employment objectives supported by the local authority, and other key partners, to sustain an existing settlement or region;

and

iii) it concurs with the aims of PPW and meets the definition of previously developed land; and,

iv) the potential consequences of a flooding event for the particular type of development have been considered, and in terms of the criteria contained in sections 5 and 7 and appendix 1 found to be acceptable.

The proposed development has been assessed against the requirements of the Justification Test.

Criterion i

The proposed development will help in sustaining the existing settlement of Trefeglwys.

Criterion ii

TAN15 states that a development will be justified if it complies with either criteria (i) or (ii). The proposed development complies with criterion (ii) it is not necessary to consider criterion (i).

Criterion iii

Previously developed land is defined in Planning Policy Wales (PPW) as:

"…that which is or was occupied by a permanent structure (excluding agricultural or forestry buildings) and associated fixed surface infrastructure."

The site is occupied by existing buildings and is therefore, defined as previously developed land.

Criterion iv

The potential consequences of a flooding event for the particular type of development have been considered within this FCA. This FCA details the potential consequences of flooding from all sources taking into account the proposed development type has been considered and has been found to be acceptable. The development proposals should be considered by the LPA to satisfy the Justification Test as set out in TAN15.

5.2 Assessment of Acceptability Criteria

New development should be directed away from Zone C and towards suitable land in Zone A, otherwise to Zone B, where river or coastal flooding will be less of an issue. However, in some areas where developable land is in short supply, there can be an overriding need to build in areas that are at risk of flooding.

The Council's objectives are to sustain and enhance the vitality and viability of the region, and to ensure a wide range of employment to which people have easy access by a range of transport therefore, improving the overall quality of life. This is underpinned by the quality of the physical environment, social well-being and economic and environmental improvements. The Council seeks to grant permission for developments that add to the vitality and viability of the region.

The site is suitable in size and location to accommodate the proposed development. The wider area surrounding the proposed development site is affected by a very similar, and in many cases, higher risk of flooding. The application is for a new, suitable flood-resilient design which is preferable to the existing buildings.

The exposure of people and property will be minimised. From the above it is shown that there are overriding sustainability reasons for the development to be granted planning permission at the site. The proposed development will improve the sites resilience, resistance to flooding and by using property level protection measures to protect the site from flooding, the vulnerability of the site will be improved.

There is an indicative frequency threshold of flooding below which flooding of developed may not be allowed (see Table A1.14 TAN15) and indicative consequences of flooding as set out in A1.15 of TAN15.

The upper barn will not be inundated with floodwater during the 1 in 100 year (+25%) and 1 in 1000 year events, the upper barn may be flood free during the 1 in 100 year (+25%) and 1 in 1000 year events.

The lower barn will be used as an events studio with storage and an office and can be classified as 'less vulnerable'. It should also be taken into account that the existing use of the lower barn is a kennels and can be classified as 'less vulnerable' therefore, the proposed development of the lower barn will not change the vulnerability of the building. The more flood-compatible uses the events studio, storage and office being situated in the lower part of the site at a higher risk of flooding.

The mechanism for flooding is generally prolonged episodes of rainfall, which affords good time for flood warnings to be issued. The likelihood of a rapid water level rise and possible rapid inundation of areas posing a risk to life is considered to be minimal. The maximum speed of inundation will be more than 4 hours, the maximum rate of rise of floodwaters will be less than 0.10m/hr and the maximum water velocity will be less than 0.15m/s.

The site is compliant with the indicative frequency threshold and the consequences of flooding can be acceptably managed for the lifetime of the development recognising the small scale proposal on the edge of floodplain. Therefore, the indicative requirements of A1.14 and A1.15 of TAN15 are passed. The development proposals should therefore be considered by the LPA to satisfy the Acceptability Criteria as set out in TAN15.

6.0 SUMMARY AND CONCLUSIONS

6.1 Introduction

This report presents an FCA in accordance with TAN15 for the proposed development at Rhyd Y Carw Mill, Trefeglwys, Caersws, SY17 5PU.

This FCA identifies and assesses the risks of all forms of flooding to and from the development and demonstrates how these flood risks will be managed so that the development remains safe throughout the lifetime, taking climate change into account.

6.2 Flood Risk

The site is unlikely to flood except in extreme conditions. The primary, but unlikely, flood risk posed to the site is from fluvial flooding from the River Trannon. The DAM shows that the site is located within C2 - Areas of the floodplain without significant flood defence infrastructure.

A review of the Natural Resources Wales Flood Risk Map indicates that the upper barn is shown to be located within the very low fluvial flood risk zone with a chance of flooding of less than 1 in 1000 (<0.1%) years. The lower barn is located within the high fluvial flood risk zone with a chance of flooding of greater than 1 in 30 (3.3%) years.

Hydraulic modelling shows that the upper barn will not be inundated with floodwater during the 1 in 100 year (+25%) and 1 in 1000 year events, the upper barn would be flood free during the 1 in 100 year (+25%) and 1 in 1000 year events.

The lower barn may be inundated with floodwater to a depth of 0.40m during the 1 in 100 year event, to a depth of 0.58m during the 1 in 100 year (+25%) and to a depth of 0.82m during the 1 in 1000 year event.

These results are a more accurate representation of the flood outlines compared to the DAM outline shown in Figure 5 which can only be taken as a rough guide and compare favourably with the Natural Resources Wales Flood Risk Map shown in Figure 6.

Given the scale and nature of the proposed development and the size and location of the fluvial flooding sources it has been concluded that tidal flooding poses a low flood risk to the site therefore, the risk of flooding from fluvial flooding is considered to of **medium significance**.

The proposed development is classified as 'highly vulnerable'. However, the lower barn will be used as an events studio with storage and an office and can be classified as 'less vulnerable'. It should also be taken into account that the existing use of the lower barn is a kennels and can be classified as 'less vulnerable' therefore, the proposed development of the lower barn will not change the vulnerability of the building. The more flood-compatible uses the events studio, storage and office being situated in the lower part of the site at a higher risk of flooding.

The buildings are existing therefore, the proposed development will have no impact on the movement of floodwater across the site. This will ensure no detriment to the flood storage capacity of the site. The overall direction of the movement of water will be maintained within the developed site and surrounding area. The conveyance routes (flow paths) will not be blocked or obstructed. There will be no increase in the flood water levels due to the proposed development. There will be no loss in flood storage capacity and no change in the on-site and off-site flood risk.

6.3 Risk Management

The flood risk at the site will be reduced by using a number of risk management measures to manage and reduce the overall flood risk at the site. Measures used:

Sequential Approach: The sequential approach has been applied within the site by locating the most vulnerable elements of the development in the lowest risk areas. The most vulnerable use, the accommodation classified as 'highly vulnerable', is situated within the upper barn on the higher part of the site at a lower risk of flooding within the upper barn.

The upper barn is shown to be located within the very low fluvial flood risk zone with a chance of flooding of less than 1 in 1000 (<0.1%) years and is shown to be situated above the 1 in 100 year (+25%) and 1 in 1000 year modelled flood outlines.

The more flood-compatible uses the events studio, storage and office (i.e. 'less vulnerable') will be situated in the lower part of the site, within the lower barn, at a higher risk of flooding. It should also be taken into account that the existing use of the lower barn is a kennels and can be classified as 'less vulnerable' therefore, the proposed development of the lower barn will not change the vulnerability of the building.

Finished Floor Levels: The finished floor levels of the buildings will be set no lower than the existing levels. The upper barn internal ground level has a minimum freeboard of 0.71m above the 1 in 100 year (+25%) water level. Therefore, the upper barn will not be inundated with floodwater during the 1 in 100 year (+25%) event, the upper barn would be flood free during the 1 in 100 year (+25%) event.

It is recognised however that owing to limited headroom constraints, massing, planning policy and Building Regulations it is considered impractical to raise the finished floor levels further. Therefore, in order to mitigate against this, it is recommended that the occupants of the building sign up to receive flood warnings from Natural Resources Wales and implement a flood evacuation plan to a safe area away from the buildings during times of flood. It is also proposed that flood protection measures are employed within the building design to reduce the overall risk to the occupants.

A combination of resistance (proofing) and resilience measures will be included to provide further protection. This is discussed below.

First Floor Accommodation: Accommodation will be located on the first floor as well as the ground floor of the upper barn. This will allow occupants to retreat to higher floor levels if needed. The levels of the first floor are located a minimum of 2.50m above the ground floor finished floor level well above any floodwater levels.

This provides a 'safe haven' above any floodwater levels. This will enable rapid escape should flooding occur which is unlikely. The upper floors are accessed via internal stairs and are sufficient in size to safely house all occupants of the building. The 'safe haven' will only be required in very extreme events or if a flood warning has not been received.

Flood Resilience and Resistance: Flood resilient and resistant measures will be used, including:

- The walls of the buildings will be thick.
- Sealant will be used around external doors and windows.
- All external doors and windows will be constructed from hard wearing materials with flood seals.

- Solid ground floors in preference to suspended floors with under voids.
- Any new cavity walls with polyisocyanurate (PIR) rigid closed-cell insulation that retains structural integrity and have low moisture take will be used.
- Mortar joints will be thoroughly filled to reduce the risk of water penetration.
- If frogged bricks are used, they will be laid frog up so that filling becomes easier and coverage more certain.
- Bricks manufactured with perforations will not be used. Low-water-absorbing blocks/bricks and mortar mixes will be used up to the predicted 1 in 100 year flood level, plus one course of blocks/bricks to provide freeboard (up to a maximum depth of 600 mm above floor level). This increases resistance to water penetration.
- Fixings will be galvanized/stainless steel/copper (no mild steel to be used - cause rust/staining or walls).
- Hardcore and binding will have good compaction to reduce the risk of settlement and consequential cracking.
- A proprietary damp-proof membrane system will be used that is bonded to the slab rather than below the insulation and installed in accordance with the manufacturer's requirements will be used. Care should be taken not to stretch the membrane in order to retain a waterproof layer.
- All electrics wiring, switches, sockets, socket outlets etc. to be located a minimum of 450mm above the finished floor level which provides a further freeboard above the 1 in 100 year (+25%) water level.
- Ensure that external paving's slope away from the building and not towards them.
- All other below ground service penetrations will be sealed.

Flood Warning and Evacuation: The site is located in a flood risk area therefore; the site will participate in Natural Resources Wales flood warning telephone service. The site will register contact details with the Natural Resources Wales Flood Warnings Direct Service (Floodline 0845 988 1188) in order to receive Flood Warnings.

Flood Plan: A Flood Plan outlining the precautions and actions you should take when a flood event is anticipated to help reduce the impact and damage flooding may cause will be developed.

Safe Access and Egress Route: A safe access and egress route, including emergency access can be maintained for vehicles and/or by foot by the access road to the north.

Given that the site is located within a flood warning area, site users would be aware of the flood risk and should have more than sufficient time to evacuate the site before flooding of the access road would be expected. Therefore, the lead time of the flooding will provide site users with more than ample time to evacuate the site and seek safe refuge outside the floodplain. In the event of a flood warning, vital belongings, including waterproof clothing, necessary medication and essentials for

infants and children will be collected. It should be ensured that all occupiers and visitors to the site are accounted for, and then exit the site.

In the event of a flood warning, vital belongings, including waterproof clothing, necessary medication and essentials for infants and children will be collected. It should be ensured that all occupiers and visitors to the site are accounted for, and then exit the site using the routes shown in Figure 15.

Therefore, safe access and egress from the site will be possible. The above factors would, therefore, allow safe access and egress as per TAN15 and Natural Resources Wales guidance. In the event of a flood warning, vital belongings, including waterproof clothing, necessary medication will be collected. It should be ensured that all occupiers and visitors to the site are accounted for, and then exit the site.

6.4 Justifying the Location of the Development

The development proposals should be considered by the LPA to satisfy the Justification Test and Acceptability Criteria as set out in TAN15.

6.5 Conclusion

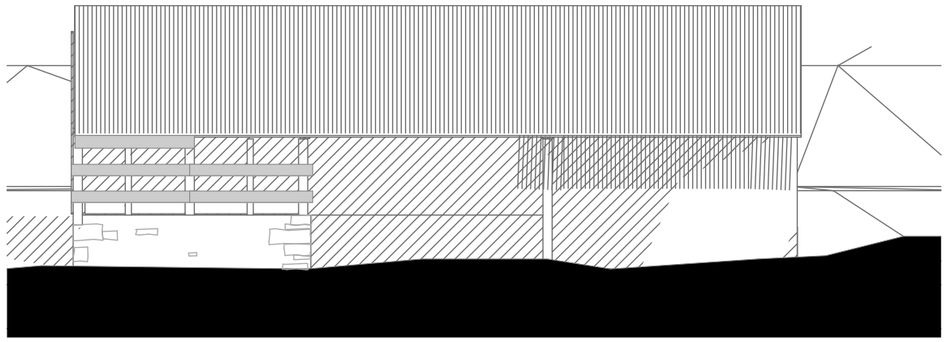
In conclusion, the proposed development would be expected to remain dry in all but the most extreme conditions. Providing the recommendations made in this FCA are instigated, flood risk from all sources would be minimised, the consequences of flooding are acceptable and the development would be in accordance with the requirements of TAN15. The proposed development of the site will provide betterment compared to the existing situation.

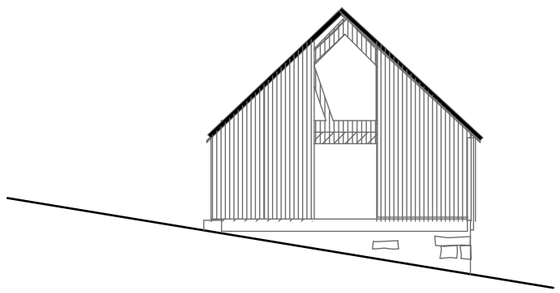
This FCA demonstrates that the proposed development would be operated with minimal risk from flooding, would not increase flood risk elsewhere and is compliant with the requirements of TAN15. The development should not therefore be precluded on the grounds of flood risk.

APPENDICES

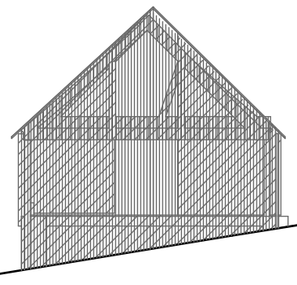
APPENDIX 1 – Existing Site Layout

South Elevation 1:100

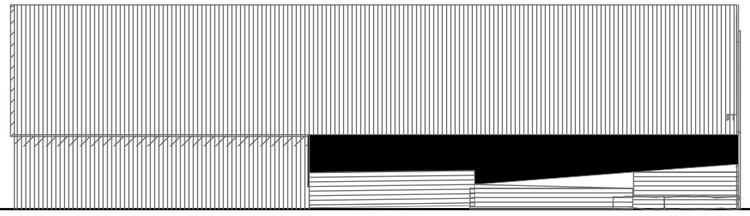




West Elevation

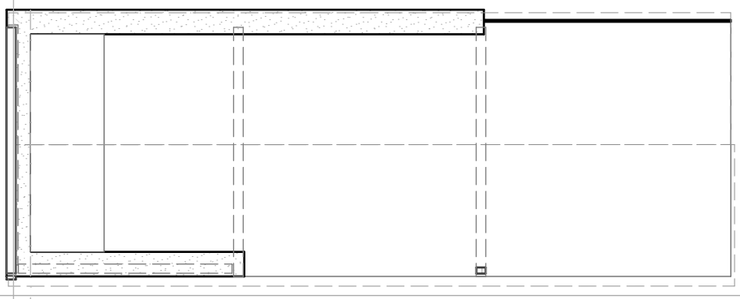


East Elevation

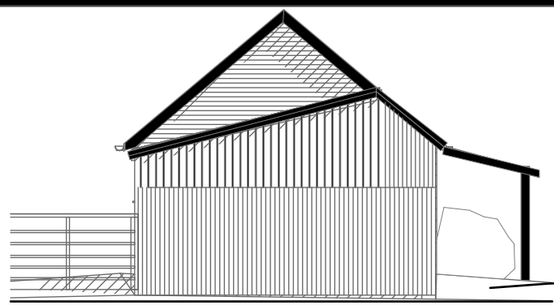


North Elevation

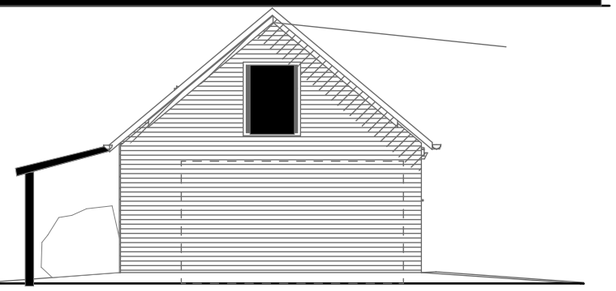
Plan 1:100



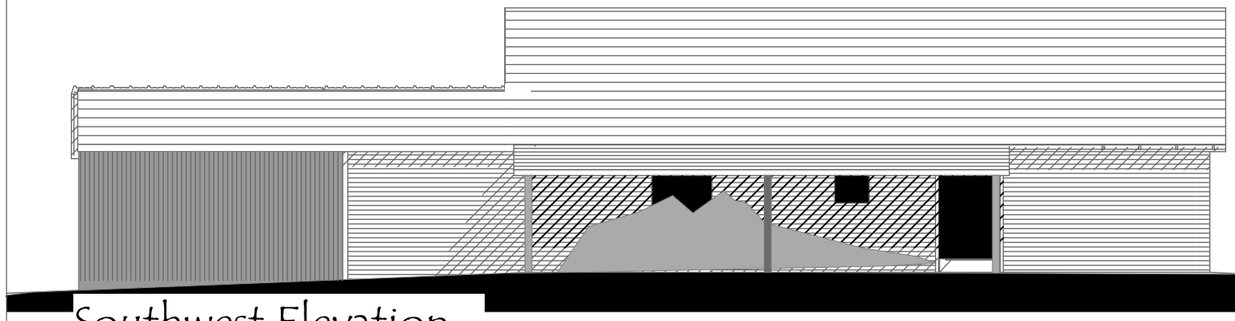
Northwest Elevation 1:100



Southeast Elevation

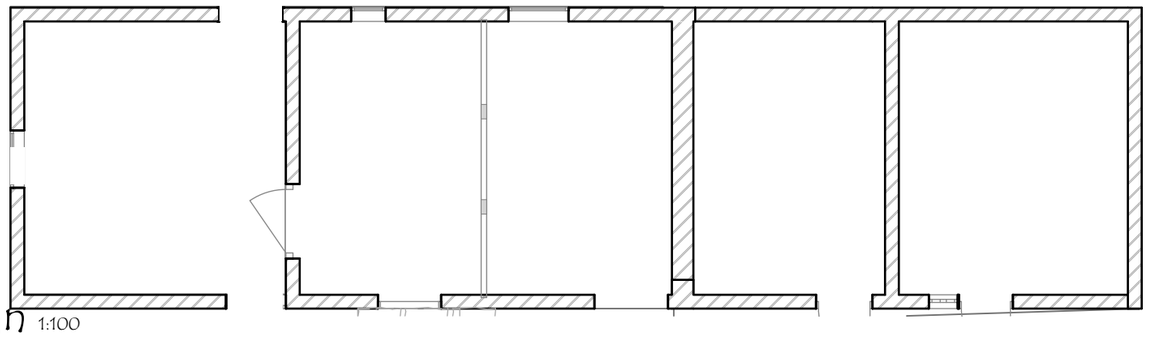


Northeast Elevation



Southwest Elevation

Plan 1:100



SURVEY AS EXISTING, RHYD Y CARW MILL BARNS, TREFEGLWYS.

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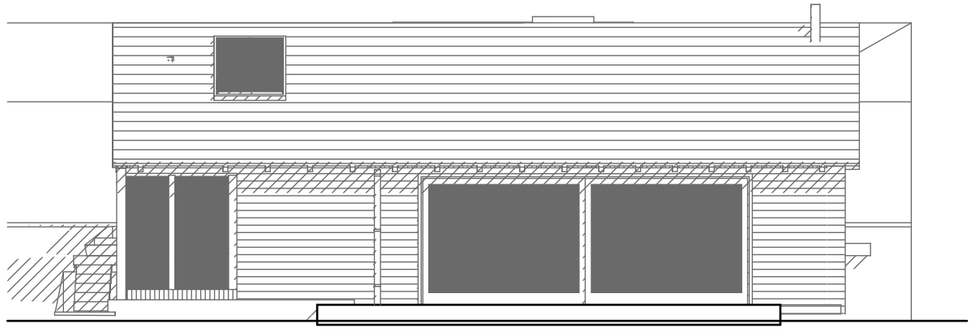
Email: fredatect@live.com

DATE	1/8/2020	DRAWN	FC
DWG No	S/2020/50/01		

APPENDIX 2 – Proposed Site Layout



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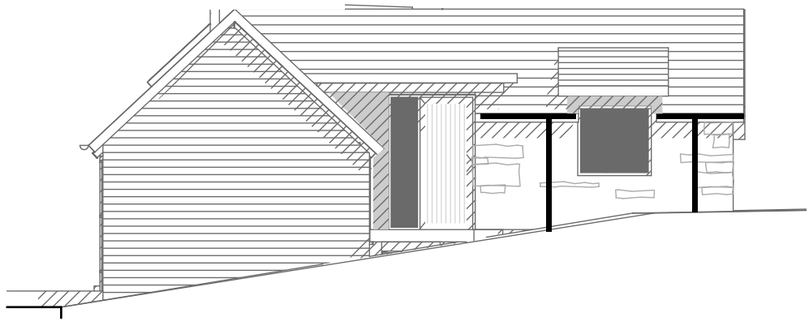
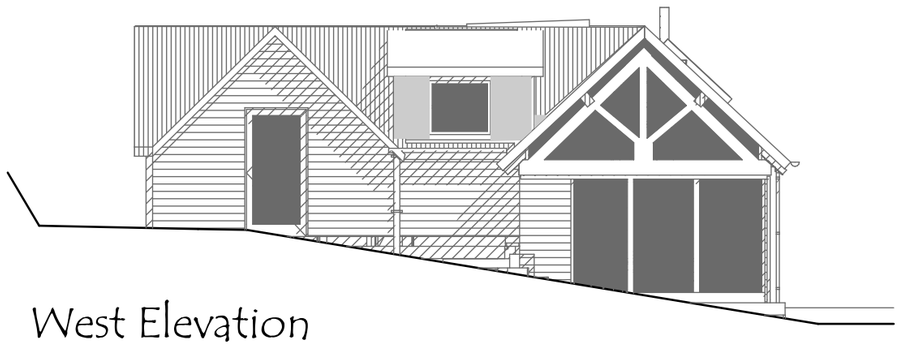
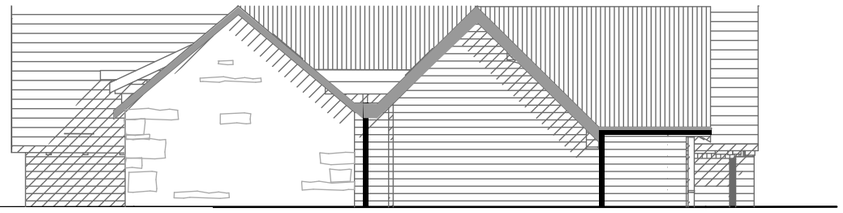


East Elevation

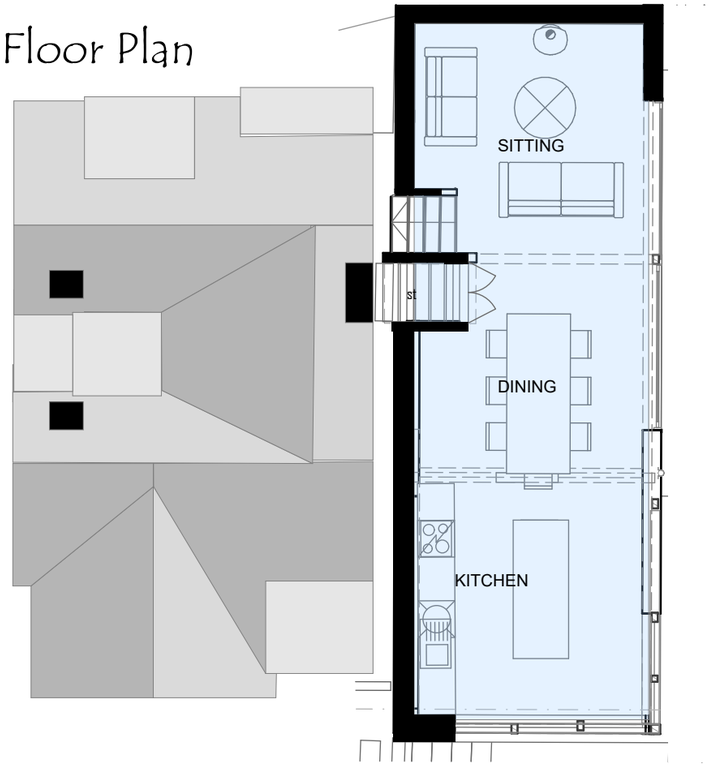


West Elevation

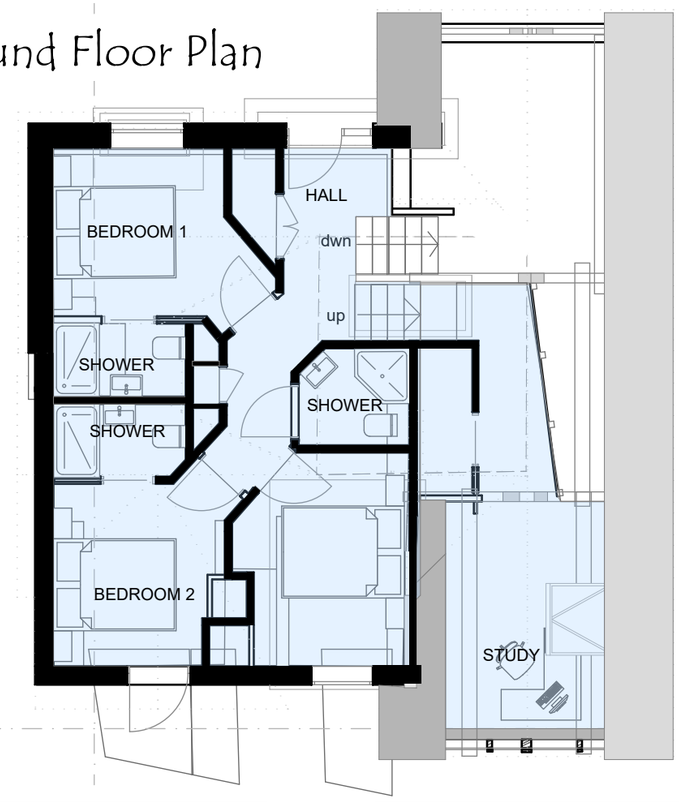


North Elevation

First Floor Plan

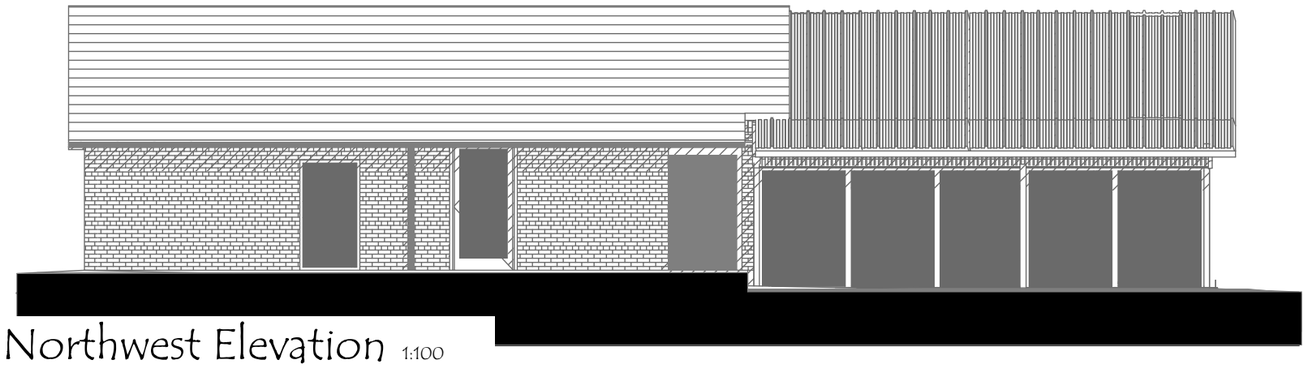


Ground Floor Plan



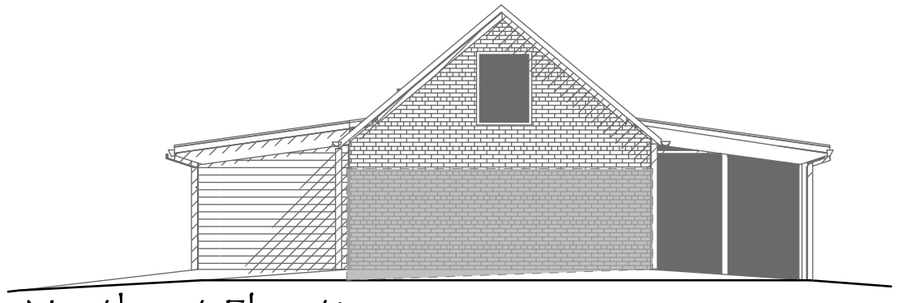
PROPOSED MULTIFUNCTIONAL CORPORATE RETREAT/ EVENTS DEVELOPMENT, RHYD Y CARW MILL, TREFEGLWYS.

DATE	1/8/2020	DRAWN	FC	DWG No	P/2020/50/01

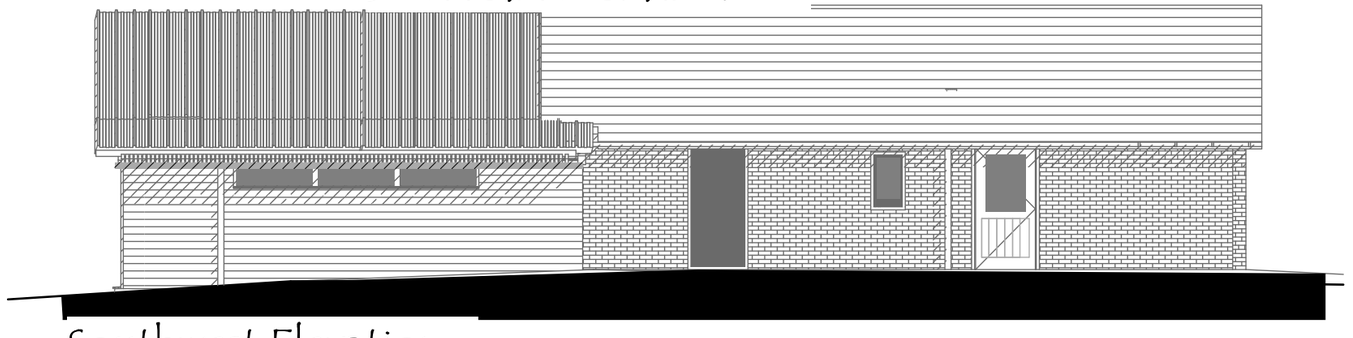


Northwest Elevation 1:100

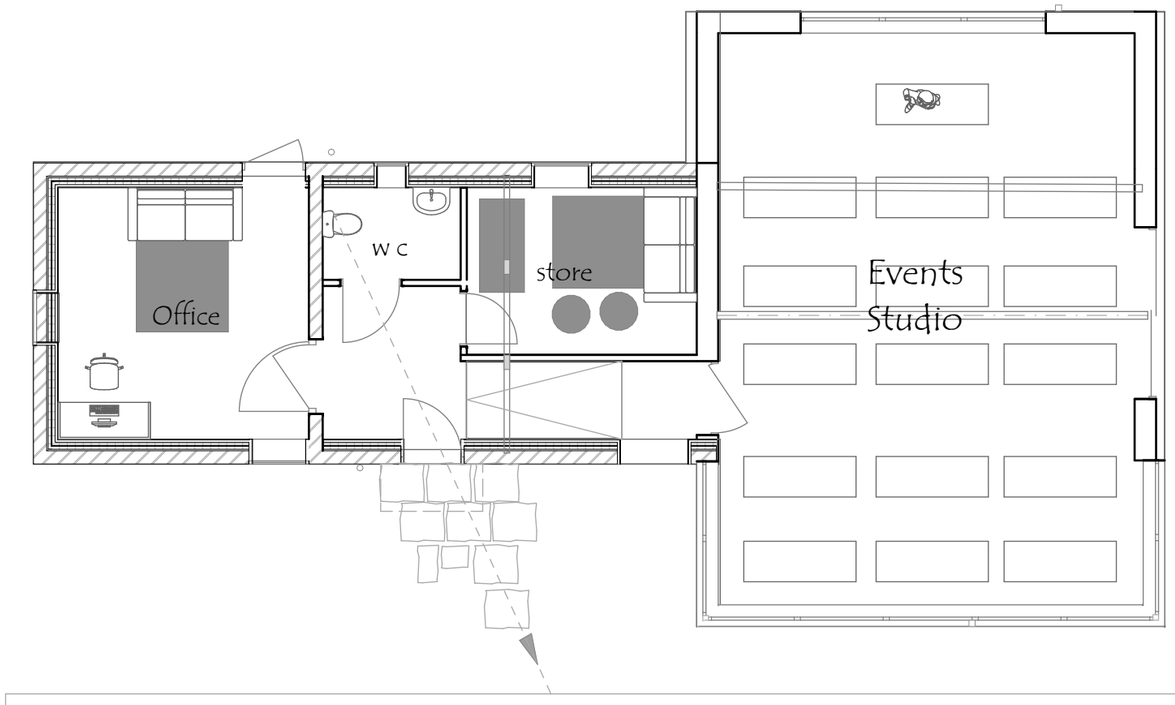
Southeast Elevation



Northeast Elevation



Southwest Elevation



PROPOSED MULTIFUNCTIONAL CORPORATE RETREAT/ EVENTS DEVELOPMENT, RHYD Y CARW MILL, TREFEGLWYS.

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DATE	1/8/2020	DRAWN	FC
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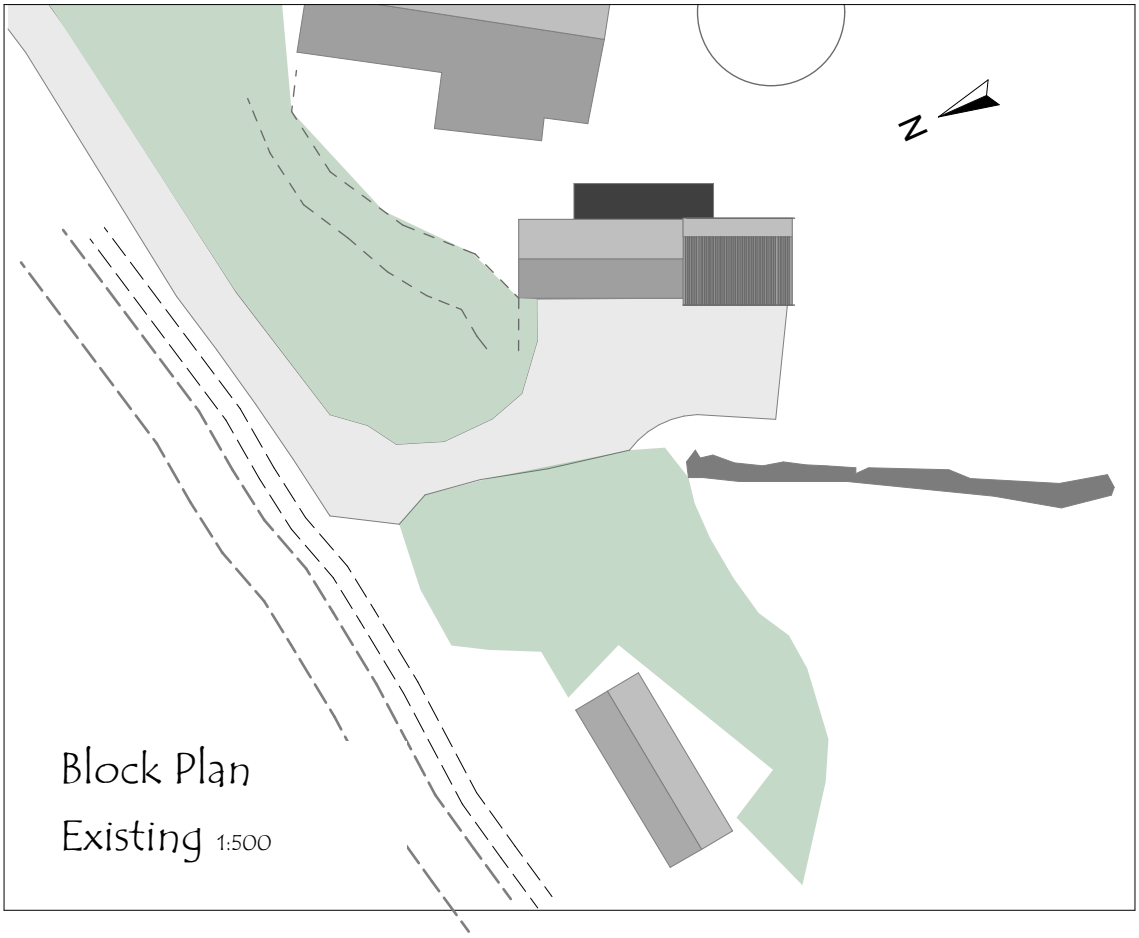
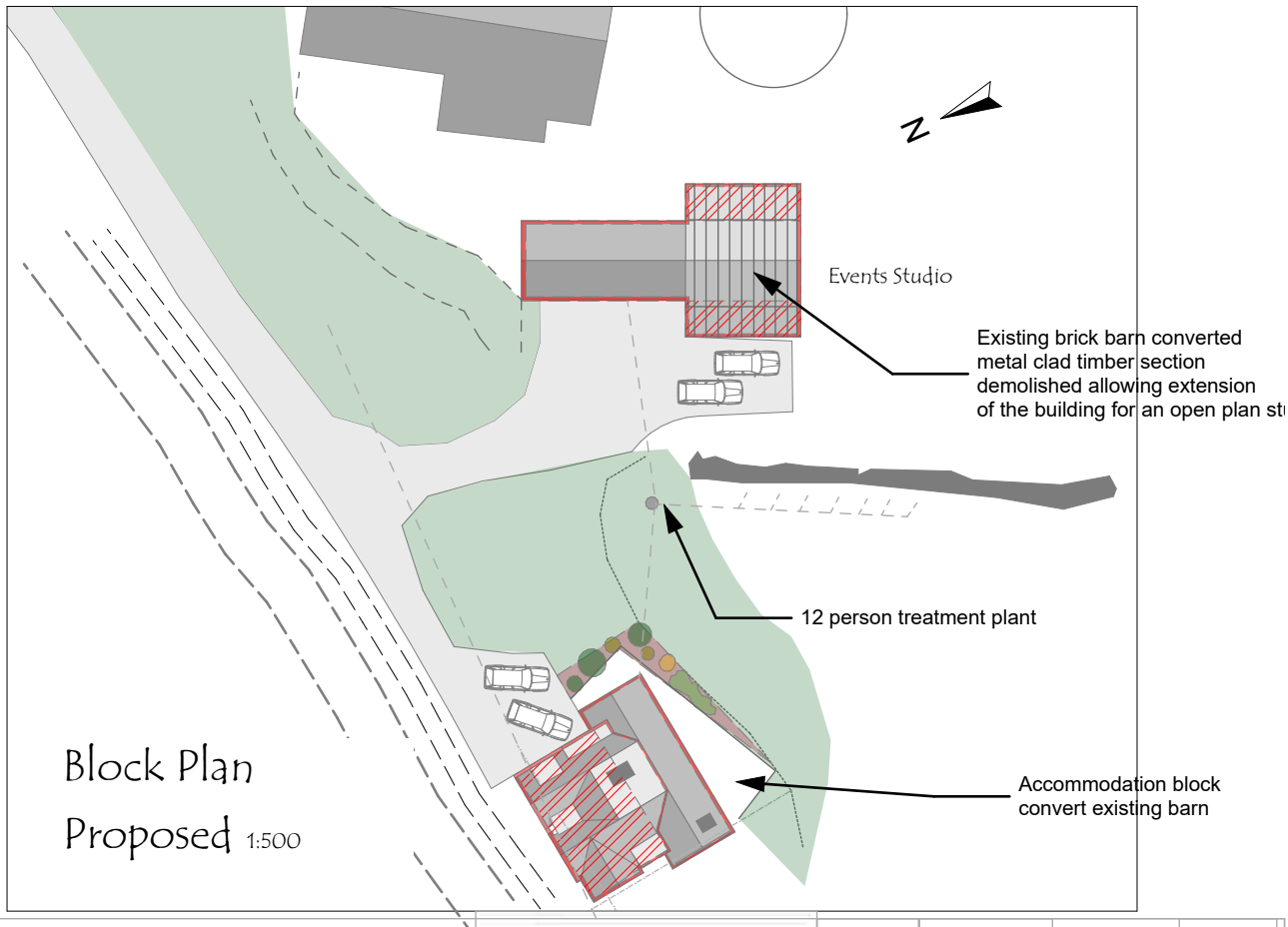




MULTIFUNCTIONAL CORPORATE RETREAT/ EVENTS DEVELOPMENT, RHYD Y CARW MILL, TREFEGLWYS.

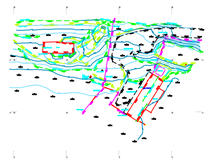
Frederick Carter
Design, Detailing and Visualization
Architectural Services

DATE	1/8/2020	Drawn	FC
DWG	P/2020/50/03		

APPENDIX 3 – Topographical Survey

295840 E
295860 E
295880 E
295900 E
N
290620 N
290600 N
barn
ridge 154.72
eaves 152.55
hard standing
dog run
1.0m WMF
1.0m SWF
1.2m WPR
Stn ULS01
MH
CL149.10
IL 148.31
0.15 dia
conc
FL 148.45
ridge lvl 152.66
ridge lvl 151.04
lean-to
eaves 150.56
eaves 150.26
bottom of slope
top of slope

KEY PLAN



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(Abbreviations apply to survey data only)

STN	CO-ORDINATES	LEVEL	STN	CO-ORDINATES	LEVEL

NATIONAL GRID.

ALL LEVELS RELATE TO ORDNANCE DATUM NEWLYN.

CONTROL USED:

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Client

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EMAIL jonbarton@usklandsurvey.co.uk

Project

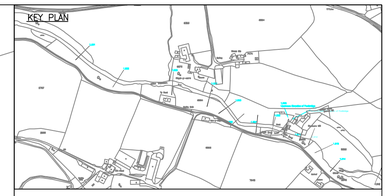
Rhyd Y Carw Mill
Topographical Survey

Site

Rhyd Y Carw Mill
Trefeglwys
Caersws
SY17 5PW

Surveyed by J.Barton	Date: NOV 2020
Checked by J.Barton	Date: NOV 2020
Drawn by J.Barton	Date: NOV 2020
Drawing No. Topo	Revision —
Drawing Scale: 1:100	Job Ref 1029
CAD Filename: 1029.dwg	Plot Scale: 1=1

KEY PLAN



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Rhyd Y Carw Mill
Topographical Survey

Site

Rhyd Y Carw Mill
Trefeglwys
Caersws
SY17 5PW

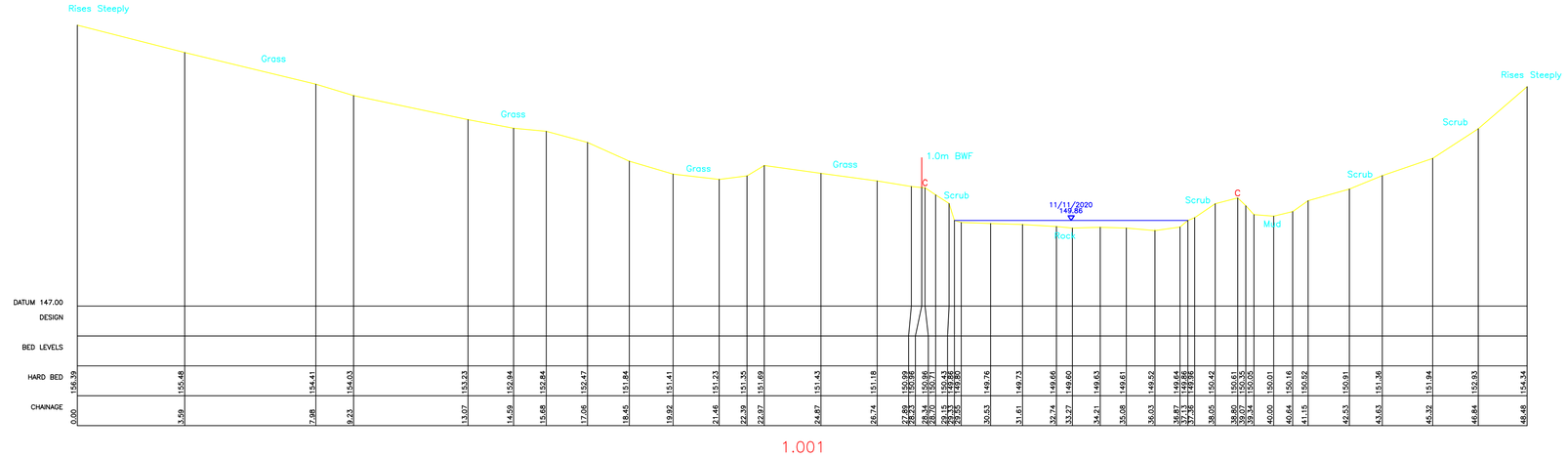
Surveyed by J.Barton	Date: NOV 2020
Checked by J.Barton	Date: NOV 2020
Drawn by J.Barton	Date: NOV 2020

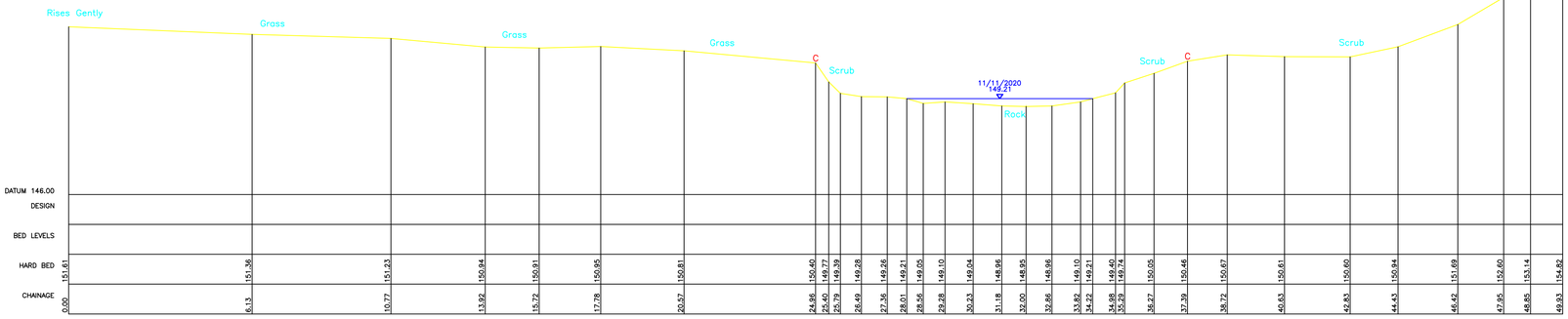
Drawing No.

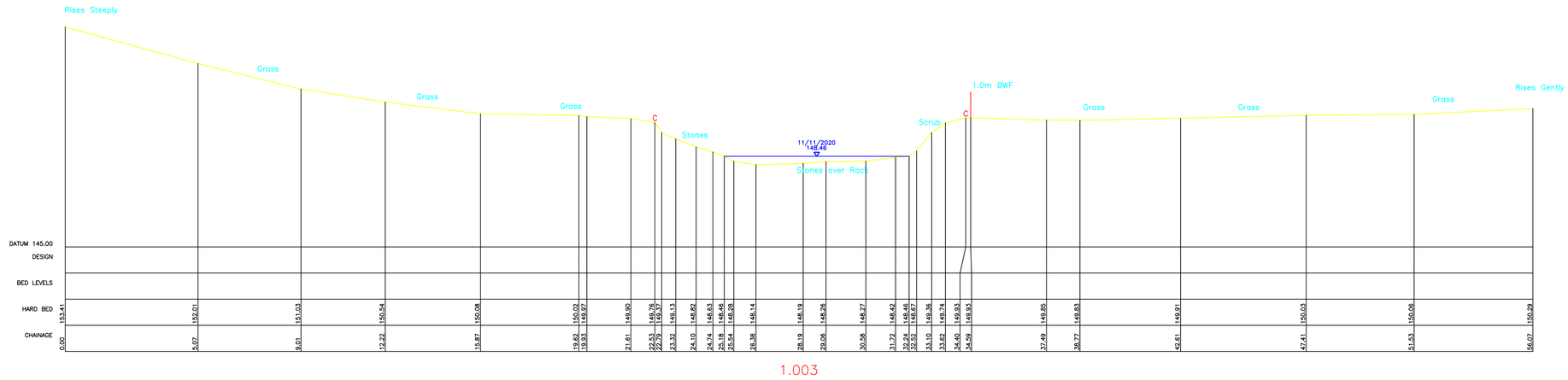
Section Locations

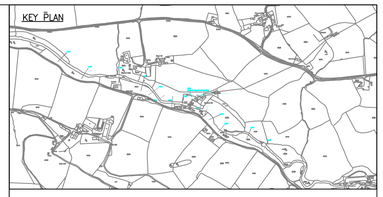
Revision _

Drawing Scale: 1:1250	Job Ref 1029
CAD Filename: 1029.dwg	Plot Scale: 1=1









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Rhyd Y Carw Mill
Topographical Survey

Site

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Trefeglwys
Caersws
SY17 5PW

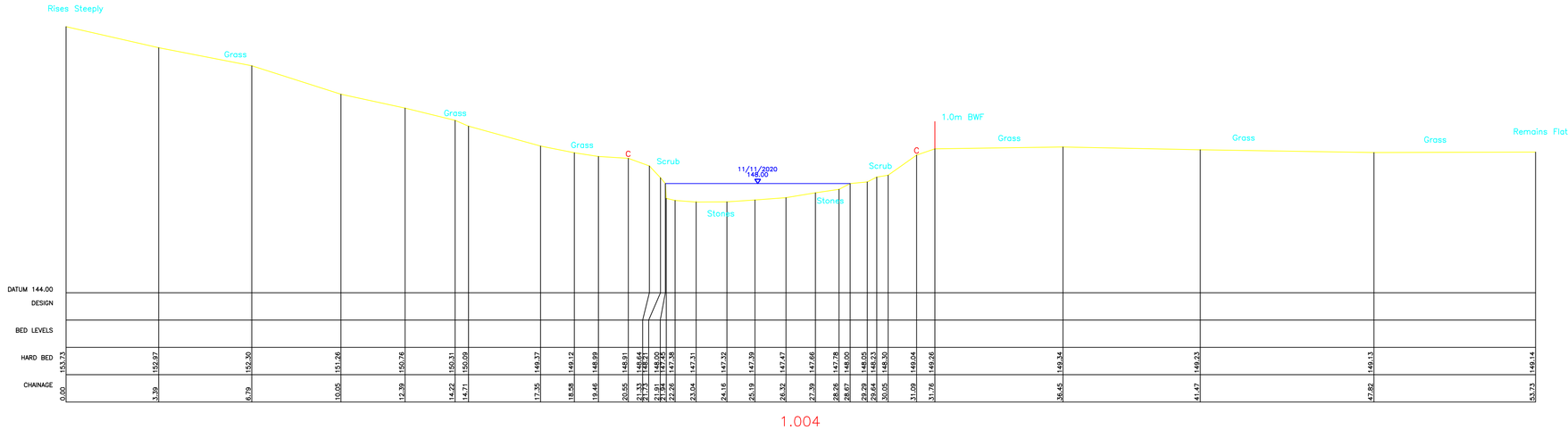
Surveyed by J.Barton	Date: NOV 2020
Checked by J.Barton	Date: NOV 2020
Drawn by J.Barton	Date: NOV 2020

Drawing No. Section_1

Revision _

Drawing Scale: 1:100 Job Ref 1029

CAD Filename: 1029.dwg Plot Scale: 1=1



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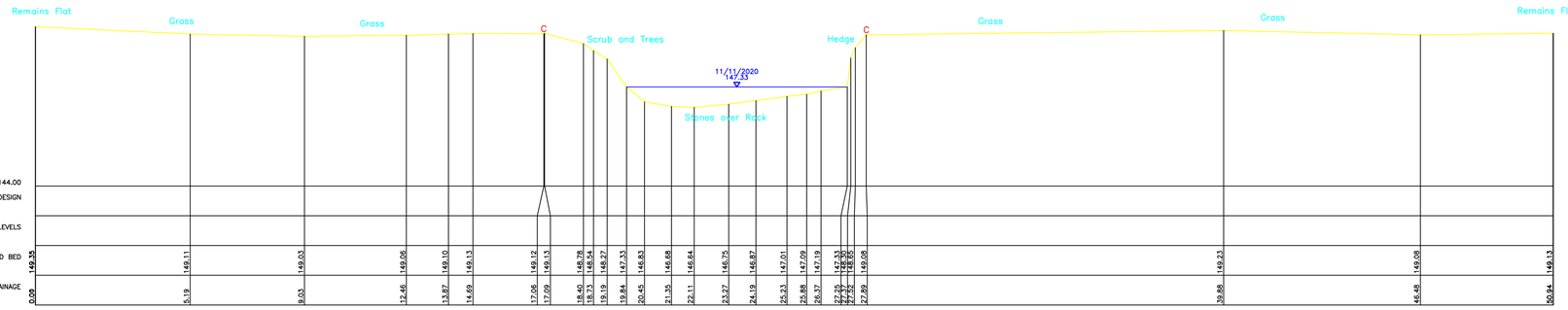

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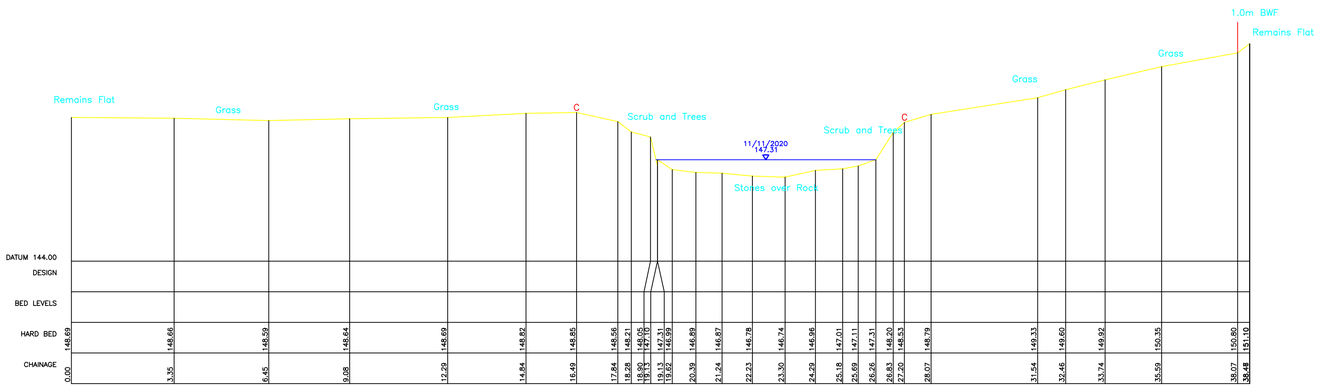

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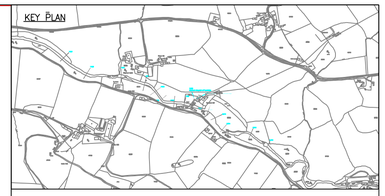
KEY PLAN



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Project

Rhyd Y Carw Mill Topographical Survey

Site

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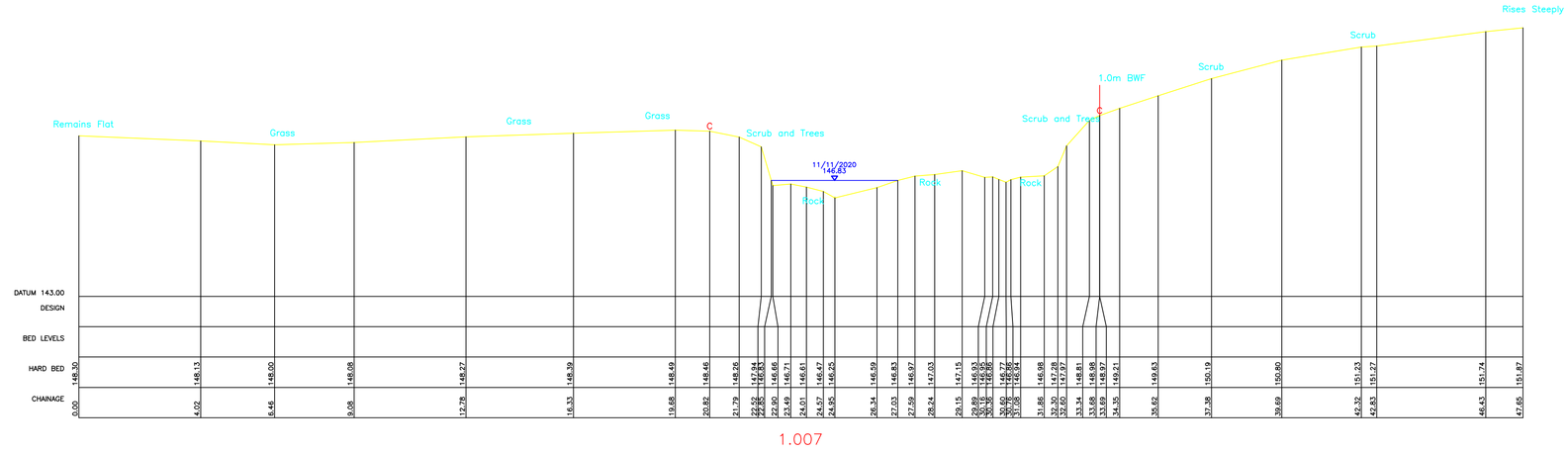
SY17 5PW

Surveyed by J.Barton	Date: NOV 2020
Checked by J.Barton	Date: NOV 2020
Drawn by J.Barton	Date: NOV 2020

Drawing No. Section_2 | Revision _

Drawing Scale: 1:100 | Job Ref 1029

CAD Filename: 1029.dwg | Plot Scale: 1=1



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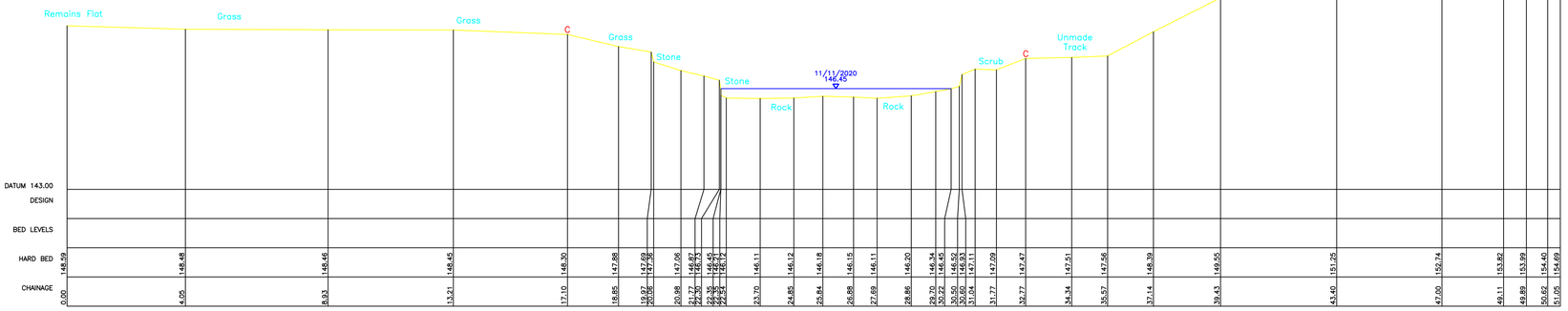

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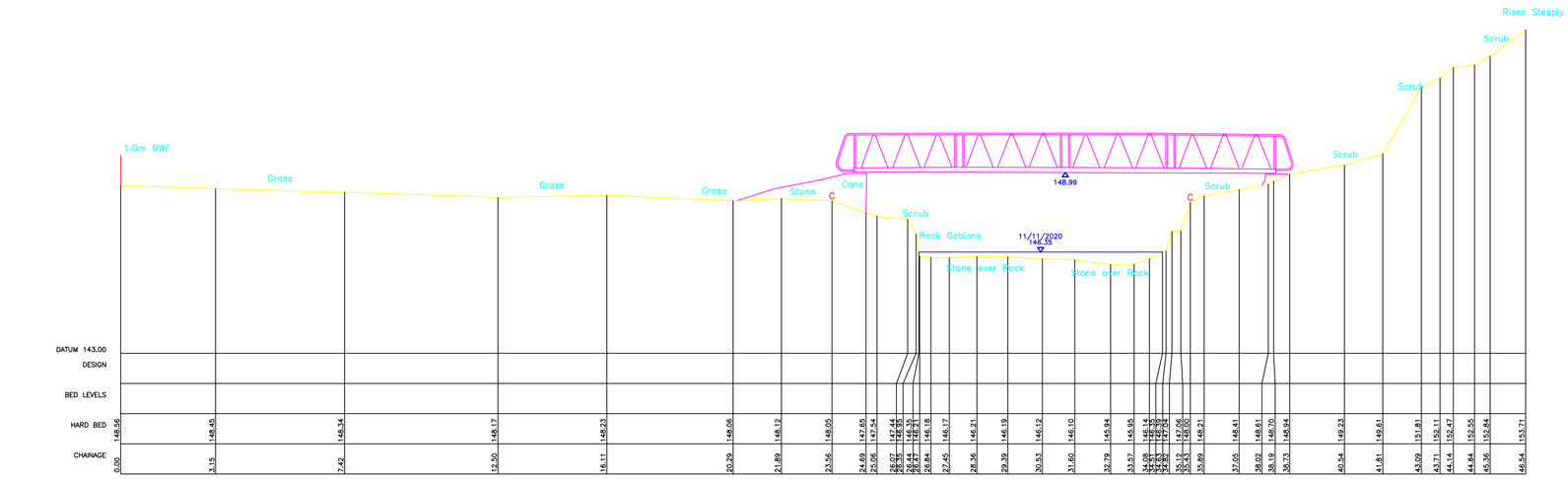

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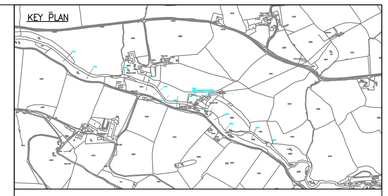
Upstream Elevation of Footbridge



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Revision	By	Checked	Approved	Date	Description

SURVEY LEGEND

AB	AIR BRICK	LP	LAMP POST
AV	AIR VALVE	MB	MOORING BOLLARD
B	BOLLARD	MF	MISCELLANEOUS FENCING
BB	BELISHA BEACON	MH	MANHOLE
BDY	BOUNDARY	MKR	MARKER
BH	BOREHOLE	MP	MOORING PILE
BL	BED LEVEL	MRF	METAL RAILING FENCE
BRK	BRICKWORK	MS	MILE STONE
BS	BUS STOP	NB	NOTICE BOARD
BM	BENCH MARK	NRA	NATIONAL RIVERS AUTHORITY
BW	BRICK WALL	OHC	OVERHEAD CABLE
BWF	BARBED WIRE FENCE	OS	ORDNANCE SURVEY
CBF	CLOSE BOARDED FENCE	OSR	OPEN STEEL RAILINGS
CIF	CORRUGATED IRON FENCE	P	PILE
CL	COVER LEVEL	PB	PILLAR BOX
CLF	CHAIN LINK FENCE	PM	PARKING METER
CONC	CONCRETE	PO	POST
CP	CONCRETE POST	PRF	POST & RAIL FENCE
CPF	CHESTNUT PALING FENCE	PTM	PARKING TICKET MACHINE
CR	CYCLE RACK	PWF	POST & WIRE FENCE
CTV	CABLE T.V. MANHOLE	RB	RIGHT BANK
CUL	CULVERT	RE	RODDING EYE
DK	DROP KERB	RS	ROAD SIGN
DL	DECK LEVEL	RTW	RETAINING WALL
DP	DOWNPIPE	RWP	RAINWATER PIPE
DPC	DAMP PROOF COURSE	SC	STOP COCK
DR	DRAIN	SDP	STAND PIPE
DWB	DOG WASTE BIN	SK	SOAKAWAY
EA	ENVIRONMENT AGENCY	SL	SOFFIT LEVEL
EB	ELECTRICITY BOX	SMH	SURFACE WATER MANHOLE
ECF	ELECTRIC CABLE FENCE	SMP	SHEET METAL PILING
ECP	ELECTRICITY CABLE PIT	SP	SIGN POST
EMH	ELECTRICITY MANHOLE	STN	STATION
EP	ELECTRICITY POLE	SV	SLUICE VALVE
ER	EARTHING ROD	SVP	SOIL VENT PIPE
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IWF	INTERWOVEN FENCE	WP	WOODEN POST
JB	JUNCTION BOX	WPR	WOODEN POST & RAIL FENCE
KIG	KERB INLET GULLY	WV	WATER VALVE
LB	LEFT BANK	YG	YARD GULLY
LFB	LIFEBUOY		

(Abbreviations apply to survey data only)

STN	CO-ORDINATES	LEVEL	STN	CO-ORDINATES	LEVEL

NATIONAL GRID.

ALL LEVELS RELATE TO ORDNANCE DATUM NEWLYN.

CONTROL USED:

TYPE	REFERENCE	VALUE(M)

Client

KRS Environmental Ltd
No.3 Princes Square, Princes Street
Montgomery, Powys, SY15 6PZ

Usk Land Survey
No.40 ABERGAVENNY ROAD, USK, NP15 1SB
TEL: 01291 673491 MOB: 0787 2560386
EMAIL jonbarton@usklandsurvey.co.uk

Project

Rhyd Y Carw Mill
Topographical Survey

Site

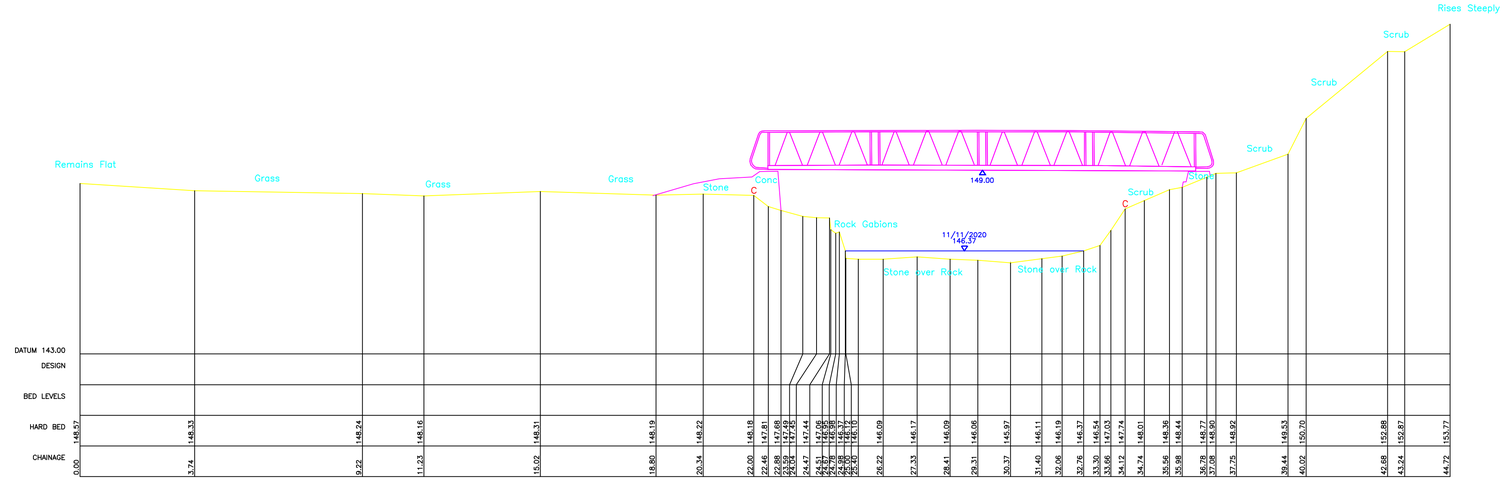
Rhyd Y Carw Mill
Trefeglwys
Caersws
SY17 5PW

Surveyed by J.Barton	Date: NOV 2020
Checked by J.Barton	Date: NOV 2020
Drawn by J.Barton	Date: NOV 2020

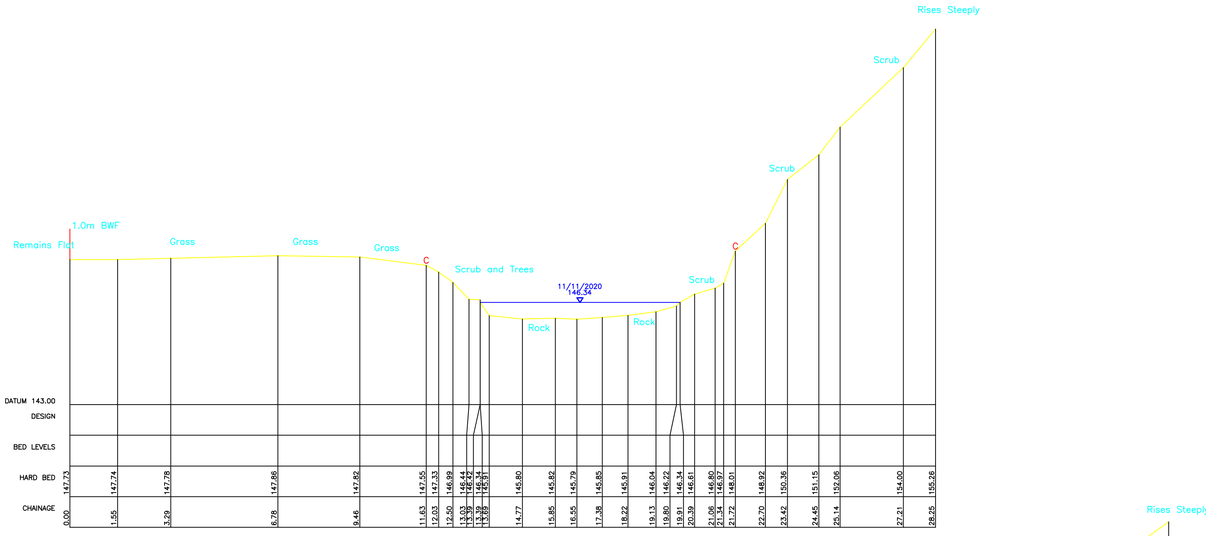
Drawing No. Section_3 | Revision _

Drawing Scale: 1:100 | Job Ref 1029

CAD Filename: 1029.dwg | Plot Scale: 1=1



1.010
Downstream Elevation of Footbridge



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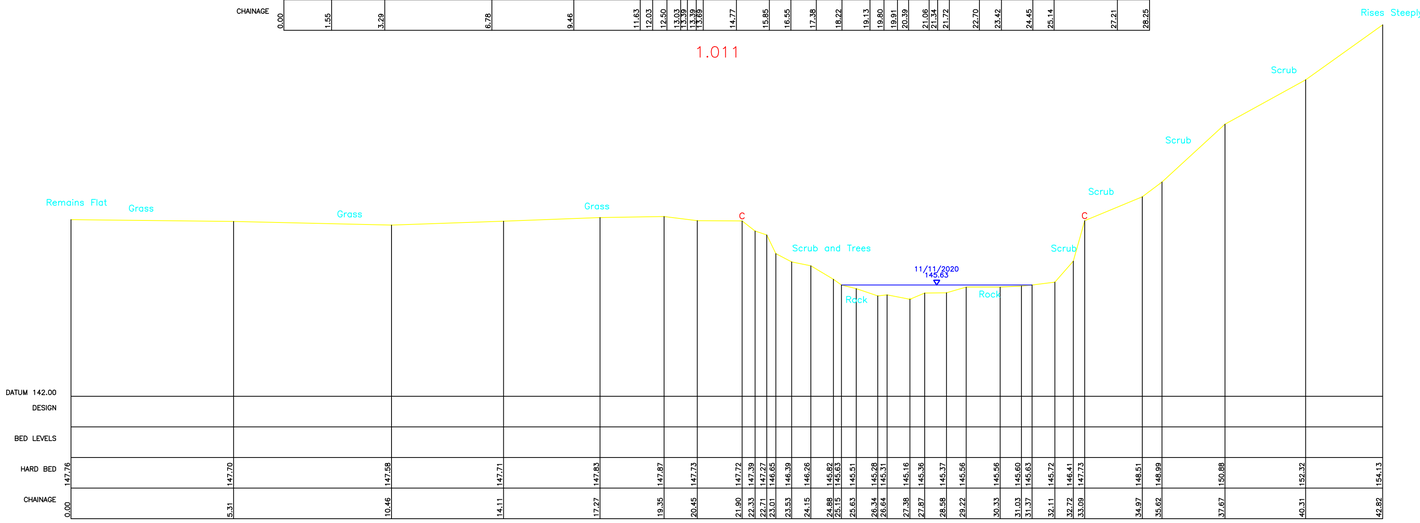

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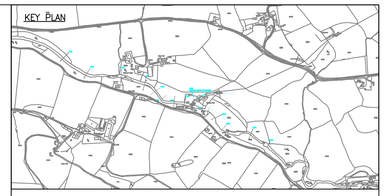
KEY PLAN



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Revision	By	Checked	Approved	Date	Description

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(Abbreviations apply to survey data only)

STN	CO-ORDINATES	LEVEL	STN	CO-ORDINATES	LEVEL

NATIONAL GRID.

ALL LEVELS RELATE TO ORDNANCE DATUM NEWLYN.

CONTROL USED:

TYPE	REFERENCE	VALUE(M)

Client

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EMAIL jonbarton@usklandsurvey.co.uk

Project

Rhyd Y Carw Mill
Topographical Survey

Site

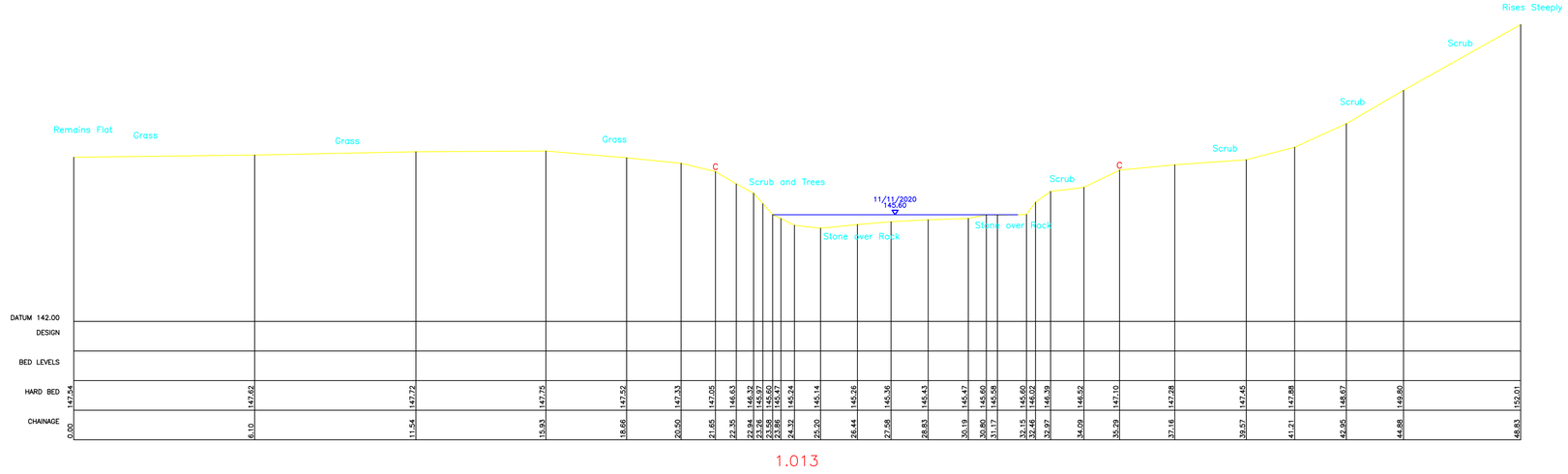
Rhyd Y Carw Mill
Trefeglwys
Caersws
SY17 5PW

Surveyed by J.Barton	Date: NOV 2020
Checked by J.Barton	Date: NOV 2020
Drawn by J.Barton	Date: NOV 2020

Drawing No. Section_4 | Revision _

Drawing Scale: 1:100 | Job Ref 1029

CAD Filename: 1029.dwg | Plot Scale: 1=1



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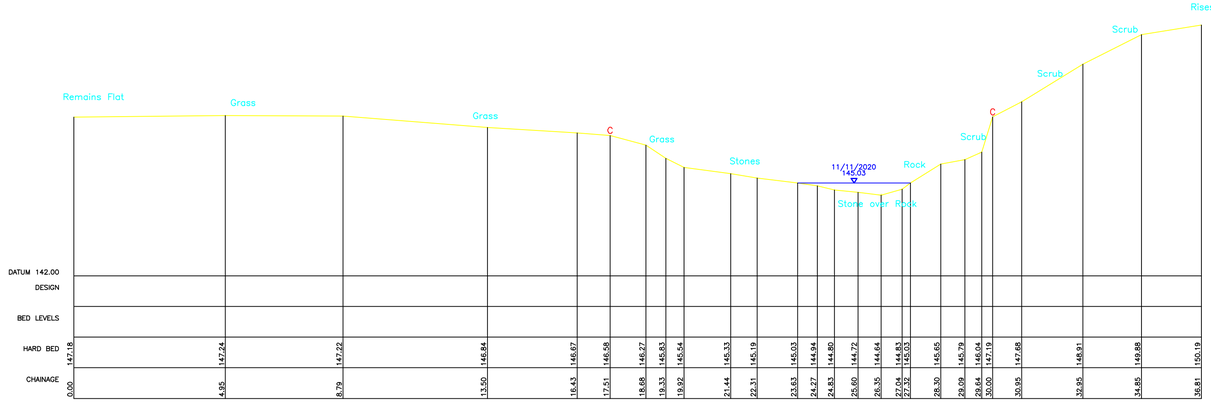

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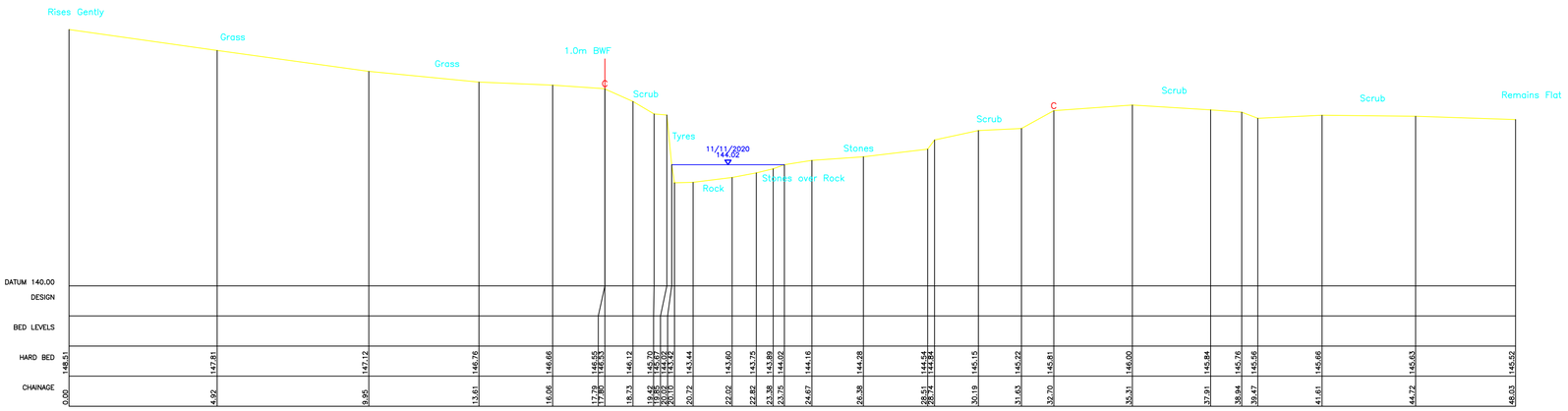

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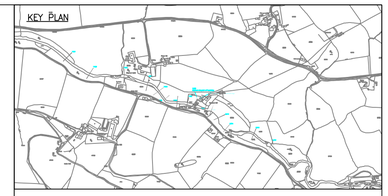
KEY PLAN



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(Abbreviations apply to survey data only)

STN	CO-ORDINATES	LEVEL	STN	CO-ORDINATES	LEVEL

NATIONAL GRID.

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CONTROL USED:

TYPE	REFERENCE	VALUE(M)

Client

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Montgomery, Powys, SY15 6PZ

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TEL: 01291 673491 MOB: 0787 2560386
EMAIL jonbarton@usklandsurvey.co.uk

Project

Rhyd Y Carw Mill
Topographical Survey

Site

Rhyd Y Carw Mill
Trefeglwys
Caersws
SY17 5PW

Surveyed by J.Barton	Date: NOV 2020
Checked by J.Barton	Date: NOV 2020
Drawn by J.Barton	Date: NOV 2020

Drawing No. Section_5 | Revision _

Drawing Scale: 1:100 | Job Ref 1029

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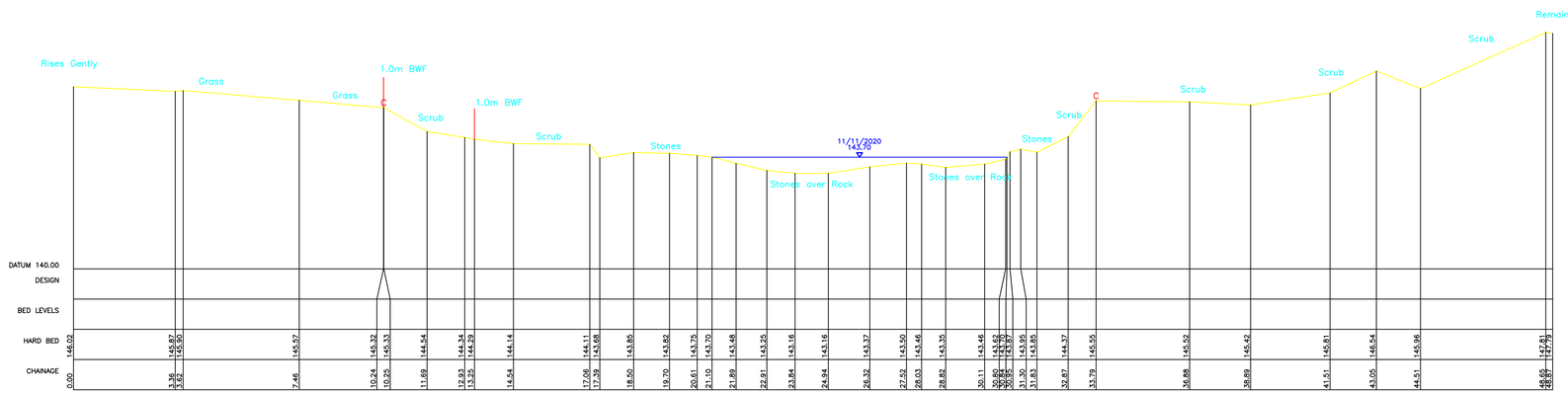

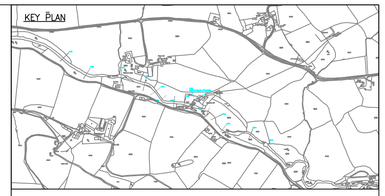

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Revision	By	Checked	Approved	Date	Description

SURVEY LEGEND

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Project

Rhyd Y Carw Mill
Topographical Survey

Site

Rhyd Y Carw Mill
Trefeglwys
Caersws
SY17 5PW

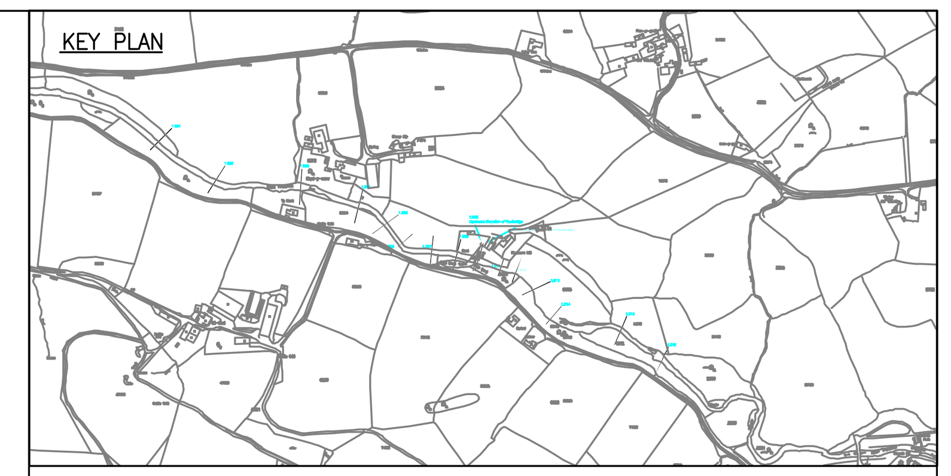
Surveyed by J.Barton	Date: NOV 2020
Checked by J.Barton	Date: NOV 2020
Drawn by J.Barton	Date: NOV 2020

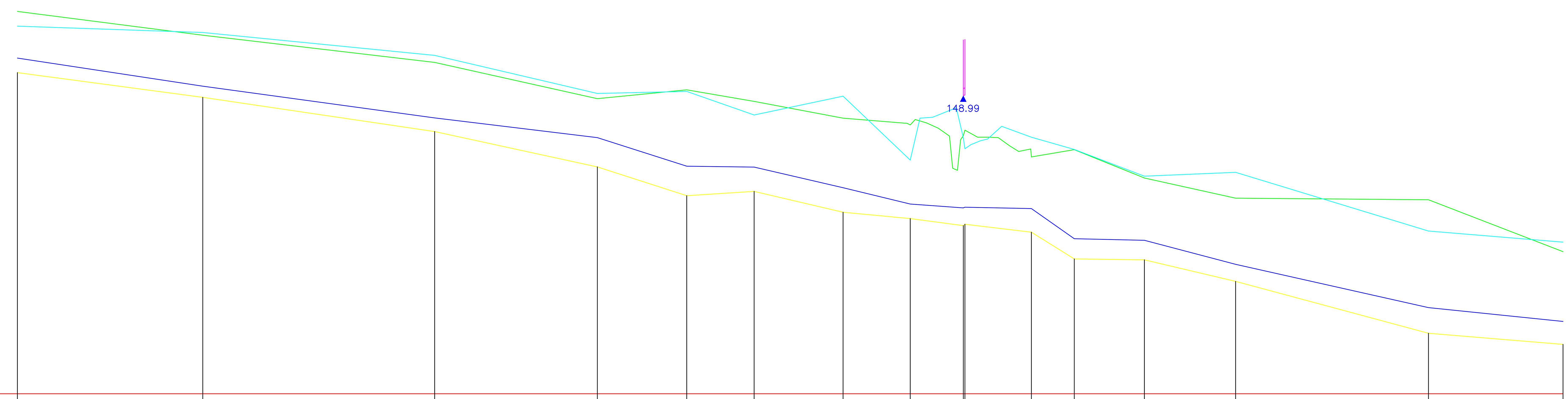
Drawing No. Section_6 | Revision _

Drawing Scale: 1:100 | Job Ref 1029

CAD Filename: 1029.dwg | Plot Scale: 1=1

KEY PLAN





Datum 142.00M

DESIGN																
W.LEVEL	149.86	149.21	148.46	148.00	147.33	147.31	146.83	146.45	146.35	146.37	146.34	145.63	145.60	145.03	144.02	143.70
HARD BED	149.52	148.95	148.14	147.31	146.64	146.74	146.25	146.11	145.94	145.97	145.79	145.16	145.14	144.64	143.42	143.16
GROUND																
L.BANK	150.96	150.40	149.76	148.91	149.12	148.85	148.46	148.30	148.05	148.18	147.55	147.72	147.05	146.58	146.55	145.33
R.BANK	150.61	150.46	149.93	149.04	149.08	148.53	148.97	147.47	148.00	147.74	148.01	147.73	147.10	147.19	145.81	145.55
CHAINAGE	0.0	108.4	243.9	339.1	391.4	430.7	482.9	522.1	553.1	554.1	592.9	618.0	659.0	712.3	825.2	903.9
SECT NO.	1.001	1.002	1.003	1.004	1.005	1.006	1.007	1.008	1.009	1.010	1.011	1.012	1.013	1.014	1.015	1.016
WATER DATE	11/11/20	11/11/20	11/11/20	11/11/20	11/11/20	11/11/20	11/11/20	11/11/20	11/11/20	11/11/20	11/11/20	11/11/20	11/11/20	11/11/20	11/11/20	11/11/20

Upstream Elevation of Footbridge
Downstream Elevation of Footbridge

Notes:

1. This drawing is copyright and its use or reproduction without the written permission of Usk Land Survey is prohibited
2. Due to unavoidable inaccuracies during the reproduction process these drawings should not be scaled. Where dimensions are critical Usk Land Survey should be requested to confirm dimensions based on survey information. Scales appearing at the base of this plan are for indicative purposed only.
3. This plan has been prepared in accordance with B.S. 1192, Part 1 in relation to scale and dimension. Tolerances permitted within the British Standard should be observed.
4. All dimensions and particulars should be checked on site. Any discrepancies sohuld be reported to Usk Land Survey before any work commences.

Revision	By	Checked	Approved	Date	Description

SURVEY LEGEND

AB	AIR BRICK	LP	LAMP POST
AV	AIR VALVE	MB	MOORING BOLLARD
B	BOLLARD	MF	MISCELLANEOUS FENCING
BB	BELISHA BEACON	MH	MANHOLE
BDY	BOUNDARY	MKR	MARKER
BH	BOREHOLE	MP	MOORING PILE
BL	BED LEVEL	MRF	METAL RAILING FENCE
BRK	BRICKWORK	MS	MILE STONE
BS	BUS STOP	NB	NOTICE BOARD
BM	BENCH MARK	NRA	NATIONAL RIVERS AUTHORITY
BW	BRICK WALL	OHC	OVERHEAD CABLE
BWF	BARBED WIRE FENCE	OS	ORDNANCE SURVEY
CBF	CLOSE BOARDED FENCE	OSR	OPEN STEEL RAILINGS
CIF	CORRUGATED IRON FENCE	P	PILE
CL	COVER LEVEL	PB	PILLAR BOX
CLF	CHAIN LINK FENCE	PM	PARKING METER
CONC	CONCRETE	PO	POST
CP	CONCRETE POST	PRF	POST & RAIL FENCE
CPF	CHESTNUT PALING FENCE	PTM	PARKING TICKET MACHINE
CR	CYCLE RACK	PWF	POST & WIRE FENCE
CTV	CABLE T.V. MANHOLE	RB	RIGHT BANK
CUL	CULVERT	RE	RODDING EYE
DK	DROP KERB	RS	ROAD SIGN
DL	DECK LEVEL	RTW	RETAINING WALL
DP	DOWNPIPE	RWP	RAINWATER PIPE
DPC	DAMP PROOF COURSE	SC	STOP COCK
DR	DRAIN	SDP	STAND PIPE
DWB	DOG WASTE BIN	SK	SOAKAWAY
EA	ENVIRONMENT AGENCY	SL	SOFFIT LEVEL
EB	ELECTRICITY BOX	SMH	SURFACE WATER MANHOLE
ECF	ELECTRIC CABLE FENCE	SMP	SHEET METAL PILING
ECP	ELECTRICITY CABLE PIT	SP	SIGN POST
EMH	ELECTRICITY MANHOLE	STN	STATION
EP	ELECTRICITY POLE	SV	SLUICE VALVE
ER	EARTHING ROD	SVP	SOIL VENT PIPE
ETL	ELECTRICITY TRANSMISSION LINE	SWF	SHEEP WIRE FENCE
FB	FLOWER BED	TBM	TEMPORARY BENCH MARK
FBR	FOOTBRIDGE	TCB/TCP	TELEPHONE CALL BOX/POST
FH	FIRE HYDRANT	TC	TELECOM CABINET
FHM	FIRE HYDRANT MARKER	TMH	TELECOM MANHOLE
FL	FLOOR LEVEL	THL	THRESHOLD LEVEL
FP	FENCE POST	TL	TRAFFIC LIGHT
FWM	FOUL WATER MANHOLE	TLB	TRAFFIC LIGHT BOX
G	GULLY	TP	TELEGRAPH POLE
GL	GROUND LEVEL	TRS	TIMBER RUBBING STRIP
GP	GATE POST	TS	TREE STUMP
GM	GAS MARKER	TSR	TUBULAR STEEL RAILINGS
GV	GAS VALVE	VP	VENT PIPE
HW	HEAD WALL	WB	WASTE BIN
IC	INSPECTION CHAMBER	WL	WATER LEVEL/WATER LINE
IL	INVERT LEVEL	WM	WATER METER
IRF	IRON RAILING FENCE	WMF	WIRE MESH FENCE
IWF	INTERWOVEN FENCE	WP	WOODEN POST
JB	JUNCTION BOX	WPR	WOODEN POST & RAIL FENCE
KIG	KERB INLET GULLY	WV	WATER VALVE
LB	LEFT BANK	YG	YARD GULLY
LFB	LIFEBUOY		

(Abbreviations apply to survey data only)

STN	CO-ORDINATES	LEVEL	STN	CO-ORDINATES	LEVEL

NATIONAL GRID.

ALL LEVELS RELATE TO ORDNANCE DATUM NEWLYN.

CONTROL USED:

TYPE	REFERENCE	VALUE(M)

Client

KRS Environmental Ltd
No.3 Princes Square, Princes Street
Montgomery, Powys, SY15 6PZ

Usk Land Survey
No.40 ABERGAVENNY ROAD, USK, NP15 1SB
TEL: 01291 673491 MOB: 0787 2560386
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Project

Rhyd Y Carw Mill
Topographical Survey

Site

Rhyd Y Carw Mill
Trefeglwys
Caersws
SY17 5PW

Surveyed by J.Barton Date: NOV 2020
Checked by J.Barton Date: NOV 2020
Drawn by J.Barton Date: NOV 2020

Drawing No.

Long Section

Revision —

Drawing Scale: 1:N/A Job Ref 1029

CAD Filename: 1029.dwg Plot Scale: 1=1

APPENDIX 4 – Natural Resources Wales Correspondence

Keelan

From: Data Distribution <datadistribution@cyfoethnaturiolcymru.gov.uk>
Sent: 15 January 2019 12:09
To: Keelan
Subject: ATI 16695A - Product 4 : RHYD Y CARW MILL, TREFEGLWYS, CAERSWS SY17 5PU

Hello Keelan

Unfortunately we do not hold any detailed flood modelling for this area, nor do we have any historic flood information.

Therefore we cannot provide the requested Product 4.

Regards

Kathy Banner
Swyddog Cysylltiadu Allanol / External Relations Officer
Cyfoeth Naturiol Cymru / Natural Resources Wales
03000 653568
Llys Afon, Hwlffordd / River Court, Haverfordwest
Dysgwr Cymraeg

www.cyfoethnaturiol.cymru / www.naturalresources.wales

Yn falch o arwain y ffordd at ddyfodol gwell i Gymru trwy reoli'r amgylchedd ac adnoddau naturiol yn gynaliadwy.

Proud to be leading the way to a better future for Wales by managing the environment and natural resources sustainably.

Croesewir gohebiaeth yn Gymraeg a byddwn yn ymateb yn Gymraeg, heb i hynny arwain at oedi

Correspondence in Welsh is welcomed, and we will respond in Welsh without it leading to a delay

---

From: Keelan <Keelan@krsenvironmental.com>
Sent: 19 December 2018 20:42
To: Data Distribution <datadistribution@cyfoethnaturiolcymru.gov.uk>
Subject: RHYD Y CARW MILL, TREFEGLWYS, CAERSWS SY17 5PU

Dear Sir/Madam,

RE: RHYD Y CARW MILL, TREFEGLWYS, CAERSWS SY17 5PU

I have been commissioned by my client to assess the flood risk issues for the site shown above, see attached.

I wish to obtain Product 4: Detailed Flood Risk Assessment Map for the site.

If you have any queries do not hesitate to contact me.

Regards,

Keelan Serjeant | Director
BSc, MSc, MCIWEM
KRS Environmental Ltd

T: 01686 668957
T: 01484 437420
M: 07857 264 376
E: keelan@krsenvironmental.com
W: krsenvironmental.com

APPENDIX 5 – FEH Calculation Record

FLOOD ESTIMATION REPORT

Introduction

This report template is based on a supporting document to the Environment Agency's flood estimation guidelines (Version 5, 2015). It provides a record of the hydrological context, the method statement, the calculations and decisions made during flood estimation and the results.

Contents

Approval

	Name and Qualifications	Date
Calculations prepared by:	Keelan Serjeant BSc (Hons), MSc, MCIWEM	19/01/2021
Calculations reviewed by:	Emma Serjeant LL.B, MSc	19/01/2021

Abbreviations

AM	Annual maximum
AREA	Catchment area (km^2)
BFI	Base flow index
BFIHOST	Base flow index derived using the HOST soil classification
DPLBAR	Mean drainage path length (km)
DPSBAR	Mean drainage path slope (m/km)
FARL	FEH index of flood attenuation due to reservoirs and lakes
FEH	Flood Estimation Handbook
FPEXT	Floodplain extent
FSR	Flood Studies Report
HOST	Hydrology of soil types
NRFA	National River Flow Archive
NRW	Natural Resources Wales
POT	Peaks over a threshold
QMED	Median annual flood (with return period 2 years)
ReFH	Revitalised flood hydrograph method – used for rainfall runoff method
SAAR	Standard average annual rainfall (mm)
SPR	Standard percentage run-off
SPRHOST	Standard percentage run-off derived using the HOST soil classification
Tp (0)	Time to peak of the instantaneous unit hydrograph
URBAN	Flood Studies Report index of fractional urban extent
URBEXT2000	Revised index of urban extent
WINFAP	Windows Frequency Analysis Package – used for FEH statistical method

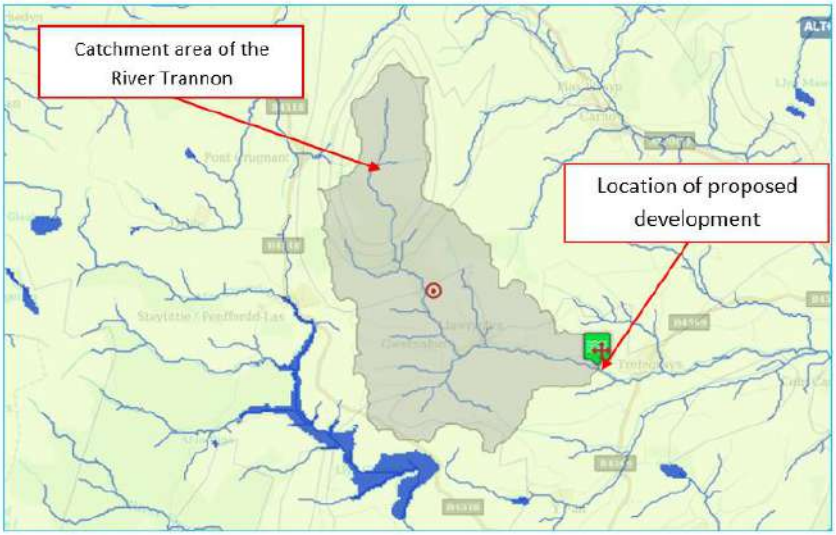
1.0 Method statement

1.1 Requirements for flood estimates

Item	Comments
Overview • Purpose of study • Peak flows or hydrographs? • Range of return periods and locations	The purpose of this assessment is to provide inflows into a 1D hydraulic model of the River Trannon, to support a Flood Consequence Assessment. The site for the estimation of inflows is located at Rhyd Y Carw Mill, Trefeglwys, Caersws, SY17 5PU. Flood estimates are only required for one location just downstream of the site. The peak inflow estimates for the site have been obtained by assessment using ReFH v2.2 and WINFAP FEH (3.0.003) methods and have been undertaken in accordance with Natural Resources Wales flood estimation technical guidance. The effects of climate change will be accounted for. The study is being undertaken for a small development application; the project scope reflects this purpose.

1.2 Overview of catchment

Item	Comments
Brief description of catchment, or reference to section in accompanying report. Include maps where necessary.	The catchment boundary has been checked against the OS mapping and no changes are necessary. Qualitative checks on FARL using mapping and BFIHOST checked using soil maps was undertaken. The soil catchment details were checked by using soil maps the catchment location. A visual assessment using Google Maps and the FEH Webservice Map was used to check the URBEXT2000 value and FARL. With a low URBEXT value, it was not necessary to consider any updating. These values were consistent with the maps. No catchment descriptors were altered from the initial FEH catchment descriptors. The catchment area is small at 29.58km2, the SPRHOST value (Standard Percentage Runoff) is 44.95% and indicates a low permeable catchment. Approximately 44.95% of the rainfall will contribute to direct runoff rather than be stored and reflects the low permeability of the underlying geology. The BFIHOST value (Baseflow Index) is low at 0.410. The descriptors BFIHOST and SPRHOST are representative of the permeability of catchment soils and geology, a high BFIHOST and a low SPRHOST value indicate a very permeable catchment, whilst a low BFIHOST and high SPRHOST indicate a very impermeable catchment. Based on the relatively broad scale data sets that inform the catchment descriptors, the catchment descriptors values indicate a reasonably impermeable catchment. The SAAR6190 (Standard Average Annual Rainfall) value is high at 1559. The URBEXT2000 value is 0.00 and therefore, the catchment is essentially

	rural. The catchment descriptors were used to calculate the design flow on River Trannon, using the FEH Statistical Method and the ReFH2 method.  **River Trannon Upstream Catchment as shown on the FEH webservice**

1.3 Source of flood peak data

Item	Comments
Was the NRFA Peak Flows dataset used? If so, which version? If not, why not? Record any changes made.	Access was made to the annual maximum flow data available via the NRFA web site.

1.4 Gauging stations (flow or level)

At the sites of flood estimates or nearby at potential donor sites. Also state gauging authority number where it is different to the NRFA number.

Watercourse	Station Name	Gauging authority number	NRFA number (used in FEH)	Grid Reference	Catchment area (km²)	Type (rated / ultrasonic / level…)	Start and end of flow record
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

1.5 Data available at each flow gauging station

Station Name	**Start and end date on NRFA**	**Update for this study?**	**Suitable for QMED?**	**Suitable for pooling?**	**Data quality check needed?**	**Other comments on station and flow quality** e.g. information from NRFA Peak Flows, trends in flood peaks, outliers
N/A	N/A	N/A	N/A	N/A	N/A	N/A
Give link/reference to any further data quality checks if carried out						

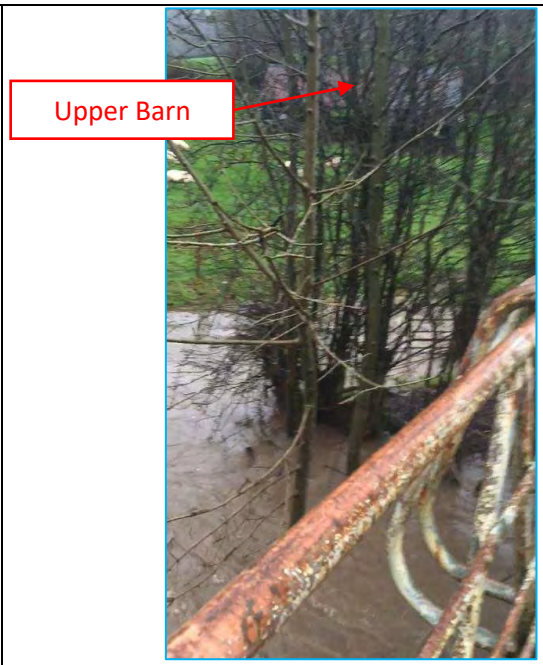
1.6 Rating equations

Station name	**Type of rating** e.g. theoretical, empirical, degree of extrapolation	**Rating review needed?**	**Reasons** e.g. availability of recent flow gaugings, amount of scatter in the rating
N/A	N/A	N/A	N/A
Include a link or reference to any rating reviews carried out			

1.7 Other data available and how it has been obtained

Type of data	**Data relevant to this study?**	**Data available?**	**Source of data**	**Details**
Check flow gaugings (if planned to review ratings)	No	N/A		
Historic flood data – give link to historic review if carried out	Yes	The Natural Resource Wales historic flood outline map shows that the site has not historically flooded. The British Hydrological Society (BHS) "Chronology of British Hydrological Events[1]" has no information on flooding within the vicinity of the site. No other historical records of flooding for the site have been recorded. The River Trannon does overtop its banks within the vicinity of the site but this does not result in flooding of the site, as shown in the photographs below.		

[1] http://www.dundee.ac.uk/geography/cbhe/

		 **Flooding on the 29/10/2020 from the Footbridge Looking at the Upper Barn**  **Figure 4 - Flooding on the 29/10/2020**
Flow data for events	No	Flood event analysis is not within the scope of this study.
Rainfall data for events	No	N/A
Results from previous studies	No	N/A
Other data or information e.g. groundwater, tides	No	N/A

1.8 Initial choice of approach

Item	Comment
Is FEH appropriate? (it may not be for very small, heavily urbanised or complex catchments) If not, describe other methods to be used.	FEH is considered to be appropriate for the catchment. Both the FEH Statistical and ReFH2 methods are suitable for peak flow estimation. The study catchments are <1000km², not highly permeable or heavily urbanised. Natural Resources Wales requires the use of ReFH v2 with FEH13 rainfall statistics when applying a rainfall-runoff approach. The FEH Statistical and ReFH2 methods will both be applied, and the results compared.
Outline the conceptual model, addressing questions such as: • Where are the main sites of interest? • What is likely to cause flooding at those locations? (peak flows, flood volumes, combinations of peaks, groundwater, snowmelt, tides…) • Might those locations flood from runoff generated on part of the catchment only, e.g. downstream of a reservoir? • Is there a need to consider temporary debris dams that could collapse?	The conceptual model considered the main cause of flooding at this location to occur by peak flows and volumes from the nearby River Trannon. The main site of interest is the proposed development site located in the valley bottom adjacent to natural floodplain environment. Flooding is likely to result from peak flows and volumes exceeding channel capacity in the River Trannon. It is likely that flooding would occur from the entire catchment and would not be caused only by sub-catchment runoff. There are no records to suggest that the site is at risk from temporary debris dams collapsing.
Any unusual catchment features to take into account? e.g. • highly permeable (BFIHOST> 0.65) – consider permeable catchment adjustment for statistical method if SPRHOST<20% • highly urbanised – consider choice of method carefully; consider method that can account for differing sewer and topographic catchments • pumped watercourse – consider lowland catchment version of rainfall-runoff method • major reservoir influence (FARL<0.90) – consider flood routing • extensive floodplain storage – consider choice of method carefully	The catchment is not considered permeable with a BFIHOST <0.65 and SPRHOST >20%. The catchment has no reservoir influence. The catchment is predominantly rural.

Initial choice of method(s) and reasons Will the catchment be split into subcatchments? If so, how?	ReFH2 and FEH Statistical methods are appropriate. The flow estimates at the bottom of the modelled extents will be input into the top of the model as inflows.
Software to be used (with version numbers) edit or delete as applicable, or add others	FEH Webservice ReFH version 2.2 WINFAP-FEH Version 3.0.003 HEC-RAS 5.0.7

2.0 Locations where flood estimates are required

2.1 Summary of subject sites

The table below lists the locations of subject sites. Include site codes in all subsequent tables to save space.

Site code	Watercourse	Site	Easting	Northing	AREA on FEH Web Service (km^2)	Revised AREA if altered
gb 295900, 290600	River Trannon	Rhyd Y Carw Mill	295900	290600	29.58	N/A
Reasons for choosing above locations		This is at the downstream end of the site.				

2.2 Important catchment descriptors at each subject site (incorporating any changes made)

Site code	FARL	PROPWET	BFIHOST	DPLBAR (km)	DPSBAR (m/km)	SAAR (mm)	SPRHOST	URBEXT 2000	FPEXT
gb 295900, 290600	1.00	0.660	0.410	6.59	145.00	1559	44.95	0.0000	0.0360

2.3 Checking catchment descriptors

Item	Comment
Record how catchment boundary was checked • describe any changes • refer to maps if needed	The catchment boundary was checked by visually analysing its extent on the FEH Webservice Map and checking that the boundary appeared to be consistent with Ordnance Survey maps and Opendata LIDAR. The catchment was considered to be appropriate.
Record how other catchment descriptors were checked, especially soils • describe any changes • include a before and after table if necessary	Qualitative check on FARL using mapping. BFIHOST checked using BGS soil maps. The soil catchment details were checked by using Soilscapes soil type viewer for the catchment location. A visual assessment using Google Maps and the FEH Webservice Map was used to check the URBEXT2000 value and FARL. These values were consistent with the maps. No catchment descriptors were altered from the initial FEH catchment descriptors.
Source of URBEXT	FEH Webservice – UREBEXT2000
Method for updating URBEXT / URBAN	With a very low URBEXT value, it was not necessary to consider any updating.

3.0 Statistical method

3.1 Search for donor sites for QMED (if applicable)

Note that donor catchments will usually be rural but may be urban provided the data is deurbanised prior to the adjustment process. Please include a map if necessary.

Comment on potential donor sites Mention: • Number of potential donor sites available • Distances from subject site • Similarity in terms of AREA, BFIHOST, FARL and other catchment descriptors • Quality of flood peak data Include a map if necessary. Note that donor catchments should usually be rural.	An assessment of donor stations was carried out for this study using WINFAPFEH to assess stations that are suitable for QMED within the HiFlows-UK dataset. The search area was restricted to 10km because the effect that the new data transfer method has on QMED adjustment becomes negligible when the distance between catchment centroids is greater than 10km.

3.2 Donor sites chosen and QMED adjustment factors

NRFA number	Reasons for choosing or rejecting	Method (AM or POT)	Adjusted for climatic variation?	QMED from flow data (A)	QMED from catchment descriptors (B)	Adjustment ratio (A/B)
54014 (Severn @ Abermule)	Too large a catchment area at 574.66km^2.	-	-	-	8.64	-
54091 (Severn @ Hafren Flume)	Too large a catchment area at 3.44km^2 and SAAR value is too high at 2514.	-	-	-	9.47	-
54022 (Severn @ Plynlimon Flume)	Too large a catchment area at 8.69km^2 and SAAR value is too high at 2483.	-	-	-	9.75	-
Which version of the urban adjustment was used for QMED at donor sites, and why? Note: The guidelines recommend great caution in urban adjustment of QMED on catchments that are also highly permeable (BFIHOST>0.8).				None		

3.3 Overview of estimation of QMED at each subject site

Site code	Method	Initial estimate of QMED	Data transfer						Final estimate of QMED (m^3/s)
			NRFA numbers for donor sites used (see 3.2)	Distance between centroids dij (km)	Power term, a	Moderated QMED adjustment factor, (A/B)a	If more than one donor		
							Weight	Weighted average adjustment factor	
gb 295900, 290600	CD	26.58	N/A	N/A	N/A	N/A	N/A	N/A	26.58
Are the values of QMED consistent, for example at successive points along the watercourse and at confluences?						N/A			
Which version of the urban adjustment was used for QMED, and why?						None considered necessary.			

Notes
Methods: AM – Annual maxima; POT – Peaks over threshold; DT – Data transfer; CD – Catchment descriptors alone.
When QMED is estimated from POT data, it should also be adjusted for climatic variation. Details should be added.
When QMED is estimated from catchment descriptors, the revised 2008 equation from Science Report SC050050 should be used. If the original FEH equation has been used, say so and give the reason why.
The guidelines recommend great caution in urban adjustment of QMED on catchments that are also highly permeable (BFIHOST>0.8). The adjustment method used in WINFAP-FEH v3.0.003 is likely to overestimate adjustment factors for such catchments. In this case the only reliable flood estimates are likely to be derived from local flow data.
The data transfer procedure is from Science Report SC050050. The QMED adjustment factor A/B for each donor site is given in Table 3.3. This is moderated using the power term, a, which is a function of the distance between the centroids of the subject catchment and the donor catchment. The final estimate of QMED is (A/B)a times the initial estimate from catchment descriptors.
If more than one donor has been used, use multiple rows for the site and give the weights used in the averaging. Record the weighted average adjustment factor in the penultimate column.

3.4 Derivation of pooling groups

The composition of pooling groups is given in the Annex. Several subject sites may use the same pooling group.

Name of group	**Site code from whose descriptors group was derived**	**Subject site treated as gauged? (enhanced single site analysis)**	**Changes made to default pooling group, with reasons.** Include any sites that were investigated but retained in the group
River Trannon	gb 295900, 290600	No	None. See the FRA for further information. 524 years of data.
Notes	Pooling groups were derived using the procedures from Science Report SC050050 (2008).		

3.5 Derivation of flood growth curves at subject sites

Site code	**Method** (SS, P, ESS, FH)	**If P, ESS, or FH, name of pooling group** (3.4)	**Distribution used and reason for choice**	**Note any urban adjustment or permeable adjustment**	**Parameters of distribution** (location, scale, and shape) after adjustments	**Growth factor for 100-year return period**
gb 295900, 290600	P	River Trannon	GL has a lowest Z value	None, as catchment is rural	N/A	2.66

Notes
Methods: SS – Single site; P – Pooled; ESS – Enhanced single site; J – Joint analysis
A pooling group (or ESS analysis) derived at one gauge can be applied to estimate growth curves at a number of ungauged sites. Each site may have a different urban adjustment, and therefore different growth curve parameters.
Urban adjustments to growth curves should use the version 3 option in WINFAP-FEH: Kjeldsen (2010).
Growth curves were derived using the revised procedures from Science Report SC050050 (2008).

3.6 Flood estimates from the statistical method

	Flood peak (m^3/s) for the following return periods (in years)								
Site code	**2**	**5**	**10**	**20**	**50**	**100**	**200**	**500**	**1000**
gb 295900, 290600	26.58	36.69	42.41	49.78	60.91	70.80	82.22	100.12	116.19

4.0 Revitalised flood hydrograph (ReFH) 2 method

4.1 Parameters for ReFH2 model

If parameters are estimated from catchment descriptors, they are easily reproducible, so it is not essential to enter them in the table.

Site code	**Details of method** OPT: optimisation BR: base flow recession fitting CD: catchment descriptors DT: data transfer	**Tp (hours)** Time to peak	**C_{max} (mm) maximum storage capacity**	**BL (hours)** baseflow lag	**BR** baseflow recharge
gb 295900, 290600	CD	1.87	112.01	33.01	1.27
Brief description of any flood event analysis carried out Provide further details either here or in a project report			N/A		

4.2 Design events for ReFH2 method

We recommend that the ReFH2 technical guidance should be referred to when completing this table

Site code	**Urban or rural**	**Season of design event (summer or winter)**	**Storm duration (hours)**	**Storm area for ARF (if not catchment area)**	**Source of design rainfall statistic (FEH13 or FEH99)**
gb 295900, 290600	Rural	Winter	4.45	-	FEH13
Are the storm durations likely to be changed in the next stage of the study, e.g. by optimisation within a hydraulic model?				No	

4.3 Flood estimates from the ReFH2 method

Site code	**Flood peak (m^3/s) or volumes (m^3) for the following return periods (in years)**								
	2	**5**	**10**	**20**	**50**	**100**	**200**	**500**	**1000**
gb 295900, 290600	25.32	35.15	42.39	50.21	62.29	72.91	85.17	N/A	119.93

5.0 Discussion and summary of results

5.1 Comparison of results from different methods

This table compares peak flows from the ReFH2 method with those from the FEH Statistical method at each site for two key return periods.

	Return period 2 years (QMED)			Return period 100 years		
Site code	**Statistical**	**ReFH2**	**Ratio (ReFH2 / statistical)**	**Statistical**	**ReFH2**	**Ratio (ReFH2 / statistical)**
gb 295900, 290600	26.58	25.32	0.95	70.80	72.91	1.03

5.2 Final choice of method

Choice of method and reasons Include reference to type of study, nature of catchment, and type of data available	The ReFH2 Method yielded more conservative results than the FEH Statistical Method. Although in this case they are very similar and suggests that either method can be used on this occasion for a permeable catchment. The FEH Statistical method is the preferred method as a larger dataset of gauged data was used in the calibration of the method and it has been more directly calibrated to reproduce flood frequency on UK catchments. The ReFH2 method flows presented here are based solely on catchment descriptors. For this reason, there is lower confidence in the flow estimates derived from the ReFH model. The growth curves for the ReFH2 and the Statistical method are shown in Section 5.4. The growth curves show a relatively consistent relationship between the ReFH2 and Statistical growth curves. Although the Statistical method is preferred here over the ReFH2 method, there are significant uncertainties associated with applying it to events beyond the 1 in 200 year event, due to the typically short length of river gauge records. To reduce these uncertainties, a hybrid approach has been taken to derive the 1 in 1000 year event flow, as recommended in Natural Resources Wales guidance on flood estimation. The 1 in 1000 year event peak flows from the Statistical method have been adjusted using the ratio of the 1 in 1000 year and 1 in 100 year event flows from the ReFH2 model.

5.3 Assumptions, limitations, and uncertainty

List the main assumptions made specific to the study	It is assumed that: • QMED estimated from the catchment descriptors is representative • The pooling group is representative of the study catchment • ReFH2 hydrograph shape is representative of the catchment response.

Discuss any particular limitations For example applying methods outside the range of catchment types or return periods for which they were developed	The FEH Statistical method is generally believed to only be suitable for return periods up to 200 years (0.5% AEP event). ReFH is calibrated for return periods up to 150 years (0.67% AEP event). Estimates of flows beyond these return periods are extrapolations and have a higher degree of uncertainty.
Give what information you can on uncertainty in the results For example using the methods detailed in 'Making better use of local and historic data, and estimating uncertainty in FEH design flood estimation (FEH Local) SC130009	For the FEH Statistical method, the uncertainty will depend on a variety of factors, for example, how unusual the catchment is relative to the pooling group and donor catchment, and the uncertainty in flow measurement at other gauges. Recent guidance on the reliability of design flood estimates in the UK (Kjeldsen, 2014) quotes average UK measures of uncertainty. The 95% confidence limits for a 1% AEP event flood estimate are: • Without donor adjustment of QMED (CDs): 0.42 - 2.37 times the best estimate • With donor adjustment of QMED (DT): 0.45 - 2.25 times the best estimate
Comment on the suitability of the results for future studies For example at nearby locations or for different purposes	It is emphasised that the results of the analysis should be considered in the context of the needs of this study. The results of this assessment should be revisited for use on future studies.
Give any other comments on the study For example suggestions for additional work	None, other than efforts to make good records of flood events – especially in respect of peak flood levels.

5.4 Checks

Are the results consistent, for example at confluences?	None with study reach
What do the results imply regarding the return periods of floods during the period of record?	There is no flow gauge at the site of interest against which to compare the design flow estimates.
What is the 100-year growth factor? Is this realistic? (The guidance suggests a typical range of 2.1 - 4.0)	2.66. The normal range of values is 2.1-4.0. This is considered to be reasonable although at the lower end of the range. These values are realistic for a steep, wet catchment where flows are expected to be high for less frequent events (therefore constraining the flood growth curves).
If 1000-year flows have been derived, what is the range of ratios for the 1000-year flow over 100-year flow?	WINFAP FEH scaling factor: 1.64. ReFH 2 scaling factor: 1.65.
What is the range of specific runoffs (l/s/ha)? Are there any inconsistencies?	For the 1 in 100 year event, the range of specific runoffs equate to 23.94l/s/ha to 24.65l/s/ha. These are reasonable.
How did the results compare with those of other studies?	N/A

Explain any differences and conclude which results should be preferred	
Are the results compatible with the longer-term flood history?	Yes – in relation to the paucity of observed floods in the observational record.
Describe any other checks on the results	Modelled flood levels and extents will be sensibility-checked to ensure that flow inputs result in realistic outputs.

5.5 Final results

	Flood peak (m^3/s) for the following return periods (in years)								
Site code	**2**	**5**	**10**	**20**	**50**	**100**	**200**	**500**	**1000**
gb 295900, 290600	26.58	36.69	42.41	49.78	60.91	70.80	82.22	100.12	116.46*

* Guidance confirms that flood estimates for the FEH Statistical 1 in 1000 year event should be obtained by applying a scaling factor to the 1 in 100 year event. The scaling factor is obtained by dividing the 1 in 1000 year event by the 1 in 100 year estimate from the ReFH2 method.

If flood hydrographs are needed for the next stage of the study, where are they provided? For example give a name of spreadsheet, name of hydraulic model, or reference to table below	Not required

6.0 Annex

A.1 Pooling Group composition

	Station	Distance	Years of data	QMED AM	L-CV	L-SKEW	Discordancy
1	55017 (Chwefru @ Carreg-y-wen)	0.144	7	21.421	0.428	0.535	2.314
2	61003 (Gwaun @ Cilrhedyn Bridge)	0.167	39	20.679	0.157	0.030	0.915
3	21029 (Tweed @ Glenbreck)	0.269	9	37.765	0.069	0.138	2.384
4	48004 (Warleggan @ Trengoffe)	0.299	39	9.565	0.244	0.207	0.234
5	25012 (Harwood Beck @ Harwood)	0.308	39	31.368	0.176	0.264	0.572
6	60004 (Dewi Fawr @ Glasfryn Ford)	0.325	34	17.911	0.053	-0.097	1.809
7	67013 (Hirnant @ Plas Rhiwedog)	0.329	12	24.081	0.200	-0.026	2.375
8	72007 (Brock @ U/s a6)	0.337	30	29.438	0.194	0.273	2.025
9	48009 (st Neot @ Craigshill Wood)	0.409	12	8.469	0.246	0.372	0.426
10	48801 (Cober @ Trenear Intake)	0.454	21	2.591	0.265	0.252	0.309
11	27032 (Hebden Beck @ Hebden)	0.465	42	3.910	0.222	0.267	0.173
12	76811 (Dacre Beck @ Dacre Bridge)	0.481	9	34.576	0.250	0.345	2.185
13	21017 (Ettrick Water @ Brockhoperig)	0.504	41	60.364	0.203	0.276	0.167
14	48001 (Fowey @ Trekeivesteps)	0.512	39	16.858	0.220	0.300	0.169
15	48010 (Seaton @	0.517	36	6.470	0.236	0.254	0.262

	Station	Distance	Years of data	QMED AM	L-CV	L-SKEW	Discordancy
	Trebrownbridge)						
16	55015 (Honddu @ Tafolog)	0.521	29	16.682	0.337	0.355	0.920
17	47009 (Tiddy @ Tideford)	0.522	39	5.916	0.175	0.133	0.617
18	72013 (Borrowbeck @ Borrow Bridge Weir)	0.528	5	73.779	0.255	0.426	0.950
19	49003 (de Lank @ de Lank)	0.543	42	12.994	0.223	0.250	0.194
	Total		524				

APPENDIX 6 – FEH Statistical Method Calculations

Institute of Hydrology - Flood Peaks Database
Printed : 13 January 2021
Station : 999200 (gb 295900 290600 (sn 95900 90600))

Growth Curve Fittings

Standardised by median

Pooled L-moments

L-CV: 0.212
L-skewness: 0.215

Fitted parameters

	Location	Scale	Shape	Bound
GL	1.000	0.212	-0.215	0.015

Return periods

	GL
2	1.000
5	1.343
10	1.596
20	1.872
50	2.292
100	2.664
200	3.093
500	3.767
1000	4.371

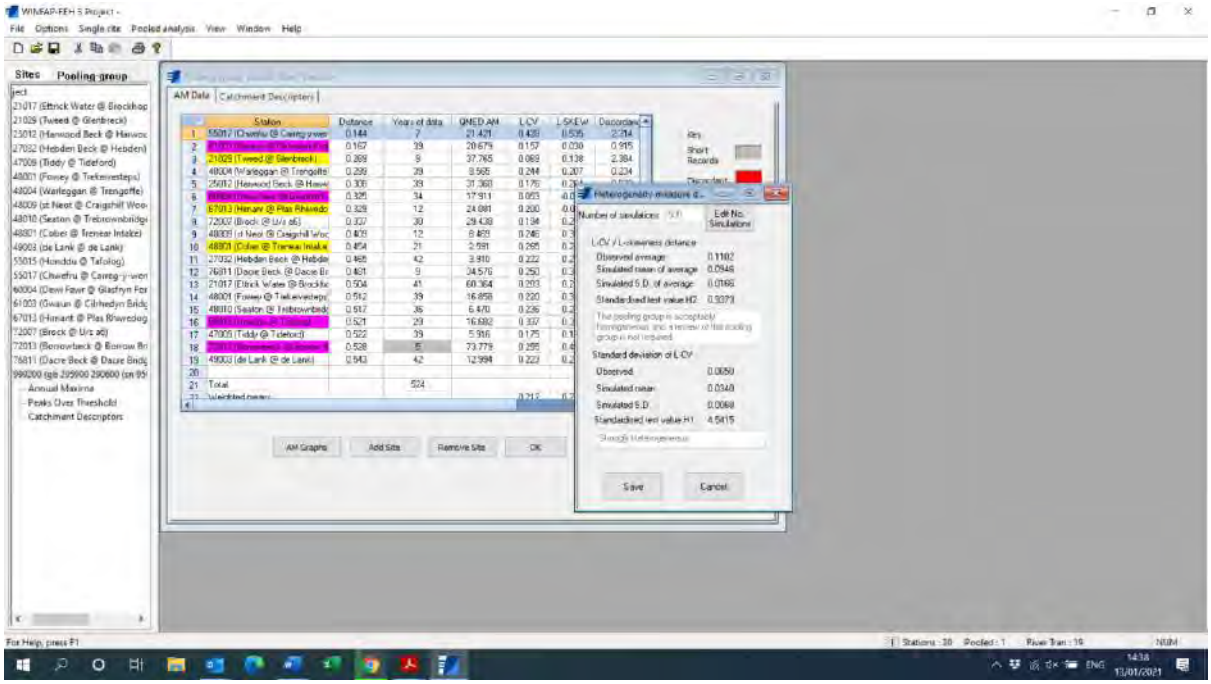
Institute of Hydrology - Flood Peaks Database
Printed : 13 January 2021
Station : 999200 (gb 295900 290600 (sn 95900 90600))

Fittings for FFC

Standardised by median

Return periods

	GL
2	26.580
5	35.685
10	42.415
20	49.748
50	60.911
100	70.801
200	82.216
500	100.118
1000	116.186


WINFAP-FEH 5 Project -
File Options Single site Pooled analysis View Window Help
Sites Pooling group
Annual Maxima
Peaks Over Threshold
Catchment Descriptors
AM Data
Catchment Descriptors
Station
Distance
Years of data
QMED AM
L-CV
L-SKEW
Key
Short Records
Discordant
AM Graphs
Add Site
Remove Site
OK
Number of simulations
Edit No. Simulations
L-CV / L-skewness distance
Observed average
Simulated mean of average
Simulated S.D. of average
Standardised test value H2
Standard deviation of L-CV
Observed
Simulated mean
Simulated S.D.
Standardised test value H1
Save
Cancel
For Help, press F1
Stations : 38
Pooled : 1
Rows Total : 38
NUM
ENG
14:38
13/01/2021

APPENDIX 7 – ReFH2 Method Calculations

UK Design Flood Estimation

Generated on 14 January 2021 08:59:21 by Emma
Printed from the ReFH2 Flood Modelling software package, version 3.1.7439.12207

Summary of estimate using the Flood Estimation Handbook revitalised flood hydrograph method (ReFH2)

Site details Checksum: 8F9D-35EA

Site name: FEH_Catchment_Descriptors_295900_290600

Easting: 295900

Northing: 290600

Country: England, Wales or Northern Ireland

Catchment Area (km²): 29.58

Using plot scale calculations: No

Model: ReFH2.2

Site description: None

Model run: 2 year

Summary of results

Rainfall - FEH 2013 model (mm):	30.51	Total runoff (ML):	317.52
Total Rainfall (mm):	24.30	Total flow (ML):	720.17
Peak Rainfall (mm):	3.31	Peak flow (m³/s):	25.32

Parameters

Where the user has overriden a system-generated value, this original value is shown in square brackets after the value used.
** Indicates that the user locked the duration/timestep*

Rainfall parameters (Rainfall - FEH 2013 model)

Name	Value	User-defined?
Duration (hh:mm:ss)	04:45:00	No
Timestep (hh:mm:ss)	00:15:00	No
SCF (Seasonal correction factor)	0.86	No
ARF (Areal reduction factor)	0.93	No
Seasonality	Winter	No

Loss model parameters

Name	Value	User-defined?
Cini (mm)	112.01	No
Cmax (mm)	281.13	No
Use alpha correction factor	No	No
Alpha correction factor	n/a	No
Use seasonal CIni for equations	Yes	No

Routing model parameters

Name	Value	User-defined?
Tp (hr)	1.87	No
Up	0.65	No
Uk	0.8	No

Baseflow model parameters

Name	Value	User-defined?
BF0 (m^3/s)	2.39	No
BL (hr)	33.01	No
BR	1.27	No

Urbanisation parameters

Name	Value	User-defined?
Urban area (km^2)	0	No
Urbext 2000	0	No
Impervious runoff factor	0.7	No
Imperviousness factor	0.3	No
Tp scaling factor	0.5	No
Exporting drained area (km^2)	0.00	Yes
Sewer capacity (m^3/s)	0.00	Yes

Time series data

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
00:00:00	0.275	0.000	0.110	0.000	2.389	2.389
00:15:00	0.371	0.000	0.148	0.021	2.371	2.392
00:30:00	0.500	0.000	0.201	0.091	2.354	2.445
00:45:00	0.673	0.000	0.272	0.229	2.338	2.566
01:00:00	0.904	0.000	0.367	0.457	2.323	2.780
01:15:00	1.210	0.000	0.497	0.807	2.312	3.119
01:30:00	1.615	0.000	0.671	1.322	2.305	3.627
01:45:00	2.142	0.000	0.904	2.062	2.303	4.365
02:00:00	2.806	0.000	1.209	3.093	2.311	5.403
02:15:00	3.314	0.000	1.464	4.466	2.329	6.795
02:30:00	2.806	0.000	1.270	6.259	2.363	8.622
02:45:00	2.142	0.000	0.988	8.450	2.416	10.866
03:00:00	1.615	0.000	0.756	10.906	2.490	13.396
03:15:00	1.210	0.000	0.572	13.467	2.588	16.055
03:30:00	0.904	0.000	0.431	15.976	2.709	18.685
03:45:00	0.673	0.000	0.323	18.261	2.852	21.113
04:00:00	0.500	0.000	0.241	20.139	3.015	23.153
04:15:00	0.371	0.000	0.179	21.406	3.191	24.596
04:30:00	0.275	0.000	0.133	21.920	3.374	25.294
04:45:00	0.000	0.000	0.000	21.765	3.557	25.322
05:00:00	0.000	0.000	0.000	21.077	3.735	24.812
05:15:00	0.000	0.000	0.000	19.986	3.904	23.889
05:30:00	0.000	0.000	0.000	18.620	4.059	22.679
05:45:00	0.000	0.000	0.000	17.093	4.199	21.292
06:00:00	0.000	0.000	0.000	15.504	4.323	19.827
06:15:00	0.000	0.000	0.000	13.937	4.431	18.368
06:30:00	0.000	0.000	0.000	12.429	4.524	16.953
06:45:00	0.000	0.000	0.000	10.987	4.602	15.589
07:00:00	0.000	0.000	0.000	9.651	4.666	14.317
07:15:00	0.000	0.000	0.000	8.409	4.717	13.126
07:30:00	0.000	0.000	0.000	7.246	4.756	12.003
07:45:00	0.000	0.000	0.000	6.154	4.785	10.939
08:00:00	0.000	0.000	0.000	5.130	4.802	9.933
08:15:00	0.000	0.000	0.000	4.177	4.811	8.987
08:30:00	0.000	0.000	0.000	3.303	4.810	8.113

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
08:45:00	0.000	0.000	0.000	2.518	4.802	7.320
09:00:00	0.000	0.000	0.000	1.842	4.786	6.629
09:15:00	0.000	0.000	0.000	1.303	4.765	6.068
09:30:00	0.000	0.000	0.000	0.896	4.740	5.636
09:45:00	0.000	0.000	0.000	0.599	4.711	5.310
10:00:00	0.000	0.000	0.000	0.384	4.680	5.065
10:15:00	0.000	0.000	0.000	0.234	4.648	4.882
10:30:00	0.000	0.000	0.000	0.131	4.615	4.746
10:45:00	0.000	0.000	0.000	0.064	4.581	4.645
11:00:00	0.000	0.000	0.000	0.025	4.547	4.571
11:15:00	0.000	0.000	0.000	0.005	4.512	4.517
11:30:00	0.000	0.000	0.000	0.000	4.478	4.478
11:45:00	0.000	0.000	0.000	0.000	4.445	4.445
12:00:00	0.000	0.000	0.000	0.000	4.411	4.411
12:15:00	0.000	0.000	0.000	0.000	4.378	4.378
12:30:00	0.000	0.000	0.000	0.000	4.345	4.345
12:45:00	0.000	0.000	0.000	0.000	4.312	4.312
13:00:00	0.000	0.000	0.000	0.000	4.279	4.279
13:15:00	0.000	0.000	0.000	0.000	4.247	4.247
13:30:00	0.000	0.000	0.000	0.000	4.215	4.215
13:45:00	0.000	0.000	0.000	0.000	4.183	4.183
14:00:00	0.000	0.000	0.000	0.000	4.152	4.152
14:15:00	0.000	0.000	0.000	0.000	4.120	4.120
14:30:00	0.000	0.000	0.000	0.000	4.089	4.089
14:45:00	0.000	0.000	0.000	0.000	4.058	4.058
15:00:00	0.000	0.000	0.000	0.000	4.028	4.028
15:15:00	0.000	0.000	0.000	0.000	3.997	3.997
15:30:00	0.000	0.000	0.000	0.000	3.967	3.967
15:45:00	0.000	0.000	0.000	0.000	3.937	3.937
16:00:00	0.000	0.000	0.000	0.000	3.908	3.908
16:15:00	0.000	0.000	0.000	0.000	3.878	3.878
16:30:00	0.000	0.000	0.000	0.000	3.849	3.849
16:45:00	0.000	0.000	0.000	0.000	3.820	3.820
17:00:00	0.000	0.000	0.000	0.000	3.791	3.791
17:15:00	0.000	0.000	0.000	0.000	3.762	3.762
17:30:00	0.000	0.000	0.000	0.000	3.734	3.734

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
17:45:00	0.000	0.000	0.000	0.000	3.706	3.706
18:00:00	0.000	0.000	0.000	0.000	3.678	3.678
18:15:00	0.000	0.000	0.000	0.000	3.650	3.650
18:30:00	0.000	0.000	0.000	0.000	3.623	3.623
18:45:00	0.000	0.000	0.000	0.000	3.595	3.595
19:00:00	0.000	0.000	0.000	0.000	3.568	3.568
19:15:00	0.000	0.000	0.000	0.000	3.541	3.541
19:30:00	0.000	0.000	0.000	0.000	3.515	3.515
19:45:00	0.000	0.000	0.000	0.000	3.488	3.488
20:00:00	0.000	0.000	0.000	0.000	3.462	3.462
20:15:00	0.000	0.000	0.000	0.000	3.436	3.436
20:30:00	0.000	0.000	0.000	0.000	3.410	3.410
20:45:00	0.000	0.000	0.000	0.000	3.384	3.384
21:00:00	0.000	0.000	0.000	0.000	3.358	3.358
21:15:00	0.000	0.000	0.000	0.000	3.333	3.333
21:30:00	0.000	0.000	0.000	0.000	3.308	3.308
21:45:00	0.000	0.000	0.000	0.000	3.283	3.283
22:00:00	0.000	0.000	0.000	0.000	3.258	3.258
22:15:00	0.000	0.000	0.000	0.000	3.234	3.234
22:30:00	0.000	0.000	0.000	0.000	3.209	3.209
22:45:00	0.000	0.000	0.000	0.000	3.185	3.185
23:00:00	0.000	0.000	0.000	0.000	3.161	3.161
23:15:00	0.000	0.000	0.000	0.000	3.137	3.137
23:30:00	0.000	0.000	0.000	0.000	3.113	3.113
23:45:00	0.000	0.000	0.000	0.000	3.090	3.090
24:00:00	0.000	0.000	0.000	0.000	3.067	3.067
24:15:00	0.000	0.000	0.000	0.000	3.043	3.043
24:30:00	0.000	0.000	0.000	0.000	3.020	3.020
24:45:00	0.000	0.000	0.000	0.000	2.998	2.998
25:00:00	0.000	0.000	0.000	0.000	2.975	2.975
25:15:00	0.000	0.000	0.000	0.000	2.953	2.953
25:30:00	0.000	0.000	0.000	0.000	2.930	2.930
25:45:00	0.000	0.000	0.000	0.000	2.908	2.908
26:00:00	0.000	0.000	0.000	0.000	2.886	2.886
26:15:00	0.000	0.000	0.000	0.000	2.865	2.865
26:30:00	0.000	0.000	0.000	0.000	2.843	2.843

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
26:45:00	0.000	0.000	0.000	0.000	2.821	2.821
27:00:00	0.000	0.000	0.000	0.000	2.800	2.800
27:15:00	0.000	0.000	0.000	0.000	2.779	2.779
27:30:00	0.000	0.000	0.000	0.000	2.758	2.758
27:45:00	0.000	0.000	0.000	0.000	2.737	2.737
28:00:00	0.000	0.000	0.000	0.000	2.717	2.717
28:15:00	0.000	0.000	0.000	0.000	2.696	2.696
28:30:00	0.000	0.000	0.000	0.000	2.676	2.676
28:45:00	0.000	0.000	0.000	0.000	2.656	2.656
29:00:00	0.000	0.000	0.000	0.000	2.636	2.636
29:15:00	0.000	0.000	0.000	0.000	2.616	2.616
29:30:00	0.000	0.000	0.000	0.000	2.596	2.596
29:45:00	0.000	0.000	0.000	0.000	2.576	2.576
30:00:00	0.000	0.000	0.000	0.000	2.557	2.557
30:15:00	0.000	0.000	0.000	0.000	2.538	2.538
30:30:00	0.000	0.000	0.000	0.000	2.518	2.518
30:45:00	0.000	0.000	0.000	0.000	2.499	2.499
31:00:00	0.000	0.000	0.000	0.000	2.481	2.481
31:15:00	0.000	0.000	0.000	0.000	2.462	2.462
31:30:00	0.000	0.000	0.000	0.000	2.443	2.443
31:45:00	0.000	0.000	0.000	0.000	2.425	2.425
32:00:00	0.000	0.000	0.000	0.000	2.407	2.407

Appendix

Catchment descriptors

Name	Value	User-defined value used?
Area (km^2)	29.58	No
ALTBAR	358	No
ASPBAR	147	No
ASPVAR	0.16	No
BFIHOST	0.41	No
DPLBAR (km)	6.59	No
DPSBAR (mkm^{-1})	145	No
FARL	1	No
LDP	12.94	No
PROPWET (mm)	0.66	No
RMED1H	10.9	No
RMED1D	50.4	No
RMED2D	62.8	No
SAAR (mm)	1559	No
SAAR4170 (mm)	1492	No
SPRHOST	44.95	No
Urbext2000	0	No
Urbext1990	0	No
URBCONC	0	No
URBLOC	0	No
DDF parameter C	-0.03	No
DDF parameter D1	0.48	No
DDF parameter D2	0.39	No
DDF parameter D3	0.38	No
DDF parameter E	0.29	No
DDF parameter F	2.47	No
DDF parameter C (1km grid value)	-0.03	No
DDF parameter D1 (1km grid value)	0.48	No
DDF parameter D2 (1km grid value)	0.38	No
DDF parameter D3 (1km grid value)	0.38	No
DDF parameter E (1km grid value)	0.29	No
DDF parameter F (1km grid value)	2.37	No

UK Design Flood Estimation

Generated on 14 January 2021 08:59:45 by Emma
Printed from the ReFH2 Flood Modelling software package, version 3.1.7439.12207

Summary of estimate using the Flood Estimation Handbook revitalised flood hydrograph method (ReFH2)

Site details Checksum: 8F9D-35EA

Site name: FEH_Catchment_Descriptors_295900_290600

Easting: 295900

Northing: 290600

Country: England, Wales or Northern Ireland

Catchment Area (km²): 29.58

Using plot scale calculations: No

Model: ReFH2.2

Site description: None

Model run: 20 year

Summary of results

Rainfall - FEH 2013 model (mm):	57.94	Total runoff (ML):	655.97
Total Rainfall (mm):	46.15	Total flow (ML):	1486.88
Peak Rainfall (mm):	6.29	Peak flow (m³/s):	50.21

Parameters

Where the user has overriden a system-generated value, this original value is shown in square brackets after the value used.
** Indicates that the user locked the duration/timestep*

Rainfall parameters (Rainfall - FEH 2013 model)

Name	Value	User-defined?
Duration (hh:mm:ss)	04:45:00	No
Timestep (hh:mm:ss)	00:15:00	No
SCF (Seasonal correction factor)	0.86	No
ARF (Areal reduction factor)	0.93	No
Seasonality	Winter	No

Loss model parameters

Name	Value	User-defined?
Cini (mm)	112.01	No
Cmax (mm)	281.13	No
Use alpha correction factor	No	No
Alpha correction factor	n/a	No
Use seasonal CIni for equations	Yes	No

Routing model parameters

Name	Value	User-defined?
Tp (hr)	1.87	No
Up	0.65	No
Uk	0.8	No

Baseflow model parameters

Name	Value	User-defined?
BF0 (m^3/s)	2.39	No
BL (hr)	33.01	No
BR	1.27	No

Urbanisation parameters

Name	Value	User-defined?
Urban area (km^2)	0	No
Urbext 2000	0	No
Impervious runoff factor	0.7	No
Imperviousness factor	0.3	No
Tp scaling factor	0.5	No
Exporting drained area (km^2)	0.00	Yes
Sewer capacity (m^3/s)	0.00	Yes

Time series data

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
00:00:00	0.522	0.000	0.209	0.000	2.389	2.389
00:15:00	0.705	0.000	0.283	0.040	2.371	2.411
00:30:00	0.950	0.000	0.384	0.174	2.354	2.528
00:45:00	1.278	0.000	0.522	0.436	2.340	2.775
01:00:00	1.716	0.000	0.710	0.871	2.328	3.199
01:15:00	2.298	0.000	0.967	1.542	2.322	3.864
01:30:00	3.066	0.000	1.320	2.535	2.324	4.859
01:45:00	4.067	0.000	1.802	3.965	2.338	6.303
02:00:00	5.327	0.000	2.450	5.975	2.368	8.343
02:15:00	6.293	0.000	3.024	8.681	2.420	11.101
02:30:00	5.327	0.000	2.670	12.259	2.502	14.761
02:45:00	4.067	0.000	2.106	16.689	2.621	19.311
03:00:00	3.066	0.000	1.627	21.710	2.785	24.495
03:15:00	2.298	0.000	1.241	27.005	2.997	30.003
03:30:00	1.716	0.000	0.939	32.250	3.258	35.508
03:45:00	1.278	0.000	0.706	37.092	3.565	40.658
04:00:00	0.950	0.000	0.529	41.147	3.913	45.060
04:15:00	0.705	0.000	0.394	43.976	4.290	48.267
04:30:00	0.522	0.000	0.293	45.258	4.685	49.942
04:45:00	0.000	0.000	0.000	45.132	5.082	50.214
05:00:00	0.000	0.000	0.000	43.865	5.469	49.334
05:15:00	0.000	0.000	0.000	41.718	5.837	47.556
05:30:00	0.000	0.000	0.000	38.964	6.179	45.143
05:45:00	0.000	0.000	0.000	35.837	6.490	42.327
06:00:00	0.000	0.000	0.000	32.551	6.768	39.319
06:15:00	0.000	0.000	0.000	29.289	7.013	36.302
06:30:00	0.000	0.000	0.000	26.139	7.225	33.364
06:45:00	0.000	0.000	0.000	23.123	7.406	30.529
07:00:00	0.000	0.000	0.000	20.329	7.558	27.887
07:15:00	0.000	0.000	0.000	17.736	7.683	25.420
07:30:00	0.000	0.000	0.000	15.312	7.783	23.096
07:45:00	0.000	0.000	0.000	13.035	7.860	20.896
08:00:00	0.000	0.000	0.000	10.898	7.915	18.814
08:15:00	0.000	0.000	0.000	8.905	7.950	16.856
08:30:00	0.000	0.000	0.000	7.073	7.967	15.039

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
08:45:00	0.000	0.000	0.000	5.418	7.966	13.385
09:00:00	0.000	0.000	0.000	3.985	7.951	11.936
09:15:00	0.000	0.000	0.000	2.831	7.924	10.755
09:30:00	0.000	0.000	0.000	1.955	7.887	9.842
09:45:00	0.000	0.000	0.000	1.309	7.843	9.152
10:00:00	0.000	0.000	0.000	0.842	7.794	8.637
10:15:00	0.000	0.000	0.000	0.513	7.742	8.255
10:30:00	0.000	0.000	0.000	0.288	7.687	7.975
10:45:00	0.000	0.000	0.000	0.142	7.631	7.773
11:00:00	0.000	0.000	0.000	0.054	7.575	7.629
11:15:00	0.000	0.000	0.000	0.011	7.518	7.529
11:30:00	0.000	0.000	0.000	0.000	7.461	7.461
11:45:00	0.000	0.000	0.000	0.000	7.405	7.405
12:00:00	0.000	0.000	0.000	0.000	7.349	7.349
12:15:00	0.000	0.000	0.000	0.000	7.294	7.294
12:30:00	0.000	0.000	0.000	0.000	7.239	7.239
12:45:00	0.000	0.000	0.000	0.000	7.184	7.184
13:00:00	0.000	0.000	0.000	0.000	7.130	7.130
13:15:00	0.000	0.000	0.000	0.000	7.076	7.076
13:30:00	0.000	0.000	0.000	0.000	7.023	7.023
13:45:00	0.000	0.000	0.000	0.000	6.970	6.970
14:00:00	0.000	0.000	0.000	0.000	6.917	6.917
14:15:00	0.000	0.000	0.000	0.000	6.865	6.865
14:30:00	0.000	0.000	0.000	0.000	6.813	6.813
14:45:00	0.000	0.000	0.000	0.000	6.762	6.762
15:00:00	0.000	0.000	0.000	0.000	6.711	6.711
15:15:00	0.000	0.000	0.000	0.000	6.660	6.660
15:30:00	0.000	0.000	0.000	0.000	6.610	6.610
15:45:00	0.000	0.000	0.000	0.000	6.560	6.560
16:00:00	0.000	0.000	0.000	0.000	6.510	6.510
16:15:00	0.000	0.000	0.000	0.000	6.461	6.461
16:30:00	0.000	0.000	0.000	0.000	6.412	6.412
16:45:00	0.000	0.000	0.000	0.000	6.364	6.364
17:00:00	0.000	0.000	0.000	0.000	6.316	6.316
17:15:00	0.000	0.000	0.000	0.000	6.268	6.268
17:30:00	0.000	0.000	0.000	0.000	6.221	6.221

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
17:45:00	0.000	0.000	0.000	0.000	6.174	6.174
18:00:00	0.000	0.000	0.000	0.000	6.128	6.128
18:15:00	0.000	0.000	0.000	0.000	6.081	6.081
18:30:00	0.000	0.000	0.000	0.000	6.035	6.035
18:45:00	0.000	0.000	0.000	0.000	5.990	5.990
19:00:00	0.000	0.000	0.000	0.000	5.945	5.945
19:15:00	0.000	0.000	0.000	0.000	5.900	5.900
19:30:00	0.000	0.000	0.000	0.000	5.855	5.855
19:45:00	0.000	0.000	0.000	0.000	5.811	5.811
20:00:00	0.000	0.000	0.000	0.000	5.767	5.767
20:15:00	0.000	0.000	0.000	0.000	5.724	5.724
20:30:00	0.000	0.000	0.000	0.000	5.681	5.681
20:45:00	0.000	0.000	0.000	0.000	5.638	5.638
21:00:00	0.000	0.000	0.000	0.000	5.595	5.595
21:15:00	0.000	0.000	0.000	0.000	5.553	5.553
21:30:00	0.000	0.000	0.000	0.000	5.511	5.511
21:45:00	0.000	0.000	0.000	0.000	5.469	5.469
22:00:00	0.000	0.000	0.000	0.000	5.428	5.428
22:15:00	0.000	0.000	0.000	0.000	5.387	5.387
22:30:00	0.000	0.000	0.000	0.000	5.347	5.347
22:45:00	0.000	0.000	0.000	0.000	5.306	5.306
23:00:00	0.000	0.000	0.000	0.000	5.266	5.266
23:15:00	0.000	0.000	0.000	0.000	5.226	5.226
23:30:00	0.000	0.000	0.000	0.000	5.187	5.187
23:45:00	0.000	0.000	0.000	0.000	5.148	5.148
24:00:00	0.000	0.000	0.000	0.000	5.109	5.109
24:15:00	0.000	0.000	0.000	0.000	5.070	5.070
24:30:00	0.000	0.000	0.000	0.000	5.032	5.032
24:45:00	0.000	0.000	0.000	0.000	4.994	4.994
25:00:00	0.000	0.000	0.000	0.000	4.957	4.957
25:15:00	0.000	0.000	0.000	0.000	4.919	4.919
25:30:00	0.000	0.000	0.000	0.000	4.882	4.882
25:45:00	0.000	0.000	0.000	0.000	4.845	4.845
26:00:00	0.000	0.000	0.000	0.000	4.809	4.809
26:15:00	0.000	0.000	0.000	0.000	4.772	4.772
26:30:00	0.000	0.000	0.000	0.000	4.736	4.736

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
26:45:00	0.000	0.000	0.000	0.000	4.701	4.701
27:00:00	0.000	0.000	0.000	0.000	4.665	4.665
27:15:00	0.000	0.000	0.000	0.000	4.630	4.630
27:30:00	0.000	0.000	0.000	0.000	4.595	4.595
27:45:00	0.000	0.000	0.000	0.000	4.560	4.560
28:00:00	0.000	0.000	0.000	0.000	4.526	4.526
28:15:00	0.000	0.000	0.000	0.000	4.492	4.492
28:30:00	0.000	0.000	0.000	0.000	4.458	4.458
28:45:00	0.000	0.000	0.000	0.000	4.424	4.424
29:00:00	0.000	0.000	0.000	0.000	4.391	4.391
29:15:00	0.000	0.000	0.000	0.000	4.358	4.358
29:30:00	0.000	0.000	0.000	0.000	4.325	4.325
29:45:00	0.000	0.000	0.000	0.000	4.292	4.292
30:00:00	0.000	0.000	0.000	0.000	4.260	4.260
30:15:00	0.000	0.000	0.000	0.000	4.228	4.228
30:30:00	0.000	0.000	0.000	0.000	4.196	4.196
30:45:00	0.000	0.000	0.000	0.000	4.164	4.164
31:00:00	0.000	0.000	0.000	0.000	4.133	4.133
31:15:00	0.000	0.000	0.000	0.000	4.102	4.102
31:30:00	0.000	0.000	0.000	0.000	4.071	4.071
31:45:00	0.000	0.000	0.000	0.000	4.040	4.040
32:00:00	0.000	0.000	0.000	0.000	4.009	4.009
32:15:00	0.000	0.000	0.000	0.000	3.979	3.979
32:30:00	0.000	0.000	0.000	0.000	3.949	3.949
32:45:00	0.000	0.000	0.000	0.000	3.919	3.919
33:00:00	0.000	0.000	0.000	0.000	3.890	3.890
33:15:00	0.000	0.000	0.000	0.000	3.860	3.860
33:30:00	0.000	0.000	0.000	0.000	3.831	3.831
33:45:00	0.000	0.000	0.000	0.000	3.802	3.802
34:00:00	0.000	0.000	0.000	0.000	3.774	3.774
34:15:00	0.000	0.000	0.000	0.000	3.745	3.745
34:30:00	0.000	0.000	0.000	0.000	3.717	3.717
34:45:00	0.000	0.000	0.000	0.000	3.689	3.689
35:00:00	0.000	0.000	0.000	0.000	3.661	3.661
35:15:00	0.000	0.000	0.000	0.000	3.633	3.633
35:30:00	0.000	0.000	0.000	0.000	3.606	3.606

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
35:45:00	0.000	0.000	0.000	0.000	3.579	3.579
36:00:00	0.000	0.000	0.000	0.000	3.552	3.552
36:15:00	0.000	0.000	0.000	0.000	3.525	3.525
36:30:00	0.000	0.000	0.000	0.000	3.498	3.498
36:45:00	0.000	0.000	0.000	0.000	3.472	3.472
37:00:00	0.000	0.000	0.000	0.000	3.446	3.446
37:15:00	0.000	0.000	0.000	0.000	3.420	3.420
37:30:00	0.000	0.000	0.000	0.000	3.394	3.394
37:45:00	0.000	0.000	0.000	0.000	3.368	3.368
38:00:00	0.000	0.000	0.000	0.000	3.343	3.343
38:15:00	0.000	0.000	0.000	0.000	3.318	3.318
38:30:00	0.000	0.000	0.000	0.000	3.293	3.293
38:45:00	0.000	0.000	0.000	0.000	3.268	3.268
39:00:00	0.000	0.000	0.000	0.000	3.243	3.243
39:15:00	0.000	0.000	0.000	0.000	3.219	3.219
39:30:00	0.000	0.000	0.000	0.000	3.194	3.194
39:45:00	0.000	0.000	0.000	0.000	3.170	3.170
40:00:00	0.000	0.000	0.000	0.000	3.146	3.146
40:15:00	0.000	0.000	0.000	0.000	3.123	3.123
40:30:00	0.000	0.000	0.000	0.000	3.099	3.099
40:45:00	0.000	0.000	0.000	0.000	3.076	3.076
41:00:00	0.000	0.000	0.000	0.000	3.053	3.053
41:15:00	0.000	0.000	0.000	0.000	3.029	3.029
41:30:00	0.000	0.000	0.000	0.000	3.007	3.007
41:45:00	0.000	0.000	0.000	0.000	2.984	2.984
42:00:00	0.000	0.000	0.000	0.000	2.961	2.961
42:15:00	0.000	0.000	0.000	0.000	2.939	2.939
42:30:00	0.000	0.000	0.000	0.000	2.917	2.917
42:45:00	0.000	0.000	0.000	0.000	2.895	2.895
43:00:00	0.000	0.000	0.000	0.000	2.873	2.873
43:15:00	0.000	0.000	0.000	0.000	2.851	2.851
43:30:00	0.000	0.000	0.000	0.000	2.830	2.830
43:45:00	0.000	0.000	0.000	0.000	2.808	2.808
44:00:00	0.000	0.000	0.000	0.000	2.787	2.787
44:15:00	0.000	0.000	0.000	0.000	2.766	2.766
44:30:00	0.000	0.000	0.000	0.000	2.745	2.745

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
44:45:00	0.000	0.000	0.000	0.000	2.725	2.725
45:00:00	0.000	0.000	0.000	0.000	2.704	2.704
45:15:00	0.000	0.000	0.000	0.000	2.684	2.684
45:30:00	0.000	0.000	0.000	0.000	2.663	2.663
45:45:00	0.000	0.000	0.000	0.000	2.643	2.643
46:00:00	0.000	0.000	0.000	0.000	2.623	2.623
46:15:00	0.000	0.000	0.000	0.000	2.604	2.604
46:30:00	0.000	0.000	0.000	0.000	2.584	2.584
46:45:00	0.000	0.000	0.000	0.000	2.564	2.564
47:00:00	0.000	0.000	0.000	0.000	2.545	2.545
47:15:00	0.000	0.000	0.000	0.000	2.526	2.526
47:30:00	0.000	0.000	0.000	0.000	2.507	2.507
47:45:00	0.000	0.000	0.000	0.000	2.488	2.488
48:00:00	0.000	0.000	0.000	0.000	2.469	2.469
48:15:00	0.000	0.000	0.000	0.000	2.451	2.451
48:30:00	0.000	0.000	0.000	0.000	2.432	2.432
48:45:00	0.000	0.000	0.000	0.000	2.414	2.414

Appendix

Catchment descriptors

Name	Value	User-defined value used?
Area (km^2)	29.58	No
ALTBAR	358	No
ASPBAR	147	No
ASPVAR	0.16	No
BFIHOST	0.41	No
DPLBAR (km)	6.59	No
DPSBAR (mkm^{-1})	145	No
FARL	1	No
LDP	12.94	No
PROPWET (mm)	0.66	No
RMED1H	10.9	No
RMED1D	50.4	No
RMED2D	62.8	No
SAAR (mm)	1559	No
SAAR4170 (mm)	1492	No
SPRHOST	44.95	No
Urbext2000	0	No
Urbext1990	0	No
URBCONC	0	No
URBLOC	0	No
DDF parameter C	-0.03	No
DDF parameter D1	0.48	No
DDF parameter D2	0.39	No
DDF parameter D3	0.38	No
DDF parameter E	0.29	No
DDF parameter F	2.47	No
DDF parameter C (1km grid value)	-0.03	No
DDF parameter D1 (1km grid value)	0.48	No
DDF parameter D2 (1km grid value)	0.38	No
DDF parameter D3 (1km grid value)	0.38	No
DDF parameter E (1km grid value)	0.29	No
DDF parameter F (1km grid value)	2.37	No

UK Design Flood Estimation

Generated on 14 January 2021 08:59:59 by Emma
Printed from the ReFH2 Flood Modelling software package, version 3.1.7439.12207

Summary of estimate using the Flood Estimation Handbook revitalised flood hydrograph method (ReFH2)

Site details Checksum: 8F9D-35EA

Site name: FEH_Catchment_Descriptors_295900_290600

Easting: 295900

Northing: 290600

Country: England, Wales or Northern Ireland

Catchment Area (km²): 29.58

Using plot scale calculations: No

Model: ReFH2.2

Site description: None

Model run: 50 year

Summary of results

Rainfall - FEH 2013 model (mm):	69.94	Total runoff (ML):	819.83
Total Rainfall (mm):	55.71	Total flow (ML):	1859.81
Peak Rainfall (mm):	7.60	Peak flow (m³/s):	62.29

Parameters

Where the user has overriden a system-generated value, this original value is shown in square brackets after the value used.
** Indicates that the user locked the duration/timestep*

Rainfall parameters (Rainfall - FEH 2013 model)

Name	Value	User-defined?
Duration (hh:mm:ss)	04:45:00	No
Timestep (hh:mm:ss)	00:15:00	No
SCF (Seasonal correction factor)	0.86	No
ARF (Areal reduction factor)	0.93	No
Seasonality	Winter	No

Loss model parameters

Name	Value	User-defined?
Cini (mm)	112.01	No
Cmax (mm)	281.13	No
Use alpha correction factor	No	No
Alpha correction factor	n/a	No
Use seasonal CIni for equations	Yes	No

Routing model parameters

Name	Value	User-defined?
Tp (hr)	1.87	No
Up	0.65	No
Uk	0.8	No

Baseflow model parameters

Name	Value	User-defined?
BF0 (m^3/s)	2.39	No
BL (hr)	33.01	No
BR	1.27	No

Urbanisation parameters

Name	Value	User-defined?
Urban area (km^2)	0	No
Urbext 2000	0	No
Impervious runoff factor	0.7	No
Imperviousness factor	0.3	No
Tp scaling factor	0.5	No
Exporting drained area (km^2)	0.00	Yes
Sewer capacity (m^3/s)	0.00	Yes

Time series data

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
00:00:00	0.630	0.000	0.252	0.000	2.389	2.389
00:15:00	0.851	0.000	0.342	0.048	2.371	2.420
00:30:00	1.146	0.000	0.465	0.210	2.355	2.565
00:45:00	1.543	0.000	0.633	0.527	2.340	2.867
01:00:00	2.071	0.000	0.864	1.054	2.330	3.384
01:15:00	2.774	0.000	1.180	1.867	2.327	4.194
01:30:00	3.701	0.000	1.618	3.072	2.333	5.405
01:45:00	4.909	0.000	2.221	4.813	2.353	7.166
02:00:00	6.431	0.000	3.039	7.267	2.393	9.660
02:15:00	7.596	0.000	3.779	10.585	2.460	13.045
02:30:00	6.431	0.000	3.360	14.996	2.564	17.560
02:45:00	4.909	0.000	2.664	20.485	2.715	23.200
03:00:00	3.701	0.000	2.065	26.735	2.920	29.655
03:15:00	2.774	0.000	1.580	33.354	3.185	36.540
03:30:00	2.071	0.000	1.197	39.939	3.512	43.451
03:45:00	1.543	0.000	0.902	46.050	3.897	49.947
04:00:00	1.146	0.000	0.676	51.203	4.333	55.536
04:15:00	0.851	0.000	0.504	54.842	4.807	59.649
04:30:00	0.630	0.000	0.375	56.549	5.304	61.853
04:45:00	0.000	0.000	0.000	56.486	5.804	62.291
05:00:00	0.000	0.000	0.000	54.978	6.294	61.272
05:15:00	0.000	0.000	0.000	52.348	6.760	59.108
05:30:00	0.000	0.000	0.000	48.937	7.193	56.130
05:45:00	0.000	0.000	0.000	45.042	7.588	52.631
06:00:00	0.000	0.000	0.000	40.934	7.942	48.876
06:15:00	0.000	0.000	0.000	36.846	8.254	45.100
06:30:00	0.000	0.000	0.000	32.892	8.526	41.417
06:45:00	0.000	0.000	0.000	29.104	8.758	37.862
07:00:00	0.000	0.000	0.000	25.597	8.953	34.550
07:15:00	0.000	0.000	0.000	22.344	9.115	31.459
07:30:00	0.000	0.000	0.000	19.303	9.246	28.548
07:45:00	0.000	0.000	0.000	16.447	9.347	25.794
08:00:00	0.000	0.000	0.000	13.766	9.421	23.187
08:15:00	0.000	0.000	0.000	11.264	9.469	20.733
08:30:00	0.000	0.000	0.000	8.960	9.495	18.455

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
08:45:00	0.000	0.000	0.000	6.877	9.499	16.376
09:00:00	0.000	0.000	0.000	5.067	9.484	14.551
09:15:00	0.000	0.000	0.000	3.606	9.454	13.060
09:30:00	0.000	0.000	0.000	2.494	9.412	11.906
09:45:00	0.000	0.000	0.000	1.672	9.361	11.032
10:00:00	0.000	0.000	0.000	1.076	9.303	10.380
10:15:00	0.000	0.000	0.000	0.656	9.241	9.897
10:30:00	0.000	0.000	0.000	0.368	9.177	9.545
10:45:00	0.000	0.000	0.000	0.181	9.110	9.291
11:00:00	0.000	0.000	0.000	0.069	9.042	9.112
11:15:00	0.000	0.000	0.000	0.014	8.975	8.988
11:30:00	0.000	0.000	0.000	0.000	8.907	8.907
11:45:00	0.000	0.000	0.000	0.000	8.840	8.840
12:00:00	0.000	0.000	0.000	0.000	8.773	8.773
12:15:00	0.000	0.000	0.000	0.000	8.707	8.707
12:30:00	0.000	0.000	0.000	0.000	8.641	8.641
12:45:00	0.000	0.000	0.000	0.000	8.576	8.576
13:00:00	0.000	0.000	0.000	0.000	8.511	8.511
13:15:00	0.000	0.000	0.000	0.000	8.447	8.447
13:30:00	0.000	0.000	0.000	0.000	8.383	8.383
13:45:00	0.000	0.000	0.000	0.000	8.320	8.320
14:00:00	0.000	0.000	0.000	0.000	8.257	8.257
14:15:00	0.000	0.000	0.000	0.000	8.195	8.195
14:30:00	0.000	0.000	0.000	0.000	8.133	8.133
14:45:00	0.000	0.000	0.000	0.000	8.072	8.072
15:00:00	0.000	0.000	0.000	0.000	8.011	8.011
15:15:00	0.000	0.000	0.000	0.000	7.950	7.950
15:30:00	0.000	0.000	0.000	0.000	7.890	7.890
15:45:00	0.000	0.000	0.000	0.000	7.831	7.831
16:00:00	0.000	0.000	0.000	0.000	7.772	7.772
16:15:00	0.000	0.000	0.000	0.000	7.713	7.713
16:30:00	0.000	0.000	0.000	0.000	7.655	7.655
16:45:00	0.000	0.000	0.000	0.000	7.597	7.597
17:00:00	0.000	0.000	0.000	0.000	7.540	7.540
17:15:00	0.000	0.000	0.000	0.000	7.483	7.483
17:30:00	0.000	0.000	0.000	0.000	7.426	7.426

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
17:45:00	0.000	0.000	0.000	0.000	7.370	7.370
18:00:00	0.000	0.000	0.000	0.000	7.315	7.315
18:15:00	0.000	0.000	0.000	0.000	7.260	7.260
18:30:00	0.000	0.000	0.000	0.000	7.205	7.205
18:45:00	0.000	0.000	0.000	0.000	7.150	7.150
19:00:00	0.000	0.000	0.000	0.000	7.097	7.097
19:15:00	0.000	0.000	0.000	0.000	7.043	7.043
19:30:00	0.000	0.000	0.000	0.000	6.990	6.990
19:45:00	0.000	0.000	0.000	0.000	6.937	6.937
20:00:00	0.000	0.000	0.000	0.000	6.885	6.885
20:15:00	0.000	0.000	0.000	0.000	6.833	6.833
20:30:00	0.000	0.000	0.000	0.000	6.781	6.781
20:45:00	0.000	0.000	0.000	0.000	6.730	6.730
21:00:00	0.000	0.000	0.000	0.000	6.679	6.679
21:15:00	0.000	0.000	0.000	0.000	6.629	6.629
21:30:00	0.000	0.000	0.000	0.000	6.579	6.579
21:45:00	0.000	0.000	0.000	0.000	6.529	6.529
22:00:00	0.000	0.000	0.000	0.000	6.480	6.480
22:15:00	0.000	0.000	0.000	0.000	6.431	6.431
22:30:00	0.000	0.000	0.000	0.000	6.383	6.383
22:45:00	0.000	0.000	0.000	0.000	6.334	6.334
23:00:00	0.000	0.000	0.000	0.000	6.287	6.287
23:15:00	0.000	0.000	0.000	0.000	6.239	6.239
23:30:00	0.000	0.000	0.000	0.000	6.192	6.192
23:45:00	0.000	0.000	0.000	0.000	6.145	6.145
24:00:00	0.000	0.000	0.000	0.000	6.099	6.099
24:15:00	0.000	0.000	0.000	0.000	6.053	6.053
24:30:00	0.000	0.000	0.000	0.000	6.007	6.007
24:45:00	0.000	0.000	0.000	0.000	5.962	5.962
25:00:00	0.000	0.000	0.000	0.000	5.917	5.917
25:15:00	0.000	0.000	0.000	0.000	5.872	5.872
25:30:00	0.000	0.000	0.000	0.000	5.828	5.828
25:45:00	0.000	0.000	0.000	0.000	5.784	5.784
26:00:00	0.000	0.000	0.000	0.000	5.740	5.740
26:15:00	0.000	0.000	0.000	0.000	5.697	5.697
26:30:00	0.000	0.000	0.000	0.000	5.654	5.654

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
26:45:00	0.000	0.000	0.000	0.000	5.611	5.611
27:00:00	0.000	0.000	0.000	0.000	5.569	5.569
27:15:00	0.000	0.000	0.000	0.000	5.527	5.527
27:30:00	0.000	0.000	0.000	0.000	5.485	5.485
27:45:00	0.000	0.000	0.000	0.000	5.444	5.444
28:00:00	0.000	0.000	0.000	0.000	5.403	5.403
28:15:00	0.000	0.000	0.000	0.000	5.362	5.362
28:30:00	0.000	0.000	0.000	0.000	5.322	5.322
28:45:00	0.000	0.000	0.000	0.000	5.281	5.281
29:00:00	0.000	0.000	0.000	0.000	5.242	5.242
29:15:00	0.000	0.000	0.000	0.000	5.202	5.202
29:30:00	0.000	0.000	0.000	0.000	5.163	5.163
29:45:00	0.000	0.000	0.000	0.000	5.124	5.124
30:00:00	0.000	0.000	0.000	0.000	5.085	5.085
30:15:00	0.000	0.000	0.000	0.000	5.047	5.047
30:30:00	0.000	0.000	0.000	0.000	5.009	5.009
30:45:00	0.000	0.000	0.000	0.000	4.971	4.971
31:00:00	0.000	0.000	0.000	0.000	4.933	4.933
31:15:00	0.000	0.000	0.000	0.000	4.896	4.896
31:30:00	0.000	0.000	0.000	0.000	4.859	4.859
31:45:00	0.000	0.000	0.000	0.000	4.823	4.823
32:00:00	0.000	0.000	0.000	0.000	4.786	4.786
32:15:00	0.000	0.000	0.000	0.000	4.750	4.750
32:30:00	0.000	0.000	0.000	0.000	4.714	4.714
32:45:00	0.000	0.000	0.000	0.000	4.679	4.679
33:00:00	0.000	0.000	0.000	0.000	4.643	4.643
33:15:00	0.000	0.000	0.000	0.000	4.608	4.608
33:30:00	0.000	0.000	0.000	0.000	4.574	4.574
33:45:00	0.000	0.000	0.000	0.000	4.539	4.539
34:00:00	0.000	0.000	0.000	0.000	4.505	4.505
34:15:00	0.000	0.000	0.000	0.000	4.471	4.471
34:30:00	0.000	0.000	0.000	0.000	4.437	4.437
34:45:00	0.000	0.000	0.000	0.000	4.404	4.404
35:00:00	0.000	0.000	0.000	0.000	4.370	4.370
35:15:00	0.000	0.000	0.000	0.000	4.337	4.337
35:30:00	0.000	0.000	0.000	0.000	4.305	4.305

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
35:45:00	0.000	0.000	0.000	0.000	4.272	4.272
36:00:00	0.000	0.000	0.000	0.000	4.240	4.240
36:15:00	0.000	0.000	0.000	0.000	4.208	4.208
36:30:00	0.000	0.000	0.000	0.000	4.176	4.176
36:45:00	0.000	0.000	0.000	0.000	4.145	4.145
37:00:00	0.000	0.000	0.000	0.000	4.113	4.113
37:15:00	0.000	0.000	0.000	0.000	4.082	4.082
37:30:00	0.000	0.000	0.000	0.000	4.052	4.052
37:45:00	0.000	0.000	0.000	0.000	4.021	4.021
38:00:00	0.000	0.000	0.000	0.000	3.991	3.991
38:15:00	0.000	0.000	0.000	0.000	3.961	3.961
38:30:00	0.000	0.000	0.000	0.000	3.931	3.931
38:45:00	0.000	0.000	0.000	0.000	3.901	3.901
39:00:00	0.000	0.000	0.000	0.000	3.872	3.872
39:15:00	0.000	0.000	0.000	0.000	3.842	3.842
39:30:00	0.000	0.000	0.000	0.000	3.813	3.813
39:45:00	0.000	0.000	0.000	0.000	3.785	3.785
40:00:00	0.000	0.000	0.000	0.000	3.756	3.756
40:15:00	0.000	0.000	0.000	0.000	3.728	3.728
40:30:00	0.000	0.000	0.000	0.000	3.700	3.700
40:45:00	0.000	0.000	0.000	0.000	3.672	3.672
41:00:00	0.000	0.000	0.000	0.000	3.644	3.644
41:15:00	0.000	0.000	0.000	0.000	3.616	3.616
41:30:00	0.000	0.000	0.000	0.000	3.589	3.589
41:45:00	0.000	0.000	0.000	0.000	3.562	3.562
42:00:00	0.000	0.000	0.000	0.000	3.535	3.535
42:15:00	0.000	0.000	0.000	0.000	3.509	3.509
42:30:00	0.000	0.000	0.000	0.000	3.482	3.482
42:45:00	0.000	0.000	0.000	0.000	3.456	3.456
43:00:00	0.000	0.000	0.000	0.000	3.430	3.430
43:15:00	0.000	0.000	0.000	0.000	3.404	3.404
43:30:00	0.000	0.000	0.000	0.000	3.378	3.378
43:45:00	0.000	0.000	0.000	0.000	3.353	3.353
44:00:00	0.000	0.000	0.000	0.000	3.327	3.327
44:15:00	0.000	0.000	0.000	0.000	3.302	3.302
44:30:00	0.000	0.000	0.000	0.000	3.277	3.277

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
44:45:00	0.000	0.000	0.000	0.000	3.253	3.253
45:00:00	0.000	0.000	0.000	0.000	3.228	3.228
45:15:00	0.000	0.000	0.000	0.000	3.204	3.204
45:30:00	0.000	0.000	0.000	0.000	3.180	3.180
45:45:00	0.000	0.000	0.000	0.000	3.156	3.156
46:00:00	0.000	0.000	0.000	0.000	3.132	3.132
46:15:00	0.000	0.000	0.000	0.000	3.108	3.108
46:30:00	0.000	0.000	0.000	0.000	3.085	3.085
46:45:00	0.000	0.000	0.000	0.000	3.061	3.061
47:00:00	0.000	0.000	0.000	0.000	3.038	3.038
47:15:00	0.000	0.000	0.000	0.000	3.015	3.015
47:30:00	0.000	0.000	0.000	0.000	2.993	2.993
47:45:00	0.000	0.000	0.000	0.000	2.970	2.970
48:00:00	0.000	0.000	0.000	0.000	2.948	2.948
48:15:00	0.000	0.000	0.000	0.000	2.925	2.925
48:30:00	0.000	0.000	0.000	0.000	2.903	2.903
48:45:00	0.000	0.000	0.000	0.000	2.881	2.881
49:00:00	0.000	0.000	0.000	0.000	2.860	2.860
49:15:00	0.000	0.000	0.000	0.000	2.838	2.838
49:30:00	0.000	0.000	0.000	0.000	2.817	2.817
49:45:00	0.000	0.000	0.000	0.000	2.795	2.795
50:00:00	0.000	0.000	0.000	0.000	2.774	2.774
50:15:00	0.000	0.000	0.000	0.000	2.753	2.753
50:30:00	0.000	0.000	0.000	0.000	2.733	2.733
50:45:00	0.000	0.000	0.000	0.000	2.712	2.712
51:00:00	0.000	0.000	0.000	0.000	2.692	2.692
51:15:00	0.000	0.000	0.000	0.000	2.671	2.671
51:30:00	0.000	0.000	0.000	0.000	2.651	2.651
51:45:00	0.000	0.000	0.000	0.000	2.631	2.631
52:00:00	0.000	0.000	0.000	0.000	2.611	2.611
52:15:00	0.000	0.000	0.000	0.000	2.591	2.591
52:30:00	0.000	0.000	0.000	0.000	2.572	2.572
52:45:00	0.000	0.000	0.000	0.000	2.553	2.553
53:00:00	0.000	0.000	0.000	0.000	2.533	2.533
53:15:00	0.000	0.000	0.000	0.000	2.514	2.514
53:30:00	0.000	0.000	0.000	0.000	2.495	2.495

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
53:45:00	0.000	0.000	0.000	0.000	2.476	2.476
54:00:00	0.000	0.000	0.000	0.000	2.458	2.458
54:15:00	0.000	0.000	0.000	0.000	2.439	2.439
54:30:00	0.000	0.000	0.000	0.000	2.421	2.421
54:45:00	0.000	0.000	0.000	0.000	2.402	2.402

Appendix

Catchment descriptors

Name	Value	User-defined value used?
Area (km²)	29.58	No
ALTBAR	358	No
ASPBAR	147	No
ASPVAR	0.16	No
BFIHOST	0.41	No
DPLBAR (km)	6.59	No
DPSBAR (mkm-¹)	145	No
FARL	1	No
LDP	12.94	No
PROPWET (mm)	0.66	No
RMED1H	10.9	No
RMED1D	50.4	No
RMED2D	62.8	No
SAAR (mm)	1559	No
SAAR4170 (mm)	1492	No
SPRHOST	44.95	No
Urbext2000	0	No
Urbext1990	0	No
URBCONC	0	No
URBLOC	0	No
DDF parameter C	-0.03	No
DDF parameter D1	0.48	No
DDF parameter D2	0.39	No
DDF parameter D3	0.38	No
DDF parameter E	0.29	No
DDF parameter F	2.47	No
DDF parameter C (1km grid value)	-0.03	No
DDF parameter D1 (1km grid value)	0.48	No
DDF parameter D2 (1km grid value)	0.38	No
DDF parameter D3 (1km grid value)	0.38	No
DDF parameter E (1km grid value)	0.29	No
DDF parameter F (1km grid value)	2.37	No

UK Design Flood Estimation

Generated on 14 January 2021 09:00:15 by Emma
Printed from the ReFH2 Flood Modelling software package, version 3.1.7439.12207

Summary of estimate using the Flood Estimation Handbook revitalised flood hydrograph method (ReFH2)

Site details Checksum: 8F9D-35EA

Site name: FEH_Catchment_Descriptors_295900_290600

Easting: 295900

Northing: 290600

Country: England, Wales or Northern Ireland

Catchment Area (km²): 29.58

Using plot scale calculations: No

Model: ReFH2.2

Site description: None

Model run: 100 year

Summary of results

Rainfall - FEH 2013 model (mm):	79.94	Total runoff (ML):	963.73
Total Rainfall (mm):	63.67	Total flow (ML):	2184.85
Peak Rainfall (mm):	8.68	Peak flow (m³/s):	72.91

Parameters

Where the user has overriden a system-generated value, this original value is shown in square brackets after the value used.
** Indicates that the user locked the duration/timestep*

Rainfall parameters (Rainfall - FEH 2013 model)

Name	Value	User-defined?
Duration (hh:mm:ss)	04:45:00	No
Timestep (hh:mm:ss)	00:15:00	No
SCF (Seasonal correction factor)	0.86	No
ARF (Areal reduction factor)	0.93	No
Seasonality	Winter	No

Loss model parameters

Name	Value	User-defined?
Cini (mm)	112.01	No
Cmax (mm)	281.13	No
Use alpha correction factor	No	No
Alpha correction factor	n/a	No
Use seasonal CIni for equations	Yes	No

Routing model parameters

Name	Value	User-defined?
Tp (hr)	1.87	No
Up	0.65	No
Uk	0.8	No

Baseflow model parameters

Name	Value	User-defined?
BF0 (m^3/s)	2.39	No
BL (hr)	33.01	No
BR	1.27	No

Urbanisation parameters

Name	Value	User-defined?
Urban area (km^2)	0	No
Urbext 2000	0	No
Impervious runoff factor	0.7	No
Imperviousness factor	0.3	No
Tp scaling factor	0.5	No
Exporting drained area (km^2)	0.00	Yes
Sewer capacity (m^3/s)	0.00	Yes

Time series data

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
00:00:00	0.720	0.000	0.288	0.000	2.389	2.389
00:15:00	0.972	0.000	0.392	0.055	2.371	2.427
00:30:00	1.310	0.000	0.533	0.240	2.355	2.595
00:45:00	1.763	0.000	0.727	0.603	2.341	2.944
01:00:00	2.367	0.000	0.993	1.206	2.332	3.538
01:15:00	3.171	0.000	1.362	2.139	2.331	4.470
01:30:00	4.230	0.000	1.872	3.523	2.340	5.863
01:45:00	5.611	0.000	2.582	5.526	2.366	7.892
02:00:00	7.350	0.000	3.551	8.358	2.414	10.772
02:15:00	8.682	0.000	4.442	12.199	2.494	14.694
02:30:00	7.350	0.000	3.971	17.328	2.617	19.945
02:45:00	5.611	0.000	3.161	23.738	2.794	26.531
03:00:00	4.230	0.000	2.457	31.061	3.035	34.096
03:15:00	3.171	0.000	1.883	38.844	3.346	42.190
03:30:00	2.367	0.000	1.429	46.612	3.730	50.341
03:45:00	1.763	0.000	1.077	53.850	4.182	58.033
04:00:00	1.310	0.000	0.808	59.986	4.695	64.681
04:15:00	0.972	0.000	0.603	64.358	5.255	69.613
04:30:00	0.720	0.000	0.449	66.462	5.841	72.303
04:45:00	0.000	0.000	0.000	66.476	6.432	72.908
05:00:00	0.000	0.000	0.000	64.772	7.012	71.783
05:15:00	0.000	0.000	0.000	61.728	7.564	69.292
05:30:00	0.000	0.000	0.000	57.747	8.078	65.826
05:45:00	0.000	0.000	0.000	53.182	8.548	61.730
06:00:00	0.000	0.000	0.000	48.351	8.969	57.320
06:15:00	0.000	0.000	0.000	43.534	9.341	52.875
06:30:00	0.000	0.000	0.000	38.871	9.664	48.535
06:45:00	0.000	0.000	0.000	34.401	9.942	44.343
07:00:00	0.000	0.000	0.000	30.264	10.176	40.441
07:15:00	0.000	0.000	0.000	26.428	10.371	36.799
07:30:00	0.000	0.000	0.000	22.844	10.528	33.372
07:45:00	0.000	0.000	0.000	19.478	10.651	30.129
08:00:00	0.000	0.000	0.000	16.316	10.742	27.058
08:15:00	0.000	0.000	0.000	13.364	10.803	24.167
08:30:00	0.000	0.000	0.000	10.644	10.836	21.480

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
08:45:00	0.000	0.000	0.000	8.181	10.844	19.025
09:00:00	0.000	0.000	0.000	6.037	10.830	16.867
09:15:00	0.000	0.000	0.000	4.301	10.798	15.099
09:30:00	0.000	0.000	0.000	2.977	10.752	13.729
09:45:00	0.000	0.000	0.000	1.997	10.694	12.691
10:00:00	0.000	0.000	0.000	1.287	10.629	11.916
10:15:00	0.000	0.000	0.000	0.784	10.559	11.343
10:30:00	0.000	0.000	0.000	0.441	10.485	10.926
10:45:00	0.000	0.000	0.000	0.217	10.409	10.626
11:00:00	0.000	0.000	0.000	0.083	10.332	10.415
11:15:00	0.000	0.000	0.000	0.016	10.255	10.271
11:30:00	0.000	0.000	0.000	0.000	10.177	10.177
11:45:00	0.000	0.000	0.000	0.000	10.100	10.100
12:00:00	0.000	0.000	0.000	0.000	10.024	10.024
12:15:00	0.000	0.000	0.000	0.000	9.949	9.949
12:30:00	0.000	0.000	0.000	0.000	9.873	9.873
12:45:00	0.000	0.000	0.000	0.000	9.799	9.799
13:00:00	0.000	0.000	0.000	0.000	9.725	9.725
13:15:00	0.000	0.000	0.000	0.000	9.652	9.652
13:30:00	0.000	0.000	0.000	0.000	9.579	9.579
13:45:00	0.000	0.000	0.000	0.000	9.507	9.507
14:00:00	0.000	0.000	0.000	0.000	9.435	9.435
14:15:00	0.000	0.000	0.000	0.000	9.364	9.364
14:30:00	0.000	0.000	0.000	0.000	9.293	9.293
14:45:00	0.000	0.000	0.000	0.000	9.223	9.223
15:00:00	0.000	0.000	0.000	0.000	9.153	9.153
15:15:00	0.000	0.000	0.000	0.000	9.084	9.084
15:30:00	0.000	0.000	0.000	0.000	9.016	9.016
15:45:00	0.000	0.000	0.000	0.000	8.948	8.948
16:00:00	0.000	0.000	0.000	0.000	8.880	8.880
16:15:00	0.000	0.000	0.000	0.000	8.813	8.813
16:30:00	0.000	0.000	0.000	0.000	8.747	8.747
16:45:00	0.000	0.000	0.000	0.000	8.681	8.681
17:00:00	0.000	0.000	0.000	0.000	8.615	8.615
17:15:00	0.000	0.000	0.000	0.000	8.550	8.550
17:30:00	0.000	0.000	0.000	0.000	8.486	8.486

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
17:45:00	0.000	0.000	0.000	0.000	8.422	8.422
18:00:00	0.000	0.000	0.000	0.000	8.358	8.358
18:15:00	0.000	0.000	0.000	0.000	8.295	8.295
18:30:00	0.000	0.000	0.000	0.000	8.232	8.232
18:45:00	0.000	0.000	0.000	0.000	8.170	8.170
19:00:00	0.000	0.000	0.000	0.000	8.109	8.109
19:15:00	0.000	0.000	0.000	0.000	8.047	8.047
19:30:00	0.000	0.000	0.000	0.000	7.987	7.987
19:45:00	0.000	0.000	0.000	0.000	7.926	7.926
20:00:00	0.000	0.000	0.000	0.000	7.867	7.867
20:15:00	0.000	0.000	0.000	0.000	7.807	7.807
20:30:00	0.000	0.000	0.000	0.000	7.748	7.748
20:45:00	0.000	0.000	0.000	0.000	7.690	7.690
21:00:00	0.000	0.000	0.000	0.000	7.632	7.632
21:15:00	0.000	0.000	0.000	0.000	7.574	7.574
21:30:00	0.000	0.000	0.000	0.000	7.517	7.517
21:45:00	0.000	0.000	0.000	0.000	7.460	7.460
22:00:00	0.000	0.000	0.000	0.000	7.404	7.404
22:15:00	0.000	0.000	0.000	0.000	7.348	7.348
22:30:00	0.000	0.000	0.000	0.000	7.293	7.293
22:45:00	0.000	0.000	0.000	0.000	7.238	7.238
23:00:00	0.000	0.000	0.000	0.000	7.183	7.183
23:15:00	0.000	0.000	0.000	0.000	7.129	7.129
23:30:00	0.000	0.000	0.000	0.000	7.075	7.075
23:45:00	0.000	0.000	0.000	0.000	7.022	7.022
24:00:00	0.000	0.000	0.000	0.000	6.969	6.969
24:15:00	0.000	0.000	0.000	0.000	6.916	6.916
24:30:00	0.000	0.000	0.000	0.000	6.864	6.864
24:45:00	0.000	0.000	0.000	0.000	6.812	6.812
25:00:00	0.000	0.000	0.000	0.000	6.761	6.761
25:15:00	0.000	0.000	0.000	0.000	6.710	6.710
25:30:00	0.000	0.000	0.000	0.000	6.659	6.659
25:45:00	0.000	0.000	0.000	0.000	6.609	6.609
26:00:00	0.000	0.000	0.000	0.000	6.559	6.559
26:15:00	0.000	0.000	0.000	0.000	6.510	6.510
26:30:00	0.000	0.000	0.000	0.000	6.460	6.460

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
26:45:00	0.000	0.000	0.000	0.000	6.412	6.412
27:00:00	0.000	0.000	0.000	0.000	6.363	6.363
27:15:00	0.000	0.000	0.000	0.000	6.315	6.315
27:30:00	0.000	0.000	0.000	0.000	6.268	6.268
27:45:00	0.000	0.000	0.000	0.000	6.220	6.220
28:00:00	0.000	0.000	0.000	0.000	6.173	6.173
28:15:00	0.000	0.000	0.000	0.000	6.127	6.127
28:30:00	0.000	0.000	0.000	0.000	6.081	6.081
28:45:00	0.000	0.000	0.000	0.000	6.035	6.035
29:00:00	0.000	0.000	0.000	0.000	5.989	5.989
29:15:00	0.000	0.000	0.000	0.000	5.944	5.944
29:30:00	0.000	0.000	0.000	0.000	5.899	5.899
29:45:00	0.000	0.000	0.000	0.000	5.855	5.855
30:00:00	0.000	0.000	0.000	0.000	5.810	5.810
30:15:00	0.000	0.000	0.000	0.000	5.767	5.767
30:30:00	0.000	0.000	0.000	0.000	5.723	5.723
30:45:00	0.000	0.000	0.000	0.000	5.680	5.680
31:00:00	0.000	0.000	0.000	0.000	5.637	5.637
31:15:00	0.000	0.000	0.000	0.000	5.595	5.595
31:30:00	0.000	0.000	0.000	0.000	5.552	5.552
31:45:00	0.000	0.000	0.000	0.000	5.510	5.510
32:00:00	0.000	0.000	0.000	0.000	5.469	5.469
32:15:00	0.000	0.000	0.000	0.000	5.428	5.428
32:30:00	0.000	0.000	0.000	0.000	5.387	5.387
32:45:00	0.000	0.000	0.000	0.000	5.346	5.346
33:00:00	0.000	0.000	0.000	0.000	5.306	5.306
33:15:00	0.000	0.000	0.000	0.000	5.266	5.266
33:30:00	0.000	0.000	0.000	0.000	5.226	5.226
33:45:00	0.000	0.000	0.000	0.000	5.186	5.186
34:00:00	0.000	0.000	0.000	0.000	5.147	5.147
34:15:00	0.000	0.000	0.000	0.000	5.108	5.108
34:30:00	0.000	0.000	0.000	0.000	5.070	5.070
34:45:00	0.000	0.000	0.000	0.000	5.032	5.032
35:00:00	0.000	0.000	0.000	0.000	4.994	4.994
35:15:00	0.000	0.000	0.000	0.000	4.956	4.956
35:30:00	0.000	0.000	0.000	0.000	4.919	4.919

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
35:45:00	0.000	0.000	0.000	0.000	4.882	4.882
36:00:00	0.000	0.000	0.000	0.000	4.845	4.845
36:15:00	0.000	0.000	0.000	0.000	4.808	4.808
36:30:00	0.000	0.000	0.000	0.000	4.772	4.772
36:45:00	0.000	0.000	0.000	0.000	4.736	4.736
37:00:00	0.000	0.000	0.000	0.000	4.700	4.700
37:15:00	0.000	0.000	0.000	0.000	4.665	4.665
37:30:00	0.000	0.000	0.000	0.000	4.629	4.629
37:45:00	0.000	0.000	0.000	0.000	4.595	4.595
38:00:00	0.000	0.000	0.000	0.000	4.560	4.560
38:15:00	0.000	0.000	0.000	0.000	4.525	4.525
38:30:00	0.000	0.000	0.000	0.000	4.491	4.491
38:45:00	0.000	0.000	0.000	0.000	4.457	4.457
39:00:00	0.000	0.000	0.000	0.000	4.424	4.424
39:15:00	0.000	0.000	0.000	0.000	4.390	4.390
39:30:00	0.000	0.000	0.000	0.000	4.357	4.357
39:45:00	0.000	0.000	0.000	0.000	4.324	4.324
40:00:00	0.000	0.000	0.000	0.000	4.292	4.292
40:15:00	0.000	0.000	0.000	0.000	4.259	4.259
40:30:00	0.000	0.000	0.000	0.000	4.227	4.227
40:45:00	0.000	0.000	0.000	0.000	4.195	4.195
41:00:00	0.000	0.000	0.000	0.000	4.164	4.164
41:15:00	0.000	0.000	0.000	0.000	4.132	4.132
41:30:00	0.000	0.000	0.000	0.000	4.101	4.101
41:45:00	0.000	0.000	0.000	0.000	4.070	4.070
42:00:00	0.000	0.000	0.000	0.000	4.039	4.039
42:15:00	0.000	0.000	0.000	0.000	4.009	4.009
42:30:00	0.000	0.000	0.000	0.000	3.979	3.979
42:45:00	0.000	0.000	0.000	0.000	3.949	3.949
43:00:00	0.000	0.000	0.000	0.000	3.919	3.919
43:15:00	0.000	0.000	0.000	0.000	3.889	3.889
43:30:00	0.000	0.000	0.000	0.000	3.860	3.860
43:45:00	0.000	0.000	0.000	0.000	3.831	3.831
44:00:00	0.000	0.000	0.000	0.000	3.802	3.802
44:15:00	0.000	0.000	0.000	0.000	3.773	3.773
44:30:00	0.000	0.000	0.000	0.000	3.745	3.745

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
44:45:00	0.000	0.000	0.000	0.000	3.717	3.717
45:00:00	0.000	0.000	0.000	0.000	3.688	3.688
45:15:00	0.000	0.000	0.000	0.000	3.661	3.661
45:30:00	0.000	0.000	0.000	0.000	3.633	3.633
45:45:00	0.000	0.000	0.000	0.000	3.606	3.606
46:00:00	0.000	0.000	0.000	0.000	3.578	3.578
46:15:00	0.000	0.000	0.000	0.000	3.551	3.551
46:30:00	0.000	0.000	0.000	0.000	3.525	3.525
46:45:00	0.000	0.000	0.000	0.000	3.498	3.498
47:00:00	0.000	0.000	0.000	0.000	3.472	3.472
47:15:00	0.000	0.000	0.000	0.000	3.445	3.445
47:30:00	0.000	0.000	0.000	0.000	3.419	3.419
47:45:00	0.000	0.000	0.000	0.000	3.394	3.394
48:00:00	0.000	0.000	0.000	0.000	3.368	3.368
48:15:00	0.000	0.000	0.000	0.000	3.343	3.343
48:30:00	0.000	0.000	0.000	0.000	3.317	3.317
48:45:00	0.000	0.000	0.000	0.000	3.292	3.292
49:00:00	0.000	0.000	0.000	0.000	3.267	3.267
49:15:00	0.000	0.000	0.000	0.000	3.243	3.243
49:30:00	0.000	0.000	0.000	0.000	3.218	3.218
49:45:00	0.000	0.000	0.000	0.000	3.194	3.194
50:00:00	0.000	0.000	0.000	0.000	3.170	3.170
50:15:00	0.000	0.000	0.000	0.000	3.146	3.146
50:30:00	0.000	0.000	0.000	0.000	3.122	3.122
50:45:00	0.000	0.000	0.000	0.000	3.099	3.099
51:00:00	0.000	0.000	0.000	0.000	3.075	3.075
51:15:00	0.000	0.000	0.000	0.000	3.052	3.052
51:30:00	0.000	0.000	0.000	0.000	3.029	3.029
51:45:00	0.000	0.000	0.000	0.000	3.006	3.006
52:00:00	0.000	0.000	0.000	0.000	2.984	2.984
52:15:00	0.000	0.000	0.000	0.000	2.961	2.961
52:30:00	0.000	0.000	0.000	0.000	2.939	2.939
52:45:00	0.000	0.000	0.000	0.000	2.917	2.917
53:00:00	0.000	0.000	0.000	0.000	2.895	2.895
53:15:00	0.000	0.000	0.000	0.000	2.873	2.873
53:30:00	0.000	0.000	0.000	0.000	2.851	2.851

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
53:45:00	0.000	0.000	0.000	0.000	2.830	2.830
54:00:00	0.000	0.000	0.000	0.000	2.808	2.808
54:15:00	0.000	0.000	0.000	0.000	2.787	2.787
54:30:00	0.000	0.000	0.000	0.000	2.766	2.766
54:45:00	0.000	0.000	0.000	0.000	2.745	2.745
55:00:00	0.000	0.000	0.000	0.000	2.724	2.724
55:15:00	0.000	0.000	0.000	0.000	2.704	2.704
55:30:00	0.000	0.000	0.000	0.000	2.683	2.683
55:45:00	0.000	0.000	0.000	0.000	2.663	2.663
56:00:00	0.000	0.000	0.000	0.000	2.643	2.643
56:15:00	0.000	0.000	0.000	0.000	2.623	2.623
56:30:00	0.000	0.000	0.000	0.000	2.603	2.603
56:45:00	0.000	0.000	0.000	0.000	2.584	2.584
57:00:00	0.000	0.000	0.000	0.000	2.564	2.564
57:15:00	0.000	0.000	0.000	0.000	2.545	2.545
57:30:00	0.000	0.000	0.000	0.000	2.526	2.526
57:45:00	0.000	0.000	0.000	0.000	2.507	2.507
58:00:00	0.000	0.000	0.000	0.000	2.488	2.488
58:15:00	0.000	0.000	0.000	0.000	2.469	2.469
58:30:00	0.000	0.000	0.000	0.000	2.450	2.450
58:45:00	0.000	0.000	0.000	0.000	2.432	2.432
59:00:00	0.000	0.000	0.000	0.000	2.413	2.413

Appendix

Catchment descriptors

Name	Value	User-defined value used?
Area (km²)	29.58	No
ALTBAR	358	No
ASPBAR	147	No
ASPVAR	0.16	No
BFIHOST	0.41	No
DPLBAR (km)	6.59	No
DPSBAR (mkm-¹)	145	No
FARL	1	No
LDP	12.94	No
PROPWET (mm)	0.66	No
RMED1H	10.9	No
RMED1D	50.4	No
RMED2D	62.8	No
SAAR (mm)	1559	No
SAAR4170 (mm)	1492	No
SPRHOST	44.95	No
Urbext2000	0	No
Urbext1990	0	No
URBCONC	0	No
URBLOC	0	No
DDF parameter C	-0.03	No
DDF parameter D1	0.48	No
DDF parameter D2	0.39	No
DDF parameter D3	0.38	No
DDF parameter E	0.29	No
DDF parameter F	2.47	No
DDF parameter C (1km grid value)	-0.03	No
DDF parameter D1 (1km grid value)	0.48	No
DDF parameter D2 (1km grid value)	0.38	No
DDF parameter D3 (1km grid value)	0.38	No
DDF parameter E (1km grid value)	0.29	No
DDF parameter F (1km grid value)	2.37	No

UK Design Flood Estimation

Generated on 14 January 2021 09:00:28 by Emma
Printed from the ReFH2 Flood Modelling software package, version 3.1.7439.12207

Summary of estimate using the Flood Estimation Handbook revitalised flood hydrograph method (ReFH2)

Site details Checksum: 8F9D-35EA

Site name: FEH_Catchment_Descriptors_295900_290600

Easting: 295900

Northing: 290600

Country: England, Wales or Northern Ireland

Catchment Area (km²): 29.58

Using plot scale calculations: No

Model: ReFH2.2

Site description: None

Model run: 1000 year

Summary of results

Rainfall - FEH 2013 model (mm):	119.57	Total runoff (ML):	1599.72
Total Rainfall (mm):	95.24	Total flow (ML):	3627.06
Peak Rainfall (mm):	12.99	Peak flow (m³/s):	119.93

Parameters

Where the user has overriden a system-generated value, this original value is shown in square brackets after the value used.
** Indicates that the user locked the duration/timestep*

Rainfall parameters (Rainfall - FEH 2013 model)

Name	Value	User-defined?
Duration (hh:mm:ss)	04:45:00	No
Timestep (hh:mm:ss)	00:15:00	No
SCF (Seasonal correction factor)	0.86	No
ARF (Areal reduction factor)	0.93	No
Seasonality	Winter	No

Loss model parameters

Name	Value	User-defined?
Cini (mm)	112.01	No
Cmax (mm)	281.13	No
Use alpha correction factor	No	No
Alpha correction factor	n/a	No
Use seasonal CIni for equations	Yes	No

Routing model parameters

Name	Value	User-defined?
Tp (hr)	1.87	No
Up	0.65	No
Uk	0.8	No

Baseflow model parameters

Name	Value	User-defined?
BF0 (m^3/s)	2.39	No
BL (hr)	33.01	No
BR	1.27	No

Urbanisation parameters

Name	Value	User-defined?
Urban area (km^2)	0	No
Urbext 2000	0	No
Impervious runoff factor	0.7	No
Imperviousness factor	0.3	No
Tp scaling factor	0.5	No
Exporting drained area (km^2)	0.00	Yes
Sewer capacity (m^3/s)	0.00	Yes

Time series data

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
00:00:00	1.077	0.000	0.431	0.000	2.389	2.389
00:15:00	1.454	0.000	0.589	0.083	2.372	2.454
00:30:00	1.960	0.000	0.805	0.361	2.356	2.716
00:45:00	2.637	0.000	1.105	0.905	2.344	3.249
01:00:00	3.541	0.000	1.523	1.816	2.339	4.156
01:15:00	4.742	0.000	2.110	3.230	2.346	5.576
01:30:00	6.328	0.000	2.939	5.340	2.369	7.709
01:45:00	8.393	0.000	4.119	8.417	2.417	10.834
02:00:00	10.994	0.000	5.774	12.808	2.500	15.308
02:15:00	12.986	0.000	7.374	18.846	2.633	21.479
02:30:00	10.994	0.000	6.712	27.037	2.833	29.870
02:45:00	8.393	0.000	5.413	37.425	3.120	40.545
03:00:00	6.328	0.000	4.247	49.448	3.512	52.960
03:15:00	4.742	0.000	3.276	62.374	4.020	66.394
03:30:00	3.541	0.000	2.499	75.428	4.649	80.077
03:45:00	2.637	0.000	1.890	87.757	5.395	93.152
04:00:00	1.960	0.000	1.420	98.394	6.244	104.638
04:15:00	1.454	0.000	1.063	106.197	7.176	113.373
04:30:00	1.077	0.000	0.792	110.251	8.157	118.408
04:45:00	0.000	0.000	0.000	110.774	9.153	119.927
05:00:00	0.000	0.000	0.000	108.343	10.132	118.475
05:15:00	0.000	0.000	0.000	103.570	11.069	114.639
05:30:00	0.000	0.000	0.000	97.131	11.945	109.076
05:45:00	0.000	0.000	0.000	89.624	12.749	102.372
06:00:00	0.000	0.000	0.000	81.598	13.471	95.070
06:15:00	0.000	0.000	0.000	73.541	14.112	87.653
06:30:00	0.000	0.000	0.000	65.710	14.671	80.381
06:45:00	0.000	0.000	0.000	58.193	15.153	73.346
07:00:00	0.000	0.000	0.000	51.243	15.562	66.805
07:15:00	0.000	0.000	0.000	44.808	15.904	60.712
07:30:00	0.000	0.000	0.000	38.798	16.184	54.982
07:45:00	0.000	0.000	0.000	33.157	16.406	49.563

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
08:00:00	0.000	0.000	0.000	27.855	16.574	44.429
08:15:00	0.000	0.000	0.000	22.895	16.692	39.587
08:30:00	0.000	0.000	0.000	18.311	16.763	35.074
08:45:00	0.000	0.000	0.000	14.138	16.792	30.930
09:00:00	0.000	0.000	0.000	10.481	16.783	27.264
09:15:00	0.000	0.000	0.000	7.499	16.742	24.241
09:30:00	0.000	0.000	0.000	5.208	16.676	21.884
09:45:00	0.000	0.000	0.000	3.502	16.592	20.094
10:00:00	0.000	0.000	0.000	2.260	16.495	18.755
10:15:00	0.000	0.000	0.000	1.380	16.388	17.767
10:30:00	0.000	0.000	0.000	0.776	16.274	17.050
10:45:00	0.000	0.000	0.000	0.382	16.157	16.539
11:00:00	0.000	0.000	0.000	0.146	16.038	16.184
11:15:00	0.000	0.000	0.000	0.029	15.917	15.946
11:30:00	0.000	0.000	0.000	0.000	15.797	15.797
11:45:00	0.000	0.000	0.000	0.000	15.678	15.678
12:00:00	0.000	0.000	0.000	0.000	15.560	15.560
12:15:00	0.000	0.000	0.000	0.000	15.442	15.442
12:30:00	0.000	0.000	0.000	0.000	15.326	15.326
12:45:00	0.000	0.000	0.000	0.000	15.210	15.210
13:00:00	0.000	0.000	0.000	0.000	15.096	15.096
13:15:00	0.000	0.000	0.000	0.000	14.982	14.982
13:30:00	0.000	0.000	0.000	0.000	14.869	14.869
13:45:00	0.000	0.000	0.000	0.000	14.756	14.756
14:00:00	0.000	0.000	0.000	0.000	14.645	14.645
14:15:00	0.000	0.000	0.000	0.000	14.535	14.535
14:30:00	0.000	0.000	0.000	0.000	14.425	14.425
14:45:00	0.000	0.000	0.000	0.000	14.316	14.316
15:00:00	0.000	0.000	0.000	0.000	14.208	14.208
15:15:00	0.000	0.000	0.000	0.000	14.101	14.101
15:30:00	0.000	0.000	0.000	0.000	13.994	13.994
15:45:00	0.000	0.000	0.000	0.000	13.889	13.889
16:00:00	0.000	0.000	0.000	0.000	13.784	13.784
16:15:00	0.000	0.000	0.000	0.000	13.680	13.680
16:30:00	0.000	0.000	0.000	0.000	13.577	13.577
16:45:00	0.000	0.000	0.000	0.000	13.474	13.474

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
17:00:00	0.000	0.000	0.000	0.000	13.373	13.373
17:15:00	0.000	0.000	0.000	0.000	13.272	13.272
17:30:00	0.000	0.000	0.000	0.000	13.172	13.172
17:45:00	0.000	0.000	0.000	0.000	13.072	13.072
18:00:00	0.000	0.000	0.000	0.000	12.974	12.974
18:15:00	0.000	0.000	0.000	0.000	12.876	12.876
18:30:00	0.000	0.000	0.000	0.000	12.779	12.779
18:45:00	0.000	0.000	0.000	0.000	12.682	12.682
19:00:00	0.000	0.000	0.000	0.000	12.586	12.586
19:15:00	0.000	0.000	0.000	0.000	12.491	12.491
19:30:00	0.000	0.000	0.000	0.000	12.397	12.397
19:45:00	0.000	0.000	0.000	0.000	12.304	12.304
20:00:00	0.000	0.000	0.000	0.000	12.211	12.211
20:15:00	0.000	0.000	0.000	0.000	12.119	12.119
20:30:00	0.000	0.000	0.000	0.000	12.027	12.027
20:45:00	0.000	0.000	0.000	0.000	11.936	11.936
21:00:00	0.000	0.000	0.000	0.000	11.846	11.846
21:15:00	0.000	0.000	0.000	0.000	11.757	11.757
21:30:00	0.000	0.000	0.000	0.000	11.668	11.668
21:45:00	0.000	0.000	0.000	0.000	11.580	11.580
22:00:00	0.000	0.000	0.000	0.000	11.493	11.493
22:15:00	0.000	0.000	0.000	0.000	11.406	11.406
22:30:00	0.000	0.000	0.000	0.000	11.320	11.320
22:45:00	0.000	0.000	0.000	0.000	11.235	11.235
23:00:00	0.000	0.000	0.000	0.000	11.150	11.150
23:15:00	0.000	0.000	0.000	0.000	11.066	11.066
23:30:00	0.000	0.000	0.000	0.000	10.982	10.982
23:45:00	0.000	0.000	0.000	0.000	10.899	10.899
24:00:00	0.000	0.000	0.000	0.000	10.817	10.817
24:15:00	0.000	0.000	0.000	0.000	10.736	10.736
24:30:00	0.000	0.000	0.000	0.000	10.655	10.655
24:45:00	0.000	0.000	0.000	0.000	10.574	10.574
25:00:00	0.000	0.000	0.000	0.000	10.494	10.494
25:15:00	0.000	0.000	0.000	0.000	10.415	10.415
25:30:00	0.000	0.000	0.000	0.000	10.337	10.337
25:45:00	0.000	0.000	0.000	0.000	10.259	10.259

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
26:00:00	0.000	0.000	0.000	0.000	10.181	10.181
26:15:00	0.000	0.000	0.000	0.000	10.104	10.104
26:30:00	0.000	0.000	0.000	0.000	10.028	10.028
26:45:00	0.000	0.000	0.000	0.000	9.952	9.952
27:00:00	0.000	0.000	0.000	0.000	9.877	9.877
27:15:00	0.000	0.000	0.000	0.000	9.803	9.803
27:30:00	0.000	0.000	0.000	0.000	9.729	9.729
27:45:00	0.000	0.000	0.000	0.000	9.655	9.655
28:00:00	0.000	0.000	0.000	0.000	9.583	9.583
28:15:00	0.000	0.000	0.000	0.000	9.510	9.510
28:30:00	0.000	0.000	0.000	0.000	9.439	9.439
28:45:00	0.000	0.000	0.000	0.000	9.367	9.367
29:00:00	0.000	0.000	0.000	0.000	9.297	9.297
29:15:00	0.000	0.000	0.000	0.000	9.226	9.226
29:30:00	0.000	0.000	0.000	0.000	9.157	9.157
29:45:00	0.000	0.000	0.000	0.000	9.088	9.088
30:00:00	0.000	0.000	0.000	0.000	9.019	9.019
30:15:00	0.000	0.000	0.000	0.000	8.951	8.951
30:30:00	0.000	0.000	0.000	0.000	8.884	8.884
30:45:00	0.000	0.000	0.000	0.000	8.817	8.817
31:00:00	0.000	0.000	0.000	0.000	8.750	8.750
31:15:00	0.000	0.000	0.000	0.000	8.684	8.684
31:30:00	0.000	0.000	0.000	0.000	8.618	8.618
31:45:00	0.000	0.000	0.000	0.000	8.553	8.553
32:00:00	0.000	0.000	0.000	0.000	8.489	8.489
32:15:00	0.000	0.000	0.000	0.000	8.425	8.425
32:30:00	0.000	0.000	0.000	0.000	8.361	8.361
32:45:00	0.000	0.000	0.000	0.000	8.298	8.298
33:00:00	0.000	0.000	0.000	0.000	8.236	8.236
33:15:00	0.000	0.000	0.000	0.000	8.173	8.173
33:30:00	0.000	0.000	0.000	0.000	8.112	8.112
33:45:00	0.000	0.000	0.000	0.000	8.051	8.051
34:00:00	0.000	0.000	0.000	0.000	7.990	7.990
34:15:00	0.000	0.000	0.000	0.000	7.930	7.930
34:30:00	0.000	0.000	0.000	0.000	7.870	7.870
34:45:00	0.000	0.000	0.000	0.000	7.810	7.810

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
35:00:00	0.000	0.000	0.000	0.000	7.751	7.751
35:15:00	0.000	0.000	0.000	0.000	7.693	7.693
35:30:00	0.000	0.000	0.000	0.000	7.635	7.635
35:45:00	0.000	0.000	0.000	0.000	7.577	7.577
36:00:00	0.000	0.000	0.000	0.000	7.520	7.520
36:15:00	0.000	0.000	0.000	0.000	7.463	7.463
36:30:00	0.000	0.000	0.000	0.000	7.407	7.407
36:45:00	0.000	0.000	0.000	0.000	7.351	7.351
37:00:00	0.000	0.000	0.000	0.000	7.296	7.296
37:15:00	0.000	0.000	0.000	0.000	7.241	7.241
37:30:00	0.000	0.000	0.000	0.000	7.186	7.186
37:45:00	0.000	0.000	0.000	0.000	7.132	7.132
38:00:00	0.000	0.000	0.000	0.000	7.078	7.078
38:15:00	0.000	0.000	0.000	0.000	7.025	7.025
38:30:00	0.000	0.000	0.000	0.000	6.972	6.972
38:45:00	0.000	0.000	0.000	0.000	6.919	6.919
39:00:00	0.000	0.000	0.000	0.000	6.867	6.867
39:15:00	0.000	0.000	0.000	0.000	6.815	6.815
39:30:00	0.000	0.000	0.000	0.000	6.763	6.763
39:45:00	0.000	0.000	0.000	0.000	6.712	6.712
40:00:00	0.000	0.000	0.000	0.000	6.662	6.662
40:15:00	0.000	0.000	0.000	0.000	6.612	6.612
40:30:00	0.000	0.000	0.000	0.000	6.562	6.562
40:45:00	0.000	0.000	0.000	0.000	6.512	6.512
41:00:00	0.000	0.000	0.000	0.000	6.463	6.463
41:15:00	0.000	0.000	0.000	0.000	6.414	6.414
41:30:00	0.000	0.000	0.000	0.000	6.366	6.366
41:45:00	0.000	0.000	0.000	0.000	6.318	6.318
42:00:00	0.000	0.000	0.000	0.000	6.270	6.270
42:15:00	0.000	0.000	0.000	0.000	6.223	6.223
42:30:00	0.000	0.000	0.000	0.000	6.176	6.176
42:45:00	0.000	0.000	0.000	0.000	6.129	6.129
43:00:00	0.000	0.000	0.000	0.000	6.083	6.083
43:15:00	0.000	0.000	0.000	0.000	6.037	6.037
43:30:00	0.000	0.000	0.000	0.000	5.992	5.992
43:45:00	0.000	0.000	0.000	0.000	5.946	5.946

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
44:00:00	0.000	0.000	0.000	0.000	5.901	5.901
44:15:00	0.000	0.000	0.000	0.000	5.857	5.857
44:30:00	0.000	0.000	0.000	0.000	5.813	5.813
44:45:00	0.000	0.000	0.000	0.000	5.769	5.769
45:00:00	0.000	0.000	0.000	0.000	5.725	5.725
45:15:00	0.000	0.000	0.000	0.000	5.682	5.682
45:30:00	0.000	0.000	0.000	0.000	5.639	5.639
45:45:00	0.000	0.000	0.000	0.000	5.597	5.597
46:00:00	0.000	0.000	0.000	0.000	5.554	5.554
46:15:00	0.000	0.000	0.000	0.000	5.513	5.513
46:30:00	0.000	0.000	0.000	0.000	5.471	5.471
46:45:00	0.000	0.000	0.000	0.000	5.430	5.430
47:00:00	0.000	0.000	0.000	0.000	5.389	5.389
47:15:00	0.000	0.000	0.000	0.000	5.348	5.348
47:30:00	0.000	0.000	0.000	0.000	5.308	5.308
47:45:00	0.000	0.000	0.000	0.000	5.268	5.268
48:00:00	0.000	0.000	0.000	0.000	5.228	5.228
48:15:00	0.000	0.000	0.000	0.000	5.188	5.188
48:30:00	0.000	0.000	0.000	0.000	5.149	5.149
48:45:00	0.000	0.000	0.000	0.000	5.110	5.110
49:00:00	0.000	0.000	0.000	0.000	5.072	5.072
49:15:00	0.000	0.000	0.000	0.000	5.034	5.034
49:30:00	0.000	0.000	0.000	0.000	4.996	4.996
49:45:00	0.000	0.000	0.000	0.000	4.958	4.958
50:00:00	0.000	0.000	0.000	0.000	4.921	4.921
50:15:00	0.000	0.000	0.000	0.000	4.883	4.883
50:30:00	0.000	0.000	0.000	0.000	4.847	4.847
50:45:00	0.000	0.000	0.000	0.000	4.810	4.810
51:00:00	0.000	0.000	0.000	0.000	4.774	4.774
51:15:00	0.000	0.000	0.000	0.000	4.738	4.738
51:30:00	0.000	0.000	0.000	0.000	4.702	4.702
51:45:00	0.000	0.000	0.000	0.000	4.666	4.666
52:00:00	0.000	0.000	0.000	0.000	4.631	4.631
52:15:00	0.000	0.000	0.000	0.000	4.596	4.596
52:30:00	0.000	0.000	0.000	0.000	4.562	4.562
52:45:00	0.000	0.000	0.000	0.000	4.527	4.527

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
53:00:00	0.000	0.000	0.000	0.000	4.493	4.493
53:15:00	0.000	0.000	0.000	0.000	4.459	4.459
53:30:00	0.000	0.000	0.000	0.000	4.425	4.425
53:45:00	0.000	0.000	0.000	0.000	4.392	4.392
54:00:00	0.000	0.000	0.000	0.000	4.359	4.359
54:15:00	0.000	0.000	0.000	0.000	4.326	4.326
54:30:00	0.000	0.000	0.000	0.000	4.293	4.293
54:45:00	0.000	0.000	0.000	0.000	4.261	4.261
55:00:00	0.000	0.000	0.000	0.000	4.229	4.229
55:15:00	0.000	0.000	0.000	0.000	4.197	4.197
55:30:00	0.000	0.000	0.000	0.000	4.165	4.165
55:45:00	0.000	0.000	0.000	0.000	4.134	4.134
56:00:00	0.000	0.000	0.000	0.000	4.103	4.103
56:15:00	0.000	0.000	0.000	0.000	4.072	4.072
56:30:00	0.000	0.000	0.000	0.000	4.041	4.041
56:45:00	0.000	0.000	0.000	0.000	4.011	4.011
57:00:00	0.000	0.000	0.000	0.000	3.980	3.980
57:15:00	0.000	0.000	0.000	0.000	3.950	3.950
57:30:00	0.000	0.000	0.000	0.000	3.920	3.920
57:45:00	0.000	0.000	0.000	0.000	3.891	3.891
58:00:00	0.000	0.000	0.000	0.000	3.861	3.861
58:15:00	0.000	0.000	0.000	0.000	3.832	3.832
58:30:00	0.000	0.000	0.000	0.000	3.803	3.803
58:45:00	0.000	0.000	0.000	0.000	3.775	3.775
59:00:00	0.000	0.000	0.000	0.000	3.746	3.746
59:15:00	0.000	0.000	0.000	0.000	3.718	3.718
59:30:00	0.000	0.000	0.000	0.000	3.690	3.690
59:45:00	0.000	0.000	0.000	0.000	3.662	3.662
60:00:00	0.000	0.000	0.000	0.000	3.634	3.634
60:15:00	0.000	0.000	0.000	0.000	3.607	3.607
60:30:00	0.000	0.000	0.000	0.000	3.580	3.580
60:45:00	0.000	0.000	0.000	0.000	3.553	3.553
61:00:00	0.000	0.000	0.000	0.000	3.526	3.526
61:15:00	0.000	0.000	0.000	0.000	3.499	3.499
61:30:00	0.000	0.000	0.000	0.000	3.473	3.473
61:45:00	0.000	0.000	0.000	0.000	3.447	3.447

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
62:00:00	0.000	0.000	0.000	0.000	3.421	3.421
62:15:00	0.000	0.000	0.000	0.000	3.395	3.395
62:30:00	0.000	0.000	0.000	0.000	3.369	3.369
62:45:00	0.000	0.000	0.000	0.000	3.344	3.344
63:00:00	0.000	0.000	0.000	0.000	3.319	3.319
63:15:00	0.000	0.000	0.000	0.000	3.294	3.294
63:30:00	0.000	0.000	0.000	0.000	3.269	3.269
63:45:00	0.000	0.000	0.000	0.000	3.244	3.244
64:00:00	0.000	0.000	0.000	0.000	3.220	3.220
64:15:00	0.000	0.000	0.000	0.000	3.195	3.195
64:30:00	0.000	0.000	0.000	0.000	3.171	3.171
64:45:00	0.000	0.000	0.000	0.000	3.147	3.147
65:00:00	0.000	0.000	0.000	0.000	3.124	3.124
65:15:00	0.000	0.000	0.000	0.000	3.100	3.100
65:30:00	0.000	0.000	0.000	0.000	3.077	3.077
65:45:00	0.000	0.000	0.000	0.000	3.053	3.053
66:00:00	0.000	0.000	0.000	0.000	3.030	3.030
66:15:00	0.000	0.000	0.000	0.000	3.007	3.007
66:30:00	0.000	0.000	0.000	0.000	2.985	2.985
66:45:00	0.000	0.000	0.000	0.000	2.962	2.962
67:00:00	0.000	0.000	0.000	0.000	2.940	2.940
67:15:00	0.000	0.000	0.000	0.000	2.918	2.918
67:30:00	0.000	0.000	0.000	0.000	2.896	2.896
67:45:00	0.000	0.000	0.000	0.000	2.874	2.874
68:00:00	0.000	0.000	0.000	0.000	2.852	2.852
68:15:00	0.000	0.000	0.000	0.000	2.831	2.831
68:30:00	0.000	0.000	0.000	0.000	2.809	2.809
68:45:00	0.000	0.000	0.000	0.000	2.788	2.788
69:00:00	0.000	0.000	0.000	0.000	2.767	2.767
69:15:00	0.000	0.000	0.000	0.000	2.746	2.746
69:30:00	0.000	0.000	0.000	0.000	2.725	2.725
69:45:00	0.000	0.000	0.000	0.000	2.705	2.705
70:00:00	0.000	0.000	0.000	0.000	2.684	2.684
70:15:00	0.000	0.000	0.000	0.000	2.664	2.664
70:30:00	0.000	0.000	0.000	0.000	2.644	2.644
70:45:00	0.000	0.000	0.000	0.000	2.624	2.624

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
71:00:00	0.000	0.000	0.000	0.000	2.604	2.604
71:15:00	0.000	0.000	0.000	0.000	2.585	2.585
71:30:00	0.000	0.000	0.000	0.000	2.565	2.565
71:45:00	0.000	0.000	0.000	0.000	2.546	2.546
72:00:00	0.000	0.000	0.000	0.000	2.527	2.527
72:15:00	0.000	0.000	0.000	0.000	2.508	2.508
72:30:00	0.000	0.000	0.000	0.000	2.489	2.489
72:45:00	0.000	0.000	0.000	0.000	2.470	2.470
73:00:00	0.000	0.000	0.000	0.000	2.451	2.451
73:15:00	0.000	0.000	0.000	0.000	2.433	2.433
73:30:00	0.000	0.000	0.000	0.000	2.414	2.414

Appendix

Catchment descriptors

Name	Value	User-defined value used?
Area (km²)	29.58	No
ALTBAR	358	No
ASPBAR	147	No
ASPVAR	0.16	No
BFIHOST	0.41	No
DPLBAR (km)	6.59	No
DPSBAR (mkm-¹)	145	No
FARL	1	No
LDP	12.94	No
PROPWET (mm)	0.66	No
RMED1H	10.9	No
RMED1D	50.4	No
RMED2D	62.8	No
SAAR (mm)	1559	No
SAAR4170 (mm)	1492	No
SPRHOST	44.95	No
Urbext2000	0	No
Urbext1990	0	No
URBCONC	0	No
URBLOC	0	No
DDF parameter C	-0.03	No
DDF parameter D1	0.48	No
DDF parameter D2	0.39	No
DDF parameter D3	0.38	No
DDF parameter E	0.29	No
DDF parameter F	2.47	No
DDF parameter C (1km grid value)	-0.03	No
DDF parameter D1 (1km grid value)	0.48	No
DDF parameter D2 (1km grid value)	0.38	No
DDF parameter D3 (1km grid value)	0.38	No
DDF parameter E (1km grid value)	0.29	No
DDF parameter F (1km grid value)	2.37	No

APPENDIX 8 – HEC-RAS Baseline Modelling Results

HEC-RAS Plan: Baseline River: River Trannon Reach: 001

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
001	0874	2	26.58	149.52	150.92	150.68	151.15	0.005192	2.21	13.17	14.17	0.64
001	0874	20	49.78	149.52	151.36	151.12	151.71	0.005442	2.79	20.48	20.39	0.70
001	0874	50	60.91	149.52	151.52	151.31	151.92	0.005641	3.02	23.85	22.99	0.72
001	0874	100	70.80	149.52	151.63	151.48	152.08	0.005899	3.21	26.53	24.69	0.74
001	0874	100 +5%	74.34	149.52	151.67	151.53	152.13	0.005977	3.28	27.48	25.27	0.75
001	0874	100 +25%	88.50	149.52	151.81	151.73	152.32	0.006220	3.50	31.13	26.38	0.77
001	0874	100 +70%	120.36	149.52	152.09	152.04	152.69	0.006487	3.89	38.64	27.63	0.81
001	0874	1000	116.46	149.52	152.06	152.00	152.65	0.006453	3.84	37.79	27.52	0.80
001	864.00*	2	26.58	149.47	150.86		151.10	0.005246	2.21	13.12	14.51	0.65
001	864.00*	20	49.78	149.47	151.31		151.66	0.005357	2.76	20.62	20.74	0.69
001	864.00*	50	60.91	149.47	151.46	151.26	151.86	0.005539	2.98	24.04	23.51	0.71
001	864.00*	100	70.80	149.47	151.58	151.43	152.02	0.005798	3.18	26.74	25.30	0.74
001	864.00*	100 +5%	74.34	149.47	151.61	151.47	152.07	0.005916	3.25	27.65	25.86	0.75
001	864.00*	100 +25%	88.50	149.47	151.75	151.68	152.26	0.006117	3.46	31.35	26.78	0.77
001	864.00*	100 +70%	120.36	149.47	152.03	151.97	152.63	0.006391	3.85	38.90	28.08	0.80
001	864.00*	1000	116.46	149.47	152.00	151.96	152.58	0.006356	3.80	38.04	27.96	0.80
001	854.00*	2	26.58	149.41	150.81		151.04	0.005329	2.21	13.02	14.79	0.65
001	854.00*	20	49.78	149.41	151.26		151.60	0.005289	2.74	20.74	21.09	0.69
001	854.00*	50	60.91	149.41	151.41	151.21	151.80	0.005457	2.95	24.22	24.07	0.71
001	854.00*	100	70.80	149.41	151.52	151.37	151.95	0.005716	3.15	26.94	25.95	0.73
001	854.00*	100 +5%	74.34	149.41	151.56	151.41	152.01	0.005821	3.21	27.87	26.25	0.74
001	854.00*	100 +25%	88.50	149.41	151.69	151.62	152.19	0.006025	3.43	31.57	27.17	0.76
001	854.00*	100 +70%	120.36	149.41	151.97	151.91	152.56	0.006311	3.81	39.16	28.56	0.80
001	854.00*	1000	116.46	149.41	151.94	151.87	152.52	0.006274	3.77	38.31	28.43	0.79
001	844.00*	2	26.58	149.35	150.75		150.99	0.005439	2.21	12.89	15.02	0.66
001	844.00*	20	49.78	149.35	151.21		151.55	0.005239	2.71	20.85	21.34	0.68
001	844.00*	50	60.91	149.35	151.36	151.16	151.74	0.005391	2.93	24.38	24.67	0.71
001	844.00*	100	70.80	149.35	151.46	151.32	151.90	0.005684	3.12	27.10	26.41	0.73
001	844.00*	100 +5%	74.34	149.35	151.50	151.37	151.95	0.005749	3.18	28.07	26.68	0.74
001	844.00*	100 +25%	88.50	149.35	151.64	151.57	152.13	0.005958	3.39	31.78	27.59	0.76
001	844.00*	100 +70%	120.36	149.35	151.91	151.85	152.49	0.006254	3.78	39.41	29.07	0.79
001	844.00*	1000	116.46	149.35	151.88	151.82	152.45	0.006215	3.73	38.55	28.93	0.79
001	834.00*	2	26.58	149.29	150.69		150.93	0.005581	2.22	12.71	15.16	0.67
001	834.00*	20	49.78	149.29	151.15		151.49	0.005215	2.69	20.91	21.54	0.68
001	834.00*	50	60.91	149.29	151.31	151.11	151.69	0.005349	2.90	24.52	25.32	0.70
001	834.00*	100	70.80	149.29	151.41	151.26	151.84	0.005638	3.10	27.26	26.85	0.73
001	834.00*	100 +5%	74.34	149.29	151.45	151.32	151.89	0.005704	3.15	28.23	27.14	0.73
001	834.00*	100 +25%	88.50	149.29	151.58	151.50	152.07	0.005913	3.36	31.96	28.04	0.76
001	834.00*	100 +70%	120.36	149.29	151.85	151.79	152.43	0.006219	3.75	39.63	29.64	0.79
001	834.00*	1000	116.46	149.29	151.82	151.76	152.39	0.006177	3.70	38.77	29.49	0.79
001	824.00*	2	26.58	149.23	150.63		150.88	0.005726	2.22	12.52	15.17	0.67
001	824.00*	20	49.78	149.23	151.10		151.44	0.005206	2.68	20.96	21.64	0.68
001	824.00*	50	60.91	149.23	151.25		151.63	0.005323	2.88	24.63	26.05	0.70
001	824.00*	100	70.80	149.23	151.35	151.21	151.78	0.005614	3.07	27.38	27.34	0.73
001	824.00*	100 +5%	74.34	149.23	151.39	151.27	151.83	0.005679	3.13	28.36	27.64	0.73
001	824.00*	100 +25%	88.50	149.23	151.52	151.45	152.01	0.005890	3.34	32.11	28.54	0.75
001	824.00*	100 +70%	120.36	149.23	151.79	151.73	152.36	0.006232	3.73	39.83	30.51	0.79
001	824.00*	1000	116.46	149.23	151.76	151.69	152.32	0.006178	3.68	38.96	30.27	0.79
001	814.00*	2	26.58	149.18	150.57		150.82	0.005830	2.21	12.34	14.66	0.68
001	814.00*	20	49.78	149.18	151.05		151.38	0.005213	2.66	20.98	21.39	0.68
001	814.00*	50	60.91	149.18	151.19	151.02	151.58	0.005410	2.88	24.59	26.73	0.70
001	814.00*	100	70.80	149.18	151.30	151.15	151.72	0.005613	3.05	27.47	27.87	0.72
001	814.00*	100 +5%	74.34	149.18	151.33	151.24	151.77	0.005675	3.11	28.46	28.14	0.73
001	814.00*	100 +25%	88.50	149.18	151.47	151.39	151.95	0.005895	3.32	32.22	29.13	0.75
001	814.00*	100 +70%	120.36	149.18	151.72	151.67	152.30	0.006247	3.71	40.05	31.46	0.79
001	814.00*	1000	116.46	149.18	151.70	151.64	152.26	0.006195	3.66	39.17	31.22	0.79
001	804.00*	2	26.58	149.12	150.52		150.76	0.005899	2.19	12.21	13.92	0.68
001	804.00*	20	49.78	149.12	150.99		151.33	0.005236	2.64	20.97	21.88	0.68
001	804.00*	50	60.91	149.12	151.14	150.96	151.52	0.005430	2.86	24.60	27.19	0.70
001	804.00*	100	70.80	149.12	151.24	151.15	151.66	0.005634	3.03	27.51	28.42	0.72
001	804.00*	100 +5%	74.34	149.12	151.28	151.20	151.71	0.005697	3.09	28.52	28.73	0.73
001	804.00*	100 +25%	88.50	149.12	151.41	151.34	151.89	0.005940	3.30	32.29	29.94	0.75
001	804.00*	100 +70%	120.36	149.12	151.66	151.62	152.24	0.006291	3.69	40.33	32.94	0.79
001	804.00*	1000	116.46	149.12	151.63	151.58	152.20	0.006240	3.64	39.43	32.64	0.79
001	794.00*	2	26.58	149.06	150.46		150.70	0.005888	2.17	12.27	12.01	0.68
001	794.00*	20	49.78	149.06	150.94		151.27	0.005255	2.63	20.95	22.42	0.68
001	794.00*	50	60.91	149.06	151.08	150.91	151.47	0.005466	2.85	24.59	27.85	0.70
001	794.00*	100	70.80	149.06	151.18	151.10	151.61	0.005675	3.02	27.53	29.18	0.72
001	794.00*	100 +5%	74.34	149.06	151.22	151.14	151.65	0.005748	3.08	28.53	29.56	0.73
001	794.00*	100 +25%	88.50	149.06	151.34	151.29	151.83	0.006022	3.30	32.35	31.17	0.76
001	794.00*	100 +70%	120.36	149.06	151.60	151.58	152.17	0.006253	3.65	40.84	34.33	0.79
001	794.00*	1000	116.46	149.06	151.58	151.54	152.13	0.006208	3.61	39.90	34.02	0.78
001	784.00*	2	26.58	149.00	150.41		150.64	0.005776	2.14	12.43	11.96	0.67
001	784.00*	20	49.78	149.00	150.88	150.63	151.22	0.005288	2.62	20.88	22.96	0.68
001	784.00*	50	60.91	149.00	151.02	150.85	151.41	0.005539	2.84	24.50	28.79	0.71
001	784.00*	100	70.80	149.00	151.13	151.05	151.55	0.005768	3.02	27.51	30.69	0.73

HEC-RAS Plan: Baseline River: River Trannon Reach: 001 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
001	784.00*	100 +5%	74.34	149.00	151.16	151.10	151.60	0.005832	3.07	28.56	31.08	0.74
001	784.00*	100 +25%	88.50	149.00	151.28	151.25	151.77	0.006075	3.28	32.55	32.73	0.76
001	784.00*	100 +70%	120.36	149.00	151.54	151.51	152.10	0.006250	3.63	41.53	37.05	0.79
001	784.00*	1000	116.46	149.00	151.52	151.47	152.07	0.006197	3.58	40.54	36.44	0.78
001	0774	2	26.58	148.95	150.35		150.58	0.005602	2.11	12.61	12.09	0.66
001	0774	20	49.78	148.95	150.83	150.52	151.16	0.005315	2.60	20.80	23.68	0.68
001	0774	50	60.91	148.95	150.97	150.81	151.35	0.005623	2.84	24.45	30.88	0.71
001	0774	100	70.80	148.95	151.07	151.01	151.49	0.005783	3.00	27.71	32.27	0.73
001	0774	100 +5%	74.34	148.95	151.10	151.06	151.54	0.005843	3.05	28.80	32.73	0.73
001	0774	100 +25%	88.50	148.95	151.23	151.17	151.70	0.006047	3.25	32.99	34.42	0.75
001	0774	100 +70%	120.36	148.95	151.50	151.49	152.03	0.006002	3.54	43.60	43.15	0.77
001	0774	1000	116.46	148.95	151.46	151.45	151.99	0.006085	3.53	42.10	42.19	0.77
001	764.58*	2	26.58	148.88	150.29		150.52	0.005800	2.14	12.43	12.00	0.67
001	764.58*	20	49.78	148.88	150.77	150.47	151.11	0.005427	2.63	20.73	24.61	0.69
001	764.58*	50	60.91	148.88	150.90	150.76	151.30	0.005717	2.86	24.45	31.49	0.72
001	764.58*	100	70.80	148.88	151.01	150.96	151.43	0.005846	3.01	27.78	32.91	0.73
001	764.58*	100 +5%	74.34	148.88	151.04	151.00	151.48	0.005896	3.06	28.90	33.37	0.74
001	764.58*	100 +25%	88.50	148.88	151.17	151.13	151.64	0.006048	3.25	33.23	35.08	0.76
001	764.58*	100 +70%	120.36	148.88	151.41	151.41	151.96	0.006289	3.60	42.59	40.96	0.79
001	764.58*	1000	116.46	148.88	151.38	151.38	151.93	0.006292	3.57	41.40	40.25	0.78
001	755.17*	2	26.58	148.81	150.23		150.47	0.006000	2.17	12.25	11.89	0.68
001	755.17*	20	49.78	148.81	150.71	150.43	151.05	0.005538	2.65	20.65	25.55	0.70
001	755.17*	50	60.91	148.81	150.84	150.72	151.24	0.005778	2.87	24.50	31.73	0.72
001	755.17*	100	70.80	148.81	150.95	150.91	151.37	0.005892	3.02	27.90	33.59	0.74
001	755.17*	100 +5%	74.34	148.81	150.98	150.95	151.41	0.005931	3.07	29.05	34.06	0.74
001	755.17*	100 +25%	88.50	148.81	151.11	151.08	151.58	0.006032	3.25	33.53	35.82	0.76
001	755.17*	100 +70%	120.36	148.81	151.28	151.34	151.90	0.007389	3.81	39.89	38.90	0.85
001	755.17*	1000	116.46	148.81	151.25	151.31	151.86	0.007423	3.78	38.73	38.32	0.85
001	745.75*	2	26.58	148.74	150.16		150.41	0.006198	2.20	12.08	11.78	0.69
001	745.75*	20	49.78	148.74	150.64	150.37	151.00	0.005653	2.68	20.56	26.45	0.70
001	745.75*	50	60.91	148.74	150.78	150.68	151.18	0.005832	2.89	24.57	32.19	0.72
001	745.75*	100	70.80	148.74	150.88	150.86	151.31	0.005930	3.03	28.03	34.30	0.74
001	745.75*	100 +5%	74.34	148.74	150.92	150.89	151.35	0.005954	3.08	29.22	34.79	0.74
001	745.75*	100 +25%	88.50	148.74	151.05	151.04	151.51	0.005993	3.24	33.88	36.61	0.75
001	745.75*	100 +70%	120.36	148.74	151.21	151.28	151.83	0.007385	3.80	40.13	39.22	0.85
001	745.75*	1000	116.46	148.74	151.18	151.25	151.79	0.007429	3.78	38.96	38.67	0.85
001	736.33*	2	26.58	148.68	150.09		150.35	0.006397	2.23	11.92	11.67	0.70
001	736.33*	20	49.78	148.68	150.58	150.31	150.94	0.005769	2.70	20.46	27.33	0.71
001	736.33*	50	60.91	148.68	150.72	150.64	151.12	0.005880	2.90	24.65	32.80	0.73
001	736.33*	100	70.80	148.68	150.82	150.80	151.25	0.005953	3.04	28.19	35.07	0.74
001	736.33*	100 +5%	74.34	148.68	150.86	150.84	151.29	0.005960	3.08	29.43	35.58	0.74
001	736.33*	100 +25%	88.50	148.68	150.99	150.98	151.45	0.005921	3.23	34.32	37.46	0.75
001	736.33*	100 +70%	120.36	148.68	151.15	151.22	151.76	0.007426	3.81	40.31	39.66	0.85
001	736.33*	1000	116.46	148.68	151.12	151.19	151.72	0.007476	3.78	39.12	39.13	0.85
001	726.92*	2	26.58	148.61	150.02		150.29	0.006585	2.26	11.76	11.55	0.71
001	726.92*	20	49.78	148.61	150.52	150.23	150.88	0.005879	2.73	20.35	28.21	0.72
001	726.92*	50	60.91	148.61	150.66	150.61	151.06	0.005905	2.91	24.76	33.51	0.73
001	726.92*	100	70.80	148.61	150.76	150.75	151.19	0.005943	3.04	28.42	35.87	0.74
001	726.92*	100 +5%	74.34	148.61	150.80	150.79	151.23	0.005932	3.08	29.72	36.43	0.74
001	726.92*	100 +25%	88.50	148.61	150.93	150.92	151.38	0.005961	3.23	34.49	38.25	0.75
001	726.92*	100 +70%	120.36	148.61	151.08	151.15	151.69	0.007453	3.81	40.55	40.31	0.85
001	726.92*	1000	116.46	148.61	151.05	151.12	151.65	0.007519	3.79	39.33	39.90	0.85
001	717.50*	2	26.58	148.54	149.96		150.22	0.006765	2.29	11.62	11.42	0.72
001	717.50*	20	49.78	148.54	150.45	150.19	150.82	0.005986	2.75	20.24	29.08	0.72
001	717.50*	50	60.91	148.54	150.60	150.57	151.00	0.005910	2.91	24.91	34.31	0.73
001	717.50*	100	70.80	148.54	150.70	150.69	151.12	0.005895	3.03	28.72	36.68	0.74
001	717.50*	100 +5%	74.34	148.54	150.74	150.73	151.16	0.005868	3.07	30.08	37.34	0.74
001	717.50*	100 +25%	88.50	148.54	150.87	150.86	151.31	0.005888	3.22	34.94	39.16	0.75
001	717.50*	100 +70%	120.36	148.54	151.01	151.10	151.62	0.007470	3.81	40.83	41.14	0.85
001	717.50*	1000	116.46	148.54	150.98	151.07	151.58	0.007543	3.79	39.59	40.73	0.85
001	708.08*	2	26.58	148.48	149.89		150.16	0.006931	2.31	11.49	11.30	0.73
001	708.08*	20	49.78	148.48	150.38	150.13	150.76	0.006104	2.78	20.09	29.87	0.73
001	708.08*	50	60.91	148.48	150.54	150.52	150.94	0.005912	2.92	25.05	35.11	0.73
001	708.08*	100	70.80	148.48	150.65	150.64	151.06	0.005830	3.03	29.06	37.52	0.73
001	708.08*	100 +5%	74.34	148.48	150.68	150.68	151.10	0.005918	3.08	30.17	38.15	0.74
001	708.08*	100 +25%	88.50	148.48	150.81	150.81	151.25	0.005793	3.20	35.44	40.13	0.74
001	708.08*	100 +70%	120.36	148.48	150.95	151.04	151.55	0.007493	3.81	41.09	41.99	0.85
001	708.08*	1000	116.46	148.48	150.92	151.01	151.51	0.007574	3.80	39.83	41.58	0.85
001	698.67*	2	26.58	148.41	149.82		150.09	0.007068	2.34	11.37	11.17	0.74
001	698.67*	20	49.78	148.41	150.32	150.07	150.71	0.006214	2.80	19.93	30.66	0.73
001	698.67*	50	60.91	148.41	150.48	150.46	150.87	0.005883	2.92	25.25	36.02	0.73
001	698.67*	100	70.80	148.41	150.58	150.58	151.00	0.005833	3.03	29.24	38.38	0.73
001	698.67*	100 +5%	74.34	148.41	150.57	150.62	151.04	0.006718	3.23	28.66	38.05	0.78
001	698.67*	100 +25%	88.50	148.41	150.68	150.74	151.19	0.006874	3.41	33.18	40.20	0.80
001	698.67*	100 +70%	120.36	148.41	150.88	150.98	151.47	0.007502	3.81	41.39	42.89	0.85
001	698.67*	1000	116.46	148.41	150.85	150.95	151.44	0.007590	3.80	40.10	42.48	0.85

HEC-RAS Plan: Baseline River: River Trannon Reach: 001 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
001	689.25*	2	26.58	148.34	149.75		150.03	0.007184	2.36	11.27	11.04	0.75
001	689.25*	20	49.78	148.34	150.25	150.01	150.65	0.006314	2.83	19.77	31.40	0.74
001	689.25*	50	60.91	148.34	150.42	150.40	150.81	0.005825	2.91	25.50	37.01	0.72
001	689.25*	100	70.80	148.34	150.48	150.52	150.93	0.006610	3.18	27.75	38.37	0.77
001	689.25*	100 +5%	74.34	148.34	150.51	150.56	150.97	0.006638	3.22	29.00	39.09	0.78
001	689.25*	100 +25%	88.50	148.34	150.62	150.67	151.12	0.006768	3.39	33.64	41.19	0.79
001	689.25*	100 +70%	120.36	148.34	150.81	150.92	151.40	0.007496	3.81	41.73	43.84	0.85
001	689.25*	1000	116.46	148.34	150.78	150.89	151.37	0.007592	3.80	40.41	43.42	0.85
001	679.83*	2	26.58	148.28	149.67		149.96	0.007249	2.37	11.20	10.91	0.75
001	679.83*	20	49.78	148.28	150.18	149.94	150.59	0.006411	2.85	19.59	32.08	0.74
001	679.83*	50	60.91	148.28	150.36	150.35	150.75	0.005741	2.90	25.80	38.09	0.72
001	679.83*	100	70.80	148.28	150.42	150.47	150.87	0.006507	3.16	28.11	39.50	0.77
001	679.83*	100 +5%	74.34	148.28	150.45	150.50	150.91	0.006614	3.22	29.22	40.15	0.78
001	679.83*	100 +25%	88.50	148.28	150.56	150.61	151.05	0.006742	3.39	33.92	42.11	0.79
001	679.83*	100 +70%	120.36	148.28	150.75	150.85	151.33	0.007486	3.81	42.06	44.80	0.85
001	679.83*	1000	116.46	148.28	150.72	150.82	151.30	0.007589	3.80	40.71	44.38	0.85
001	670.42*	2	26.58	148.21	149.60		149.89	0.007253	2.38	11.16	10.79	0.75
001	670.42*	20	49.78	148.21	150.12	149.87	150.52	0.006484	2.87	19.42	32.44	0.75
001	670.42*	50	60.91	148.21	150.30	150.30	150.69	0.005720	2.90	25.95	39.12	0.71
001	670.42*	100	70.80	148.21	150.36	150.40	150.81	0.006458	3.16	28.37	40.66	0.76
001	670.42*	100 +5%	74.34	148.21	150.38	150.44	150.85	0.006571	3.22	29.49	41.27	0.77
001	670.42*	100 +25%	88.50	148.21	150.50	150.57	150.98	0.006694	3.38	34.25	43.09	0.79
001	670.42*	100 +70%	120.36	148.21	150.68	150.78	151.26	0.007469	3.80	42.42	45.82	0.84
001	670.42*	1000	116.46	148.21	150.65	150.76	151.23	0.007578	3.79	41.04	45.39	0.85
001	0661	2	26.58	148.14	149.54		149.83	0.007162	2.38	11.17	10.67	0.74
001	0661	20	49.78	148.14	150.05	149.80	150.46	0.006501	2.88	19.31	32.41	0.75
001	0661	50	60.91	148.14	150.17	150.24	150.63	0.006789	3.10	23.80	38.59	0.77
001	0661	100	70.80	148.14	150.30	150.34	150.74	0.006380	3.15	28.68	41.93	0.76
001	0661	100 +5%	74.34	148.14	150.32	150.39	150.78	0.006500	3.21	29.79	42.34	0.77
001	0661	100 +25%	88.50	148.14	150.53	150.52	150.91	0.005104	3.06	38.76	45.58	0.69
001	0661	100 +70%	120.36	148.14	150.73	150.71	151.17	0.005443	3.37	48.57	48.58	0.73
001	0661	1000	116.46	148.14	150.71	150.69	151.14	0.005417	3.34	47.40	48.24	0.72
001	651.60*	2	26.58	148.06	149.47		149.76	0.006997	2.37	11.22	10.58	0.73
001	651.60*	20	49.78	148.06	149.98	149.73	150.39	0.006410	2.87	19.41	33.29	0.74
001	651.60*	50	60.91	148.06	150.12	150.18	150.56	0.006549	3.07	24.14	38.64	0.76
001	651.60*	100	70.80	148.06	150.23	150.27	150.67	0.006186	3.12	28.94	41.25	0.75
001	651.60*	100 +5%	74.34	148.06	150.26	150.33	150.71	0.006330	3.19	29.98	41.64	0.76
001	651.60*	100 +25%	88.50	148.06	150.42	150.42	150.84	0.005715	3.20	36.69	44.13	0.73
001	651.60*	100 +70%	120.36	148.06	150.66	150.65	151.11	0.005582	3.42	47.83	47.89	0.74
001	651.60*	1000	116.46	148.06	150.63	150.63	151.08	0.005543	3.38	46.71	47.54	0.73
001	642.20*	2	26.58	147.98	149.40		149.69	0.006861	2.36	11.26	10.49	0.73
001	642.20*	20	49.78	147.98	149.92	149.66	150.33	0.006323	2.86	19.54	33.47	0.74
001	642.20*	50	60.91	147.98	150.05	150.10	150.49	0.006413	3.05	24.38	38.69	0.75
001	642.20*	100	70.80	147.98	150.18	150.20	150.60	0.005991	3.09	29.29	40.82	0.74
001	642.20*	100 +5%	74.34	147.98	150.20	150.23	150.64	0.006157	3.16	30.27	41.17	0.75
001	642.20*	100 +25%	88.50	147.98	150.37	150.38	150.78	0.005391	3.14	37.49	43.89	0.71
001	642.20*	100 +70%	120.36	147.98	150.57	150.57	151.05	0.005972	3.52	46.40	47.08	0.76
001	642.20*	1000	116.46	147.98	150.54	150.54	151.02	0.005957	3.49	45.22	46.66	0.76
001	632.80*	2	26.58	147.89	149.34		149.62	0.006759	2.36	11.28	10.40	0.72
001	632.80*	20	49.78	147.89	149.84	149.59	150.26	0.006414	2.88	19.39	33.54	0.74
001	632.80*	50	60.91	147.89	149.99	150.03	150.42	0.006239	3.02	24.72	38.29	0.74
001	632.80*	100	70.80	147.89	150.13	150.13	150.53	0.005664	3.03	30.05	40.82	0.72
001	632.80*	100 +5%	74.34	147.89	150.14	150.19	150.57	0.005978	3.13	30.66	41.05	0.74
001	632.80*	100 +25%	88.50	147.89	150.22	150.29	150.72	0.006754	3.42	33.95	42.24	0.79
001	632.80*	100 +70%	120.36	147.89	150.51	150.51	150.98	0.005794	3.48	46.87	46.82	0.75
001	632.80*	1000	116.46	147.89	150.48	150.49	150.95	0.005792	3.45	45.65	46.44	0.75
001	623.40*	2	26.58	147.81	149.27		149.55	0.006691	2.35	11.30	10.30	0.72
001	623.40*	20	49.78	147.81	149.79	149.52	150.19	0.006243	2.86	19.79	34.49	0.73
001	623.40*	50	60.91	147.81	149.94	149.97	150.35	0.005934	2.97	25.42	38.34	0.73
001	623.40*	100	70.80	147.81	150.00	150.06	150.47	0.006705	3.23	27.77	39.58	0.78
001	623.40*	100 +5%	74.34	147.81	150.09	150.11	150.50	0.005659	3.07	31.49	41.33	0.72
001	623.40*	100 +25%	88.50	147.81	150.16	150.21	150.65	0.006539	3.38	34.49	42.50	0.78
001	623.40*	100 +70%	120.36	147.81	150.36	150.45	150.92	0.007092	3.76	43.18	45.35	0.82
001	623.40*	1000	116.46	147.81	150.34	150.42	150.89	0.007083	3.73	42.06	45.00	0.82
001	614.00*	2	26.58	147.73	149.20		149.49	0.006647	2.35	11.29	10.21	0.71
001	614.00*	20	49.78	147.73	149.71	149.45	150.12	0.006341	2.87	19.73	35.14	0.74
001	614.00*	50	60.91	147.73	149.90	149.90	150.28	0.005508	2.88	26.50	38.95	0.70
001	614.00*	100	70.80	147.73	149.94	150.00	150.40	0.006498	3.19	28.31	39.91	0.76
001	614.00*	100 +5%	74.34	147.73	149.96	150.03	150.44	0.006818	3.29	28.99	40.26	0.78
001	614.00*	100 +25%	88.50	147.73	150.10	150.14	150.57	0.006421	3.35	34.90	42.76	0.77
001	614.00*	100 +70%	120.36	147.73	150.30	150.35	150.84	0.006909	3.72	43.70	45.24	0.81
001	614.00*	1000	116.46	147.73	150.28	150.34	150.81	0.006898	3.68	42.57	44.90	0.81
001	604.60*	2	26.58	147.65	149.14		149.42	0.006630	2.36	11.26	10.25	0.71
001	604.60*	20	49.78	147.65	149.64	149.41	150.05	0.006495	2.89	19.62	35.26	0.74
001	604.60*	50	60.91	147.65	149.74	149.82	150.22	0.007160	3.17	23.34	37.58	0.79

HEC-RAS Plan: Baseline River: River Trannon Reach: 001 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
001	604.60*	100	70.80	147.65	149.89	149.92	150.32	0.006241	3.13	29.07	40.67	0.75
001	604.60*	100 +5%	74.34	147.65	149.90	149.96	150.36	0.006607	3.24	29.63	40.86	0.77
001	604.60*	100 +25%	88.50	147.65	150.07	150.08	150.49	0.005837	3.23	36.51	43.15	0.73
001	604.60*	100 +70%	120.36	147.65	150.24	150.29	150.77	0.006818	3.69	44.05	45.18	0.80
001	604.60*	1000	116.46	147.65	150.21	150.27	150.74	0.006807	3.65	42.94	44.89	0.80
001	595.20*	2	26.58	147.56	149.07		149.36	0.006672	2.37	11.21	10.25	0.71
001	595.20*	20	49.78	147.56	149.56	149.36	149.98	0.006727	2.93	19.44	35.69	0.75
001	595.20*	50	60.91	147.56	149.68	149.76	150.14	0.006980	3.13	23.95	38.90	0.78
001	595.20*	100	70.80	147.56	149.78	149.85	150.25	0.006966	3.25	27.84	40.23	0.78
001	595.20*	100 +5%	74.34	147.56	149.87	149.88	150.28	0.005866	3.09	31.50	41.44	0.73
001	595.20*	100 +25%	88.50	147.56	149.92	150.00	150.43	0.007308	3.50	33.34	42.03	0.81
001	595.20*	100 +70%	120.36	147.56	150.20	150.22	150.68	0.006277	3.56	45.63	45.24	0.77
001	595.20*	1000	116.46	147.56	150.17	150.20	150.65	0.006272	3.53	44.50	45.04	0.77
001	585.80*	2	26.58	147.48	148.99		149.29	0.006864	2.40	11.09	10.21	0.72
001	585.80*	20	49.78	147.48	149.48	149.31	149.91	0.007036	2.97	19.25	36.97	0.77
001	585.80*	50	60.91	147.48	149.62	149.68	150.06	0.006920	3.11	24.38	39.16	0.77
001	585.80*	100	70.80	147.48	149.74	149.78	150.17	0.006332	3.12	29.40	40.79	0.75
001	585.80*	100 +5%	74.34	147.48	149.73	149.81	150.22	0.007279	3.33	28.84	40.61	0.80
001	585.80*	100 +25%	88.50	147.48	149.93	149.92	150.34	0.005704	3.17	37.28	43.13	0.72
001	585.80*	100 +70%	120.36	147.48	150.17	150.14	150.60	0.005555	3.38	47.87	45.01	0.73
001	585.80*	1000	116.46	147.48	150.15	150.12	150.57	0.005518	3.34	46.82	44.86	0.72
001	576.40*	2	26.58	147.40	148.91		149.22	0.007168	2.44	10.91	10.14	0.73
001	576.40*	20	49.78	147.40	149.49	149.48	149.83	0.005578	2.71	22.48	38.67	0.69
001	576.40*	50	60.91	147.40	149.65	149.61	149.98	0.005056	2.75	28.74	40.66	0.66
001	576.40*	100	70.80	147.40	149.76	149.70	150.09	0.004819	2.80	33.46	41.90	0.66
001	576.40*	100 +5%	74.34	147.40	149.79	149.73	150.12	0.004822	2.83	34.83	42.16	0.66
001	576.40*	100 +25%	88.50	147.40	149.93		150.26	0.004596	2.90	40.82	43.28	0.65
001	576.40*	100 +70%	120.36	147.40	150.17		150.53	0.004696	3.15	51.02	44.94	0.67
001	576.40*	1000	116.46	147.40	150.14		150.50	0.004643	3.11	50.02	44.80	0.66
001	0567	2	26.58	147.31	148.83		149.15	0.007643	2.50	10.67	10.01	0.75
001	0567	20	49.78	147.31	149.48	149.41	149.76	0.004566	2.50	25.34	39.74	0.62
001	0567	50	60.91	147.31	149.65		149.91	0.003956	2.49	32.32	41.23	0.59
001	0567	100	70.80	147.31	149.77		150.02	0.003830	2.55	36.99	42.08	0.59
001	0567	100 +5%	74.34	147.31	149.80		150.06	0.003857	2.58	38.33	42.33	0.59
001	0567	100 +25%	88.50	147.31	149.93		150.21	0.003779	2.67	44.15	43.36	0.59
001	0567	100 +70%	120.36	147.31	150.16		150.48	0.004018	2.95	54.11	44.99	0.62
001	0567	1000	116.46	147.31	150.14		150.45	0.003958	2.91	53.13	44.85	0.61
001	558.50*	2	26.58	147.20	148.80		149.08	0.006260	2.34	11.39	10.02	0.69
001	558.50*	20	49.78	147.20	149.44	149.03	149.72	0.004264	2.47	25.26	40.14	0.60
001	558.50*	50	60.91	147.20	149.62		149.87	0.003697	2.46	32.58	41.77	0.57
001	558.50*	100	70.80	147.20	149.73		149.99	0.003603	2.52	37.36	42.74	0.57
001	558.50*	100 +5%	74.34	147.20	149.76		150.03	0.003650	2.57	38.66	43.00	0.58
001	558.50*	100 +25%	88.50	147.20	149.90		150.17	0.003580	2.66	44.69	44.18	0.58
001	558.50*	100 +70%	120.36	147.20	150.12		150.44	0.003850	2.94	54.72	45.80	0.61
001	558.50*	1000	116.46	147.20	150.10		150.41	0.003772	2.89	53.81	45.62	0.60
001	550.00*	2	26.58	147.09	148.77		149.02	0.005313	2.21	12.05	9.84	0.64
001	550.00*	20	49.78	147.09	149.40	148.94	149.68	0.004031	2.44	25.26	40.68	0.59
001	550.00*	50	60.91	147.09	149.59		149.84	0.003496	2.43	32.93	42.57	0.56
001	550.00*	100	70.80	147.09	149.70		149.96	0.003421	2.49	37.85	43.69	0.56
001	550.00*	100 +5%	74.34	147.09	149.73		149.99	0.003480	2.54	39.14	43.98	0.56
001	550.00*	100 +25%	88.50	147.09	149.87		150.14	0.003395	2.62	45.45	45.12	0.56
001	550.00*	100 +70%	120.36	147.09	150.09		150.41	0.003722	2.92	55.57	47.33	0.60
001	550.00*	1000	116.46	147.09	150.07		150.38	0.003639	2.87	54.67	47.14	0.59
001	541.50*	2	26.58	146.98	148.75		148.97	0.004566	2.10	12.63	9.76	0.59
001	541.50*	20	49.78	146.98	149.37	148.84	149.65	0.003914	2.42	25.11	41.45	0.58
001	541.50*	50	60.91	146.98	149.56		149.81	0.003353	2.39	33.32	43.77	0.54
001	541.50*	100	70.80	146.98	149.68		149.93	0.003265	2.45	38.51	44.89	0.54
001	541.50*	100 +5%	74.34	146.98	149.71		149.96	0.003333	2.50	39.78	45.20	0.55
001	541.50*	100 +25%	88.50	146.98	149.85		150.11	0.003262	2.58	46.36	46.98	0.55
001	541.50*	100 +70%	120.36	146.98	150.07		150.38	0.003565	2.87	56.99	49.63	0.58
001	541.50*	1000	116.46	146.98	150.05		150.35	0.003481	2.82	56.08	49.40	0.57
001	533.00*	2	26.58	146.86	148.72		148.93	0.003989	2.02	13.14	9.56	0.55
001	533.00*	20	49.78	146.86	149.33	148.75	149.61	0.003914	2.41	24.77	42.61	0.57
001	533.00*	50	60.91	146.86	149.54		149.78	0.003244	2.36	33.86	45.57	0.53
001	533.00*	100	70.80	146.86	149.66		149.90	0.003142	2.41	39.42	47.35	0.53
001	533.00*	100 +5%	74.34	146.86	149.68		149.93	0.003209	2.46	40.76	47.75	0.53
001	533.00*	100 +25%	88.50	146.86	149.83		150.08	0.003086	2.52	48.01	49.93	0.53
001	533.00*	100 +70%	120.36	146.86	150.06		150.34	0.003302	2.77	59.70	53.06	0.55
001	533.00*	1000	116.46	146.86	150.04		150.31	0.003232	2.73	58.69	52.85	0.55
001	524.50*	2	26.58	146.75	148.70		148.90	0.003511	1.96	13.60	9.23	0.51
001	524.50*	20	49.78	146.75	149.29	148.65	149.57	0.004020	2.42	24.30	44.64	0.57
001	524.50*	50	60.91	146.75	149.52		149.75	0.003099	2.30	35.12	49.15	0.51
001	524.50*	100	70.80	146.75	149.64		149.87	0.002933	2.33	41.46	51.49	0.50
001	524.50*	100 +5%	74.34	146.75	149.67		149.90	0.002985	2.37	42.95	52.03	0.51
001	524.50*	100 +25%	88.50	146.75	149.83		150.05	0.002780	2.39	51.27	54.18	0.50
001	524.50*	100 +70%	120.36	146.75	150.06		150.31	0.002906	2.61	64.26	57.31	0.52

HEC-RAS Plan: Baseline River: River Trannon Reach: 001 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
001	524.50*	1000	116.46	146.75	150.04		150.28	0.002849	2.57	63.14	57.10	0.51
001	0516	2	26.58	146.64	148.68		148.87	0.003189	1.90	14.00	9.01	0.49
001	0516	20	49.78	146.64	149.26	148.57	149.54	0.004014	2.39	24.89	49.81	0.56
001	0516	50	60.91	146.64	149.52	148.82	149.72	0.002716	2.15	38.80	55.55	0.47
001	0516	100	70.80	146.64	149.65	149.42	149.83	0.002499	2.15	46.15	57.60	0.46
001	0516	100 +5%	74.34	146.64	149.68		149.87	0.002530	2.18	47.87	58.07	0.46
001	0516	100 +25%	88.50	146.64	149.84		150.01	0.002331	2.19	57.19	60.55	0.45
001	0516	100 +70%	120.36	146.64	150.07		150.27	0.002392	2.36	71.96	64.28	0.46
001	0516	1000	116.46	146.64	150.05		150.24	0.002348	2.33	70.67	63.96	0.46
001	507.20*	2	26.58	146.66	148.63		148.83	0.003751	2.00	13.28	9.14	0.53
001	507.20*	20	49.78	146.66	149.15	148.62	149.49	0.004954	2.62	21.19	32.42	0.63
001	507.20*	50	60.91	146.66	149.28	148.87	149.67	0.005312	2.84	25.87	39.38	0.66
001	507.20*	100	70.80	146.66	149.42	149.42	149.79	0.004970	2.88	32.20	51.19	0.65
001	507.20*	100 +5%	74.34	146.66	149.52	149.45	149.83	0.004097	2.70	37.47	53.50	0.59
001	507.20*	100 +25%	88.50	146.66	149.74	149.58	149.98	0.003142	2.52	49.68	57.72	0.53
001	507.20*	100 +70%	120.36	146.66	149.98		150.24	0.003120	2.69	64.31	62.38	0.53
001	507.20*	1000	116.46	146.66	149.97	149.75	150.21	0.003039	2.64	63.30	62.08	0.53
001	498.40*	2	26.58	146.68	148.57		148.80	0.004343	2.11	12.62	9.05	0.57
001	498.40*	20	49.78	146.68	149.09	148.65	149.45	0.005358	2.71	20.76	31.67	0.66
001	498.40*	50	60.91	146.68	149.22	149.20	149.62	0.005608	2.91	25.44	37.48	0.68
001	498.40*	100	70.80	146.68	149.34	149.33	149.75	0.005533	3.01	30.01	41.25	0.68
001	498.40*	100 +5%	74.34	146.68	149.39	149.35	149.79	0.005315	3.00	32.17	43.08	0.67
001	498.40*	100 +25%	88.50	146.68	149.52	149.51	149.93	0.005420	3.16	37.88	48.53	0.69
001	498.40*	100 +70%	120.36	146.68	149.76	149.76	150.19	0.005283	3.35	51.07	57.38	0.69
001	498.40*	1000	116.46	146.68	149.74	149.74	150.16	0.005265	3.32	49.69	56.88	0.69
001	489.60*	2	26.58	146.70	148.51		148.76	0.005188	2.22	11.99	9.15	0.62
001	489.60*	20	49.78	146.70	149.03	148.65	149.41	0.005696	2.78	20.64	31.98	0.68
001	489.60*	50	60.91	146.70	149.17	149.16	149.57	0.005781	2.95	25.53	36.87	0.69
001	489.60*	100	70.80	146.70	149.29	149.28	149.70	0.005620	3.03	30.16	40.71	0.69
001	489.60*	100 +5%	74.34	146.70	149.35	149.34	149.73	0.005318	3.01	32.47	42.17	0.67
001	489.60*	100 +25%	88.50	146.70	149.44	149.44	149.88	0.005783	3.24	36.76	44.77	0.71
001	489.60*	100 +70%	120.36	146.70	149.68	149.69	150.15	0.005859	3.49	48.19	51.92	0.72
001	489.60*	1000	116.46	146.70	149.65	149.66	150.12	0.005945	3.49	46.51	50.92	0.73
001	480.80*	2	26.58	146.72	148.43		148.71	0.006202	2.34	11.34	9.06	0.67
001	480.80*	20	49.78	146.72	148.97	148.63	149.36	0.006010	2.83	20.68	32.63	0.69
001	480.80*	50	60.91	146.72	149.12	149.11	149.52	0.005849	2.96	25.96	37.13	0.69
001	480.80*	100	70.80	146.72	149.23	149.23	149.64	0.005884	3.08	30.01	40.17	0.70
001	480.80*	100 +5%	74.34	146.72	149.26	149.26	149.68	0.005876	3.11	31.46	41.20	0.70
001	480.80*	100 +25%	88.50	146.72	149.40	149.40	149.82	0.005712	3.21	37.41	44.80	0.70
001	480.80*	100 +70%	120.36	146.72	149.57	149.62	150.09	0.006881	3.70	45.15	48.94	0.78
001	480.80*	1000	116.46	146.72	149.54	149.60	150.06	0.006874	3.67	43.90	48.27	0.78
001	0472	2	26.58	146.74	148.31		148.64	0.007969	2.54	10.46	8.79	0.74
001	0472	20	49.78	146.74	148.91	148.91	149.30	0.006254	2.86	20.94	33.50	0.70
001	0472	50	60.91	146.74	149.06	149.06	149.46	0.006046	2.98	26.22	37.53	0.70
001	0472	100	70.80	146.74	149.11	149.17	149.58	0.007113	3.28	28.04	38.81	0.76
001	0472	100 +5%	74.34	146.74	149.14	149.21	149.62	0.007181	3.33	29.24	39.64	0.76
001	0472	100 +25%	88.50	146.74	149.25	149.33	149.76	0.007398	3.51	33.88	42.70	0.78
001	0472	100 +70%	120.36	146.74	149.47	149.55	150.02	0.007638	3.82	43.77	48.15	0.81
001	0472	1000	116.46	146.74	149.45	149.52	149.99	0.007613	3.79	42.61	47.57	0.81
001	463.17*	2	26.58	146.66	148.25		148.56	0.007471	2.48	10.71	9.05	0.73
001	463.17*	20	49.78	146.66	148.72	148.83	149.22	0.008567	3.19	17.41	27.71	0.81
001	463.17*	50	60.91	146.66	148.88	148.98	149.39	0.008032	3.30	22.59	34.36	0.80
001	463.17*	100	70.80	146.66	148.97	149.09	149.51	0.008306	3.47	25.82	36.58	0.82
001	463.17*	100 +5%	74.34	146.66	149.01	149.13	149.55	0.008335	3.52	27.01	37.37	0.82
001	463.17*	100 +25%	88.50	146.66	149.23	149.24	149.67	0.006273	3.29	36.07	42.90	0.73
001	463.17*	100 +70%	120.36	146.66	149.47	149.46	149.94	0.006260	3.53	46.93	48.45	0.74
001	463.17*	1000	116.46	146.66	149.38	149.45	149.92	0.007281	3.72	42.84	46.47	0.79
001	454.33*	2	26.58	146.58	148.20		148.49	0.007035	2.42	10.97	9.30	0.71
001	454.33*	20	49.78	146.58	148.66	148.70	149.14	0.008252	3.12	17.91	28.18	0.80
001	454.33*	50	60.91	146.58	148.87	148.90	149.29	0.006620	3.04	24.99	35.85	0.73
001	454.33*	100	70.80	146.58	148.97	149.01	149.41	0.006647	3.16	28.73	37.99	0.74
001	454.33*	100 +5%	74.34	146.58	149.00	149.04	149.45	0.006681	3.21	29.96	38.71	0.74
001	454.33*	100 +25%	88.50	146.58	149.16	149.15	149.59	0.006142	3.24	36.27	42.22	0.72
001	454.33*	100 +70%	120.36	146.58	149.45	149.37	149.86	0.005342	3.31	49.63	48.22	0.69
001	454.33*	1000	116.46	146.58	149.42	149.35	149.83	0.005446	3.31	47.94	47.53	0.69
001	445.50*	2	26.58	146.50	148.14		148.43	0.006743	2.37	11.20	9.53	0.70
001	445.50*	20	49.78	146.50	148.58	148.65	149.05	0.008115	3.10	18.11	28.34	0.79
001	445.50*	50	60.91	146.50	148.83	148.82	149.20	0.006065	2.90	26.34	36.59	0.70
001	445.50*	100	70.80	146.50	148.96	148.94	149.32	0.005499	2.91	31.51	39.31	0.68
001	445.50*	100 +5%	74.34	146.50	149.01	148.96	149.36	0.005380	2.92	33.19	40.15	0.67
001	445.50*	100 +25%	88.50	146.50	149.16	149.08	149.51	0.005035	2.97	39.56	43.29	0.66
001	445.50*	100 +70%	120.36	146.50	149.45		149.80	0.004446	3.05	53.19	48.50	0.63
001	445.50*	1000	116.46	146.50	149.42		149.76	0.004511	3.04	51.54	47.91	0.63
001	436.67*	2	26.58	146.41	148.09		148.37	0.006588	2.33	11.39	9.74	0.69
001	436.67*	20	49.78	146.41	148.60	148.57	148.97	0.006322	2.80	21.18	34.16	0.71

HEC-RAS Plan: Baseline River: River Trannon Reach: 001 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
001	436.67*	50	60.91	146.41	148.83	148.76	149.13	0.004888	2.64	29.47	38.17	0.63
001	436.67*	100	70.80	146.41	148.97		149.25	0.004445	2.64	34.88	40.76	0.61
001	436.67*	100 +5%	74.34	146.41	149.01		149.30	0.004362	2.65	36.61	41.55	0.61
001	436.67*	100 +25%	88.50	146.41	149.16		149.45	0.004120	2.71	43.15	44.26	0.60
001	436.67*	100 +70%	120.36	146.41	149.45		149.75	0.003756	2.82	56.76	48.83	0.58
001	436.67*	1000	116.46	146.41	149.42		149.71	0.003796	2.81	55.12	48.30	0.58
001	427.83*	2	26.58	146.33	148.03		148.31	0.006718	2.33	11.43	9.92	0.69
001	427.83*	20	49.78	146.33	148.60	148.53	148.90	0.005165	2.57	23.88	35.85	0.64
001	427.83*	50	60.91	146.33	148.83		149.07	0.003979	2.41	32.55	39.62	0.57
001	427.83*	100	70.80	146.33	148.97		149.20	0.003675	2.41	38.19	42.04	0.55
001	427.83*	100 +5%	74.34	146.33	149.01		149.24	0.003616	2.43	39.97	42.79	0.55
001	427.83*	100 +25%	88.50	146.33	149.16		149.40	0.003440	2.49	46.66	45.09	0.54
001	427.83*	100 +70%	120.36	146.33	149.45		149.70	0.003216	2.62	60.32	49.19	0.54
001	427.83*	1000	116.46	146.33	149.42		149.67	0.003242	2.60	58.69	48.71	0.54
001	0419	2	26.58	146.25	147.96		148.24	0.007253	2.35	11.29	10.12	0.71
001	0419	20	49.78	146.25	148.60		148.84	0.004273	2.35	26.65	37.39	0.58
001	0419	50	60.91	146.25	148.83		149.03	0.003294	2.21	35.65	40.92	0.51
001	0419	100	70.80	146.25	148.97		149.16	0.003100	2.21	41.47	43.19	0.50
001	0419	100 +5%	74.34	146.25	149.01		149.20	0.003056	2.23	43.30	43.88	0.50
001	0419	100 +25%	88.50	146.25	149.16		149.36	0.002927	2.29	50.11	45.82	0.50
001	0419	100 +70%	120.36	146.25	149.45		149.67	0.002794	2.43	63.88	49.57	0.50
001	0419	1000	116.46	146.25	149.42		149.63	0.002810	2.41	62.23	49.14	0.50
001	409.75*	2	26.58	146.22	147.93		148.17	0.005373	2.14	12.40	10.54	0.63
001	409.75*	20	49.78	146.22	148.53	148.08	148.81	0.004255	2.41	24.66	34.33	0.59
001	409.75*	50	60.91	146.22	148.74		148.99	0.003607	2.40	32.11	38.52	0.55
001	409.75*	100	70.80	146.22	148.87		149.12	0.003407	2.44	37.52	41.06	0.54
001	409.75*	100 +5%	74.34	146.22	148.92		149.17	0.003367	2.46	39.27	41.69	0.54
001	409.75*	100 +25%	88.50	146.22	149.07		149.32	0.003268	2.54	45.80	43.98	0.54
001	409.75*	100 +70%	120.36	146.22	149.36		149.63	0.003123	2.69	59.33	48.38	0.54
001	409.75*	1000	116.46	146.22	149.33		149.60	0.003146	2.68	57.68	47.89	0.54
001	400.50*	2	26.58	146.18	147.92		148.11	0.003967	1.94	13.74	11.18	0.55
001	400.50*	20	49.78	146.18	148.50		148.77	0.003505	2.34	24.70	32.78	0.55
001	400.50*	50	60.91	146.18	148.70		148.96	0.003235	2.40	31.62	38.11	0.54
001	400.50*	100	70.80	146.18	148.83		149.10	0.003157	2.48	36.86	41.02	0.54
001	400.50*	100 +5%	74.34	146.18	148.87		149.14	0.003145	2.50	38.57	41.67	0.54
001	400.50*	100 +25%	88.50	146.18	149.02		149.30	0.003164	2.62	44.77	43.94	0.55
001	400.50*	100 +70%	120.36	146.18	149.31		149.61	0.003042	2.78	58.22	47.06	0.55
001	400.50*	1000	116.46	146.18	149.28		149.57	0.003062	2.76	56.60	46.70	0.55
001	391.25*	2	26.58	146.14	147.92		148.07	0.002707	1.74	15.66	13.27	0.47
001	391.25*	20	49.78	146.14	148.51		148.72	0.002494	2.11	27.80	33.85	0.48
001	391.25*	50	60.91	146.14	148.70		148.92	0.002400	2.20	34.78	38.80	0.47
001	391.25*	100	70.80	146.14	148.83		149.06	0.002415	2.29	39.93	41.08	0.48
001	391.25*	100 +5%	74.34	146.14	148.87		149.10	0.002425	2.32	41.60	41.42	0.48
001	391.25*	100 +25%	88.50	146.14	149.01		149.26	0.002512	2.46	47.53	42.64	0.50
001	391.25*	100 +70%	120.36	146.14	149.29		149.57	0.002617	2.69	59.81	45.06	0.52
001	391.25*	1000	116.46	146.14	149.26		149.54	0.002616	2.67	58.30	44.77	0.51
001	0382	2	26.58	146.11	147.93		148.04	0.001695	1.47	19.68	17.64	0.38
001	0382	20	49.78	146.11	148.54		148.69	0.001616	1.79	32.90	35.74	0.39
001	0382	50	60.91	146.11	148.73		148.88	0.001624	1.90	39.95	38.51	0.39
001	0382	100	70.80	146.11	148.85		149.02	0.001689	2.00	44.85	39.38	0.41
001	0382	100 +5%	74.34	146.11	148.89		149.07	0.001719	2.04	46.40	39.66	0.41
001	0382	100 +25%	88.50	146.11	149.03		149.23	0.001860	2.20	51.88	40.61	0.43
001	0382	100 +70%	120.36	146.11	149.30		149.54	0.002093	2.49	63.10	42.48	0.46
001	0382	1000	116.46	146.11	149.27		149.50	0.002075	2.46	61.72	42.26	0.46
001	372.33*	2	26.58	146.05	147.83		148.00	0.003937	1.87	14.35	13.49	0.55
001	372.33*	20	49.78	146.05	148.42		148.66	0.003132	2.19	25.57	30.35	0.53
001	372.33*	50	60.91	146.05	148.62		148.85	0.002952	2.28	32.38	38.54	0.52
001	372.33*	100	70.80	146.05	148.75		148.99	0.002869	2.35	37.71	40.22	0.52
001	372.33*	100 +5%	74.34	146.05	148.79		149.04	0.002865	2.37	39.37	40.59	0.52
001	372.33*	100 +25%	88.50	146.05	148.93		149.20	0.002934	2.51	45.14	41.81	0.53
001	372.33*	100 +70%	120.36	146.05	149.21		149.51	0.002967	2.73	57.32	44.16	0.54
001	372.33*	1000	116.46	146.05	149.18		149.47	0.002981	2.71	55.79	43.88	0.54
001	362.67*	2	26.58	146.00	147.70		147.95	0.006746	2.21	12.04	11.69	0.70
001	362.67*	20	49.78	146.00	148.31	147.92	148.61	0.005177	2.45	21.39	25.79	0.65
001	362.67*	50	60.91	146.00	148.48	148.12	148.81	0.004961	2.59	26.61	34.29	0.64
001	362.67*	100	70.80	146.00	148.61	148.38	148.95	0.004733	2.66	31.47	38.65	0.64
001	362.67*	100 +5%	74.34	146.00	148.66	148.48	148.99	0.004646	2.68	33.23	39.92	0.63
001	362.67*	100 +25%	88.50	146.00	148.82		149.15	0.004312	2.74	40.03	42.40	0.62
001	362.67*	100 +70%	120.36	146.00	149.16		149.48	0.003643	2.79	54.79	45.88	0.59
001	362.67*	1000	116.46	146.00	149.12		149.44	0.003697	2.78	53.10	45.51	0.59
001	0353	2	26.58	145.94	147.69		147.88	0.004189	1.94	13.69	10.74	0.55
001	0353	20	49.78	145.94	148.27		148.56	0.004648	2.40	21.98	26.72	0.60
001	0353	50	60.91	145.94	148.44		148.75	0.004891	2.53	27.21	33.56	0.63
001	0353	100	70.80	145.94	148.58		148.89	0.004887	2.59	32.10	38.18	0.63
001	0353	100 +5%	74.34	145.94	148.62		148.94	0.004807	2.60	33.92	39.04	0.63
001	0353	100 +25%	88.50	145.94	148.80		149.10	0.004399	2.61	41.14	42.00	0.61

HEC-RAS Plan: Baseline River: River Trannon Reach: 001 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
001	0353	100 +70%	120.36	145.94	149.14		149.43	0.003659	2.64	56.44	47.39	0.57
001	0353	1000	116.46	145.94	149.11		149.39	0.003726	2.63	54.68	46.80	0.57
001	344.60*	2	26.58	145.91	147.62		147.84	0.004908	2.09	12.69	10.11	0.60
001	344.60*	20	49.78	145.91	148.19	147.74	148.51	0.005618	2.53	20.81	27.45	0.67
001	344.60*	50	60.91	145.91	148.40		148.71	0.005023	2.56	27.25	33.66	0.64
001	344.60*	100	70.80	145.91	148.54		148.85	0.004764	2.61	32.17	37.00	0.63
001	344.60*	100 +5%	74.34	145.91	148.58		148.90	0.004653	2.62	33.95	37.74	0.63
001	344.60*	100 +25%	88.50	145.91	148.76		149.07	0.004241	2.64	41.00	40.50	0.61
001	344.60*	100 +70%	120.36	145.91	149.11		149.40	0.003565	2.69	55.68	45.30	0.57
001	344.60*	1000	116.46	145.91	149.07		149.36	0.003618	2.68	54.01	44.84	0.57
001	336.20*	2	26.58	145.88	147.53		147.79	0.006354	2.27	11.70	10.35	0.68
001	336.20*	20	49.78	145.88	148.13	147.76	148.47	0.005703	2.59	20.58	27.51	0.68
001	336.20*	50	60.91	145.88	148.36		148.67	0.004791	2.58	27.37	32.65	0.63
001	336.20*	100	70.80	145.88	148.50		148.81	0.004557	2.63	32.16	35.43	0.62
001	336.20*	100 +5%	74.34	145.88	148.55		148.86	0.004465	2.64	33.87	36.14	0.62
001	336.20*	100 +25%	88.50	145.88	148.72		149.04	0.004078	2.68	40.61	38.92	0.60
001	336.20*	100 +70%	120.36	145.88	149.07		149.38	0.003532	2.77	54.64	43.25	0.57
001	336.20*	1000	116.46	145.88	149.03		149.34	0.003571	2.76	53.06	42.83	0.58
001	327.80*	2	26.58	145.85	147.43		147.73	0.007632	2.43	10.95	10.34	0.75
001	327.80*	20	49.78	145.85	148.08	147.72	148.42	0.005602	2.65	20.36	26.83	0.68
001	327.80*	50	60.91	145.85	148.32		148.63	0.004594	2.60	27.36	31.33	0.63
001	327.80*	100	70.80	145.85	148.46		148.78	0.004391	2.67	31.93	33.80	0.62
001	327.80*	100 +5%	74.34	145.85	148.50		148.83	0.004311	2.69	33.54	34.53	0.62
001	327.80*	100 +25%	88.50	145.85	148.68		149.01	0.004000	2.75	39.98	37.12	0.60
001	327.80*	100 +70%	120.36	145.85	149.02		149.35	0.003614	2.88	53.02	41.11	0.59
001	327.80*	1000	116.46	145.85	148.98		149.31	0.003641	2.86	51.53	40.70	0.59
001	319.40*	2	26.58	145.82	147.34	147.15	147.66	0.008272	2.52	10.53	10.10	0.79
001	319.40*	20	49.78	145.82	148.00	147.66	148.38	0.005858	2.76	19.54	25.54	0.70
001	319.40*	50	60.91	145.82	148.27	148.07	148.60	0.004552	2.67	26.93	29.80	0.63
001	319.40*	100	70.80	145.82	148.40	148.21	148.74	0.004385	2.75	31.25	32.02	0.62
001	319.40*	100 +5%	74.34	145.82	148.45	148.25	148.79	0.004328	2.77	32.77	32.71	0.62
001	319.40*	100 +25%	88.50	145.82	148.63	148.41	148.98	0.004079	2.85	38.84	35.13	0.61
001	319.40*	100 +70%	120.36	145.82	148.93	148.70	149.31	0.003997	3.07	50.01	38.62	0.62
001	319.40*	1000	116.46	145.82	148.90	148.67	149.27	0.004014	3.05	48.66	38.22	0.62
001	0311	2	26.58	145.79	147.07	147.07	147.56	0.013841	3.08	8.64	8.99	1.00
001	0311	20	49.78	145.79	147.60	147.60	148.28	0.012898	3.66	13.60	10.33	1.00
001	0311	50	60.91	145.79	148.03	148.03	148.53	0.007242	3.22	21.44	25.62	0.77
001	0311	100	70.80	145.79	148.17	148.17	148.68	0.006945	3.32	25.15	27.59	0.76
001	0311	100 +5%	74.34	145.79	148.21	148.21	148.73	0.006879	3.35	26.39	28.22	0.76
001	0311	100 +25%	88.50	145.79	148.37	148.37	148.91	0.006771	3.50	30.97	30.42	0.77
001	0311	100 +70%	120.36	145.79	148.67	148.67	149.25	0.006479	3.74	40.74	34.16	0.77
001	0311	1000	116.46	145.79	148.64	148.64	149.22	0.006458	3.70	39.72	33.82	0.77
001	301.67*	2	26.58	145.58	146.80	146.90	147.40	0.019196	3.42	7.78	9.06	1.18
001	301.67*	20	49.78	145.58	147.27	147.42	148.13	0.017668	4.09	12.16	9.70	1.17
001	301.67*	50	60.91	145.58	147.52	147.60	148.41	0.015759	4.18	14.58	10.18	1.12
001	301.67*	100	70.80	145.58	147.92	148.07	148.59	0.009324	3.68	21.31	28.18	0.88
001	301.67*	100 +5%	74.34	145.58	147.97	148.11	148.64	0.009168	3.71	22.67	29.17	0.87
001	301.67*	100 +25%	88.50	145.58	148.10	148.28	148.83	0.009331	3.92	26.85	32.02	0.89
001	301.67*	100 +70%	120.36	145.58	148.35	148.56	149.16	0.009662	4.32	35.32	37.08	0.93
001	301.67*	1000	116.46	145.58	148.32	148.53	149.12	0.009615	4.27	34.36	36.60	0.92
001	292.33*	2	26.58	145.37	146.94	146.73	147.25	0.007597	2.50	10.64	9.61	0.76
001	292.33*	20	49.78	145.37	147.45	147.23	147.96	0.008434	3.15	15.79	10.41	0.82
001	292.33*	50	60.91	145.37	147.63	147.45	148.24	0.009204	3.45	17.64	10.71	0.86
001	292.33*	100	70.80	145.37	147.52	147.61	148.46	0.015019	4.29	16.51	10.53	1.09
001	292.33*	100 +5%	74.34	145.37	147.75	148.01	148.53	0.010977	3.92	19.49	21.91	0.94
001	292.33*	100 +25%	88.50	145.37	147.96	148.20	148.73	0.009887	3.99	25.62	34.73	0.91
001	292.33*	100 +70%	120.36	145.37	148.19	148.49	149.06	0.010297	4.39	34.82	42.27	0.95
001	292.33*	1000	116.46	145.37	148.18	148.45	149.02	0.010063	4.32	34.08	41.78	0.93
001	0283	2	26.58	145.16	146.94		147.17	0.004937	2.14	12.42	10.00	0.61
001	0283	20	49.78	145.16	147.46		147.86	0.006079	2.79	17.84	10.78	0.69
001	0283	50	60.91	145.16	147.65	147.26	148.13	0.006696	3.07	19.99	15.47	0.73
001	0283	100	70.80	145.16	147.80	147.43	148.33	0.006816	3.24	23.55	31.92	0.74
001	0283	100 +5%	74.34	145.16	147.87	147.48	148.39	0.006475	3.23	26.00	39.22	0.73
001	0283	100 +25%	88.50	145.16	147.80	148.15	148.63	0.010748	4.06	23.41	31.50	0.93
001	0283	100 +70%	120.36	145.16	148.07	148.36	148.96	0.010566	4.40	34.84	50.13	0.95
001	0283	1000	116.46	145.16	148.05	148.34	148.92	0.010355	4.33	33.92	49.11	0.94
001	274.00*	2	26.58	145.16	146.90		147.12	0.004674	2.08	12.78	10.52	0.60
001	274.00*	20	49.78	145.16	147.43		147.80	0.005567	2.69	18.52	11.40	0.67
001	274.00*	50	60.91	145.16	147.61		148.06	0.006076	2.95	20.70	15.24	0.71
001	274.00*	100	70.80	145.16	147.76	147.37	148.26	0.006106	3.12	24.20	31.87	0.72
001	274.00*	100 +5%	74.34	145.16	147.83	147.43	148.32	0.005870	3.13	26.52	40.28	0.71
001	274.00*	100 +25%	88.50	145.16	147.70	148.04	148.54	0.010819	4.07	22.43	24.17	0.95
001	274.00*	100 +70%	120.36	145.16	148.06	148.34	148.84	0.008755	4.12	37.66	53.14	0.88
001	274.00*	1000	116.46	145.16	148.05	148.32	148.81	0.008588	4.06	36.68	52.45	0.87
001	265.00*	2	26.58	145.15	146.87		147.08	0.004556	2.04	13.05	11.04	0.60

HEC-RAS Plan: Baseline River: River Trannon Reach: 001 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
001	265.00*	20	49.78	145.15	147.40		147.74	0.005219	2.60	19.15	12.04	0.66
001	265.00*	50	60.91	145.15	147.58		147.99	0.005504	2.85	21.46	15.06	0.69
001	265.00*	100	70.80	145.15	147.73	147.31	148.19	0.005514	3.01	25.05	32.00	0.70
001	265.00*	100 +5%	74.34	145.15	147.80	147.37	148.25	0.005294	3.02	27.46	41.25	0.69
001	265.00*	100 +25%	88.50	145.15	147.62	147.98	148.45	0.010687	4.03	22.24	20.14	0.96
001	265.00*	100 +70%	120.36	145.15	148.06	148.25	148.74	0.007414	3.88	40.68	57.91	0.83
001	265.00*	1000	116.46	145.15	148.04	148.23	148.71	0.007281	3.83	39.62	57.37	0.82
001	256.00*	2	26.58	145.15	146.83		147.03	0.004571	2.01	13.22	11.54	0.60
001	256.00*	20	49.78	145.15	147.36		147.69	0.004975	2.53	19.68	12.94	0.65
001	256.00*	50	60.91	145.15	147.55		147.94	0.005065	2.76	22.33	15.42	0.67
001	256.00*	100	70.80	145.15	147.70	147.26	148.13	0.005028	2.91	26.08	33.23	0.67
001	256.00*	100 +5%	74.34	145.15	147.77	147.32	148.19	0.004793	2.91	28.71	43.08	0.66
001	256.00*	100 +25%	88.50	145.15	147.90	147.53	148.36	0.005018	3.10	35.06	52.94	0.68
001	256.00*	100 +70%	120.36	145.15	148.23	148.22	148.62	0.004090	3.08	55.07	67.64	0.63
001	256.00*	1000	116.46	145.15	148.20	148.19	148.59	0.004134	3.07	53.06	66.87	0.63
001	247.00*	2	26.58	145.14	146.79		146.99	0.004723	2.00	13.28	12.00	0.61
001	247.00*	20	49.78	145.14	147.33		147.64	0.004753	2.47	20.21	14.51	0.64
001	247.00*	50	60.91	145.14	147.52		147.88	0.004720	2.67	23.31	17.54	0.65
001	247.00*	100	70.80	145.14	147.68	147.23	148.07	0.004596	2.79	27.46	35.75	0.65
001	247.00*	100 +5%	74.34	145.14	147.76	147.27	148.14	0.004321	2.78	30.48	46.64	0.63
001	247.00*	100 +25%	88.50	145.14	147.91	147.50	148.30	0.004290	2.91	38.38	57.63	0.64
001	247.00*	100 +70%	120.36	145.14	148.24	148.16	148.56	0.003343	2.83	61.06	73.60	0.58
001	247.00*	1000	116.46	145.14	148.20	148.12	148.54	0.003499	2.87	57.93	72.61	0.59
001	0238	2	26.58	145.14	146.74		146.95	0.005039	2.02	13.18	12.36	0.62
001	0238	20	49.78	145.14	147.29		147.59	0.004643	2.42	20.79	16.67	0.63
001	0238	50	60.91	145.14	147.50		147.83	0.004404	2.57	24.72	20.88	0.63
001	0238	100	70.80	145.14	147.68	147.19	148.02	0.004045	2.64	30.04	41.12	0.61
001	0238	100 +5%	74.34	145.14	147.76	147.25	148.09	0.003741	2.61	33.80	53.56	0.59
001	0238	100 +25%	88.50	145.14	147.92	147.47	148.24	0.003496	2.66	43.48	63.61	0.58
001	0238	100 +70%	120.36	145.14	148.26		148.52	0.002687	2.57	68.38	80.05	0.52
001	0238	1000	116.46	145.14	148.22		148.49	0.002808	2.60	65.05	79.18	0.53
001	229.50*	2	26.58	145.06	146.65		146.90	0.006048	2.18	12.22	11.79	0.68
001	229.50*	20	49.78	145.06	147.20		147.54	0.005635	2.58	19.40	14.72	0.69
001	229.50*	50	60.91	145.06	147.41		147.79	0.005332	2.74	22.75	18.25	0.69
001	229.50*	100	70.80	145.06	147.55	147.20	147.97	0.005292	2.89	25.99	31.01	0.70
001	229.50*	100 +5%	74.34	145.06	147.62	147.24	148.04	0.005053	2.90	28.40	41.40	0.68
001	229.50*	100 +25%	88.50	145.06	147.83	147.47	148.21	0.004293	2.87	38.98	55.95	0.64
001	229.50*	100 +70%	120.36	145.06	148.15	148.03	148.49	0.003534	2.87	59.85	74.38	0.60
001	229.50*	1000	116.46	145.06	148.11	148.00	148.46	0.003678	2.90	56.71	71.68	0.61
001	221.00*	2	26.58	144.97	146.57		146.84	0.006505	2.29	11.62	10.97	0.71
001	221.00*	20	49.78	144.97	147.11		147.49	0.006471	2.72	18.39	14.37	0.74
001	221.00*	50	60.91	144.97	147.32		147.74	0.006230	2.88	21.62	17.26	0.74
001	221.00*	100	70.80	144.97	147.46	147.18	147.92	0.006163	3.04	24.39	25.23	0.75
001	221.00*	100 +5%	74.34	144.97	147.53	147.23	147.99	0.005915	3.05	26.40	36.27	0.73
001	221.00*	100 +25%	88.50	144.97	147.74	147.71	148.17	0.004995	3.03	36.03	50.04	0.69
001	221.00*	100 +70%	120.36	144.97	148.07	147.97	148.45	0.004108	3.04	54.66	64.72	0.64
001	221.00*	1000	116.46	144.97	148.02	147.94	148.42	0.004269	3.06	51.89	62.40	0.65
001	212.50*	2	26.58	144.89	146.49		146.78	0.007167	2.36	11.25	10.91	0.74
001	212.50*	20	49.78	144.89	147.02		147.43	0.007137	2.83	17.67	14.20	0.77
001	212.50*	50	60.91	144.89	147.23	146.97	147.68	0.006840	2.99	20.92	17.29	0.77
001	212.50*	100	70.80	144.89	147.37	147.15	147.87	0.006940	3.15	23.54	21.14	0.78
001	212.50*	100 +5%	74.34	144.89	147.44	147.22	147.94	0.006565	3.14	25.47	32.68	0.77
001	212.50*	100 +25%	88.50	144.89	147.66	147.65	148.12	0.005508	3.12	34.47	45.94	0.72
001	212.50*	100 +70%	120.36	144.89	147.99	147.91	148.41	0.004513	3.14	51.53	57.75	0.67
001	212.50*	1000	116.46	144.89	147.95	147.89	148.37	0.004696	3.16	48.99	55.88	0.68
001	204.00*	2	26.58	144.80	146.41		146.71	0.007640	2.41	11.03	10.92	0.77
001	204.00*	20	49.78	144.80	146.94		147.37	0.007202	2.88	17.40	14.07	0.78
001	204.00*	50	60.91	144.80	147.15	146.91	147.62	0.007047	3.04	20.70	17.54	0.78
001	204.00*	100	70.80	144.80	147.29	147.10	147.80	0.007147	3.19	23.37	20.38	0.79
001	204.00*	100 +5%	74.34	144.80	147.38	147.18	147.87	0.006661	3.16	25.51	32.82	0.77
001	204.00*	100 +25%	88.50	144.80	147.62	147.58	148.06	0.005380	3.07	35.14	44.10	0.71
001	204.00*	100 +70%	120.36	144.80	147.98	147.85	148.36	0.004206	3.04	52.64	54.52	0.64
001	204.00*	1000	116.46	144.80	147.93	147.83	148.32	0.004352	3.05	50.32	53.21	0.65
001	195.50*	2	26.58	144.72	146.35		146.64	0.007669	2.41	11.04	10.97	0.77
001	195.50*	20	49.78	144.72	146.90		147.30	0.006780	2.82	17.91	15.18	0.75
001	195.50*	50	60.91	144.72	147.12	146.83	147.55	0.006371	2.95	21.54	18.52	0.74
001	195.50*	100	70.80	144.72	147.26	147.02	147.74	0.006465	3.10	24.48	23.91	0.75
001	195.50*	100 +5%	74.34	144.72	147.33	147.09	147.82	0.006301	3.12	26.63	34.37	0.75
001	195.50*	100 +25%	88.50	144.72	147.62	147.51	148.00	0.004622	2.88	37.94	43.74	0.65
001	195.50*	100 +70%	120.36	144.72	147.97		148.31	0.003789	2.91	54.58	52.39	0.61
001	195.50*	1000	116.46	144.72	147.93		148.28	0.003897	2.91	52.41	51.34	0.61
001	0187	2	26.58	144.63	146.30		146.57	0.007120	2.33	11.39	11.15	0.74
001	0187	20	49.78	144.63	146.87		147.24	0.006060	2.70	18.89	16.75	0.71
001	0187	50	60.91	144.63	147.10		147.49	0.005477	2.80	23.11	19.74	0.69
001	0187	100	70.80	144.63	147.23	146.95	147.67	0.005737	2.99	26.07	31.32	0.71
001	0187	100 +5%	74.34	144.63	147.34	147.01	147.74	0.005134	2.90	29.56	35.25	0.67

HEC-RAS Plan: Baseline River: River Trannon Reach: 001 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
001	0187	100 +25%	88.50	144.63	147.63		147.95	0.003847	2.69	41.07	43.41	0.59
001	0187	100 +70%	120.36	144.63	147.97		148.28	0.003340	2.76	57.04	50.76	0.57
001	0187	1000	116.46	144.63	147.93		148.24	0.003414	2.76	54.98	49.87	0.57
001	177.00*	2	26.58	144.51	146.21		146.50	0.007340	2.39	11.14	10.76	0.75
001	177.00*	20	49.78	144.51	146.78		147.18	0.006359	2.78	18.32	15.71	0.73
001	177.00*	50	60.91	144.51	147.00		147.42	0.006078	2.92	21.95	18.30	0.72
001	177.00*	100	70.80	144.51	147.16	146.89	147.61	0.006045	3.04	25.15	24.76	0.73
001	177.00*	100 +5%	74.34	144.51	147.21	146.98	147.69	0.006169	3.12	26.65	31.26	0.74
001	177.00*	100 +25%	88.50	144.51	147.56		147.91	0.003958	2.76	39.62	41.19	0.61
001	177.00*	100 +70%	120.36	144.51	147.90		148.24	0.003515	2.87	54.58	48.26	0.59
001	177.00*	1000	116.46	144.51	147.86		148.20	0.003589	2.87	52.60	47.37	0.59
001	167.00*	2	26.58	144.39	146.12		146.42	0.007557	2.44	10.90	10.37	0.76
001	167.00*	20	49.78	144.39	146.67		147.10	0.007108	2.92	17.41	14.54	0.77
001	167.00*	50	60.91	144.39	146.88		147.35	0.006935	3.06	20.77	17.13	0.77
001	167.00*	100	70.80	144.39	147.05		147.55	0.006725	3.16	23.87	19.48	0.77
001	167.00*	100 +5%	74.34	144.39	147.10	146.92	147.61	0.006783	3.22	24.83	22.31	0.77
001	167.00*	100 +25%	88.50	144.39	147.50	147.04	147.86	0.004025	2.84	38.30	39.18	0.62
001	167.00*	100 +70%	120.36	144.39	147.82		148.20	0.003724	3.00	52.09	45.92	0.61
001	167.00*	1000	116.46	144.39	147.78		148.16	0.003807	3.00	50.14	45.01	0.61
001	157.00*	2	26.58	144.27	146.02		146.34	0.008043	2.52	10.54	9.94	0.78
001	157.00*	20	49.78	144.27	146.55		147.02	0.008174	3.05	16.54	13.83	0.82
001	157.00*	50	60.91	144.27	146.76	146.59	147.27	0.007850	3.20	19.72	16.09	0.82
001	157.00*	100	70.80	144.27	146.93	146.78	147.47	0.007411	3.31	22.57	18.00	0.81
001	157.00*	100 +5%	74.34	144.27	146.97	146.85	147.54	0.007436	3.38	23.40	18.72	0.81
001	157.00*	100 +25%	88.50	144.27	147.45	146.95	147.82	0.003926	2.87	37.78	37.49	0.61
001	157.00*	100 +70%	120.36	144.27	147.71	147.55	148.15	0.004199	3.20	48.44	43.42	0.65
001	157.00*	1000	116.46	144.27	147.67		148.11	0.004296	3.20	46.56	42.33	0.65
001	147.00*	2	26.58	144.15	145.90		146.25	0.008692	2.62	10.14	9.53	0.81
001	147.00*	20	49.78	144.15	146.42	146.29	146.93	0.009310	3.18	15.80	13.29	0.87
001	147.00*	50	60.91	144.15	146.63	146.50	147.19	0.008546	3.33	18.82	15.17	0.85
001	147.00*	100	70.80	144.15	146.80	146.68	147.39	0.008013	3.45	21.51	17.03	0.84
001	147.00*	100 +5%	74.34	144.15	146.83	146.75	147.46	0.008207	3.54	22.11	17.50	0.85
001	147.00*	100 +25%	88.50	144.15	147.03	146.86	147.73	0.008082	3.77	25.98	26.85	0.86
001	147.00*	100 +70%	120.36	144.15	147.59	147.50	148.09	0.004734	3.41	45.26	42.33	0.69
001	147.00*	1000	116.46	144.15	147.54	147.46	148.06	0.004885	3.42	43.27	41.29	0.70
001	137.00*	2	26.58	144.03	145.78		146.16	0.009440	2.72	9.77	9.21	0.84
001	137.00*	20	49.78	144.03	146.29	146.20	146.84	0.010058	3.29	15.22	12.65	0.90
001	137.00*	50	60.91	144.03	146.47	146.42	147.10	0.009820	3.54	17.63	14.26	0.91
001	137.00*	100	70.80	144.03	146.62	146.60	147.31	0.009371	3.69	20.04	16.18	0.91
001	137.00*	100 +5%	74.34	144.03	146.69	146.67	147.37	0.009060	3.71	21.06	16.66	0.90
001	137.00*	100 +25%	88.50	144.03	146.85	146.82	147.63	0.009205	3.98	23.93	18.37	0.92
001	137.00*	100 +70%	120.36	144.03	147.47	147.47	148.03	0.005113	3.57	43.59	43.31	0.72
001	137.00*	1000	116.46	144.03	147.42	147.42	147.99	0.005287	3.59	41.47	41.39	0.73
001	127.00*	2	26.58	143.90	145.66	145.55	146.05	0.010520	2.78	9.56	9.50	0.89
001	127.00*	20	49.78	143.90	146.16	146.09	146.74	0.010279	3.37	14.91	12.53	0.92
001	127.00*	50	60.91	143.90	146.33	146.32	147.00	0.010382	3.65	17.15	14.44	0.94
001	127.00*	100	70.80	143.90	146.50	146.50	147.21	0.009549	3.76	19.76	15.60	0.92
001	127.00*	100 +5%	74.34	143.90	146.57	146.57	147.28	0.009185	3.78	20.79	16.04	0.90
001	127.00*	100 +25%	88.50	143.90	146.73	146.73	147.54	0.009472	4.06	23.43	17.18	0.93
001	127.00*	100 +70%	120.36	143.90	147.21	147.39	147.96	0.007052	4.07	37.54	40.52	0.83
001	127.00*	1000	116.46	143.90	147.19	147.36	147.92	0.006936	4.01	36.60	39.99	0.83
001	117.00*	2	26.58	143.78	145.58		145.95	0.009633	2.67	9.95	9.76	0.84
001	117.00*	20	49.78	143.78	146.10	145.97	146.63	0.008806	3.25	15.72	13.58	0.85
001	117.00*	50	60.91	143.78	146.28	146.21	146.89	0.008716	3.49	18.26	14.53	0.86
001	117.00*	100	70.80	143.78	146.30	146.38	147.10	0.011197	3.99	18.60	14.66	0.98
001	117.00*	100 +5%	74.34	143.78	146.38	146.45	147.17	0.010557	3.99	19.69	15.09	0.96
001	117.00*	100 +25%	88.50	143.78	146.57	146.58	147.44	0.010173	4.20	22.80	17.71	0.96
001	117.00*	100 +70%	120.36	143.78	146.95	147.24	147.87	0.009125	4.48	33.53	37.18	0.94
001	117.00*	1000	116.46	143.78	146.93	147.20	147.83	0.008996	4.41	32.65	36.64	0.93
001	107.00*	2	26.58	143.66	145.53		145.84	0.007385	2.47	10.81	10.09	0.74
001	107.00*	20	49.78	143.66	146.09		146.53	0.006649	2.99	17.49	13.91	0.74
001	107.00*	50	60.91	143.66	146.27	146.08	146.78	0.006684	3.22	20.23	16.17	0.76
001	107.00*	100	70.80	143.66	146.41	146.22	146.98	0.006961	3.44	23.08	26.34	0.78
001	107.00*	100 +5%	74.34	143.66	146.45	146.27	147.04	0.006990	3.50	24.32	28.52	0.79
001	107.00*	100 +25%	88.50	143.66	146.36	146.66	147.32	0.011994	4.45	21.87	24.17	1.02
001	107.00*	100 +70%	120.36	143.66	147.27	147.03	147.62	0.003244	3.00	55.01	46.79	0.57
001	107.00*	1000	116.46	143.66	147.21	147.01	147.57	0.003413	3.03	52.34	45.83	0.58
001	97.00*	2	26.58	143.54	145.52		145.76	0.005215	2.21	12.31	11.92	0.62
001	97.00*	20	49.78	143.54	146.11	145.70	146.44	0.004635	2.64	21.39	25.51	0.62
001	97.00*	50	60.91	143.54	146.36		146.67	0.003895	2.64	28.87	31.90	0.58
001	97.00*	100	70.80	143.54	146.57		146.84	0.003177	2.54	35.87	33.99	0.53
001	97.00*	100 +5%	74.34	143.54	146.64		146.90	0.003018	2.52	38.20	35.21	0.52
001	97.00*	100 +25%	88.50	143.54	146.88	146.49	147.12	0.002548	2.47	47.71	42.22	0.49
001	97.00*	100 +70%	120.36	143.54	147.34		147.55	0.001903	2.38	69.02	49.85	0.43
001	97.00*	1000	116.46	143.54	147.29		147.50	0.001960	2.39	66.45	49.10	0.44

HEC-RAS Plan: Baseline River: River Trannon Reach: 001 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
001	0087	2	26.58	143.42	145.52		145.70	0.003502	1.92	14.59	12.44	0.50
001	0087	20	49.78	143.42	146.19		146.36	0.002335	1.99	32.34	34.32	0.43
001	0087	50	60.91	143.42	146.45		146.59	0.001889	1.92	41.33	36.74	0.39
001	0087	100	70.80	143.42	146.64		146.78	0.001661	1.90	48.75	39.61	0.38
001	0087	100 +5%	74.34	143.42	146.71		146.84	0.001603	1.90	51.36	41.36	0.37
001	0087	100 +25%	88.50	143.42	146.94		147.07	0.001424	1.89	61.61	45.81	0.35
001	0087	100 +70%	120.36	143.42	147.38		147.51	0.001197	1.90	83.35	52.07	0.33
001	0087	1000	116.46	143.42	147.33		147.46	0.001219	1.90	80.74	51.42	0.33
001	77.333*	2	26.58	143.39	145.52		145.66	0.002376	1.67	16.54	13.66	0.44
001	77.333*	20	49.78	143.39	146.19		146.33	0.001723	1.81	34.55	34.55	0.40
001	77.333*	50	60.91	143.39	146.44		146.57	0.001463	1.80	43.57	37.28	0.37
001	77.333*	100	70.80	143.39	146.63		146.76	0.001319	1.80	51.24	41.71	0.36
001	77.333*	100 +5%	74.34	143.39	146.70		146.82	0.001278	1.80	54.00	43.33	0.35
001	77.333*	100 +25%	88.50	143.39	146.93		147.05	0.001155	1.81	64.60	47.16	0.34
001	77.333*	100 +70%	120.36	143.39	147.37		147.50	0.000997	1.85	86.93	53.37	0.33
001	77.333*	1000	116.46	143.39	147.32		147.45	0.001013	1.85	84.26	52.70	0.33
001	67.667*	2	26.58	143.36	145.52		145.63	0.001737	1.47	18.71	15.07	0.39
001	67.667*	20	49.78	143.36	146.19		146.31	0.001327	1.63	37.28	34.90	0.36
001	67.667*	50	60.91	143.36	146.43		146.55	0.001179	1.66	46.33	38.91	0.34
001	67.667*	100	70.80	143.36	146.63		146.74	0.001078	1.67	54.39	43.69	0.33
001	67.667*	100 +5%	74.34	143.36	146.69		146.81	0.001048	1.67	57.26	44.78	0.33
001	67.667*	100 +25%	88.50	143.36	146.93		147.04	0.000963	1.70	68.20	48.69	0.32
001	67.667*	100 +70%	120.36	143.36	147.37		147.48	0.000852	1.76	91.15	54.86	0.31
001	67.667*	1000	116.46	143.36	147.32		147.43	0.000863	1.75	88.40	54.17	0.31
001	58.000*	2	26.58	143.33	145.53		145.61	0.001310	1.29	21.08	16.54	0.34
001	58.000*	20	49.78	143.33	146.19		146.29	0.001047	1.47	40.28	35.25	0.32
001	58.000*	50	60.91	143.33	146.43		146.53	0.000960	1.52	49.60	41.12	0.31
001	58.000*	100	70.80	143.33	146.63		146.73	0.000888	1.54	58.08	45.27	0.31
001	58.000*	100 +5%	74.34	143.33	146.69		146.79	0.000870	1.55	60.98	46.35	0.30
001	58.000*	100 +25%	88.50	143.33	146.93		147.03	0.000811	1.58	72.28	50.18	0.30
001	58.000*	100 +70%	120.36	143.33	147.37		147.47	0.000734	1.65	95.91	56.54	0.29
001	58.000*	1000	116.46	143.33	147.32		147.42	0.000742	1.64	93.07	55.81	0.29
001	48.333*	2	26.58	143.30	145.53		145.59	0.001005	1.14	23.65	18.74	0.30
001	48.333*	20	49.78	143.30	146.19		146.28	0.000832	1.33	43.57	35.28	0.29
001	48.333*	50	60.91	143.30	146.44		146.52	0.000786	1.39	53.35	43.53	0.29
001	48.333*	100	70.80	143.30	146.63		146.72	0.000736	1.41	62.16	46.96	0.28
001	48.333*	100 +5%	74.34	143.30	146.69		146.78	0.000724	1.42	65.17	48.07	0.28
001	48.333*	100 +25%	88.50	143.30	146.93		147.02	0.000685	1.46	76.79	51.77	0.27
001	48.333*	100 +70%	120.36	143.30	147.37		147.46	0.000633	1.55	101.22	58.42	0.27
001	48.333*	1000	116.46	143.30	147.32		147.41	0.000638	1.54	98.29	57.67	0.27
001	38.667*	2	26.58	143.27	145.53		145.58	0.000776	1.02	26.44	21.24	0.26
001	38.667*	20	49.78	143.27	146.20		146.26	0.000672	1.21	47.20	37.52	0.26
001	38.667*	50	60.91	143.27	146.44		146.51	0.000646	1.27	57.46	45.24	0.26
001	38.667*	100	70.80	143.27	146.63		146.71	0.000612	1.30	66.65	48.76	0.26
001	38.667*	100 +5%	74.34	143.27	146.70		146.77	0.000604	1.31	69.76	49.88	0.26
001	38.667*	100 +25%	88.50	143.27	146.93		147.01	0.000580	1.36	81.77	53.54	0.25
001	38.667*	100 +70%	120.36	143.27	147.37		147.45	0.000545	1.45	107.04	60.36	0.25
001	38.667*	1000	116.46	143.27	147.32		147.40	0.000549	1.44	104.02	59.71	0.25
001	29.000*	2	26.58	143.25	145.53		145.57	0.000605	0.91	29.45	23.08	0.23
001	29.000*	20	49.78	143.25	146.20		146.25	0.000546	1.10	51.25	40.25	0.24
001	29.000*	50	60.91	143.25	146.44		146.50	0.000532	1.16	61.98	47.06	0.24
001	29.000*	100	70.80	143.25	146.63		146.70	0.000510	1.20	71.52	50.61	0.23
001	29.000*	100 +5%	74.34	143.25	146.70		146.76	0.000505	1.21	74.76	51.66	0.23
001	29.000*	100 +25%	88.50	143.25	146.93		147.00	0.000491	1.26	87.19	55.51	0.23
001	29.000*	100 +70%	120.36	143.25	147.37		147.45	0.000470	1.35	113.37	62.26	0.23
001	29.000*	1000	116.46	143.25	147.32		147.40	0.000472	1.34	110.25	61.61	0.23
001	19.333*	2	26.58	143.22	145.53		145.56	0.000475	0.82	32.69	25.01	0.21
001	19.333*	20	49.78	143.22	146.20		146.25	0.000446	1.00	55.75	42.63	0.21
001	19.333*	50	60.91	143.22	146.44		146.49	0.000440	1.07	66.90	49.00	0.21
001	19.333*	100	70.80	143.22	146.64		146.69	0.000426	1.10	76.82	52.54	0.21
001	19.333*	100 +5%	74.34	143.22	146.70		146.76	0.000424	1.12	80.17	53.65	0.21
001	19.333*	100 +25%	88.50	143.22	146.93		146.99	0.000416	1.17	93.09	57.73	0.22
001	19.333*	100 +70%	120.36	143.22	147.38		147.44	0.000404	1.26	120.21	64.23	0.22
001	19.333*	1000	116.46	143.22	147.32		147.39	0.000406	1.25	116.99	63.57	0.22
001	9.667*	2	26.58	143.19	145.53		145.56	0.000376	0.74	36.15	27.41	0.18
001	9.667*	20	49.78	143.19	146.20		146.24	0.000365	0.92	60.62	44.62	0.19
001	9.667*	50	60.91	143.19	146.44		146.49	0.000361	0.97	72.24	50.89	0.19
001	9.667*	100	70.80	143.19	146.64		146.69	0.000357	1.02	82.54	54.69	0.20
001	9.667*	100 +5%	74.34	143.19	146.70		146.75	0.000356	1.03	86.03	55.87	0.20
001	9.667*	100 +25%	88.50	143.19	146.93		146.98	0.000354	1.09	99.49	60.21	0.20
001	9.667*	100 +70%	120.36	143.19	147.38		147.43	0.000348	1.18	127.57	66.26	0.20
001	9.667*	1000	116.46	143.19	147.33		147.38	0.000349	1.17	124.25	65.60	0.20
001	0000	2	26.58	143.16	145.53	144.23	145.55	0.000300	0.67	39.89	29.56	0.17
001	0000	20	49.78	143.16	146.20	144.55	146.24	0.000301	0.84	65.87	46.77	0.18
001	0000	50	60.91	143.16	146.44	144.67	146.48	0.000300	0.90	77.99	52.78	0.18
001	0000	100	70.80	143.16	146.64	144.77	146.68	0.000300	0.94	88.72	57.11	0.18

HEC-RAS Plan: Baseline River: River Trannon Reach: 001 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
001	0000	100 +5%	74.34	143.16	146.70	144.81	146.74	0.000300	0.96	92.36	58.37	0.18
001	0000	100 +25%	88.50	143.16	146.94	144.94	146.98	0.000300	1.01	106.43	62.50	0.18
001	0000	100 +70%	120.36	143.16	147.38	145.22	147.43	0.000300	1.10	135.44	68.35	0.19
001	0000	1000	116.46	143.16	147.33	145.18	147.38	0.000300	1.09	132.01	67.68	0.19

APPENDIX 9 – HEC-RAS Model Results: Manning's n +20%

HEC-RAS Plan: Mannings n +20% River: River Trannon Reach: 001

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
001	0874	2	26.58	149.52	151.04	150.68	151.22	0.005279	1.98	14.88	15.25	0.55
001	0874	20	49.78	149.52	151.50	151.12	151.78	0.005679	2.50	23.40	22.69	0.60
001	0874	50	60.91	149.52	151.66	151.31	151.97	0.005952	2.71	27.14	25.07	0.62
001	0874	100	70.80	149.52	151.78	151.48	152.12	0.006159	2.87	30.26	26.17	0.64
001	0874	100 +5%	74.34	149.52	151.82	151.53	152.18	0.006213	2.92	31.33	26.43	0.65
001	0874	100 +25%	88.50	149.52	151.97	151.73	152.36	0.006389	3.11	35.43	27.19	0.66
001	0874	100 +70%	120.36	149.52	152.26	152.04	152.73	0.006734	3.46	43.50	28.29	0.69
001	0874	1000	116.46	149.52	152.23	152.00	152.69	0.006691	3.42	42.58	28.17	0.69
001	864.00*	2	26.58	149.47	150.98		151.16	0.005279	1.97	14.88	15.61	0.55
001	864.00*	20	49.78	149.47	151.44		151.72	0.005597	2.48	23.55	23.18	0.60
001	864.00*	50	60.91	149.47	151.60		151.91	0.005867	2.69	27.33	25.67	0.62
001	864.00*	100	70.80	149.47	151.72		152.06	0.006067	2.84	30.46	26.56	0.64
001	864.00*	100 +5%	74.34	149.47	151.76		152.11	0.006124	2.89	31.53	26.82	0.64
001	864.00*	100 +25%	88.50	149.47	151.91		152.30	0.006312	3.08	35.62	27.61	0.66
001	864.00*	100 +70%	120.36	149.47	152.20		152.67	0.006669	3.43	43.73	28.76	0.69
001	864.00*	1000	116.46	149.47	152.16		152.62	0.006624	3.39	42.81	28.64	0.69
001	854.00*	2	26.58	149.41	150.93		151.11	0.005307	1.96	14.85	15.96	0.55
001	854.00*	20	49.78	149.41	151.39		151.66	0.005533	2.46	23.69	23.69	0.59
001	854.00*	50	60.91	149.41	151.54		151.85	0.005824	2.67	27.49	26.15	0.62
001	854.00*	100	70.80	149.41	151.66		152.00	0.005994	2.82	30.64	26.98	0.63
001	854.00*	100 +5%	74.34	149.41	151.70		152.05	0.006049	2.87	31.72	27.20	0.64
001	854.00*	100 +25%	88.50	149.41	151.85		152.23	0.006247	3.05	35.82	28.02	0.66
001	854.00*	100 +70%	120.36	149.41	152.13		152.60	0.006624	3.41	43.95	29.27	0.69
001	854.00*	1000	116.46	149.41	152.10		152.56	0.006578	3.37	43.02	29.14	0.69
001	844.00*	2	26.58	149.35	150.87		151.06	0.005362	1.96	14.79	16.29	0.56
001	844.00*	20	49.78	149.35	151.33		151.60	0.005488	2.44	23.81	24.24	0.59
001	844.00*	50	60.91	149.35	151.49		151.79	0.005770	2.64	27.64	26.56	0.62
001	844.00*	100	70.80	149.35	151.60		151.94	0.005943	2.79	30.81	27.38	0.63
001	844.00*	100 +5%	74.34	149.35	151.64		151.99	0.006000	2.84	31.89	27.61	0.64
001	844.00*	100 +25%	88.50	149.35	151.79		152.17	0.006207	3.03	35.99	28.46	0.65
001	844.00*	100 +70%	120.36	149.35	152.07		152.53	0.006628	3.39	44.12	29.94	0.69
001	844.00*	1000	116.46	149.35	152.04		152.49	0.006570	3.35	43.20	29.74	0.69
001	834.00*	2	26.58	149.29	150.82		151.00	0.005449	1.96	14.67	16.60	0.56
001	834.00*	20	49.78	149.29	151.28		151.55	0.005466	2.42	23.89	24.82	0.59
001	834.00*	50	60.91	149.29	151.43		151.73	0.005741	2.62	27.77	27.00	0.61
001	834.00*	100	70.80	149.29	151.54		151.88	0.005915	2.77	30.95	27.81	0.63
001	834.00*	100 +5%	74.34	149.29	151.58		151.93	0.005975	2.82	32.03	28.05	0.63
001	834.00*	100 +25%	88.50	149.29	151.73		152.11	0.006192	3.01	36.13	28.95	0.65
001	834.00*	100 +70%	120.36	149.29	152.00		152.46	0.006668	3.38	44.26	30.75	0.69
001	834.00*	1000	116.46	149.29	151.97		152.42	0.006609	3.33	43.33	30.54	0.69
001	824.00*	2	26.58	149.23	150.76		150.95	0.005554	1.96	14.52	16.88	0.56
001	824.00*	20	49.78	149.23	151.23		151.49	0.005463	2.40	23.95	25.44	0.59
001	824.00*	50	60.91	149.23	151.37		151.68	0.005732	2.60	27.87	27.51	0.61
001	824.00*	100	70.80	149.23	151.49		151.82	0.005909	2.75	31.06	28.29	0.63
001	824.00*	100 +5%	74.34	149.23	151.52		151.87	0.005974	2.80	32.13	28.55	0.63
001	824.00*	100 +25%	88.50	149.23	151.67		152.04	0.006204	2.99	36.24	29.50	0.65
001	824.00*	100 +70%	120.36	149.23	151.93		152.40	0.006745	3.37	44.37	31.71	0.69
001	824.00*	1000	116.46	149.23	151.90		152.36	0.006666	3.32	43.46	31.40	0.69
001	814.00*	2	26.58	149.18	150.70		150.89	0.005657	1.95	14.34	16.97	0.57
001	814.00*	20	49.78	149.18	151.17		151.44	0.005482	2.39	23.97	26.13	0.59
001	814.00*	50	60.91	149.18	151.32		151.62	0.005744	2.59	27.93	27.99	0.61
001	814.00*	100	70.80	149.18	151.43		151.76	0.005933	2.74	31.12	28.84	0.63
001	814.00*	100 +5%	74.34	149.18	151.46		151.81	0.006004	2.79	32.20	29.12	0.63
001	814.00*	100 +25%	88.50	149.18	151.60		151.98	0.006275	2.98	36.28	30.34	0.65
001	814.00*	100 +70%	120.36	149.18	151.86		152.33	0.006885	3.37	44.46	33.07	0.70
001	814.00*	1000	116.46	149.18	151.83		152.29	0.006820	3.33	43.50	32.80	0.69
001	804.00*	2	26.58	149.12	150.64		150.83	0.005747	1.95	14.14	16.83	0.57
001	804.00*	20	49.78	149.12	151.11		151.38	0.005612	2.40	23.85	26.78	0.59
001	804.00*	50	60.91	149.12	151.26		151.56	0.005782	2.58	27.95	28.56	0.61
001	804.00*	100	70.80	149.12	151.37		151.70	0.005996	2.73	31.13	29.53	0.63
001	804.00*	100 +5%	74.34	149.12	151.40		151.74	0.006080	2.78	32.20	29.90	0.64
001	804.00*	100 +25%	88.50	149.12	151.54		151.92	0.006371	2.98	36.32	31.34	0.66
001	804.00*	100 +70%	120.36	149.12	151.79		152.26	0.006969	3.36	44.68	34.29	0.70
001	804.00*	1000	116.46	149.12	151.76		152.22	0.006903	3.32	43.71	34.00	0.70
001	794.00*	2	26.58	149.06	150.59		150.77	0.005789	1.93	13.97	15.70	0.57
001	794.00*	20	49.78	149.06	151.05		151.32	0.005672	2.39	23.77	27.17	0.60
001	794.00*	50	60.91	149.06	151.20		151.50	0.005863	2.57	27.90	29.32	0.61
001	794.00*	100	70.80	149.06	151.30		151.64	0.006127	2.73	31.06	30.75	0.63
001	794.00*	100 +5%	74.34	149.06	151.34		151.68	0.006210	2.78	32.15	31.11	0.64
001	794.00*	100 +25%	88.50	149.06	151.47		151.86	0.006508	2.98	36.37	32.80	0.66
001	794.00*	100 +70%	120.36	149.06	151.72		152.19	0.007108	3.36	44.90	36.01	0.71
001	794.00*	1000	116.46	149.06	151.69		152.15	0.007022	3.31	43.94	35.56	0.70
001	784.00*	2	26.58	149.00	150.53		150.72	0.005771	1.91	14.00	13.41	0.57
001	784.00*	20	49.78	149.00	150.99		151.27	0.005770	2.39	23.62	27.74	0.60
001	784.00*	50	60.91	149.00	151.13		151.44	0.006002	2.57	27.80	30.80	0.62
001	784.00*	100	70.80	149.00	151.24		151.58	0.006252	2.73	31.07	32.14	0.64

HEC-RAS Plan: Mannings n +20% River: River Trannon Reach: 001 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
001	784.00*	100 +5%	74.34	149.00	151.27		151.62	0.006341	2.78	32.18	32.59	0.65
001	784.00*	100 +25%	88.50	149.00	151.40		151.79	0.006604	2.97	36.55	34.21	0.67
001	784.00*	100 +70%	120.36	149.00	151.65	151.51	152.12	0.007264	3.36	45.42	39.14	0.71
001	784.00*	1000	116.46	149.00	151.62	151.47	152.08	0.007206	3.32	44.34	38.62	0.71
001	0774	2	26.58	148.95	150.48		150.66	0.005743	1.88	14.16	13.33	0.56
001	0774	20	49.78	148.95	150.94		151.21	0.005790	2.37	23.56	29.40	0.60
001	0774	50	60.91	148.95	151.07		151.38	0.006090	2.57	27.85	32.33	0.62
001	0774	100	70.80	148.95	151.18		151.51	0.006330	2.72	31.24	33.72	0.64
001	0774	100 +5%	74.34	148.95	151.21	151.06	151.56	0.006417	2.77	32.38	34.18	0.65
001	0774	100 +25%	88.50	148.95	151.33	151.17	151.72	0.006867	2.99	36.74	38.28	0.68
001	0774	100 +70%	120.36	148.95	151.58	151.49	152.04	0.007178	3.31	47.29	45.42	0.71
001	0774	1000	116.46	148.95	151.55	151.45	152.00	0.007165	3.28	45.99	44.63	0.70
001	764.58*	2	26.58	148.88	150.41		150.60	0.005911	1.91	13.97	13.07	0.57
001	764.58*	20	49.78	148.88	150.87		151.15	0.005890	2.39	23.56	29.98	0.60
001	764.58*	50	60.91	148.88	151.01	150.76	151.32	0.006172	2.58	27.90	32.96	0.63
001	764.58*	100	70.80	148.88	151.11	150.96	151.45	0.006403	2.73	31.32	34.34	0.64
001	764.58*	100 +5%	74.34	148.88	151.15	151.00	151.49	0.006488	2.78	32.47	34.79	0.65
001	764.58*	100 +25%	88.50	148.88	151.27	151.13	151.66	0.006854	2.98	36.84	37.31	0.68
001	764.58*	100 +70%	120.36	148.88	151.51	151.41	151.97	0.007274	3.32	46.70	42.95	0.71
001	764.58*	1000	116.46	148.88	151.48	151.38	151.93	0.007248	3.29	45.50	42.38	0.71
001	755.17*	2	26.58	148.81	150.35		150.54	0.006082	1.93	13.79	12.83	0.58
001	755.17*	20	49.78	148.81	150.81	150.43	151.09	0.006014	2.41	23.59	30.78	0.61
001	755.17*	50	60.91	148.81	150.95	150.72	151.26	0.006246	2.60	27.97	33.61	0.63
001	755.17*	100	70.80	148.81	151.05	150.91	151.39	0.006466	2.74	31.43	35.00	0.65
001	755.17*	100 +5%	74.34	148.81	151.08	150.95	151.43	0.006550	2.79	32.60	35.46	0.65
001	755.17*	100 +25%	88.50	148.81	151.20	151.08	151.59	0.006862	2.98	37.03	37.40	0.68
001	755.17*	100 +70%	120.36	148.81	151.44	151.34	151.90	0.007317	3.33	46.61	42.15	0.71
001	755.17*	1000	116.46	148.81	151.42	151.31	151.86	0.007278	3.29	45.46	41.61	0.71
001	745.75*	2	26.58	148.74	150.29		150.48	0.006256	1.95	13.61	12.57	0.59
001	745.75*	20	49.78	148.74	150.75	150.37	151.03	0.006090	2.43	23.62	31.28	0.61
001	745.75*	50	60.91	148.74	150.88	150.68	151.20	0.006319	2.61	28.03	34.30	0.63
001	745.75*	100	70.80	148.74	150.98	150.86	151.32	0.006528	2.75	31.55	35.71	0.65
001	745.75*	100 +5%	74.34	148.74	151.02	150.89	151.37	0.006609	2.80	32.72	36.17	0.66
001	745.75*	100 +25%	88.50	148.74	151.14	151.04	151.52	0.006873	2.98	37.25	37.82	0.68
001	745.75*	100 +70%	120.36	148.74	151.38	151.28	151.83	0.007314	3.32	46.76	41.91	0.71
001	745.75*	1000	116.46	148.74	151.35	151.25	151.79	0.007275	3.28	45.63	41.46	0.71
001	736.33*	2	26.58	148.68	150.22		150.42	0.006435	1.98	13.45	12.30	0.60
001	736.33*	20	49.78	148.68	150.69	150.31	150.97	0.006156	2.44	23.66	31.73	0.62
001	736.33*	50	60.91	148.68	150.82	150.64	151.14	0.006391	2.62	28.10	35.03	0.64
001	736.33*	100	70.80	148.68	150.92	150.80	151.26	0.006584	2.76	31.68	36.48	0.65
001	736.33*	100 +5%	74.34	148.68	150.95	150.84	151.30	0.006662	2.81	32.87	36.94	0.66
001	736.33*	100 +25%	88.50	148.68	151.08	150.98	151.46	0.006897	2.99	37.49	38.57	0.68
001	736.33*	100 +70%	120.36	148.68	151.31	151.22	151.76	0.007303	3.31	47.04	42.20	0.71
001	736.33*	1000	116.46	148.68	151.29	151.19	151.72	0.007267	3.28	45.91	41.80	0.71
001	726.92*	2	26.58	148.61	150.15		150.36	0.006600	2.00	13.29	12.06	0.60
001	726.92*	20	49.78	148.61	150.63	150.23	150.91	0.006217	2.45	23.70	32.48	0.62
001	726.92*	50	60.91	148.61	150.76	150.61	151.07	0.006445	2.63	28.20	35.77	0.64
001	726.92*	100	70.80	148.61	150.86	150.75	151.20	0.006622	2.77	31.84	37.29	0.66
001	726.92*	100 +5%	74.34	148.61	150.89	150.79	151.24	0.006693	2.82	33.06	37.75	0.66
001	726.92*	100 +25%	88.50	148.61	151.01	150.92	151.39	0.006901	2.99	37.77	39.38	0.68
001	726.92*	100 +70%	120.36	148.61	151.25	151.15	151.68	0.007276	3.30	47.42	42.78	0.71
001	726.92*	1000	116.46	148.61	151.22	151.12	151.65	0.007245	3.27	46.28	42.42	0.71
001	717.50*	2	26.58	148.54	150.09		150.30	0.006760	2.02	13.14	11.82	0.61
001	717.50*	20	49.78	148.54	150.56	150.19	150.85	0.006275	2.46	23.74	33.31	0.62
001	717.50*	50	60.91	148.54	150.69	150.57	151.01	0.006476	2.64	28.32	36.44	0.64
001	717.50*	100	70.80	148.54	150.79	150.69	151.13	0.006646	2.78	32.03	38.16	0.66
001	717.50*	100 +5%	74.34	148.54	150.83	150.73	151.17	0.006706	2.82	33.28	38.59	0.66
001	717.50*	100 +25%	88.50	148.54	150.95	150.86	151.32	0.006888	2.98	38.10	40.23	0.68
001	717.50*	100 +70%	120.36	148.54	151.18	151.10	151.61	0.007237	3.29	47.87	43.55	0.71
001	717.50*	1000	116.46	148.54	151.15	151.07	151.58	0.007212	3.26	46.71	43.21	0.70
001	708.08*	2	26.58	148.48	150.02		150.23	0.006907	2.04	13.00	11.61	0.62
001	708.08*	20	49.78	148.48	150.50	150.13	150.79	0.006341	2.48	23.75	34.15	0.63
001	708.08*	50	60.91	148.48	150.63	150.52	150.95	0.006511	2.65	28.44	37.17	0.64
001	708.08*	100	70.80	148.48	150.73	150.64	151.07	0.006670	2.78	32.22	39.03	0.66
001	708.08*	100 +5%	74.34	148.48	150.76	150.68	151.11	0.006720	2.82	33.50	39.48	0.66
001	708.08*	100 +25%	88.50	148.48	150.88	150.81	151.25	0.006866	2.98	38.44	41.13	0.68
001	708.08*	100 +70%	120.36	148.48	151.12	151.04	151.54	0.007172	3.28	48.41	44.41	0.70
001	708.08*	1000	116.46	148.48	151.09	151.01	151.51	0.007145	3.25	47.23	44.01	0.70
001	698.67*	2	26.58	148.41	149.95		150.17	0.007024	2.06	12.89	11.48	0.62
001	698.67*	20	49.78	148.41	150.43	150.07	150.73	0.006395	2.49	23.77	35.02	0.63
001	698.67*	50	60.91	148.41	150.57	150.46	150.88	0.006530	2.65	28.58	38.01	0.64
001	698.67*	100	70.80	148.41	150.66	150.58	151.00	0.006665	2.78	32.46	39.93	0.66
001	698.67*	100 +5%	74.34	148.41	150.70	150.62	151.04	0.006706	2.82	33.77	40.40	0.66
001	698.67*	100 +25%	88.50	148.41	150.82	150.74	151.19	0.006815	2.97	38.85	42.08	0.67
001	698.67*	100 +70%	120.36	148.41	151.05	150.98	151.47	0.007059	3.26	49.06	45.27	0.70
001	698.67*	1000	116.46	148.41	151.03	150.95	151.44	0.007040	3.23	47.86	44.89	0.70

HEC-RAS Plan: Mannings n +20% River: River Trannon Reach: 001 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
001	689.25*	2	26.58	148.34	149.88		150.10	0.007118	2.08	12.78	11.34	0.63
001	689.25*	20	49.78	148.34	150.37	150.01	150.67	0.006437	2.50	23.79	35.91	0.63
001	689.25*	50	60.91	148.34	150.50	150.40	150.82	0.006533	2.66	28.75	38.95	0.64
001	689.25*	100	70.80	148.34	150.60	150.52	150.94	0.006629	2.78	32.76	40.85	0.65
001	689.25*	100 +5%	74.34	148.34	150.64	150.56	150.98	0.006662	2.82	34.11	41.36	0.66
001	689.25*	100 +25%	88.50	148.34	150.76	150.67	151.12	0.006736	2.96	39.34	43.08	0.67
001	689.25*	100 +70%	120.36	148.34	150.99	150.92	151.40	0.006919	3.23	49.83	46.26	0.69
001	689.25*	1000	116.46	148.34	150.97	150.89	151.37	0.006911	3.20	48.58	45.91	0.69
001	679.83*	2	26.58	148.28	149.81		150.03	0.007175	2.09	12.71	11.21	0.63
001	679.83*	20	49.78	148.28	150.30	149.94	150.60	0.006474	2.51	23.80	36.80	0.63
001	679.83*	50	60.91	148.28	150.44	150.35	150.76	0.006529	2.66	28.94	39.98	0.64
001	679.83*	100	70.80	148.28	150.54	150.47	150.87	0.006567	2.77	33.10	41.79	0.65
001	679.83*	100 +5%	74.34	148.28	150.57	150.50	150.91	0.006591	2.81	34.50	42.33	0.65
001	679.83*	100 +25%	88.50	148.28	150.70	150.61	151.05	0.006629	2.94	39.90	44.12	0.66
001	679.83*	100 +70%	120.36	148.28	150.93		151.33	0.006756	3.20	50.70	47.36	0.68
001	679.83*	1000	116.46	148.28	150.91		151.29	0.006754	3.17	49.41	46.99	0.68
001	670.42*	2	26.58	148.21	149.74		149.97	0.007191	2.10	12.66	11.08	0.63
001	670.42*	20	49.78	148.21	150.24	149.87	150.54	0.006501	2.52	23.81	37.70	0.63
001	670.42*	50	60.91	148.21	150.37	150.30	150.69	0.006512	2.66	29.14	41.13	0.64
001	670.42*	100	70.80	148.21	150.48	150.40	150.81	0.006477	2.76	33.52	42.82	0.64
001	670.42*	100 +5%	74.34	148.21	150.51	150.44	150.84	0.006490	2.79	34.96	43.35	0.65
001	670.42*	100 +25%	88.50	148.21	150.64	150.57	150.98	0.006489	2.92	40.55	45.24	0.65
001	670.42*	100 +70%	120.36	148.21	150.88		151.25	0.006560	3.16	51.70	48.55	0.67
001	670.42*	1000	116.46	148.21	150.85		151.22	0.006565	3.13	50.36	48.17	0.67
001	0661	2	26.58	148.14	149.67		149.90	0.007137	2.10	12.65	10.95	0.62
001	0661	20	49.78	148.14	150.18	149.80	150.48	0.006502	2.53	23.85	38.63	0.63
001	0661	50	60.91	148.14	150.31	150.24	150.63	0.006446	2.65	29.43	42.21	0.64
001	0661	100	70.80	148.14	150.42	150.34	150.74	0.006344	2.74	34.04	43.91	0.64
001	0661	100 +5%	74.34	148.14	150.45	150.39	150.78	0.006346	2.77	35.53	44.44	0.64
001	0661	100 +25%	88.50	148.14	150.58	150.52	150.92	0.006305	2.88	41.33	46.40	0.64
001	0661	100 +70%	120.36	148.14	150.83		151.19	0.006257	3.10	53.09	49.89	0.65
001	0661	1000	116.46	148.14	150.80		151.15	0.006268	3.07	51.70	49.49	0.65
001	651.60*	2	26.58	148.06	149.61		149.83	0.007007	2.09	12.69	10.88	0.62
001	651.60*	20	49.78	148.06	150.10	149.73	150.41	0.006579	2.55	23.58	38.22	0.63
001	651.60*	50	60.91	148.06	150.24	150.18	150.56	0.006527	2.68	29.08	41.30	0.64
001	651.60*	100	70.80	148.06	150.34	150.27	150.67	0.006454	2.77	33.57	42.99	0.64
001	651.60*	100 +5%	74.34	148.06	150.38	150.33	150.71	0.006472	2.80	35.00	43.51	0.65
001	651.60*	100 +25%	88.50	148.06	150.50	150.42	150.85	0.006482	2.93	40.61	45.52	0.65
001	651.60*	100 +70%	120.36	148.06	150.75		151.12	0.006488	3.15	52.08	49.18	0.67
001	651.60*	1000	116.46	148.06	150.72		151.09	0.006498	3.13	50.71	48.77	0.66
001	642.20*	2	26.58	147.98	149.54		149.76	0.006904	2.09	12.72	10.83	0.61
001	642.20*	20	49.78	147.98	150.03	149.66	150.34	0.006653	2.56	23.39	37.70	0.64
001	642.20*	50	60.91	147.98	150.16	150.10	150.49	0.006624	2.70	28.79	40.64	0.64
001	642.20*	100	70.80	147.98	150.27	150.20	150.60	0.006566	2.79	33.19	42.29	0.65
001	642.20*	100 +5%	74.34	147.98	150.30	150.23	150.64	0.006602	2.83	34.57	42.81	0.65
001	642.20*	100 +25%	88.50	147.98	150.43	150.38	150.78	0.006652	2.96	40.02	44.82	0.66
001	642.20*	100 +70%	120.36	147.98	150.67	150.57	151.06	0.006703	3.20	51.25	48.56	0.68
001	642.20*	1000	116.46	147.98	150.64	150.54	151.02	0.006719	3.18	49.89	48.17	0.68
001	632.80*	2	26.58	147.89	149.47		149.70	0.006790	2.09	12.74	10.94	0.61
001	632.80*	20	49.78	147.89	149.95	149.59	150.27	0.006740	2.58	23.25	37.46	0.64
001	632.80*	50	60.91	147.89	150.09	150.03	150.42	0.006766	2.72	28.48	40.20	0.65
001	632.80*	100	70.80	147.89	150.19	150.13	150.53	0.006701	2.81	32.85	41.85	0.65
001	632.80*	100 +5%	74.34	147.89	150.23	150.19	150.57	0.006749	2.86	34.20	42.33	0.66
001	632.80*	100 +25%	88.50	147.89	150.35	150.29	150.71	0.006835	3.00	39.52	44.39	0.67
001	632.80*	100 +70%	120.36	147.89	150.59	150.51	150.99	0.006886	3.24	50.60	47.96	0.68
001	632.80*	1000	116.46	147.89	150.56	150.49	150.96	0.006902	3.21	49.25	47.55	0.68
001	623.40*	2	26.58	147.81	149.41		149.63	0.006704	2.09	12.76	11.00	0.61
001	623.40*	20	49.78	147.81	149.89	149.52	150.20	0.006701	2.57	23.38	37.25	0.64
001	623.40*	50	60.91	147.81	150.01	149.97	150.35	0.006917	2.74	28.21	39.80	0.66
001	623.40*	100	70.80	147.81	150.12	150.06	150.47	0.006869	2.84	32.55	41.76	0.66
001	623.40*	100 +5%	74.34	147.81	150.15	150.11	150.50	0.006928	2.89	33.86	42.26	0.67
001	623.40*	100 +25%	88.50	147.81	150.27	150.21	150.64	0.006982	3.02	39.20	44.10	0.68
001	623.40*	100 +70%	120.36	147.81	150.51	150.45	150.92	0.007022	3.26	50.17	47.45	0.69
001	623.40*	1000	116.46	147.81	150.48	150.42	150.88	0.007041	3.24	48.82	47.05	0.69
001	614.00*	2	26.58	147.73	149.34		149.57	0.006639	2.09	12.78	11.04	0.60
001	614.00*	20	49.78	147.73	149.82	149.45	150.13	0.006650	2.56	23.59	37.36	0.64
001	614.00*	50	60.91	147.73	149.94	149.90	150.28	0.007074	2.76	28.02	39.76	0.66
001	614.00*	100	70.80	147.73	150.04	150.00	150.39	0.007023	2.86	32.37	41.97	0.67
001	614.00*	100 +5%	74.34	147.73	150.07	150.03	150.43	0.007076	2.91	33.69	42.39	0.67
001	614.00*	100 +25%	88.50	147.73	150.20	150.14	150.57	0.007061	3.03	39.10	43.92	0.68
001	614.00*	100 +70%	120.36	147.73	150.44		150.84	0.007091	3.27	50.00	47.10	0.69
001	614.00*	1000	116.46	147.73	150.41		150.81	0.007114	3.25	48.66	46.71	0.69
001	604.60*	2	26.58	147.65	149.28		149.50	0.006609	2.09	12.77	11.04	0.60
001	604.60*	20	49.78	147.65	149.75	149.41	150.06	0.006768	2.58	23.56	37.71	0.64
001	604.60*	50	60.91	147.65	149.86	149.82	150.21	0.007289	2.79	27.84	40.20	0.67

HEC-RAS Plan: Mannings n +20% River: River Trannon Reach: 001 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
001	604.60*	100	70.80	147.65	149.97	149.92	150.32	0.007082	2.86	32.40	41.81	0.67
001	604.60*	100 +5%	74.34	147.65	150.01	149.96	150.36	0.006982	2.88	34.04	42.36	0.67
001	604.60*	100 +25%	88.50	147.65	150.14		150.50	0.006871	2.99	39.70	44.05	0.67
001	604.60*	100 +70%	120.36	147.65	150.39		150.77	0.006628	3.18	51.35	46.94	0.67
001	604.60*	1000	116.46	147.65	150.37		150.74	0.006645	3.15	50.02	46.65	0.67
001	595.20*	2	26.58	147.56	149.21		149.44	0.006613	2.10	12.75	11.07	0.60
001	595.20*	20	49.78	147.56	149.68	149.36	149.99	0.006748	2.57	23.88	38.88	0.64
001	595.20*	50	60.91	147.56	149.82	149.76	150.13	0.006574	2.67	29.46	40.77	0.64
001	595.20*	100	70.80	147.56	149.93		150.25	0.006416	2.75	34.05	42.26	0.64
001	595.20*	100 +5%	74.34	147.56	149.97	149.88	150.29	0.006326	2.77	35.71	42.79	0.63
001	595.20*	100 +25%	88.50	147.56	150.10		150.43	0.006279	2.88	41.38	44.49	0.64
001	595.20*	100 +70%	120.36	147.56	150.36		150.70	0.006073	3.06	53.02	46.46	0.64
001	595.20*	1000	116.46	147.56	150.33		150.67	0.006081	3.04	51.70	46.23	0.64
001	585.80*	2	26.58	147.48	149.15		149.37	0.006666	2.11	12.70	11.40	0.60
001	585.80*	20	49.78	147.48	149.65	149.31	149.92	0.006064	2.46	25.55	39.55	0.60
001	585.80*	50	60.91	147.48	149.79	149.68	150.07	0.005849	2.55	31.34	41.40	0.60
001	585.80*	100	70.80	147.48	149.90		150.18	0.005714	2.62	36.03	42.84	0.60
001	585.80*	100 +5%	74.34	147.48	149.94		150.22	0.005622	2.63	37.75	43.23	0.60
001	585.80*	100 +25%	88.50	147.48	150.07		150.36	0.005584	2.74	43.46	44.36	0.60
001	585.80*	100 +70%	120.36	147.48	150.32		150.64	0.005522	2.94	54.88	46.02	0.61
001	585.80*	1000	116.46	147.48	150.30		150.61	0.005512	2.91	53.60	45.80	0.61
001	576.40*	2	26.58	147.40	149.08		149.31	0.006763	2.13	12.64	11.66	0.61
001	576.40*	20	49.78	147.40	149.62		149.86	0.005295	2.32	27.63	40.32	0.56
001	576.40*	50	60.91	147.40	149.77		150.00	0.005070	2.40	33.64	41.93	0.56
001	576.40*	100	70.80	147.40	149.88		150.12	0.004945	2.46	38.41	42.85	0.56
001	576.40*	100 +5%	74.34	147.40	149.92		150.16	0.004875	2.48	40.14	43.16	0.56
001	576.40*	100 +25%	88.50	147.40	150.05		150.30	0.004914	2.59	45.73	44.14	0.56
001	576.40*	100 +70%	120.36	147.40	150.30		150.58	0.005000	2.81	56.91	45.74	0.58
001	576.40*	1000	116.46	147.40	150.27		150.55	0.004981	2.78	55.66	45.57	0.58
001	0567	2	26.58	147.31	149.00		149.24	0.006997	2.16	12.50	11.69	0.61
001	0567	20	49.78	147.31	149.60		149.80	0.004484	2.16	30.15	40.83	0.52
001	0567	50	60.91	147.31	149.75		149.95	0.004302	2.23	36.23	41.95	0.52
001	0567	100	70.80	147.31	149.86		150.07	0.004248	2.31	40.95	42.79	0.52
001	0567	100 +5%	74.34	147.31	149.90		150.11	0.004206	2.32	42.66	43.10	0.52
001	0567	100 +25%	88.50	147.31	150.02		150.25	0.004313	2.45	48.14	44.06	0.53
001	0567	100 +70%	120.36	147.31	150.27		150.53	0.004517	2.69	59.11	45.69	0.55
001	0567	1000	116.46	147.31	150.24		150.50	0.004487	2.66	57.88	45.52	0.55
001	558.50*	2	26.58	147.20	148.97		149.18	0.005944	2.04	13.11	11.06	0.57
001	558.50*	20	49.78	147.20	149.56		149.76	0.004246	2.15	30.12	41.26	0.51
001	558.50*	50	60.91	147.20	149.71		149.91	0.004116	2.23	36.31	42.53	0.51
001	558.50*	100	70.80	147.20	149.82		150.03	0.004082	2.30	41.13	43.48	0.51
001	558.50*	100 +5%	74.34	147.20	149.86		150.07	0.004039	2.32	42.91	43.83	0.51
001	558.50*	100 +25%	88.50	147.20	149.99		150.21	0.004166	2.45	48.45	44.80	0.52
001	558.50*	100 +70%	120.36	147.20	150.23		150.49	0.004421	2.70	59.47	46.72	0.55
001	558.50*	1000	116.46	147.20	150.20		150.46	0.004380	2.67	58.26	46.49	0.54
001	550.00*	2	26.58	147.09	148.93		149.12	0.005250	1.95	13.67	10.71	0.53
001	550.00*	20	49.78	147.09	149.52		149.72	0.004096	2.14	30.08	41.91	0.50
001	550.00*	50	60.91	147.09	149.67		149.88	0.003999	2.22	36.41	43.37	0.50
001	550.00*	100	70.80	147.09	149.78		149.99	0.003965	2.29	41.39	44.42	0.50
001	550.00*	100 +5%	74.34	147.09	149.83		150.04	0.003907	2.31	43.28	44.74	0.50
001	550.00*	100 +25%	88.50	147.09	149.95		150.18	0.004062	2.44	48.85	45.84	0.51
001	550.00*	100 +70%	120.36	147.09	150.19		150.45	0.004335	2.69	60.16	48.27	0.54
001	550.00*	1000	116.46	147.09	150.16		150.42	0.004296	2.66	58.91	48.04	0.54
001	541.50*	2	26.58	146.98	148.90		149.08	0.004810	1.88	14.14	10.34	0.51
001	541.50*	20	49.78	146.98	149.48		149.69	0.004034	2.13	29.95	42.84	0.49
001	541.50*	50	60.91	146.98	149.63		149.84	0.003930	2.21	36.54	44.49	0.49
001	541.50*	100	70.80	146.98	149.75		149.96	0.003890	2.28	41.71	45.75	0.49
001	541.50*	100 +5%	74.34	146.98	149.79		150.00	0.003830	2.29	43.72	46.30	0.49
001	541.50*	100 +25%	88.50	146.98	149.91		150.14	0.003989	2.43	49.48	47.75	0.51
001	541.50*	100 +70%	120.36	146.98	150.16		150.42	0.004231	2.67	61.35	50.64	0.53
001	541.50*	1000	116.46	146.98	150.13		150.39	0.004197	2.64	60.03	50.39	0.53
001	533.00*	2	26.58	146.86	148.87		149.04	0.004397	1.83	14.54	10.08	0.49
001	533.00*	20	49.78	146.86	149.44		149.65	0.004047	2.13	29.78	44.26	0.49
001	533.00*	50	60.91	146.86	149.60		149.81	0.003917	2.20	36.76	46.55	0.49
001	533.00*	100	70.80	146.86	149.72		149.92	0.003826	2.26	42.40	48.23	0.49
001	533.00*	100 +5%	74.34	146.86	149.76		149.97	0.003743	2.27	44.60	48.91	0.48
001	533.00*	100 +25%	88.50	146.86	149.89		150.11	0.003880	2.39	50.74	50.74	0.50
001	533.00*	100 +70%	120.36	146.86	150.13		150.38	0.004009	2.60	63.69	53.74	0.51
001	533.00*	1000	116.46	146.86	150.11		150.35	0.003989	2.57	62.25	53.54	0.51
001	524.50*	2	26.58	146.75	148.84		149.00	0.004041	1.79	14.87	9.78	0.46
001	524.50*	20	49.78	146.75	149.41		149.62	0.004116	2.13	29.76	47.12	0.49
001	524.50*	50	60.91	146.75	149.57		149.77	0.003846	2.17	37.70	50.12	0.48
001	524.50*	100	70.80	146.75	149.69		149.89	0.003671	2.21	44.09	52.33	0.47
001	524.50*	100 +5%	74.34	146.75	149.74		149.93	0.003549	2.20	46.64	52.99	0.47
001	524.50*	100 +25%	88.50	146.75	149.87		150.07	0.003608	2.30	53.48	54.73	0.47
001	524.50*	100 +70%	120.36	146.75	150.12		150.34	0.003651	2.47	67.66	57.92	0.48

HEC-RAS Plan: Mannings n +20% River: River Trannon Reach: 001 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
001	524.50*	1000	116.46	146.75	150.09		150.31	0.003635	2.45	66.11	57.64	0.48
001	0516	2	26.58	146.64	148.81		148.96	0.003716	1.75	15.15	9.35	0.44
001	0516	20	49.78	146.64	149.38	148.57	149.58	0.004014	2.08	31.16	52.90	0.48
001	0516	50	60.91	146.64	149.56		149.73	0.003495	2.06	40.89	56.14	0.45
001	0516	100	70.80	146.64	149.69		149.85	0.003242	2.06	48.26	58.17	0.44
001	0516	100 +5%	74.34	146.64	149.74		149.90	0.003113	2.05	51.14	58.95	0.43
001	0516	100 +25%	88.50	146.64	149.87		150.03	0.003121	2.13	58.87	60.98	0.44
001	0516	100 +70%	120.36	146.64	150.12		150.30	0.003096	2.26	74.94	65.01	0.44
001	0516	1000	116.46	146.64	150.09		150.27	0.003087	2.25	73.17	64.58	0.44
001	507.20*	2	26.58	146.66	148.76		148.93	0.004307	1.84	14.46	9.51	0.48
001	507.20*	20	49.78	146.66	149.25	148.62	149.53	0.005572	2.40	24.60	37.93	0.56
001	507.20*	50	60.91	146.66	149.38	148.87	149.68	0.005950	2.59	30.13	48.99	0.59
001	507.20*	100	70.80	146.66	149.54	149.42	149.80	0.005020	2.51	38.66	53.93	0.55
001	507.20*	100 +5%	74.34	146.66	149.62	149.45	149.86	0.004359	2.40	43.26	55.55	0.51
001	507.20*	100 +25%	88.50	146.66	149.76		149.99	0.004271	2.47	50.93	58.14	0.51
001	507.20*	100 +70%	120.36	146.66	150.03		150.26	0.003999	2.57	67.37	63.28	0.50
001	507.20*	1000	116.46	146.66	150.00		150.23	0.004001	2.55	65.61	62.76	0.50
001	498.40*	2	26.58	146.68	148.70		148.89	0.005021	1.92	13.81	9.65	0.51
001	498.40*	20	49.78	146.68	149.19	148.65	149.48	0.005944	2.47	24.11	36.01	0.58
001	498.40*	50	60.91	146.68	149.31	149.20	149.63	0.006426	2.68	28.72	40.30	0.61
001	498.40*	100	70.80	146.68	149.41	149.33	149.75	0.006532	2.80	33.17	44.07	0.62
001	498.40*	100 +5%	74.34	146.68	149.45	149.35	149.79	0.006560	2.83	34.75	45.57	0.63
001	498.40*	100 +25%	88.50	146.68	149.58	149.51	149.94	0.006553	2.95	41.21	51.22	0.63
001	498.40*	100 +70%	120.36	146.68	149.90		150.21	0.005448	2.94	58.87	60.12	0.59
001	498.40*	1000	116.46	146.68	149.86		150.18	0.005554	2.94	56.81	59.41	0.59
001	489.60*	2	26.58	146.70	148.64		148.84	0.005754	2.01	13.20	9.56	0.55
001	489.60*	20	49.78	146.70	149.12	148.65	149.43	0.006316	2.53	23.86	35.36	0.60
001	489.60*	50	60.91	146.70	149.24	149.16	149.58	0.006970	2.76	27.97	38.97	0.64
001	489.60*	100	70.80	146.70	149.34	149.28	149.70	0.007022	2.87	32.31	42.07	0.64
001	489.60*	100 +5%	74.34	146.70	149.38	149.34	149.74	0.007016	2.91	33.85	43.02	0.65
001	489.60*	100 +25%	88.50	146.70	149.51	149.44	149.88	0.006977	3.02	39.86	46.80	0.65
001	489.60*	100 +70%	120.36	146.70	149.79	149.69	150.16	0.006490	3.16	54.03	55.26	0.64
001	489.60*	1000	116.46	146.70	149.76	149.66	150.13	0.006564	3.15	52.25	54.26	0.64
001	480.80*	2	26.58	146.72	148.56		148.79	0.006704	2.12	12.55	9.39	0.58
001	480.80*	20	49.78	146.72	149.06	148.63	149.37	0.006803	2.60	23.55	35.19	0.62
001	480.80*	50	60.91	146.72	149.16	149.11	149.52	0.007630	2.85	27.28	38.14	0.66
001	480.80*	100	70.80	146.72	149.27	149.23	149.64	0.007570	2.95	31.67	41.35	0.66
001	480.80*	100 +5%	74.34	146.72	149.30	149.26	149.68	0.007528	2.98	33.23	42.44	0.66
001	480.80*	100 +25%	88.50	146.72	149.45	149.40	149.82	0.007292	3.06	39.47	45.92	0.66
001	480.80*	100 +70%	120.36	146.72	149.73		150.10	0.006558	3.16	53.81	53.35	0.64
001	480.80*	1000	116.46	146.72	149.70		150.06	0.006647	3.15	52.05	52.48	0.64
001	0472	2	26.58	146.74	148.46		148.72	0.008131	2.25	11.80	9.15	0.63
001	0472	20	49.78	146.74	148.94	148.91	149.30	0.008470	2.80	21.64	34.07	0.68
001	0472	50	60.91	146.74	149.08	149.06	149.46	0.008362	2.93	26.74	37.90	0.68
001	0472	100	70.80	146.74	149.20	149.17	149.57	0.008007	2.99	31.48	41.14	0.68
001	0472	100 +5%	74.34	146.74	149.24	149.21	149.61	0.007891	3.01	33.14	42.22	0.67
001	0472	100 +25%	88.50	146.74	149.38	149.33	149.75	0.007475	3.07	39.66	46.06	0.66
001	0472	100 +70%	120.36	146.74	149.69		150.03	0.006448	3.11	54.72	53.40	0.63
001	0472	1000	116.46	146.74	149.65		150.00	0.006557	3.10	52.89	52.54	0.63
001	463.17*	2	26.58	146.66	148.40		148.64	0.007633	2.21	12.05	9.35	0.62
001	463.17*	20	49.78	146.66	148.87	148.83	149.22	0.007997	2.73	22.19	34.09	0.66
001	463.17*	50	60.91	146.66	149.03	148.98	149.37	0.007478	2.80	27.99	38.00	0.65
001	463.17*	100	70.80	146.66	149.15	149.09	149.49	0.007133	2.85	32.85	41.02	0.64
001	463.17*	100 +5%	74.34	146.66	149.20	149.13	149.53	0.007025	2.87	34.55	42.02	0.64
001	463.17*	100 +25%	88.50	146.66	149.35	149.24	149.68	0.006660	2.93	41.15	45.62	0.63
001	463.17*	100 +70%	120.36	146.66	149.65		149.97	0.005804	2.98	56.24	52.58	0.60
001	463.17*	1000	116.46	146.66	149.62		149.94	0.005893	2.98	54.41	51.81	0.61
001	454.33*	2	26.58	146.58	148.33		148.57	0.007280	2.16	12.28	9.54	0.61
001	454.33*	20	49.78	146.58	148.83	148.70	149.14	0.007183	2.60	23.55	34.99	0.63
001	454.33*	50	60.91	146.58	149.00	148.90	149.30	0.006524	2.64	29.83	38.63	0.61
001	454.33*	100	70.80	146.58	149.13		149.42	0.006212	2.69	34.84	41.44	0.60
001	454.33*	100 +5%	74.34	146.58	149.17		149.46	0.006126	2.70	36.57	42.37	0.60
001	454.33*	100 +25%	88.50	146.58	149.32		149.61	0.005836	2.77	43.22	45.53	0.59
001	454.33*	100 +70%	120.36	146.58	149.63		149.92	0.005180	2.84	58.18	51.78	0.57
001	454.33*	1000	116.46	146.58	149.59		149.88	0.005243	2.83	56.38	51.02	0.57
001	445.50*	2	26.58	146.50	148.27		148.51	0.007056	2.13	12.46	9.79	0.60
001	445.50*	20	49.78	146.50	148.80	148.65	149.07	0.006379	2.45	25.26	36.00	0.60
001	445.50*	50	60.91	146.50	148.98		149.23	0.005645	2.47	32.03	39.57	0.57
001	445.50*	100	70.80	146.50	149.10		149.36	0.005368	2.51	37.22	42.15	0.56
001	445.50*	100 +5%	74.34	146.50	149.14		149.40	0.005300	2.53	38.98	43.01	0.56
001	445.50*	100 +25%	88.50	146.50	149.30		149.55	0.005072	2.59	45.73	45.74	0.56
001	445.50*	100 +70%	120.36	146.50	149.60		149.86	0.004586	2.69	60.62	51.23	0.54
001	445.50*	1000	116.46	146.50	149.57		149.83	0.004629	2.68	58.85	50.56	0.54
001	436.67*	2	26.58	146.41	148.21		148.44	0.006973	2.11	12.59	10.06	0.60
001	436.67*	20	49.78	146.41	148.77		149.01	0.005583	2.31	27.19	37.09	0.56

HEC-RAS Plan: Mannings n +20% River: River Trannon Reach: 001 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
001	436.67*	50	60.91	146.41	148.96		149.17	0.004889	2.30	34.43	40.55	0.53
001	436.67*	100	70.80	146.41	149.08		149.30	0.004651	2.34	39.79	42.98	0.52
001	436.67*	100 +5%	74.34	146.41	149.13		149.34	0.004592	2.36	41.60	43.73	0.52
001	436.67*	100 +25%	88.50	146.41	149.28		149.50	0.004417	2.43	48.44	46.09	0.52
001	436.67*	100 +70%	120.36	146.41	149.59		149.82	0.004063	2.54	63.33	51.03	0.51
001	436.67*	1000	116.46	146.41	149.55		149.78	0.004092	2.52	61.58	50.41	0.51
001	427.83*	2	26.58	146.33	148.15		148.38	0.007066	2.10	12.69	12.70	0.60
001	427.83*	20	49.78	146.33	148.75		148.95	0.004820	2.16	29.33	38.21	0.52
001	427.83*	50	60.91	146.33	148.94		149.12	0.004250	2.14	36.96	41.50	0.49
001	427.83*	100	70.80	146.33	149.07		149.25	0.004044	2.18	42.49	43.79	0.49
001	427.83*	100 +5%	74.34	146.33	149.11		149.30	0.003990	2.20	44.35	44.37	0.49
001	427.83*	100 +25%	88.50	146.33	149.26		149.46	0.003864	2.27	51.27	46.50	0.48
001	427.83*	100 +70%	120.36	146.33	149.57		149.78	0.003611	2.39	66.22	50.99	0.48
001	427.83*	1000	116.46	146.33	149.54		149.74	0.003629	2.37	64.47	50.42	0.48
001	0419	2	26.58	146.25	148.08		148.31	0.007422	2.11	12.76	14.69	0.61
001	0419	20	49.78	146.25	148.73		148.90	0.004189	2.02	31.65	39.38	0.48
001	0419	50	60.91	146.25	148.92		149.08	0.003698	1.99	39.58	42.47	0.46
001	0419	100	70.80	146.25	149.05		149.21	0.003540	2.03	45.30	44.46	0.45
001	0419	100 +5%	74.34	146.25	149.10		149.26	0.003498	2.04	47.19	45.00	0.45
001	0419	100 +25%	88.50	146.25	149.25		149.42	0.003409	2.11	54.19	46.96	0.45
001	0419	100 +70%	120.36	146.25	149.56		149.74	0.003233	2.24	69.22	51.09	0.45
001	0419	1000	116.46	146.25	149.52		149.70	0.003243	2.22	67.48	50.56	0.45
001	409.75*	2	26.58	146.22	148.04		148.24	0.005835	1.96	13.59	10.93	0.55
001	409.75*	20	49.78	146.22	148.65		148.86	0.004416	2.14	28.79	36.70	0.51
001	409.75*	50	60.91	146.22	148.85		149.04	0.003913	2.16	36.34	40.52	0.48
001	409.75*	100	70.80	146.22	148.98		149.17	0.003778	2.21	41.79	42.53	0.48
001	409.75*	100 +5%	74.34	146.22	149.02		149.22	0.003753	2.23	43.60	43.19	0.48
001	409.75*	100 +25%	88.50	146.22	149.17		149.38	0.003718	2.32	50.31	45.56	0.48
001	409.75*	100 +70%	120.36	146.22	149.48		149.70	0.003504	2.45	65.28	50.09	0.48
001	409.75*	1000	116.46	146.22	149.45		149.67	0.003524	2.43	63.53	49.62	0.48
001	400.50*	2	26.58	146.18	148.02		148.18	0.004435	1.79	14.88	11.69	0.49
001	400.50*	20	49.78	146.18	148.61		148.82	0.003876	2.13	28.35	35.80	0.49
001	400.50*	50	60.91	146.18	148.80		149.01	0.003652	2.20	35.49	40.37	0.48
001	400.50*	100	70.80	146.18	148.93		149.14	0.003606	2.27	40.85	42.52	0.48
001	400.50*	100 +5%	74.34	146.18	148.97		149.19	0.003604	2.30	42.63	43.17	0.48
001	400.50*	100 +25%	88.50	146.18	149.12		149.35	0.003603	2.40	49.30	45.03	0.49
001	400.50*	100 +70%	120.36	146.18	149.43		149.67	0.003425	2.53	64.02	48.34	0.49
001	400.50*	1000	116.46	146.18	149.40		149.64	0.003440	2.52	62.33	47.97	0.49
001	391.25*	2	26.58	146.14	148.01		148.14	0.003148	1.63	16.89	14.35	0.42
001	391.25*	20	49.78	146.14	148.60		148.78	0.002923	1.96	30.95	36.58	0.43
001	391.25*	50	60.91	146.14	148.78		148.97	0.002886	2.06	37.89	40.39	0.44
001	391.25*	100	70.80	146.14	148.91		149.10	0.002916	2.14	43.12	41.74	0.44
001	391.25*	100 +5%	74.34	146.14	148.95		149.15	0.002935	2.18	44.83	42.09	0.44
001	391.25*	100 +25%	88.50	146.14	149.10		149.31	0.003027	2.30	51.12	43.36	0.46
001	391.25*	100 +70%	120.36	146.14	149.41		149.64	0.003051	2.49	64.88	46.02	0.47
001	391.25*	1000	116.46	146.14	149.37		149.60	0.003048	2.47	63.29	45.73	0.47
001	0382	2	26.58	146.11	148.01		148.10	0.001998	1.38	21.15	18.14	0.34
001	0382	20	49.78	146.11	148.62		148.74	0.001990	1.69	35.64	37.72	0.36
001	0382	50	60.91	146.11	148.79		148.93	0.002043	1.80	42.44	38.96	0.37
001	0382	100	70.80	146.11	148.92		149.07	0.002145	1.91	47.30	39.82	0.38
001	0382	100 +5%	74.34	146.11	148.96		149.11	0.002185	1.95	48.88	40.09	0.39
001	0382	100 +25%	88.50	146.11	149.10		149.27	0.002351	2.10	54.67	41.09	0.41
001	0382	100 +70%	120.36	146.11	149.39		149.60	0.002563	2.34	67.13	43.12	0.43
001	0382	1000	116.46	146.11	149.36		149.57	0.002529	2.31	65.80	42.91	0.43
001	372.33*	2	26.58	146.05	147.92		148.07	0.004375	1.72	15.65	14.53	0.49
001	372.33*	20	49.78	146.05	148.51		148.71	0.003642	2.03	28.59	35.79	0.48
001	372.33*	50	60.91	146.05	148.70		148.90	0.003462	2.11	35.67	39.77	0.47
001	372.33*	100	70.80	146.05	148.83		149.04	0.003432	2.19	40.86	40.92	0.47
001	372.33*	100 +5%	74.34	146.05	148.87		149.08	0.003441	2.22	42.54	41.28	0.48
001	372.33*	100 +25%	88.50	146.05	149.02		149.24	0.003470	2.33	48.88	42.55	0.48
001	372.33*	100 +70%	120.36	146.05	149.33		149.57	0.003429	2.51	62.32	45.07	0.49
001	372.33*	1000	116.46	146.05	149.30		149.54	0.003412	2.49	60.90	44.82	0.49
001	362.67*	2	26.58	146.00	147.81		148.01	0.007446	1.99	13.38	12.53	0.61
001	362.67*	20	49.78	146.00	148.41		148.66	0.005745	2.25	24.25	30.74	0.57
001	362.67*	50	60.91	146.00	148.60		148.85	0.005306	2.33	30.73	38.09	0.56
001	362.67*	100	70.80	146.00	148.73		148.99	0.005024	2.38	36.19	41.31	0.55
001	362.67*	100 +5%	74.34	146.00	148.78		149.03	0.004934	2.40	38.06	41.84	0.55
001	362.67*	100 +25%	88.50	146.00	148.95		149.20	0.004558	2.44	45.47	43.79	0.54
001	362.67*	100 +70%	120.36	146.00	149.27		149.53	0.004105	2.55	60.16	47.04	0.52
001	362.67*	1000	116.46	146.00	149.24		149.50	0.004110	2.53	58.65	46.72	0.52
001	0353	2	26.58	145.94	147.77		147.94	0.005034	1.82	14.61	11.01	0.50
001	0353	20	49.78	145.94	148.36		148.60	0.005619	2.23	24.49	29.97	0.56
001	0353	50	60.91	145.94	148.55		148.79	0.005602	2.30	30.90	37.38	0.56
001	0353	100	70.80	145.94	148.69		148.93	0.005371	2.33	36.38	40.06	0.56
001	0353	100 +5%	74.34	145.94	148.73		148.98	0.005260	2.34	38.34	40.86	0.55
001	0353	100 +25%	88.50	145.94	148.91		149.15	0.004897	2.36	45.87	43.79	0.54

HEC-RAS Plan: Mannings n +20% River: River Trannon Reach: 001 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
001	0353	100 +70%	120.36	145.94	149.25		149.49	0.004216	2.43	61.39	48.97	0.51
001	0353	1000	116.46	145.94	149.21		149.45	0.004266	2.42	59.62	48.45	0.51
001	344.60*	2	26.58	145.91	147.69		147.89	0.006033	1.97	13.50	10.50	0.55
001	344.60*	20	49.78	145.91	148.29		148.55	0.006282	2.30	23.89	30.59	0.59
001	344.60*	50	60.91	145.91	148.49		148.75	0.005667	2.34	30.59	36.17	0.57
001	344.60*	100	70.80	145.91	148.64		148.89	0.005335	2.37	35.94	38.54	0.56
001	344.60*	100 +5%	74.34	145.91	148.69		148.94	0.005213	2.38	37.86	39.30	0.56
001	344.60*	100 +25%	88.50	145.91	148.86		149.11	0.004795	2.42	45.14	42.16	0.54
001	344.60*	100 +70%	120.36	145.91	149.20		149.45	0.004233	2.51	59.89	46.39	0.52
001	344.60*	1000	116.46	145.91	149.16		149.41	0.004272	2.50	58.22	45.96	0.52
001	336.20*	2	26.58	145.88	147.60		147.83	0.007636	2.12	12.53	10.76	0.63
001	336.20*	20	49.78	145.88	148.23		148.51	0.006356	2.37	23.43	29.79	0.60
001	336.20*	50	60.91	145.88	148.44		148.70	0.005588	2.38	30.19	34.47	0.57
001	336.20*	100	70.80	145.88	148.59		148.85	0.005282	2.43	35.33	36.75	0.56
001	336.20*	100 +5%	74.34	145.88	148.63		148.90	0.005151	2.44	37.17	37.56	0.56
001	336.20*	100 +25%	88.50	145.88	148.82		149.08	0.004758	2.49	44.19	40.24	0.55
001	336.20*	100 +70%	120.36	145.88	149.14		149.42	0.004332	2.61	58.08	44.09	0.53
001	336.20*	1000	116.46	145.88	149.11		149.38	0.004364	2.60	56.49	43.72	0.53
001	327.80*	2	26.58	145.85	147.50		147.76	0.009115	2.26	11.78	10.81	0.69
001	327.80*	20	49.78	145.85	148.16		148.45	0.006541	2.46	22.65	28.40	0.62
001	327.80*	50	60.91	145.85	148.39		148.66	0.005581	2.45	29.59	32.61	0.58
001	327.80*	100	70.80	145.85	148.52		148.81	0.005343	2.51	34.29	34.86	0.57
001	327.80*	100 +5%	74.34	145.85	148.57		148.86	0.005228	2.53	36.05	35.63	0.57
001	327.80*	100 +25%	88.50	145.85	148.76		149.04	0.004875	2.59	42.76	38.11	0.56
001	327.80*	100 +70%	120.36	145.85	149.07		149.38	0.004651	2.76	55.36	41.72	0.56
001	327.80*	1000	116.46	145.85	149.04		149.34	0.004671	2.74	53.89	41.34	0.56
001	319.40*	2	26.58	145.82	147.40		147.69	0.010087	2.39	11.14	10.23	0.73
001	319.40*	20	49.78	145.82	148.06	147.66	148.40	0.007225	2.61	21.19	26.54	0.65
001	319.40*	50	60.91	145.82	148.31	148.07	148.62	0.005801	2.56	28.44	30.62	0.59
001	319.40*	100	70.80	145.82	148.45	148.21	148.76	0.005617	2.64	32.85	32.75	0.59
001	319.40*	100 +5%	74.34	145.82	148.50	148.25	148.81	0.005570	2.66	34.36	33.42	0.59
001	319.40*	100 +25%	88.50	145.82	148.68	148.41	149.00	0.005229	2.73	40.72	35.77	0.58
001	319.40*	100 +70%	120.36	145.82	148.98	148.70	149.33	0.005293	2.98	51.67	39.09	0.59
001	319.40*	1000	116.46	145.82	148.94	148.67	149.29	0.005301	2.95	50.33	38.71	0.59
001	0311	2	26.58	145.79	147.18		147.57	0.014474	2.76	9.63	9.18	0.86
001	0311	20	49.78	145.79	147.74	147.60	148.30	0.013524	3.31	15.16	13.00	0.86
001	0311	50	60.91	145.79	148.03	148.03	148.53	0.010428	3.22	21.44	25.62	0.77
001	0311	100	70.80	145.79	148.17	148.17	148.68	0.010001	3.32	25.15	27.59	0.76
001	0311	100 +5%	74.34	145.79	148.21	148.21	148.73	0.009906	3.35	26.39	28.22	0.76
001	0311	100 +25%	88.50	145.79	148.37	148.37	148.91	0.009750	3.50	30.97	30.42	0.77
001	0311	100 +70%	120.36	145.79	148.67	148.67	149.25	0.009329	3.74	40.74	34.16	0.77
001	0311	1000	116.46	145.79	148.64	148.64	149.22	0.009299	3.70	39.72	33.82	0.77
001	301.67*	2	26.58	145.58	147.12		147.44	0.010533	2.49	10.69	9.42	0.74
001	301.67*	20	49.78	145.58	147.69	147.42	148.16	0.010797	3.05	16.37	11.49	0.78
001	301.67*	50	60.91	145.58	147.89	147.60	148.41	0.010527	3.23	20.61	27.68	0.78
001	301.67*	100	70.80	145.58	147.99	148.07	148.57	0.011299	3.46	23.37	29.67	0.81
001	301.67*	100 +5%	74.34	145.58	148.02	148.11	148.62	0.011557	3.54	24.30	30.32	0.82
001	301.67*	100 +25%	88.50	145.58	148.16	148.28	148.80	0.011810	3.75	28.59	33.15	0.84
001	301.67*	100 +70%	120.36	145.58	148.39	148.56	149.14	0.012596	4.16	36.93	37.81	0.88
001	301.67*	1000	116.46	145.58	148.37	148.53	149.10	0.012474	4.11	36.01	37.40	0.88
001	292.33*	2	26.58	145.37	147.09		147.33	0.007426	2.20	12.10	9.75	0.63
001	292.33*	20	49.78	145.37	147.65	147.23	148.05	0.008500	2.78	17.89	10.76	0.69
001	292.33*	50	60.91	145.37	147.85	147.45	148.30	0.008578	2.99	22.22	31.41	0.70
001	292.33*	100	70.80	145.37	148.00	147.61	148.45	0.008279	3.08	27.04	36.02	0.70
001	292.33*	100 +5%	74.34	145.37	148.02	148.01	148.50	0.008620	3.17	27.91	36.79	0.71
001	292.33*	100 +25%	88.50	145.37	148.05	148.20	148.69	0.011220	3.66	29.23	37.93	0.81
001	292.33*	100 +70%	120.36	145.37	148.25	148.49	149.02	0.012899	4.17	37.31	43.88	0.89
001	292.33*	1000	116.46	145.37	148.23	148.45	148.98	0.012746	4.12	36.34	43.25	0.88
001	0283	2	26.58	145.16	147.07		147.26	0.005271	1.94	13.72	10.10	0.53
001	0283	20	49.78	145.16	147.63		147.96	0.006622	2.53	19.74	14.27	0.61
001	0283	50	60.91	145.16	147.83	147.25	148.20	0.006796	2.72	24.60	35.00	0.62
001	0283	100	70.80	145.16	147.99	147.44	148.36	0.006340	2.77	31.20	45.94	0.61
001	0283	100 +5%	74.34	145.16	148.04	147.50	148.40	0.006264	2.79	33.32	48.42	0.61
001	0283	100 +25%	88.50	145.16	148.19	148.15	148.55	0.006054	2.87	41.14	54.19	0.60
001	0283	100 +70%	120.36	145.16	148.13	148.36	148.90	0.012974	4.14	38.17	53.67	0.88
001	0283	1000	116.46	145.16	148.11	148.34	148.87	0.012805	4.08	37.05	52.50	0.87
001	274.00*	2	26.58	145.16	147.03		147.21	0.005000	1.89	14.10	10.64	0.52
001	274.00*	20	49.78	145.16	147.59		147.89	0.006139	2.45	20.33	12.38	0.59
001	274.00*	50	60.91	145.16	147.78	147.20	148.14	0.006236	2.65	24.87	34.18	0.61
001	274.00*	100	70.80	145.16	147.95	147.37	148.30	0.005857	2.71	31.61	47.41	0.60
001	274.00*	100 +5%	74.34	145.16	147.99	147.43	148.34	0.005789	2.73	33.83	50.18	0.60
001	274.00*	100 +25%	88.50	145.16	148.14	148.04	148.49	0.005625	2.82	41.81	55.97	0.59
001	274.00*	100 +70%	120.36	145.16	148.43	148.34	148.75	0.004932	2.86	59.45	61.84	0.57
001	274.00*	1000	116.46	145.16	148.40	148.32	148.72	0.005089	2.87	57.08	61.77	0.57
001	265.00*	2	26.58	145.15	146.99		147.16	0.004875	1.85	14.39	11.18	0.52

HEC-RAS Plan: Mannings n +20% River: River Trannon Reach: 001 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
001	265.00*	20	49.78	145.15	147.54		147.83	0.005676	2.38	20.98	13.12	0.58
001	265.00*	50	60.91	145.15	147.74	147.15	148.08	0.005772	2.58	25.33	33.07	0.59
001	265.00*	100	70.80	145.15	147.90	147.31	148.24	0.005442	2.64	32.19	48.64	0.58
001	265.00*	100 +5%	74.34	145.15	147.95	147.37	148.29	0.005379	2.66	34.49	51.71	0.58
001	265.00*	100 +25%	88.50	145.15	148.10	147.98	148.44	0.005214	2.75	42.99	59.07	0.58
001	265.00*	100 +70%	120.36	145.15	148.40		148.70	0.004559	2.79	61.95	67.78	0.55
001	265.00*	1000	116.46	145.15	148.36		148.67	0.004691	2.80	59.33	66.66	0.56
001	256.00*	2	26.58	145.15	146.95		147.11	0.004885	1.82	14.59	11.71	0.52
001	256.00*	20	49.78	145.15	147.50		147.78	0.005335	2.31	21.64	14.59	0.57
001	256.00*	50	60.91	145.15	147.70	147.11	148.02	0.005397	2.51	25.97	32.80	0.58
001	256.00*	100	70.80	145.15	147.86	147.26	148.18	0.005084	2.57	33.03	50.61	0.57
001	256.00*	100 +5%	74.34	145.15	147.91	147.32	148.23	0.005004	2.59	35.47	53.40	0.57
001	256.00*	100 +25%	88.50	145.15	148.06	147.53	148.38	0.004884	2.68	44.32	63.40	0.57
001	256.00*	100 +70%	120.36	145.15	148.38		148.65	0.004015	2.65	65.71	71.49	0.53
001	256.00*	1000	116.46	145.15	148.34		148.62	0.004157	2.67	62.81	70.47	0.54
001	247.00*	2	26.58	145.14	146.90		147.07	0.005059	1.81	14.68	12.30	0.53
001	247.00*	20	49.78	145.14	147.46		147.72	0.005096	2.26	22.35	16.47	0.56
001	247.00*	50	60.91	145.14	147.67	147.07	147.96	0.005077	2.43	26.87	33.64	0.57
001	247.00*	100	70.80	145.14	147.83	147.23	148.13	0.004741	2.49	34.29	53.21	0.56
001	247.00*	100 +5%	74.34	145.14	147.88	147.27	148.18	0.004640	2.50	36.95	56.14	0.55
001	247.00*	100 +25%	88.50	145.14	148.03	147.50	148.33	0.004489	2.58	46.31	66.61	0.55
001	247.00*	100 +70%	120.36	145.14	148.37		148.60	0.003505	2.50	70.46	76.51	0.50
001	247.00*	1000	116.46	145.14	148.32		148.57	0.003648	2.52	67.23	75.52	0.51
001	0238	2	26.58	145.14	146.85		147.02	0.005397	1.82	14.61	12.79	0.54
001	0238	20	49.78	145.14	147.43		147.67	0.004919	2.21	23.30	19.74	0.55
001	0238	50	60.91	145.14	147.64		147.91	0.004711	2.34	28.48	36.15	0.55
001	0238	100	70.80	145.14	147.81	147.19	148.08	0.004291	2.37	36.69	56.77	0.53
001	0238	100 +5%	74.34	145.14	147.86		148.12	0.004166	2.37	39.63	59.87	0.53
001	0238	100 +25%	88.50	145.14	148.03		148.28	0.003863	2.41	50.46	70.94	0.51
001	0238	100 +70%	120.36	145.14	148.36		148.56	0.002998	2.32	76.47	82.14	0.46
001	0238	1000	116.46	145.14	148.32		148.53	0.003087	2.33	73.39	81.35	0.47
001	229.50*	2	26.58	145.06	146.77		146.97	0.006368	1.94	13.67	12.32	0.59
001	229.50*	20	49.78	145.06	147.35		147.62	0.005830	2.33	21.71	17.18	0.60
001	229.50*	50	60.91	145.06	147.55	147.04	147.86	0.005677	2.50	25.90	30.62	0.60
001	229.50*	100	70.80	145.06	147.72	147.20	148.03	0.005189	2.54	33.28	50.77	0.58
001	229.50*	100 +5%	74.34	145.06	147.77	147.24	148.08	0.005016	2.54	35.99	53.29	0.58
001	229.50*	100 +25%	88.50	145.06	147.94	147.47	148.24	0.004617	2.57	45.71	61.60	0.56
001	229.50*	100 +70%	120.36	145.06	148.28		148.53	0.003633	2.52	69.72	77.33	0.51
001	229.50*	1000	116.46	145.06	148.24		148.49	0.003773	2.54	66.59	76.44	0.52
001	221.00*	2	26.58	144.97	146.69		146.91	0.006903	2.05	12.99	11.49	0.61
001	221.00*	20	49.78	144.97	147.27		147.57	0.006704	2.44	20.75	16.38	0.64
001	221.00*	50	60.91	144.97	147.47	147.01	147.81	0.006488	2.60	24.53	26.04	0.64
001	221.00*	100	70.80	144.97	147.64	147.18	147.98	0.005952	2.66	31.14	45.69	0.62
001	221.00*	100 +5%	74.34	144.97	147.69	147.23	148.03	0.005745	2.66	33.63	47.95	0.61
001	221.00*	100 +25%	88.50	144.97	147.86	147.71	148.19	0.005300	2.70	42.39	55.18	0.60
001	221.00*	100 +70%	120.36	144.97	148.20		148.49	0.004344	2.70	63.56	71.66	0.55
001	221.00*	1000	116.46	144.97	148.16		148.45	0.004466	2.71	60.75	69.54	0.56
001	212.50*	2	26.58	144.89	146.62		146.84	0.007389	2.10	12.64	11.30	0.63
001	212.50*	20	49.78	144.89	147.18		147.51	0.007254	2.52	20.13	16.54	0.66
001	212.50*	50	60.91	144.89	147.39	146.97	147.75	0.007216	2.68	23.82	23.60	0.67
001	212.50*	100	70.80	144.89	147.56	147.15	147.92	0.006549	2.73	30.01	41.98	0.65
001	212.50*	100 +5%	74.34	144.89	147.61	147.22	147.97	0.006303	2.73	32.35	44.31	0.64
001	212.50*	100 +25%	88.50	144.89	147.79	147.65	148.13	0.005792	2.78	40.48	50.28	0.62
001	212.50*	100 +70%	120.36	144.89	148.13		148.44	0.004714	2.78	60.02	64.04	0.57
001	212.50*	1000	116.46	144.89	148.09		148.41	0.004828	2.78	57.53	62.20	0.58
001	204.00*	2	26.58	144.80	146.55		146.78	0.007704	2.13	12.50	11.36	0.65
001	204.00*	20	49.78	144.80	147.11		147.44	0.007446	2.56	19.93	16.88	0.67
001	204.00*	50	60.91	144.80	147.32	146.91	147.68	0.007310	2.71	23.80	22.34	0.67
001	204.00*	100	70.80	144.80	147.49	147.10	147.86	0.006810	2.75	29.83	39.58	0.65
001	204.00*	100 +5%	74.34	144.80	147.56	147.18	147.91	0.006301	2.71	32.71	42.40	0.63
001	204.00*	100 +25%	88.50	144.80	147.76		148.08	0.005473	2.70	41.58	48.17	0.60
001	204.00*	100 +70%	120.36	144.80	148.10		148.40	0.004605	2.74	59.66	59.19	0.56
001	204.00*	1000	116.46	144.80	148.06		148.37	0.004687	2.74	57.43	57.70	0.57
001	195.50*	2	26.58	144.72	146.48		146.71	0.007717	2.12	12.55	11.47	0.65
001	195.50*	20	49.78	144.72	147.06		147.38	0.006901	2.52	20.47	17.43	0.64
001	195.50*	50	60.91	144.72	147.27	146.83	147.62	0.006824	2.66	24.60	24.61	0.65
001	195.50*	100	70.80	144.72	147.46	147.02	147.80	0.006284	2.68	31.03	38.72	0.63
001	195.50*	100 +5%	74.34	144.72	147.53		147.85	0.005835	2.63	34.07	41.45	0.61
001	195.50*	100 +25%	88.50	144.72	147.73		148.03	0.005072	2.61	42.98	46.53	0.57
001	195.50*	100 +70%	120.36	144.72	148.08		148.36	0.004334	2.67	60.40	55.79	0.54
001	195.50*	1000	116.46	144.72	148.04		148.32	0.004389	2.66	58.35	54.57	0.55
001	0187	2	26.58	144.63	146.42		146.64	0.007339	2.07	12.85	11.66	0.63
001	0187	20	49.78	144.63	147.02		147.31	0.006267	2.42	21.54	18.68	0.61
001	0187	50	60.91	144.63	147.23	146.76	147.55	0.006164	2.57	25.88	29.43	0.61
001	0187	100	70.80	144.63	147.43		147.74	0.005470	2.55	33.01	38.35	0.58
001	0187	100 +5%	74.34	144.63	147.51		147.80	0.005071	2.51	36.14	40.84	0.56

HEC-RAS Plan: Mannings n +20% River: River Trannon Reach: 001 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
001	0187	100 +25%	88.50	144.63	147.72		147.98	0.004548	2.49	44.96	45.32	0.54
001	0187	100 +70%	120.36	144.63	148.06		148.32	0.004004	2.58	61.68	53.13	0.52
001	0187	1000	116.46	144.63	148.02		148.28	0.004037	2.56	59.74	52.05	0.52
001	177.00*	2	26.58	144.51	146.34		146.57	0.007593	2.12	12.54	11.23	0.64
001	177.00*	20	49.78	144.51	146.93		147.25	0.006616	2.50	20.83	17.46	0.62
001	177.00*	50	60.91	144.51	147.15	146.70	147.49	0.006533	2.63	24.92	22.60	0.63
001	177.00*	100	70.80	144.51	147.32	146.89	147.67	0.006423	2.72	30.17	34.61	0.63
001	177.00*	100 +5%	74.34	144.51	147.41	146.98	147.74	0.005786	2.65	33.47	37.42	0.60
001	177.00*	100 +25%	88.50	144.51	147.64		147.93	0.004828	2.60	42.67	42.78	0.56
001	177.00*	100 +70%	120.36	144.51	147.98		148.28	0.004263	2.70	58.76	50.37	0.54
001	177.00*	1000	116.46	144.51	147.95		148.24	0.004293	2.68	56.92	49.34	0.54
001	167.00*	2	26.58	144.39	146.25		146.49	0.007867	2.17	12.24	10.79	0.65
001	167.00*	20	49.78	144.39	146.83		147.17	0.007321	2.59	19.98	16.57	0.66
001	167.00*	50	60.91	144.39	147.05		147.42	0.007204	2.73	23.82	19.44	0.66
001	167.00*	100	70.80	144.39	147.19	146.84	147.60	0.007446	2.91	27.39	30.72	0.68
001	167.00*	100 +5%	74.34	144.39	147.29	146.92	147.67	0.006546	2.82	30.61	33.70	0.64
001	167.00*	100 +25%	88.50	144.39	147.53		147.87	0.005381	2.77	39.62	39.87	0.60
001	167.00*	100 +70%	120.36	144.39	147.90		148.23	0.004586	2.83	55.75	47.73	0.56
001	167.00*	1000	116.46	144.39	147.86		148.19	0.004620	2.81	53.99	46.79	0.56
001	157.00*	2	26.58	144.27	146.16		146.41	0.008130	2.22	11.95	10.38	0.66
001	157.00*	20	49.78	144.27	146.73		147.09	0.008050	2.67	19.24	15.82	0.69
001	157.00*	50	60.91	144.27	146.93		147.33	0.007762	2.83	22.72	18.13	0.69
001	157.00*	100	70.80	144.27	147.06	146.78	147.52	0.008155	3.05	25.26	26.80	0.71
001	157.00*	100 +5%	74.34	144.27	147.16	146.85	147.60	0.007405	3.00	28.03	30.36	0.69
001	157.00*	100 +25%	88.50	144.27	147.41		147.81	0.006077	2.95	36.53	36.73	0.63
001	157.00*	100 +70%	120.36	144.27	147.79		148.17	0.005172	3.02	51.93	45.37	0.60
001	157.00*	1000	116.46	144.27	147.75		148.13	0.005219	3.01	50.23	44.42	0.60
001	147.00*	2	26.58	144.15	146.05		146.32	0.008494	2.29	11.63	9.97	0.68
001	147.00*	20	49.78	144.15	146.62		147.00	0.008503	2.75	18.59	15.02	0.71
001	147.00*	50	60.91	144.15	146.82		147.25	0.008171	2.93	21.87	17.31	0.71
001	147.00*	100	70.80	144.15	146.97	146.68	147.44	0.008192	3.10	24.61	19.75	0.72
001	147.00*	100 +5%	74.34	144.15	147.01	146.75	147.52	0.008458	3.20	25.60	26.41	0.73
001	147.00*	100 +25%	88.50	144.15	147.28	146.86	147.74	0.006819	3.13	33.76	33.82	0.67
001	147.00*	100 +70%	120.36	144.15	147.67	147.50	148.11	0.005817	3.22	48.70	44.23	0.64
001	147.00*	1000	116.46	144.15	147.63	147.46	148.07	0.005883	3.21	46.99	43.23	0.64
001	137.00*	2	26.58	144.03	145.95		146.23	0.009167	2.32	11.44	10.17	0.70
001	137.00*	20	49.78	144.03	146.51		146.91	0.008532	2.80	18.28	14.81	0.71
001	137.00*	50	60.91	144.03	146.71		147.16	0.008249	2.99	21.54	16.88	0.71
001	137.00*	100	70.80	144.03	146.88	146.60	147.36	0.008079	3.13	24.40	18.75	0.72
001	137.00*	100 +5%	74.34	144.03	146.93	146.67	147.43	0.008107	3.19	25.42	20.52	0.72
001	137.00*	100 +25%	88.50	144.03	147.16	146.82	147.67	0.007415	3.29	31.73	31.13	0.70
001	137.00*	100 +70%	120.36	144.03	147.57	147.47	148.04	0.006037	3.32	47.93	45.66	0.65
001	137.00*	1000	116.46	144.03	147.51	147.42	148.00	0.006400	3.36	45.20	44.49	0.67
001	127.00*	2	26.58	143.90	145.87		146.13	0.008836	2.28	11.66	10.36	0.69
001	127.00*	20	49.78	143.90	146.44		146.82	0.007726	2.75	18.84	15.19	0.68
001	127.00*	50	60.91	143.90	146.65		147.08	0.007458	2.93	22.20	16.62	0.68
001	127.00*	100	70.80	143.90	146.81		147.28	0.007536	3.10	24.88	18.78	0.70
001	127.00*	100 +5%	74.34	143.90	146.86	146.57	147.35	0.007582	3.17	25.90	20.76	0.70
001	127.00*	100 +25%	88.50	143.90	147.04	146.73	147.59	0.007852	3.40	30.96	33.92	0.72
001	127.00*	100 +70%	120.36	143.90	147.58		147.96	0.004715	3.05	53.89	47.71	0.58
001	127.00*	1000	116.46	143.90	147.52		147.91	0.004969	3.08	51.11	46.61	0.59
001	117.00*	2	26.58	143.78	145.80		146.05	0.007520	2.18	12.19	10.55	0.64
001	117.00*	20	49.78	143.78	146.40		146.74	0.006548	2.64	19.99	15.20	0.63
001	117.00*	50	60.91	143.78	146.61	146.21	147.00	0.006495	2.83	23.44	18.73	0.64
001	117.00*	100	70.80	143.78	146.75	146.37	147.20	0.006825	3.04	26.94	29.23	0.66
001	117.00*	100 +5%	74.34	143.78	146.82	146.42	147.26	0.006599	3.05	28.91	31.29	0.66
001	117.00*	100 +25%	88.50	143.78	147.09	146.58	147.47	0.005254	2.94	38.94	40.39	0.60
001	117.00*	100 +70%	120.36	143.78	147.61		147.89	0.003376	2.68	62.69	50.50	0.49
001	117.00*	1000	116.46	143.78	147.56		147.84	0.003520	2.70	59.88	49.50	0.50
001	107.00*	2	26.58	143.66	145.76		145.97	0.005926	2.04	13.23	11.97	0.57
001	107.00*	20	49.78	143.66	146.37		146.67	0.005333	2.48	22.16	24.69	0.57
001	107.00*	50	60.91	143.66	146.62		146.91	0.004758	2.54	29.25	30.68	0.55
001	107.00*	100	70.80	143.66	146.82		147.10	0.004168	2.52	35.94	37.04	0.52
001	107.00*	100 +5%	74.34	143.66	146.89		147.16	0.003944	2.50	38.63	39.03	0.51
001	107.00*	100 +25%	88.50	143.66	147.15		147.38	0.003221	2.42	49.54	44.63	0.47
001	107.00*	100 +70%	120.36	143.66	147.64		147.83	0.002311	2.29	73.52	52.74	0.41
001	107.00*	1000	116.46	143.66	147.59		147.78	0.002382	2.30	70.71	51.86	0.41
001	97.00*	2	26.58	143.54	145.74		145.91	0.004356	1.85	15.01	12.42	0.48
001	97.00*	20	49.78	143.54	146.41		146.59	0.003345	2.07	30.36	32.36	0.45
001	97.00*	50	60.91	143.54	146.67		146.84	0.002724	2.01	39.34	36.01	0.41
001	97.00*	100	70.80	143.54	146.87		147.03	0.002400	1.99	47.27	42.03	0.39
001	97.00*	100 +5%	74.34	143.54	146.94		147.09	0.002297	1.98	50.15	43.26	0.39
001	97.00*	100 +25%	88.50	143.54	147.19		147.33	0.001978	1.95	61.51	47.63	0.36
001	97.00*	100 +70%	120.36	143.54	147.67		147.79	0.001573	1.92	85.79	54.53	0.33
001	97.00*	1000	116.46	143.54	147.61		147.74	0.001606	1.92	82.95	53.76	0.33

HEC-RAS Plan: Mannings n +20% River: River Trannon Reach: 001 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
001	0087	2	26.58	143.42	145.74		145.86	0.003014	1.61	18.59	23.73	0.39
001	0087	20	49.78	143.42	146.44		146.54	0.001820	1.57	41.30	36.73	0.32
001	0087	50	60.91	143.42	146.70		146.79	0.001557	1.56	51.26	41.29	0.30
001	0087	100	70.80	143.42	146.90		146.99	0.001412	1.55	59.89	45.21	0.29
001	0087	100 +5%	74.34	143.42	146.97		147.06	0.001372	1.56	62.90	46.26	0.29
001	0087	100 +25%	88.50	143.42	147.21		147.30	0.001244	1.56	74.68	49.87	0.28
001	0087	100 +70%	120.36	143.42	147.68		147.77	0.001078	1.59	99.47	55.93	0.27
001	0087	1000	116.46	143.42	147.63		147.72	0.001092	1.59	96.58	55.26	0.27
001	77.333*	2	26.58	143.39	145.73		145.83	0.002118	1.43	20.50	24.19	0.35
001	77.333*	20	49.78	143.39	146.43		146.52	0.001415	1.47	43.47	37.26	0.31
001	77.333*	50	60.91	143.39	146.69		146.78	0.001244	1.48	53.85	43.27	0.29
001	77.333*	100	70.80	143.39	146.89		146.98	0.001144	1.49	62.78	46.52	0.28
001	77.333*	100 +5%	74.34	143.39	146.96		147.04	0.001116	1.50	65.88	47.60	0.28
001	77.333*	100 +25%	88.50	143.39	147.20		147.29	0.001028	1.51	78.00	51.09	0.27
001	77.333*	100 +70%	120.36	143.39	147.67		147.76	0.000912	1.57	103.45	57.35	0.26
001	77.333*	1000	116.46	143.39	147.62		147.71	0.000921	1.56	100.49	56.66	0.26
001	67.667*	2	26.58	143.36	145.72		145.80	0.001585	1.26	22.75	25.14	0.31
001	67.667*	20	49.78	143.36	146.43		146.51	0.001147	1.36	46.11	38.80	0.28
001	67.667*	50	60.91	143.36	146.69		146.76	0.001025	1.38	57.00	44.68	0.27
001	67.667*	100	70.80	143.36	146.89		146.96	0.000955	1.40	66.22	48.01	0.27
001	67.667*	100 +5%	74.34	143.36	146.95		147.03	0.000936	1.40	69.42	49.09	0.26
001	67.667*	100 +25%	88.50	143.36	147.20		147.28	0.000873	1.43	81.88	52.48	0.26
001	67.667*	100 +70%	120.36	143.36	147.67		147.75	0.000790	1.49	108.06	58.94	0.25
001	67.667*	1000	116.46	143.36	147.62		147.70	0.000797	1.49	105.01	58.24	0.25
001	58.000*	2	26.58	143.33	145.72		145.78	0.001216	1.12	25.27	26.29	0.28
001	58.000*	20	49.78	143.33	146.42		146.49	0.000942	1.25	49.20	40.84	0.26
001	58.000*	50	60.91	143.33	146.68		146.75	0.000854	1.27	60.59	46.21	0.25
001	58.000*	100	70.80	143.33	146.88		146.95	0.000806	1.30	70.12	49.55	0.25
001	58.000*	100 +5%	74.34	143.33	146.95		147.02	0.000792	1.31	73.42	50.50	0.25
001	58.000*	100 +25%	88.50	143.33	147.19		147.26	0.000748	1.34	86.25	54.03	0.24
001	58.000*	100 +70%	120.36	143.33	147.66		147.74	0.000689	1.41	113.21	60.59	0.24
001	58.000*	1000	116.46	143.33	147.61		147.69	0.000694	1.40	110.07	59.92	0.24
001	48.333*	2	26.58	143.30	145.72		145.77	0.000948	1.00	28.06	28.12	0.25
001	48.333*	20	49.78	143.30	146.42		146.48	0.000777	1.14	52.74	43.23	0.24
001	48.333*	50	60.91	143.30	146.68		146.74	0.000715	1.18	64.59	47.86	0.23
001	48.333*	100	70.80	143.30	146.88		146.94	0.000682	1.20	74.45	51.08	0.23
001	48.333*	100 +5%	74.34	143.30	146.95		147.01	0.000673	1.22	77.85	52.08	0.23
001	48.333*	100 +25%	88.50	143.30	147.19		147.26	0.000643	1.25	91.11	55.77	0.22
001	48.333*	100 +70%	120.36	143.30	147.66		147.73	0.000601	1.33	118.92	62.32	0.22
001	48.333*	1000	116.46	143.30	147.61		147.68	0.000605	1.32	115.69	61.65	0.22
001	38.667*	2	26.58	143.27	145.72		145.76	0.000743	0.90	31.14	30.21	0.22
001	38.667*	20	49.78	143.27	146.42		146.47	0.000641	1.05	56.72	44.94	0.22
001	38.667*	50	60.91	143.27	146.68		146.73	0.000599	1.08	69.03	49.64	0.21
001	38.667*	100	70.80	143.27	146.88		146.93	0.000578	1.12	79.22	52.79	0.21
001	38.667*	100 +5%	74.34	143.27	146.95		147.00	0.000572	1.13	82.74	53.83	0.21
001	38.667*	100 +25%	88.50	143.27	147.19		147.25	0.000553	1.17	96.45	57.70	0.21
001	38.667*	100 +70%	120.36	143.27	147.66		147.72	0.000525	1.25	125.14	64.13	0.21
001	38.667*	1000	116.46	143.27	147.61		147.67	0.000527	1.24	121.82	63.45	0.21
001	29.000*	2	26.58	143.25	145.71		145.75	0.000586	0.81	34.50	31.53	0.19
001	29.000*	20	49.78	143.25	146.42		146.46	0.000529	0.96	61.09	46.71	0.20
001	29.000*	50	60.91	143.25	146.68		146.73	0.000503	1.00	73.88	51.38	0.19
001	29.000*	100	70.80	143.25	146.88		146.93	0.000490	1.04	84.43	54.68	0.19
001	29.000*	100 +5%	74.34	143.25	146.95		146.99	0.000487	1.05	88.07	55.78	0.19
001	29.000*	100 +25%	88.50	143.25	147.19		147.24	0.000475	1.09	102.28	59.86	0.19
001	29.000*	100 +70%	120.36	143.25	147.66		147.72	0.000458	1.17	131.89	66.02	0.20
001	29.000*	1000	116.46	143.25	147.61		147.66	0.000459	1.16	128.46	65.34	0.19
001	19.333*	2	26.58	143.22	145.71		145.74	0.000465	0.73	38.10	32.19	0.17
001	19.333*	20	49.78	143.22	146.42		146.46	0.000439	0.88	65.88	48.60	0.18
001	19.333*	50	60.91	143.22	146.68		146.72	0.000422	0.93	79.16	53.31	0.18
001	19.333*	100	70.80	143.22	146.88		146.92	0.000416	0.96	90.11	56.81	0.18
001	19.333*	100 +5%	74.34	143.22	146.95		146.99	0.000414	0.97	93.89	57.97	0.18
001	19.333*	100 +25%	88.50	143.22	147.19		147.24	0.000408	1.02	108.66	61.83	0.18
001	19.333*	100 +70%	120.36	143.22	147.66		147.71	0.000399	1.10	139.17	67.98	0.18
001	19.333*	1000	116.46	143.22	147.61		147.66	0.000399	1.09	135.65	67.30	0.18
001	9.667*	2	26.58	143.19	145.71		145.73	0.000372	0.66	41.92	33.33	0.16
001	9.667*	20	49.78	143.19	146.42		146.45	0.000360	0.81	71.09	50.31	0.16
001	9.667*	50	60.91	143.19	146.68		146.71	0.000356	0.86	84.88	55.48	0.16
001	9.667*	100	70.80	143.19	146.88		146.91	0.000353	0.89	96.28	59.20	0.17
001	9.667*	100 +5%	74.34	143.19	146.95		146.98	0.000353	0.91	100.23	60.44	0.17
001	9.667*	100 +25%	88.50	143.19	147.19		147.23	0.000350	0.95	115.53	63.83	0.17
001	9.667*	100 +70%	120.36	143.19	147.66		147.71	0.000346	1.03	146.99	69.48	0.17
001	9.667*	1000	116.46	143.19	147.61		147.65	0.000347	1.02	143.37	69.32	0.17
001	0000	2	26.58	143.16	145.71	144.23	145.73	0.000300	0.60	46.01	35.06	0.14
001	0000	20	49.78	143.16	146.42	144.55	146.45	0.000300	0.74	76.72	52.19	0.15
001	0000	50	60.91	143.16	146.68	144.67	146.71	0.000300	0.79	91.08	57.93	0.15
001	0000	100	70.80	143.16	146.88	144.77	146.91	0.000300	0.83	103.00	61.78	0.15

HEC-RAS Plan: Mannings n +20% River: River Trannon Reach: 001 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
001	0000	100 +5%	74.34	143.16	146.95	144.81	146.98	0.000300	0.84	107.10	62.65	0.15
001	0000	100 +25%	88.50	143.16	147.19	144.94	147.23	0.000300	0.89	122.92	65.89	0.15
001	0000	100 +70%	120.36	143.16	147.66	145.22	147.70	0.000300	0.97	155.24	70.32	0.16
001	0000	1000	116.46	143.16	147.61	145.18	147.65	0.000300	0.96	151.57	70.20	0.16

APPENDIX 10 – HEC-RAS Model Results: Manning's n -20%

HEC-RAS Plan: Mannings n -20% River: River Trannon Reach: 001

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
001	0874	2	26.58	149.52	150.79	150.68	151.10	0.005084	2.53	11.38	13.53	0.78
001	0874	20	49.78	149.52	151.21	151.12	151.67	0.005109	3.17	17.66	16.74	0.83
001	0874	50	60.91	149.52	151.36	151.31	151.89	0.005248	3.42	20.43	20.33	0.85
001	0874	100	70.80	149.52	151.49	151.48	152.06	0.005263	3.60	23.11	22.49	0.87
001	0874	100 +5%	74.34	149.52	151.54	151.53	152.11	0.005141	3.63	24.30	23.28	0.86
001	0874	100 +25%	88.50	149.52	151.62	151.73	152.33	0.006001	4.04	26.34	24.58	0.94
001	0874	100 +70%	120.36	149.52	151.91	152.04	152.72	0.006001	4.43	33.69	26.91	0.96
001	0874	1000	116.46	149.52	151.87	152.00	152.67	0.006001	4.39	32.85	26.75	0.96
001	864.00*	2	26.58	149.47	150.73		151.05	0.005216	2.54	11.25	13.76	0.79
001	864.00*	20	49.78	149.47	151.16	151.07	151.61	0.005028	3.14	17.79	17.21	0.82
001	864.00*	50	60.91	149.47	151.31	151.26	151.83	0.005133	3.38	20.61	20.74	0.85
001	864.00*	100	70.80	149.47	151.44	151.43	152.00	0.005115	3.55	23.39	23.07	0.86
001	864.00*	100 +5%	74.34	149.47	151.48	151.47	152.05	0.005091	3.60	24.41	23.76	0.86
001	864.00*	100 +25%	88.50	149.47	151.58	151.68	152.26	0.005783	3.97	26.77	25.31	0.92
001	864.00*	100 +70%	120.36	149.47	151.86	151.97	152.64	0.005736	4.34	34.29	27.36	0.94
001	864.00*	1000	116.46	149.47	151.83	151.96	152.60	0.005732	4.30	33.45	27.19	0.94
001	854.00*	2	26.58	149.41	150.67		150.99	0.005395	2.56	11.07	13.92	0.81
001	854.00*	20	49.78	149.41	151.11	151.03	151.56	0.004973	3.11	17.89	17.68	0.82
001	854.00*	50	60.91	149.41	151.26	151.21	151.77	0.005036	3.34	20.79	21.15	0.84
001	854.00*	100	70.80	149.41	151.38	151.37	151.94	0.005044	3.51	23.55	23.60	0.85
001	854.00*	100 +5%	74.34	149.41	151.42	151.41	151.99	0.005042	3.57	24.54	24.30	0.85
001	854.00*	100 +25%	88.50	149.41	151.52	151.62	152.20	0.005742	3.94	26.89	25.91	0.92
001	854.00*	100 +70%	120.36	149.41	151.80	151.91	152.57	0.005652	4.29	34.53	27.77	0.93
001	854.00*	1000	116.46	149.41	151.77	151.87	152.53	0.005651	4.25	33.68	27.60	0.93
001	844.00*	2	26.58	149.35	150.61	150.52	150.94	0.005600	2.57	10.87	13.99	0.82
001	844.00*	20	49.78	149.35	151.06	150.98	151.50	0.004935	3.08	17.97	18.15	0.82
001	844.00*	50	60.91	149.35	151.21	151.16	151.71	0.004950	3.30	20.96	21.54	0.83
001	844.00*	100	70.80	149.35	151.34	151.32	151.88	0.004928	3.47	23.82	24.25	0.84
001	844.00*	100 +5%	74.34	149.35	151.38	151.37	151.93	0.004915	3.52	24.85	25.02	0.84
001	844.00*	100 +25%	88.50	149.35	151.46	151.57	152.14	0.005727	3.91	27.02	26.38	0.92
001	844.00*	100 +70%	120.36	149.35	151.75	151.85	152.50	0.005580	4.25	34.78	28.21	0.93
001	844.00*	1000	116.46	149.35	151.71	151.82	152.46	0.005580	4.21	33.91	28.03	0.93
001	834.00*	2	26.58	149.29	150.55	150.46	150.88	0.005771	2.58	10.67	13.54	0.83
001	834.00*	20	49.78	149.29	151.00	150.93	151.45	0.004930	3.07	17.99	18.60	0.82
001	834.00*	50	60.91	149.29	151.16	151.11	151.66	0.004893	3.27	21.09	21.85	0.83
001	834.00*	100	70.80	149.29	151.29	151.26	151.82	0.004833	3.42	24.06	24.96	0.83
001	834.00*	100 +5%	74.34	149.29	151.34	151.32	151.87	0.004743	3.45	25.28	25.94	0.83
001	834.00*	100 +25%	88.50	149.29	151.40	151.50	152.08	0.005714	3.89	27.11	26.80	0.92
001	834.00*	100 +70%	120.36	149.29	151.69	151.79	152.44	0.005517	4.20	35.04	28.71	0.92
001	834.00*	1000	116.46	149.29	151.66	151.76	152.40	0.005521	4.17	34.15	28.52	0.92
001	824.00*	2	26.58	149.23	150.49	150.39	150.83	0.005980	2.58	10.49	13.09	0.84
001	824.00*	20	49.78	149.23	150.95	150.89	151.40	0.004941	3.05	17.99	19.05	0.82
001	824.00*	50	60.91	149.23	151.11	151.06	151.60	0.004847	3.24	21.20	22.14	0.82
001	824.00*	100	70.80	149.23	151.24	151.21	151.76	0.004685	3.36	24.44	25.88	0.82
001	824.00*	100 +5%	74.34	149.23	151.28	151.27	151.82	0.004709	3.43	25.49	26.67	0.83
001	824.00*	100 +25%	88.50	149.23	151.35	151.45	152.02	0.005717	3.86	27.18	27.27	0.91
001	824.00*	100 +70%	120.36	149.23	151.63	151.73	152.37	0.005462	4.16	35.30	29.29	0.92
001	824.00*	1000	116.46	149.23	151.60	151.69	152.33	0.005470	4.13	34.40	29.08	0.91
001	814.00*	2	26.58	149.18	150.43	150.31	150.76	0.006074	2.57	10.38	12.44	0.84
001	814.00*	20	49.78	149.18	150.90	150.84	151.34	0.004965	3.03	17.94	19.50	0.82
001	814.00*	50	60.91	149.18	151.06	151.02	151.55	0.004812	3.21	21.29	22.26	0.82
001	814.00*	100	70.80	149.18	151.19	151.15	151.71	0.004703	3.35	24.53	26.71	0.82
001	814.00*	100 +5%	74.34	149.18	151.24	151.24	151.76	0.004529	3.36	25.98	27.31	0.81
001	814.00*	100 +25%	88.50	149.18	151.29	151.39	151.96	0.005736	3.84	27.22	27.80	0.91
001	814.00*	100 +70%	120.36	149.18	151.58	151.67	152.31	0.005422	4.13	35.58	30.09	0.91
001	814.00*	1000	116.46	149.18	151.55	151.64	152.27	0.005429	4.09	34.65	29.77	0.91
001	804.00*	2	26.58	149.12	150.37		150.70	0.005928	2.53	10.49	11.16	0.83
001	804.00*	20	49.78	149.12	150.84	150.79	151.29	0.004998	3.02	17.87	19.93	0.82
001	804.00*	50	60.91	149.12	151.01	150.96	151.49	0.004788	3.19	21.36	22.11	0.82
001	804.00*	100	70.80	149.12	151.15	151.15	151.66	0.004555	3.29	24.93	27.36	0.81
001	804.00*	100 +5%	74.34	149.12	151.19	151.20	151.70	0.004492	3.33	26.15	27.98	0.80
001	804.00*	100 +25%	88.50	149.12	151.23	151.34	151.90	0.005769	3.82	27.25	28.34	0.92
001	804.00*	100 +70%	120.36	149.12	151.52	151.62	152.25	0.005386	4.09	35.92	31.22	0.91
001	804.00*	1000	116.46	149.12	151.49	151.58	152.21	0.005402	4.05	34.96	30.93	0.91
001	794.00*	2	26.58	149.06	150.32		150.64	0.005729	2.49	10.66	11.33	0.82
001	794.00*	20	49.78	149.06	150.79	150.73	151.24	0.005001	3.00	17.81	20.39	0.82
001	794.00*	50	60.91	149.06	150.96	150.91	151.44	0.004749	3.16	21.45	22.73	0.81
001	794.00*	100	70.80	149.06	151.10	151.10	151.60	0.004539	3.27	25.03	28.18	0.80
001	794.00*	100 +5%	74.34	149.06	151.13	151.14	151.65	0.004607	3.33	25.94	28.55	0.81
001	794.00*	100 +25%	88.50	149.06	151.18	151.29	151.85	0.005810	3.81	27.26	29.07	0.92
001	794.00*	100 +70%	120.36	149.06	151.47	151.58	152.18	0.005345	4.05	36.38	32.81	0.90
001	794.00*	1000	116.46	149.06	151.44	151.54	152.15	0.005368	4.02	35.36	32.44	0.90
001	784.00*	2	26.58	149.00	150.27		150.58	0.005515	2.45	10.84	11.49	0.81
001	784.00*	20	49.78	149.00	150.74	150.63	151.18	0.004990	2.97	17.74	20.87	0.81
001	784.00*	50	60.91	149.00	150.91	150.85	151.39	0.004725	3.13	21.51	23.51	0.81
001	784.00*	100	70.80	149.00	151.06	151.05	151.54	0.004394	3.21	25.46	29.36	0.79

HEC-RAS Plan: Mannings n -20% River: River Trannon Reach: 001 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
001	784.00*	100 +5%	74.34	149.00	151.08	151.10	151.59	0.004520	3.29	26.26	29.86	0.80
001	784.00*	100 +25%	88.50	149.00	151.12	151.25	151.79	0.005883	3.80	27.28	30.60	0.92
001	784.00*	100 +70%	120.36	149.00	151.45	151.51	152.11	0.004910	3.90	38.08	34.87	0.86
001	784.00*	1000	116.46	149.00	151.41	151.47	152.07	0.005040	3.90	36.67	34.26	0.87
001	0774	2	26.58	148.95	150.22		150.52	0.005266	2.41	11.05	11.64	0.79
001	0774	20	49.78	148.95	150.69	150.52	151.12	0.004923	2.93	17.71	21.39	0.81
001	0774	50	60.91	148.95	150.86	150.81	151.33	0.004681	3.09	21.58	24.47	0.80
001	0774	100	70.80	148.95	151.01	151.01	151.49	0.004295	3.16	25.90	31.51	0.78
001	0774	100 +5%	74.34	148.95	151.05	151.06	151.53	0.004337	3.22	26.96	31.96	0.79
001	0774	100 +25%	88.50	148.95	151.06	151.17	151.73	0.005921	3.78	27.41	32.15	0.92
001	0774	100 +70%	120.36	148.95	151.43	151.49	152.03	0.004484	3.74	40.73	41.30	0.83
001	0774	1000	116.46	148.95	151.36	151.45	152.01	0.004993	3.86	37.71	39.21	0.87
001	764.58*	2	26.58	148.88	150.16		150.46	0.005523	2.45	10.86	11.60	0.81
001	764.58*	20	49.78	148.88	150.63	150.47	151.07	0.005095	2.98	17.46	22.01	0.82
001	764.58*	50	60.91	148.88	150.80	150.76	151.28	0.004734	3.11	21.62	25.55	0.81
001	764.58*	100	70.80	148.88	150.85	150.96	151.44	0.005629	3.47	22.89	26.83	0.88
001	764.58*	100 +5%	74.34	148.88	150.95	151.00	151.48	0.004854	3.35	25.81	32.08	0.83
001	764.58*	100 +25%	88.50	148.88	151.00	151.13	151.67	0.005893	3.78	27.69	32.87	0.92
001	764.58*	100 +70%	120.36	148.88	151.29	151.41	151.98	0.005340	3.98	37.71	37.89	0.90
001	764.58*	1000	116.46	148.88	151.37	151.38	151.93	0.004135	3.60	40.93	39.96	0.79
001	755.17*	2	26.58	148.81	150.09		150.41	0.005773	2.49	10.68	11.53	0.83
001	755.17*	20	49.78	148.81	150.56	150.43	151.02	0.005274	3.02	17.19	22.58	0.83
001	755.17*	50	60.91	148.81	150.75	150.72	151.22	0.004768	3.13	21.69	26.67	0.81
001	755.17*	100	70.80	148.81	150.81	150.91	151.38	0.005488	3.45	23.35	30.35	0.87
001	755.17*	100 +5%	74.34	148.81	150.92	150.95	151.42	0.004477	3.26	26.99	33.21	0.80
001	755.17*	100 +25%	88.50	148.81	150.95	151.08	151.61	0.005849	3.77	27.99	33.62	0.92
001	755.17*	100 +70%	120.36	148.81	151.31	151.34	151.89	0.004354	3.70	41.29	39.60	0.82
001	755.17*	1000	116.46	148.81	151.20	151.31	151.87	0.005348	3.94	36.83	37.27	0.90
001	745.75*	2	26.58	148.74	150.02		150.35	0.006021	2.53	10.50	11.43	0.84
001	745.75*	20	49.78	148.74	150.49	150.37	150.97	0.005467	3.07	16.90	23.09	0.85
001	745.75*	50	60.91	148.74	150.69	150.68	151.17	0.004787	3.14	21.79	27.84	0.81
001	745.75*	100	70.80	148.74	150.75	150.86	151.32	0.005445	3.45	23.68	31.41	0.87
001	745.75*	100 +5%	74.34	148.74	150.79	150.89	151.37	0.005417	3.49	24.88	32.46	0.87
001	745.75*	100 +25%	88.50	148.74	150.89	151.04	151.54	0.005787	3.76	28.34	34.43	0.91
001	745.75*	100 +70%	120.36	148.74	151.16	151.28	151.84	0.005424	4.00	37.89	38.08	0.90
001	745.75*	1000	116.46	148.74	151.21	151.25	151.79	0.004436	3.68	40.09	39.20	0.82
001	736.33*	2	26.58	148.68	149.95		150.29	0.006267	2.57	10.33	11.33	0.86
001	736.33*	20	49.78	148.68	150.43	150.31	150.92	0.005670	3.11	16.58	23.48	0.86
001	736.33*	50	60.91	148.68	150.65	150.64	151.11	0.004531	3.09	22.51	29.72	0.79
001	736.33*	100	70.80	148.68	150.70	150.80	151.26	0.005340	3.43	24.08	32.36	0.86
001	736.33*	100 +5%	74.34	148.68	150.74	150.84	151.30	0.005229	3.45	25.47	33.42	0.86
001	736.33*	100 +25%	88.50	148.68	150.84	150.98	151.48	0.005706	3.74	28.73	35.30	0.91
001	736.33*	100 +70%	120.36	148.68	151.18	151.22	151.75	0.004379	3.70	41.70	40.30	0.82
001	736.33*	1000	116.46	148.68	151.07	151.19	151.74	0.005435	3.96	37.13	38.45	0.90
001	726.92*	2	26.58	148.61	149.89		150.23	0.006501	2.61	10.18	11.21	0.88
001	726.92*	20	49.78	148.61	150.36	150.23	150.86	0.005851	3.16	16.30	22.42	0.88
001	726.92*	50	60.91	148.61	150.61	150.61	151.06	0.004272	3.03	23.33	32.07	0.77
001	726.92*	100	70.80	148.61	150.65	150.75	151.20	0.005209	3.40	24.53	33.35	0.86
001	726.92*	100 +5%	74.34	148.61	150.72	150.79	151.24	0.004764	3.34	26.79	34.89	0.82
001	726.92*	100 +25%	88.50	148.61	150.78	150.92	151.41	0.005599	3.72	29.19	36.21	0.90
001	726.92*	100 +70%	120.36	148.61	151.03	151.15	151.70	0.005414	3.99	38.51	39.62	0.90
001	726.92*	1000	116.46	148.61	151.10	151.12	151.64	0.004230	3.61	41.45	40.61	0.80
001	717.50*	2	26.58	148.54	149.82		150.17	0.006721	2.65	10.03	11.09	0.89
001	717.50*	20	49.78	148.54	150.29	150.19	150.81	0.006020	3.19	16.04	21.69	0.89
001	717.50*	50	60.91	148.54	150.47	150.57	151.00	0.005434	3.31	20.80	29.83	0.86
001	717.50*	100	70.80	148.54	150.62	150.69	151.13	0.004733	3.29	25.84	34.91	0.82
001	717.50*	100 +5%	74.34	148.54	150.72	150.73	151.16	0.004033	3.15	29.13	36.92	0.76
001	717.50*	100 +25%	88.50	148.54	150.82	150.86	151.32	0.004345	3.39	32.88	38.45	0.80
001	717.50*	100 +70%	120.36	148.54	151.08	151.10	151.61	0.004083	3.60	43.51	42.02	0.79
001	717.50*	1000	116.46	148.54	150.95	151.07	151.60	0.005279	3.92	38.16	40.26	0.89
001	708.08*	2	26.58	148.48	149.74	149.68	150.11	0.006927	2.69	9.90	10.97	0.90
001	708.08*	20	49.78	148.48	150.22	150.13	150.75	0.006186	3.23	15.79	21.07	0.90
001	708.08*	50	60.91	148.48	150.42	150.52	150.94	0.005220	3.27	21.31	31.59	0.85
001	708.08*	100	70.80	148.48	150.62	150.64	151.06	0.003986	3.10	28.18	37.02	0.75
001	708.08*	100 +5%	74.34	148.48	150.57	150.68	151.12	0.005127	3.44	26.22	35.86	0.85
001	708.08*	100 +25%	88.50	148.48	150.70	150.81	151.27	0.005066	3.59	30.97	38.54	0.86
001	708.08*	100 +70%	120.36	148.48	150.91	151.04	151.56	0.005258	3.95	39.58	41.50	0.89
001	708.08*	1000	116.46	148.48	150.99	151.01	151.50	0.004005	3.54	43.04	42.61	0.78
001	698.67*	2	26.58	148.41	149.67	149.61	150.05	0.007099	2.72	9.78	10.85	0.91
001	698.67*	20	49.78	148.41	150.15	150.07	150.69	0.006325	3.26	15.58	20.58	0.91
001	698.67*	50	60.91	148.41	150.37	150.46	150.88	0.005066	3.24	21.73	33.44	0.83
001	698.67*	100	70.80	148.41	150.48	150.58	151.01	0.005063	3.38	25.31	36.06	0.84
001	698.67*	100 +5%	74.34	148.41	150.58	150.62	151.04	0.004160	3.19	29.10	38.30	0.77
001	698.67*	100 +25%	88.50	148.41	150.73	150.74	151.18	0.003816	3.24	35.27	40.90	0.75
001	698.67*	100 +70%	120.36	148.41	150.96	150.98	151.46	0.003922	3.54	44.91	44.00	0.77
001	698.67*	1000	116.46	148.41	150.83	150.95	151.45	0.005117	3.87	39.25	42.21	0.88

HEC-RAS Plan: Mannings n -20% River: River Trannon Reach: 001 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
001	689.25*	2	26.58	148.34	149.60	149.54	149.98	0.007251	2.75	9.68	10.72	0.92
001	689.25*	20	49.78	148.34	150.08	150.01	150.63	0.006432	3.29	15.41	20.11	0.91
001	689.25*	50	60.91	148.34	150.35	150.40	150.82	0.004542	3.13	23.08	35.42	0.79
001	689.25*	100	70.80	148.34	150.49	150.52	150.93	0.004079	3.13	28.23	38.65	0.76
001	689.25*	100 +5%	74.34	148.34	150.45	150.56	150.99	0.005013	3.42	26.81	37.83	0.84
001	689.25*	100 +25%	88.50	148.34	150.58	150.67	151.13	0.004897	3.55	31.87	40.48	0.84
001	689.25*	100 +70%	120.36	148.34	150.79	150.92	151.41	0.005097	3.90	40.70	43.51	0.87
001	689.25*	1000	116.46	148.34	150.88	150.89	151.36	0.003780	3.46	44.74	44.77	0.76
001	679.83*	2	26.58	148.28	149.53	149.48	149.92	0.007329	2.76	9.61	10.59	0.93
001	679.83*	20	49.78	148.28	150.02	149.94	150.57	0.006482	3.31	15.29	18.88	0.92
001	679.83*	50	60.91	148.28	150.34	150.35	150.75	0.003825	2.94	25.29	37.76	0.73
001	679.83*	100	70.80	148.28	150.36	150.47	150.89	0.004951	3.37	25.83	38.11	0.83
001	679.83*	100 +5%	74.34	148.28	150.48	150.50	150.91	0.003862	3.11	30.50	40.76	0.74
001	679.83*	100 +25%	88.50	148.28	150.48	150.61	151.08	0.005365	3.68	30.77	40.87	0.88
001	679.83*	100 +70%	120.36	148.28	150.85	150.85	151.32	0.003727	3.47	46.55	46.18	0.75
001	679.83*	1000	116.46	148.28	150.70	150.82	151.31	0.005035	3.85	40.11	44.19	0.87
001	670.42*	2	26.58	148.21	149.46	149.41	149.85	0.007296	2.77	9.60	10.48	0.92
001	670.42*	20	49.78	148.21	149.95	149.87	150.51	0.006487	3.31	15.24	18.02	0.92
001	670.42*	50	60.91	148.21	150.20	150.30	150.70	0.004893	3.23	22.28	36.62	0.82
001	670.42*	100	70.80	148.21	150.39	150.40	150.80	0.003789	3.06	29.58	41.30	0.73
001	670.42*	100 +5%	74.34	148.21	150.33	150.44	150.86	0.004930	3.41	27.30	39.98	0.83
001	670.42*	100 +25%	88.50	148.21	150.40	150.57	151.03	0.005727	3.77	30.04	41.48	0.90
001	670.42*	100 +70%	120.36	148.21	150.66	150.78	151.27	0.005034	3.88	41.53	45.54	0.87
001	670.42*	1000	116.46	148.21	150.76	150.76	151.21	0.003663	3.41	46.01	46.91	0.74
001	0661	2	26.58	148.14	149.39	149.33	149.78	0.007129	2.76	9.64	10.36	0.91
001	0661	20	49.78	148.14	149.89	149.80	150.45	0.006420	3.31	15.27	17.85	0.91
001	0661	50	60.91	148.14	150.20	150.24	150.62	0.003956	2.99	25.02	39.46	0.74
001	0661	100	70.80	148.14	150.23	150.34	150.76	0.004898	3.37	26.17	40.27	0.83
001	0661	100 +5%	74.34	148.14	150.38	150.39	150.77	0.003532	3.02	32.14	43.22	0.71
001	0661	100 +25%	88.50	148.14	150.31	150.52	150.98	0.006075	3.86	29.37	42.19	0.93
001	0661	100 +70%	120.36	148.14	150.55	150.71	151.22	0.005653	4.05	39.86	45.95	0.91
001	0661	1000	116.46	148.14	150.57	150.69	151.16	0.004974	3.83	40.91	46.27	0.86
001	651.60*	2	26.58	148.06	149.32	149.25	149.71	0.006898	2.74	9.70	10.27	0.90
001	651.60*	20	49.78	148.06	149.82	149.73	150.38	0.006313	3.30	15.27	17.42	0.90
001	651.60*	50	60.91	148.06	150.07	150.18	150.57	0.004737	3.21	22.58	37.41	0.81
001	651.60*	100	70.80	148.06	150.13	150.27	150.71	0.005400	3.50	24.76	39.09	0.86
001	651.60*	100 +5%	74.34	148.06	150.20	150.33	150.73	0.004777	3.39	27.70	40.77	0.82
001	651.60*	100 +25%	88.50	148.06	150.23	150.42	150.92	0.006325	3.94	28.63	41.13	0.94
001	651.60*	100 +70%	120.36	148.06	150.47	150.65	151.16	0.005841	4.12	39.07	44.97	0.93
001	651.60*	1000	116.46	148.06	150.60	150.63	151.08	0.003888	3.50	45.01	47.01	0.76
001	642.20*	2	26.58	147.98	149.26	149.18	149.64	0.006699	2.72	9.77	10.19	0.89
001	642.20*	20	49.78	147.98	149.75	149.66	150.31	0.006352	3.32	15.17	15.84	0.91
001	642.20*	50	60.91	147.98	149.95	150.10	150.52	0.005588	3.41	20.50	34.60	0.87
001	642.20*	100	70.80	147.98	150.05	150.20	150.64	0.005547	3.55	24.37	38.69	0.88
001	642.20*	100 +5%	74.34	147.98	150.10	150.23	150.68	0.005325	3.54	26.18	39.66	0.86
001	642.20*	100 +25%	88.50	147.98	150.16	150.38	150.86	0.006372	3.95	28.45	40.51	0.95
001	642.20*	100 +70%	120.36	147.98	150.39	150.57	151.11	0.006056	4.19	38.33	44.20	0.94
001	642.20*	1000	116.46	147.98	150.44	150.54	151.04	0.004893	3.83	40.79	45.09	0.85
001	632.80*	2	26.58	147.89	149.19	149.10	149.57	0.006537	2.71	9.82	10.10	0.88
001	632.80*	20	49.78	147.89	149.69	149.59	150.24	0.006194	3.30	15.31	15.55	0.90
001	632.80*	50	60.91	147.89	150.00	150.03	150.42	0.003909	3.00	25.00	38.44	0.74
001	632.80*	100	70.80	147.89	149.96	150.13	150.59	0.005890	3.63	23.61	37.67	0.90
001	632.80*	100 +5%	74.34	147.89	150.19	150.19	150.57	0.003361	2.98	32.51	41.72	0.69
001	632.80*	100 +25%	88.50	147.89	150.08	150.29	150.79	0.006450	3.98	28.26	40.11	0.95
001	632.80*	100 +70%	120.36	147.89	150.31	150.51	151.05	0.006277	4.25	37.71	43.70	0.96
001	632.80*	1000	116.46	147.89	150.48	150.49	150.95	0.003725	3.46	45.57	46.41	0.75
001	623.40*	2	26.58	147.81	149.13	149.03	149.50	0.006413	2.70	9.86	10.02	0.87
001	623.40*	20	49.78	147.81	149.62	149.52	150.18	0.006165	3.30	15.36	13.90	0.89
001	623.40*	50	60.91	147.81	149.86	149.97	150.36	0.004789	3.23	22.50	36.76	0.81
001	623.40*	100	70.80	147.81	149.87	150.06	150.53	0.006283	3.71	22.86	36.96	0.93
001	623.40*	100 +5%	74.34	147.81	149.99	150.11	150.52	0.004951	3.45	27.16	39.26	0.83
001	623.40*	100 +25%	88.50	147.81	150.01	150.21	150.73	0.006553	4.00	28.08	39.74	0.96
001	623.40*	100 +70%	120.36	147.81	150.23	150.45	150.99	0.006506	4.31	37.19	43.48	0.97
001	623.40*	1000	116.46	147.81	150.30	150.42	150.90	0.004957	3.85	40.54	44.52	0.86
001	614.00*	2	26.58	147.73	149.07	148.96	149.43	0.006315	2.69	9.89	9.93	0.86
001	614.00*	20	49.78	147.73	149.57	149.45	150.11	0.006033	3.28	15.52	14.03	0.88
001	614.00*	50	60.91	147.73	149.74	149.90	150.31	0.005676	3.43	20.55	35.62	0.87
001	614.00*	100	70.80	147.73	149.80	150.00	150.46	0.006436	3.74	22.68	36.85	0.94
001	614.00*	100 +5%	74.34	147.73	149.88	150.03	150.47	0.005561	3.60	25.75	38.55	0.88
001	614.00*	100 +25%	88.50	147.73	149.94	150.14	150.66	0.006586	4.00	28.13	39.81	0.96
001	614.00*	100 +70%	120.36	147.73	150.15	150.35	150.93	0.006700	4.35	36.83	43.31	0.99
001	614.00*	1000	116.46	147.73	150.19	150.34	150.85	0.005571	4.02	38.70	43.81	0.90
001	604.60*	2	26.58	147.65	149.01		149.37	0.006158	2.67	9.96	9.85	0.85
001	604.60*	20	49.78	147.65	149.51	149.41	150.05	0.005944	3.26	15.66	14.21	0.88
001	604.60*	50	60.91	147.65	149.65	149.82	150.25	0.006081	3.51	19.90	35.43	0.90

HEC-RAS Plan: Mannings n -20% River: River Trannon Reach: 001 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
001	604.60*	100	70.80	147.65	149.72	149.92	150.39	0.006526	3.76	22.69	37.18	0.94
001	604.60*	100 +5%	74.34	147.65	149.79	149.96	150.41	0.005981	3.69	25.01	38.57	0.91
001	604.60*	100 +25%	88.50	147.65	149.87	150.08	150.59	0.006658	4.01	28.20	40.36	0.96
001	604.60*	100 +70%	120.36	147.65	150.06	150.29	150.86	0.006930	4.39	36.46	43.13	1.00
001	604.60*	1000	116.46	147.65	150.09	150.27	150.79	0.006101	4.15	37.42	43.42	0.94
001	595.20*	2	26.58	147.56	148.94		149.31	0.006151	2.67	9.95	9.76	0.84
001	595.20*	20	49.78	147.56	149.45	149.36	149.98	0.005862	3.25	15.87	20.26	0.87
001	595.20*	50	60.91	147.56	149.56	149.76	150.19	0.006401	3.57	19.52	35.76	0.92
001	595.20*	100	70.80	147.56	149.65	149.85	150.33	0.006653	3.78	22.72	38.07	0.95
001	595.20*	100 +5%	74.34	147.56	149.70	149.88	150.35	0.006255	3.74	24.73	39.17	0.92
001	595.20*	100 +25%	88.50	147.56	149.78	150.00	150.52	0.006948	4.06	27.87	40.24	0.98
001	595.20*	100 +70%	120.36	147.56	149.98	150.22	150.79	0.007199	4.44	36.07	42.90	1.01
001	595.20*	1000	116.46	147.56	149.99	150.20	150.73	0.006522	4.24	36.57	43.06	0.97
001	585.80*	2	26.58	147.48	148.87		149.24	0.006209	2.68	9.90	9.68	0.85
001	585.80*	20	49.78	147.48	149.41	149.31	149.92	0.005578	3.19	16.67	27.97	0.85
001	585.80*	50	60.91	147.48	149.49	149.68	150.12	0.006510	3.58	19.67	37.39	0.92
001	585.80*	100	70.80	147.48	149.57	149.78	150.26	0.006966	3.83	22.51	38.54	0.96
001	585.80*	100 +5%	74.34	147.48	149.62	149.81	150.28	0.006582	3.79	24.41	39.17	0.94
001	585.80*	100 +25%	88.50	147.48	149.70	149.92	150.45	0.007257	4.11	27.60	40.21	1.00
001	585.80*	100 +70%	120.36	147.48	149.89	150.14	150.72	0.007509	4.49	35.68	42.74	1.03
001	585.80*	1000	116.46	147.48	149.90	150.12	150.66	0.006830	4.30	36.12	42.87	0.98
001	576.40*	2	26.58	147.40	148.80	148.69	149.18	0.006427	2.72	9.76	9.63	0.86
001	576.40*	20	49.78	147.40	149.48	149.48	149.83	0.003687	2.74	22.10	38.55	0.70
001	576.40*	50	60.91	147.40	149.41	149.61	150.05	0.006829	3.63	19.56	37.68	0.94
001	576.40*	100	70.80	147.40	149.49	149.70	150.19	0.007308	3.87	22.34	38.63	0.98
001	576.40*	100 +5%	74.34	147.40	149.53	149.73	150.21	0.006951	3.85	24.13	39.20	0.96
001	576.40*	100 +25%	88.50	147.40	149.61	149.85	150.38	0.007596	4.16	27.37	40.23	1.01
001	576.40*	100 +70%	120.36	147.40	149.80	150.05	150.64	0.007863	4.54	35.25	42.25	1.05
001	576.40*	1000	116.46	147.40	149.81	150.03	150.58	0.007184	4.35	35.60	42.31	1.00
001	0567	2	26.58	147.31	148.62	148.62	149.10	0.009163	3.07	8.67	9.17	1.01
001	0567	20	49.78	147.31	149.26	149.41	149.77	0.005967	3.24	17.03	28.45	0.87
001	0567	50	60.91	147.31	149.33	149.56	149.98	0.007136	3.66	19.50	37.44	0.96
001	0567	100	70.80	147.31	149.41	149.64	150.11	0.007517	3.89	22.47	38.84	0.99
001	0567	100 +5%	74.34	147.31	149.45	149.67	150.14	0.007353	3.91	23.89	39.29	0.98
001	0567	100 +25%	88.50	147.31	149.53	149.77	150.29	0.007820	4.17	27.40	40.31	1.02
001	0567	100 +70%	120.36	147.31	149.72	149.96	150.56	0.008079	4.55	35.10	41.74	1.06
001	0567	1000	116.46	147.31	149.72	149.94	150.51	0.007582	4.41	35.07	41.73	1.03
001	558.50*	2	26.58	147.20	148.43	148.52	149.01	0.012010	3.38	7.87	8.98	1.15
001	558.50*	20	49.78	147.20	149.22	149.03	149.71	0.005217	3.12	17.20	27.15	0.82
001	558.50*	50	60.91	147.20	149.27	149.49	149.93	0.006806	3.64	18.76	33.82	0.94
001	558.50*	100	70.80	147.20	149.38	149.58	150.05	0.006565	3.75	23.04	39.36	0.93
001	558.50*	100 +5%	74.34	147.20	149.42	149.61	150.08	0.006405	3.76	24.60	39.94	0.92
001	558.50*	100 +25%	88.50	147.20	149.54	149.71	150.21	0.006318	3.91	29.35	41.10	0.93
001	558.50*	100 +70%	120.36	147.20	150.01	149.92	150.41	0.003205	3.25	49.66	44.98	0.69
001	558.50*	1000	116.46	147.20	149.99	149.90	150.38	0.003143	3.20	48.81	44.85	0.68
001	550.00*	2	26.58	147.09	148.60	148.41	148.93	0.005235	2.56	10.38	9.46	0.78
001	550.00*	20	49.78	147.09	149.21	148.94	149.65	0.004444	2.96	17.99	28.18	0.76
001	550.00*	50	60.91	147.09	149.21	149.45	149.87	0.006647	3.62	18.00	28.27	0.92
001	550.00*	100	70.80	147.09	149.35	149.56	150.00	0.006085	3.67	23.18	39.96	0.90
001	550.00*	100 +5%	74.34	147.09	149.39	149.58	150.03	0.005932	3.68	24.84	40.55	0.89
001	550.00*	100 +25%	88.50	147.09	149.78	149.71	150.11	0.002760	2.87	41.35	44.41	0.63
001	550.00*	100 +70%	120.36	147.09	149.99		150.38	0.002991	3.18	50.97	46.32	0.66
001	550.00*	1000	116.46	147.09	149.98		150.35	0.002917	3.13	50.17	46.14	0.65
001	541.50*	2	26.58	146.98	148.59		148.88	0.004127	2.38	11.16	9.33	0.70
001	541.50*	20	49.78	146.98	149.20	148.84	149.61	0.003950	2.84	18.58	27.78	0.71
001	541.50*	50	60.91	146.98	149.48	149.40	149.79	0.002675	2.60	30.00	42.86	0.60
001	541.50*	100	70.80	146.98	149.61	149.52	149.91	0.002521	2.64	35.49	44.27	0.59
001	541.50*	100 +5%	74.34	146.98	149.64	149.55	149.94	0.002530	2.67	36.99	44.58	0.59
001	541.50*	100 +25%	88.50	146.98	149.77		150.08	0.002541	2.79	42.79	46.05	0.60
001	541.50*	100 +70%	120.36	146.98	149.99		150.35	0.002752	3.09	53.00	48.62	0.63
001	541.50*	1000	116.46	146.98	149.97		150.32	0.002685	3.03	52.16	48.41	0.63
001	533.00*	2	26.58	146.86	148.59		148.84	0.003365	2.24	11.85	9.11	0.63
001	533.00*	20	49.78	146.86	149.19	148.75	149.57	0.003627	2.75	19.11	29.20	0.68
001	533.00*	50	60.91	146.86	149.48	148.96	149.76	0.002458	2.52	31.18	44.64	0.57
001	533.00*	100	70.80	146.86	149.60		149.88	0.002323	2.55	36.96	46.61	0.56
001	533.00*	100 +5%	74.34	146.86	149.64		149.92	0.002329	2.58	38.57	47.10	0.57
001	533.00*	100 +25%	88.50	146.86	149.77		150.06	0.002310	2.68	44.98	49.02	0.57
001	533.00*	100 +70%	120.36	146.86	150.00		150.32	0.002448	2.94	56.40	52.36	0.59
001	533.00*	1000	116.46	146.86	149.98		150.29	0.002395	2.89	55.42	52.09	0.59
001	524.50*	2	26.58	146.75	148.58		148.81	0.002862	2.13	12.46	8.96	0.58
001	524.50*	20	49.78	146.75	149.17	148.65	149.54	0.003499	2.70	19.35	31.40	0.66
001	524.50*	50	60.91	146.75	149.48		149.73	0.002242	2.41	33.05	48.36	0.54
001	524.50*	100	70.80	146.75	149.61		149.85	0.002070	2.42	39.66	50.84	0.53
001	524.50*	100 +5%	74.34	146.75	149.64		149.89	0.002065	2.44	41.50	51.51	0.53
001	524.50*	100 +25%	88.50	146.75	149.79		150.03	0.001995	2.50	48.91	53.58	0.52
001	524.50*	100 +70%	120.36	146.75	150.01		150.28	0.002088	2.73	61.45	56.70	0.55

HEC-RAS Plan: Mannings n -20% River: River Trannon Reach: 001 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
001	524.50*	1000	116.46	146.75	149.99		150.26	0.002049	2.69	60.33	56.42	0.54
001	0516	2	26.58	146.64	148.57		148.78	0.002517	2.05	12.99	8.79	0.54
001	0516	20	49.78	146.64	149.14	148.57	149.50	0.003498	2.67	19.65	35.48	0.65
001	0516	50	60.91	146.64	149.50	148.82	149.71	0.001869	2.22	37.47	55.16	0.49
001	0516	100	70.80	146.64	149.63	149.42	149.82	0.001692	2.20	45.03	57.29	0.47
001	0516	100 +5%	74.34	146.64	149.67	149.47	149.86	0.001681	2.21	47.10	57.86	0.47
001	0516	100 +25%	88.50	146.64	149.81		150.00	0.001614	2.26	55.40	60.08	0.47
001	0516	100 +70%	120.36	146.64	150.04		150.25	0.001662	2.44	69.74	63.73	0.48
001	0516	1000	116.46	146.64	150.02		150.22	0.001636	2.41	68.42	63.40	0.48
001	507.20*	2	26.58	146.66	148.52		148.76	0.003021	2.17	12.26	8.96	0.59
001	507.20*	20	49.78	146.66	149.07	148.62	149.47	0.003909	2.81	18.61	26.81	0.69
001	507.20*	50	60.91	146.66	149.23	148.87	149.66	0.003921	2.99	23.80	36.93	0.71
001	507.20*	100	70.80	146.66	149.43	149.42	149.79	0.003092	2.85	32.71	51.72	0.64
001	507.20*	100 +5%	74.34	146.66	149.46	149.45	149.82	0.003123	2.89	34.28	52.35	0.64
001	507.20*	100 +25%	88.50	146.66	149.71	149.58	149.97	0.002193	2.61	47.84	57.11	0.55
001	507.20*	100 +70%	120.36	146.66	149.95		150.22	0.002173	2.78	62.16	61.74	0.55
001	507.20*	1000	116.46	146.66	149.93	149.75	150.20	0.002121	2.73	61.12	61.41	0.55
001	498.40*	2	26.58	146.68	148.46		148.73	0.003463	2.28	11.66	8.82	0.63
001	498.40*	20	49.78	146.68	149.01	148.65	149.43	0.004188	2.90	18.39	27.63	0.72
001	498.40*	50	60.91	146.68	149.20	149.20	149.62	0.003849	2.99	24.48	36.45	0.70
001	498.40*	100	70.80	146.68	149.33	149.33	149.75	0.003609	3.03	29.72	41.04	0.69
001	498.40*	100 +5%	74.34	146.68	149.35	149.35	149.79	0.003775	3.12	30.52	41.62	0.71
001	498.40*	100 +25%	88.50	146.68	149.51	149.51	149.93	0.003561	3.19	37.40	48.08	0.69
001	498.40*	100 +70%	120.36	146.68	149.77	149.76	150.19	0.003295	3.32	51.65	57.59	0.68
001	498.40*	1000	116.46	146.68	149.74	149.74	150.16	0.003370	3.32	49.69	56.88	0.69
001	489.60*	2	26.58	146.70	148.40		148.69	0.004092	2.41	11.01	8.63	0.68
001	489.60*	20	49.78	146.70	148.97	148.65	149.40	0.004321	2.95	18.68	29.72	0.73
001	489.60*	50	60.91	146.70	149.08	149.16	149.58	0.004736	3.23	22.36	33.82	0.78
001	489.60*	100	70.80	146.70	149.21	149.28	149.70	0.004513	3.30	26.91	38.08	0.77
001	489.60*	100 +5%	74.34	146.70	149.24	149.34	149.75	0.004557	3.36	28.14	39.12	0.77
001	489.60*	100 +25%	88.50	146.70	149.36	149.44	149.89	0.004657	3.53	33.02	42.51	0.79
001	489.60*	100 +70%	120.36	146.70	149.69	149.69	150.15	0.003670	3.46	48.65	52.19	0.72
001	489.60*	1000	116.46	146.70	149.60	149.66	150.12	0.004301	3.65	44.05	49.42	0.77
001	480.80*	2	26.58	146.72	148.32		148.65	0.004993	2.55	10.41	8.69	0.75
001	480.80*	20	49.78	146.72	148.93	148.63	149.36	0.004282	2.95	19.45	31.47	0.73
001	480.80*	50	60.91	146.72	149.10	149.11	149.52	0.003956	3.02	25.25	36.56	0.71
001	480.80*	100	70.80	146.72	149.12	149.23	149.66	0.005128	3.46	25.78	36.98	0.81
001	480.80*	100 +5%	74.34	146.72	149.26	149.26	149.68	0.003774	3.12	31.41	41.17	0.70
001	480.80*	100 +25%	88.50	146.72	149.38	149.40	149.82	0.003860	3.28	36.51	44.30	0.72
001	480.80*	100 +70%	120.36	146.72	149.51	149.62	150.10	0.005064	3.90	42.50	47.51	0.83
001	480.80*	1000	116.46	146.72	149.47	149.60	150.08	0.005214	3.92	40.77	46.61	0.84
001	0472	2	26.58	146.74	148.12	148.04	148.58	0.007985	3.00	8.86	8.14	0.92
001	0472	20	49.78	146.74	148.91	148.91	149.30	0.004003	2.86	20.94	33.50	0.70
001	0472	50	60.91	146.74	148.96	149.06	149.47	0.005160	3.32	22.67	34.88	0.80
001	0472	100	70.80	146.74	149.15	149.17	149.57	0.004022	3.13	29.73	39.98	0.72
001	0472	100 +5%	74.34	146.74	149.11	149.21	149.63	0.005091	3.47	27.85	38.68	0.80
001	0472	100 +25%	88.50	146.74	149.22	149.33	149.77	0.005204	3.64	32.45	41.78	0.82
001	0472	100 +70%	120.36	146.74	149.41	149.55	150.05	0.005749	4.07	40.82	46.66	0.87
001	0472	1000	116.46	146.74	149.38	149.52	150.02	0.005756	4.04	39.66	46.06	0.87
001	463.17*	2	26.58	146.66	148.07	148.00	148.50	0.007643	2.91	9.13	8.73	0.91
001	463.17*	20	49.78	146.66	148.61	148.83	149.24	0.007341	3.51	14.69	21.20	0.93
001	463.17*	50	60.91	146.66	148.82	148.98	149.41	0.006134	3.52	20.58	33.02	0.87
001	463.17*	100	70.80	146.66	148.95	149.09	149.52	0.005704	3.56	24.94	35.99	0.85
001	463.17*	100 +5%	74.34	146.66	148.97	149.13	149.57	0.005912	3.65	25.71	36.50	0.86
001	463.17*	100 +25%	88.50	146.66	149.10	149.24	149.71	0.005781	3.78	30.62	39.66	0.87
001	463.17*	100 +70%	120.36	146.66	149.30	149.46	149.99	0.006175	4.17	39.08	44.56	0.91
001	463.17*	1000	116.46	146.66	149.27	149.45	149.97	0.006352	4.19	37.52	43.72	0.92
001	454.33*	2	26.58	146.58	148.03		148.43	0.007114	2.82	9.41	9.03	0.88
001	454.33*	20	49.78	146.58	148.61	148.70	149.14	0.005935	3.26	16.68	25.91	0.84
001	454.33*	50	60.91	146.58	148.71	148.90	149.34	0.006815	3.62	19.51	31.03	0.91
001	454.33*	100	70.80	146.58	148.82	149.01	149.46	0.006579	3.72	23.34	34.86	0.91
001	454.33*	100 +5%	74.34	146.58	148.85	149.04	149.51	0.006698	3.79	24.27	35.42	0.92
001	454.33*	100 +25%	88.50	146.58	148.98	149.15	149.65	0.006535	3.93	28.95	38.12	0.92
001	454.33*	100 +70%	120.36	146.58	149.18	149.37	149.93	0.006841	4.31	37.24	42.73	0.96
001	454.33*	1000	116.46	146.58	149.15	149.35	149.90	0.006902	4.29	36.06	42.10	0.96
001	445.50*	2	26.58	146.50	147.99		148.37	0.006625	2.74	9.71	9.31	0.86
001	445.50*	20	49.78	146.50	148.65	148.65	149.05	0.004274	2.88	20.35	32.76	0.72
001	445.50*	50	60.91	146.50	148.59	148.82	149.28	0.007544	3.75	18.44	28.92	0.96
001	445.50*	100	70.80	146.50	148.72	148.94	149.40	0.007231	3.81	22.50	34.49	0.95
001	445.50*	100 +5%	74.34	146.50	148.75	148.96	149.44	0.007365	3.88	23.46	35.00	0.96
001	445.50*	100 +25%	88.50	146.50	148.88	149.08	149.58	0.007086	4.00	28.15	37.57	0.95
001	445.50*	100 +70%	120.36	146.50	149.08	149.30	149.86	0.007416	4.39	36.10	41.58	0.99
001	445.50*	1000	116.46	146.50	149.05	149.28	149.83	0.007500	4.37	34.93	41.01	0.99
001	436.67*	2	26.58	146.41	147.95		148.31	0.006269	2.66	9.98	9.56	0.83
001	436.67*	20	49.78	146.41	148.35	148.57	148.99	0.007784	3.55	14.60	19.03	0.96

HEC-RAS Plan: Mannings n -20% River: River Trannon Reach: 001 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
001	436.67*	50	60.91	146.41	148.51	148.76	149.20	0.007816	3.77	18.26	28.35	0.97
001	436.67*	100	70.80	146.41	148.63	148.85	149.33	0.007577	3.87	22.08	34.61	0.97
001	436.67*	100 +5%	74.34	146.41	148.66	148.88	149.37	0.007619	3.92	23.17	35.13	0.97
001	436.67*	100 +25%	88.50	146.41	148.77	148.99	149.51	0.007802	4.10	27.25	37.12	0.99
001	436.67*	100 +70%	120.36	146.41	148.98	149.22	149.78	0.007885	4.42	35.49	41.04	1.01
001	436.67*	1000	116.46	146.41	148.95	149.19	149.76	0.007986	4.41	34.35	40.51	1.02
001	427.83*	2	26.58	146.33	147.88		148.25	0.006529	2.67	9.96	9.77	0.84
001	427.83*	20	49.78	146.33	148.30	148.53	148.91	0.007522	3.47	15.21	20.64	0.94
001	427.83*	50	60.91	146.33	148.42	148.66	149.13	0.008291	3.81	17.98	27.27	1.00
001	427.83*	100	70.80	146.33	148.54	148.78	149.26	0.007905	3.90	21.91	34.96	0.98
001	427.83*	100 +5%	74.34	146.33	148.57	148.81	149.30	0.007991	3.96	22.92	35.42	0.99
001	427.83*	100 +25%	88.50	146.33	149.07	148.91	149.36	0.002794	2.72	42.58	43.82	0.61
001	427.83*	100 +70%	120.36	146.33	149.34	149.14	149.65	0.002658	2.88	54.83	47.57	0.60
001	427.83*	1000	116.46	146.33	149.31	149.11	149.61	0.002676	2.87	53.35	47.13	0.61
001	0419	2	26.58	146.25	147.80	147.72	148.18	0.007425	2.74	9.70	9.96	0.89
001	0419	20	49.78	146.25	148.23	148.39	148.83	0.007770	3.46	15.43	21.39	0.95
001	0419	50	60.91	146.25	148.35	148.61	149.05	0.008552	3.80	18.17	27.28	1.00
001	0419	100	70.80	146.25	148.90	148.71	149.12	0.002387	2.39	38.41	42.01	0.55
001	0419	100 +5%	74.34	146.25	148.94	148.72	149.17	0.002330	2.38	40.40	42.78	0.55
001	0419	100 +25%	88.50	146.25	149.09		149.32	0.002248	2.45	46.84	44.90	0.54
001	0419	100 +70%	120.36	146.25	149.35		149.61	0.002203	2.63	59.19	48.33	0.55
001	0419	1000	116.46	146.25	149.32		149.57	0.002211	2.61	57.70	47.92	0.55
001	409.75*	2	26.58	146.22	147.81		148.10	0.004812	2.39	11.11	10.25	0.73
001	409.75*	20	49.78	146.22	148.35	148.08	148.77	0.004466	2.89	18.78	27.16	0.74
001	409.75*	50	60.91	146.22	148.27	148.52	148.99	0.008032	3.77	16.91	20.85	0.99
001	409.75*	100	70.80	146.22	148.78		149.09	0.002788	2.67	33.74	39.30	0.61
001	409.75*	100 +5%	74.34	146.22	148.83		149.13	0.002673	2.66	35.85	40.29	0.60
001	409.75*	100 +25%	88.50	146.22	148.98		149.29	0.002630	2.76	41.75	42.52	0.60
001	409.75*	100 +70%	120.36	146.22	149.23		149.58	0.002642	2.99	53.27	46.57	0.61
001	409.75*	1000	116.46	146.22	149.20		149.54	0.002658	2.97	51.79	46.07	0.62
001	400.50*	2	26.58	146.18	147.82		148.04	0.003311	2.10	12.63	10.85	0.62
001	400.50*	20	49.78	146.18	148.37	147.94	148.71	0.003121	2.63	20.54	29.22	0.64
001	400.50*	50	60.91	146.18	148.59	148.13	148.92	0.002679	2.64	27.80	35.36	0.61
001	400.50*	100	70.80	146.18	148.74	148.56	149.06	0.002509	2.69	33.32	39.19	0.59
001	400.50*	100 +5%	74.34	146.18	148.79		149.11	0.002433	2.69	35.39	40.32	0.59
001	400.50*	100 +25%	88.50	146.18	148.93		149.27	0.002468	2.82	41.11	42.61	0.60
001	400.50*	100 +70%	120.36	146.18	149.18		149.56	0.002571	3.09	52.19	45.70	0.62
001	400.50*	1000	116.46	146.18	149.15		149.52	0.002588	3.07	50.69	45.35	0.62
001	391.25*	2	26.58	146.14	147.83		148.01	0.002162	1.86	14.53	12.66	0.52
001	391.25*	20	49.78	146.14	148.41		148.66	0.002028	2.30	24.45	29.68	0.53
001	391.25*	50	60.91	146.14	148.63		148.88	0.001847	2.35	31.77	37.14	0.52
001	391.25*	100	70.80	146.14	148.77		149.02	0.001796	2.42	37.26	40.07	0.52
001	391.25*	100 +5%	74.34	146.14	148.82		149.07	0.001770	2.44	39.26	40.95	0.51
001	391.25*	100 +25%	88.50	146.14	148.95		149.23	0.001848	2.59	44.84	42.09	0.53
001	391.25*	100 +70%	120.36	146.14	149.19		149.52	0.002061	2.91	55.13	44.16	0.57
001	391.25*	1000	116.46	146.14	149.16		149.49	0.002054	2.88	53.77	43.89	0.57
001	0382	2	26.58	146.11	147.85		147.97	0.001322	1.57	18.33	17.13	0.41
001	0382	20	49.78	146.11	148.46		148.62	0.001222	1.90	30.09	27.70	0.42
001	0382	50	60.91	146.11	148.67		148.84	0.001185	1.99	37.60	38.08	0.42
001	0382	100	70.80	146.11	148.81		148.99	0.001195	2.08	42.94	39.04	0.43
001	0382	100 +5%	74.34	146.11	148.85		149.04	0.001196	2.10	44.78	39.37	0.43
001	0382	100 +25%	88.50	146.11	148.98		149.19	0.001304	2.27	49.99	40.28	0.45
001	0382	100 +70%	120.36	146.11	149.22		149.49	0.001557	2.63	59.53	41.90	0.50
001	0382	1000	116.46	146.11	149.19		149.45	0.001538	2.60	58.29	41.70	0.49
001	372.33*	2	26.58	146.05	147.73		147.94	0.003290	2.03	13.14	13.05	0.62
001	372.33*	20	49.78	146.05	148.32		148.59	0.002521	2.36	22.90	22.09	0.58
001	372.33*	50	60.91	146.05	148.53		148.81	0.002349	2.46	29.05	36.24	0.57
001	372.33*	100	70.80	146.05	148.68	148.24	148.96	0.002165	2.49	35.01	39.63	0.56
001	372.33*	100 +5%	74.34	146.05	148.74	148.29	149.01	0.002072	2.48	37.32	40.14	0.55
001	372.33*	100 +25%	88.50	146.05	148.87		149.17	0.002147	2.63	42.71	41.31	0.56
001	372.33*	100 +70%	120.36	146.05	149.10		149.46	0.002410	2.98	52.26	43.20	0.61
001	372.33*	1000	116.46	146.05	149.07		149.42	0.002419	2.96	50.84	42.93	0.61
001	362.67*	2	26.58	146.00	147.57		147.89	0.005694	2.50	10.63	10.44	0.79
001	362.67*	20	49.78	146.00	148.18		148.55	0.004521	2.71	18.76	17.80	0.75
001	362.67*	50	60.91	146.00	148.32	148.12	148.76	0.004834	2.98	21.65	26.23	0.78
001	362.67*	100	70.80	146.00	148.46	148.38	148.92	0.004503	3.06	25.97	33.48	0.77
001	362.67*	100 +5%	74.34	146.00	148.51	148.48	148.97	0.004430	3.09	27.48	35.18	0.76
001	362.67*	100 +25%	88.50	146.00	148.68	148.67	149.13	0.003976	3.13	34.13	40.50	0.74
001	362.67*	100 +70%	120.36	146.00	149.03		149.43	0.003074	3.09	49.20	44.64	0.67
001	362.67*	1000	116.46	146.00	148.99	148.90	149.40	0.003179	3.10	47.30	44.21	0.67
001	0353	2	26.58	145.94	147.60		147.82	0.003261	2.08	12.75	10.43	0.60
001	0353	20	49.78	145.94	148.16		148.50	0.003639	2.59	19.53	18.01	0.66
001	0353	50	60.91	145.94	148.30	147.91	148.71	0.004193	2.86	22.83	27.82	0.72
001	0353	100	70.80	145.94	148.45	148.22	148.86	0.004114	2.91	27.64	34.10	0.72
001	0353	100 +5%	74.34	145.94	148.50	148.40	148.91	0.004083	2.92	29.32	35.82	0.72
001	0353	100 +25%	88.50	145.94	148.69	148.60	149.07	0.003678	2.90	36.61	40.15	0.69

HEC-RAS Plan: Mannings n -20% River: River Trannon Reach: 001 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
001	0353	100 +70%	120.36	145.94	149.04		149.39	0.002944	2.86	51.75	45.79	0.63
001	0353	1000	116.46	145.94	149.00		149.35	0.003047	2.87	49.82	45.11	0.64
001	344.60*	2	26.58	145.91	147.53		147.78	0.003832	2.25	11.81	9.80	0.66
001	344.60*	20	49.78	145.91	148.07		148.46	0.004603	2.78	18.08	17.36	0.75
001	344.60*	50	60.91	145.91	148.25	147.95	148.68	0.004664	2.93	22.59	29.30	0.76
001	344.60*	100	70.80	145.91	148.42	148.34	148.82	0.004063	2.90	28.13	34.35	0.72
001	344.60*	100 +5%	74.34	145.91	148.47	148.39	148.87	0.003948	2.91	29.87	35.65	0.72
001	344.60*	100 +25%	88.50	145.91	148.67	148.56	149.04	0.003454	2.89	37.04	38.98	0.68
001	344.60*	100 +70%	120.36	145.91	149.01		149.36	0.002799	2.90	51.51	44.10	0.63
001	344.60*	1000	116.46	145.91	148.97		149.32	0.002884	2.91	49.65	43.54	0.63
001	336.20*	2	26.58	145.88	147.43		147.74	0.005076	2.48	10.72	9.79	0.76
001	336.20*	20	49.78	145.88	148.01	147.76	148.43	0.004930	2.86	17.59	17.71	0.78
001	336.20*	50	60.91	145.88	148.21	148.13	148.64	0.004421	2.94	22.92	29.39	0.75
001	336.20*	100	70.80	145.88	148.40	148.30	148.79	0.003751	2.89	28.67	33.50	0.70
001	336.20*	100 +5%	74.34	145.88	148.45	148.35	148.83	0.003652	2.90	30.37	34.58	0.70
001	336.20*	100 +25%	88.50	145.88	148.64		149.01	0.003223	2.89	37.27	37.60	0.66
001	336.20*	100 +70%	120.36	145.88	148.98		149.34	0.002711	2.96	50.96	42.23	0.63
001	336.20*	1000	116.46	145.88	148.94		149.30	0.002781	2.96	49.20	41.72	0.63
001	327.80*	2	26.58	145.85	147.32	147.19	147.69	0.006364	2.69	9.89	9.74	0.85
001	327.80*	20	49.78	145.85	147.96	147.72	148.39	0.004742	2.91	17.48	21.11	0.78
001	327.80*	50	60.91	145.85	148.18	148.10	148.60	0.004118	2.95	23.28	28.82	0.73
001	327.80*	100	70.80	145.85	148.37	148.26	148.75	0.003491	2.89	29.05	32.30	0.68
001	327.80*	100 +5%	74.34	145.85	148.42	148.30	148.80	0.003401	2.90	30.68	33.23	0.68
001	327.80*	100 +25%	88.50	145.85	148.61		148.98	0.003054	2.93	37.20	36.11	0.65
001	327.80*	100 +70%	120.36	145.85	148.94		149.32	0.002681	3.04	50.07	40.28	0.63
001	327.80*	1000	116.46	145.85	148.90		149.28	0.002738	3.03	48.41	39.80	0.63
001	319.40*	2	26.58	145.82	147.16	147.15	147.62	0.008862	3.02	8.79	9.50	1.00
001	319.40*	20	49.78	145.82	147.90	147.66	148.36	0.004708	2.99	17.20	21.42	0.78
001	319.40*	50	60.91	145.82	148.14	148.07	148.57	0.003921	2.97	23.46	27.86	0.72
001	319.40*	100	70.80	145.82	148.34	148.21	148.73	0.003297	2.91	29.14	30.99	0.67
001	319.40*	100 +5%	74.34	145.82	148.39	148.25	148.77	0.003226	2.93	30.69	31.77	0.67
001	319.40*	100 +25%	88.50	145.82	148.57	148.41	148.96	0.002975	2.99	36.82	34.42	0.65
001	319.40*	100 +70%	120.36	145.82	148.90	148.70	149.30	0.002749	3.15	48.63	38.21	0.64
001	319.40*	1000	116.46	145.82	148.86	148.67	149.26	0.002767	3.13	47.26	37.81	0.64
001	0311	2	26.58	145.79	147.07	147.07	147.56	0.008859	3.08	8.64	8.99	1.00
001	0311	20	49.78	145.79	147.60	147.60	148.28	0.008255	3.66	13.60	10.33	1.00
001	0311	50	60.91	145.79	148.03	148.03	148.53	0.004635	3.22	21.44	25.62	0.77
001	0311	100	70.80	145.79	148.17	148.17	148.68	0.004445	3.32	25.15	27.59	0.76
001	0311	100 +5%	74.34	145.79	148.21	148.21	148.73	0.004402	3.35	26.39	28.22	0.76
001	0311	100 +25%	88.50	145.79	148.37	148.37	148.91	0.004333	3.50	30.97	30.42	0.77
001	0311	100 +70%	120.36	145.79	148.67	148.67	149.25	0.004146	3.74	40.74	34.16	0.77
001	0311	1000	116.46	145.79	148.64	148.64	149.22	0.004133	3.70	39.72	33.82	0.77
001	301.67*	2	26.58	145.58	146.75	146.90	147.43	0.015217	3.67	7.24	8.96	1.30
001	301.67*	20	49.78	145.58	147.21	147.42	148.16	0.013177	4.32	11.53	9.56	1.26
001	301.67*	50	60.91	145.58	147.45	147.60	148.43	0.011544	4.38	13.90	10.05	1.19
001	301.67*	100	70.80	145.58	147.85	148.07	148.61	0.006959	3.88	19.44	26.82	0.94
001	301.67*	100 +5%	74.34	145.58	147.91	148.11	148.66	0.006746	3.89	21.00	27.96	0.93
001	301.67*	100 +25%	88.50	145.58	148.06	148.28	148.85	0.006579	4.06	25.58	31.19	0.93
001	301.67*	100 +70%	120.36	145.58	148.32	148.56	149.18	0.006565	4.41	34.37	36.61	0.95
001	301.67*	1000	116.46	145.58	148.29	148.53	149.14	0.006535	4.37	33.42	36.06	0.95
001	292.33*	2	26.58	145.37	146.55	146.73	147.28	0.017260	3.80	7.00	9.08	1.38
001	292.33*	20	49.78	145.37	146.97	147.23	148.02	0.015437	4.53	10.99	9.64	1.35
001	292.33*	50	60.91	145.37	147.18	147.45	148.30	0.014008	4.69	12.99	9.83	1.30
001	292.33*	100	70.80	145.37	147.41	147.61	148.50	0.011775	4.60	15.38	10.34	1.21
001	292.33*	100 +5%	74.34	145.37	147.54	148.01	148.55	0.010249	4.45	16.70	10.56	1.13
001	292.33*	100 +25%	88.50	145.37	147.88	148.20	148.77	0.007481	4.23	23.23	32.43	0.98
001	292.33*	100 +70%	120.36	145.37	148.15	148.49	149.11	0.007358	4.58	32.93	40.95	1.00
001	292.33*	1000	116.46	145.37	148.12	148.45	149.07	0.007310	4.53	31.93	40.15	0.99
001	0283	2	26.58	145.16	146.80	146.57	147.09	0.004517	2.41	11.04	9.89	0.73
001	0283	20	49.78	145.16	146.77	147.05	147.86	0.017064	4.62	10.77	9.87	1.41
001	0283	50	60.91	145.16	146.95	147.26	148.15	0.016159	4.86	12.53	10.01	1.39
001	0283	100	70.80	145.16	147.14	147.43	148.36	0.014266	4.90	14.44	10.15	1.31
001	0283	100 +5%	74.34	145.16	147.23	147.48	148.42	0.013066	4.84	15.37	10.22	1.26
001	0283	100 +25%	88.50	145.16	147.60	148.15	148.67	0.009786	4.58	19.33	12.08	1.10
001	0283	100 +70%	120.36	145.16	148.00	148.36	149.04	0.007962	4.67	31.63	46.46	1.02
001	0283	1000	116.46	145.16	147.98	148.34	149.00	0.007898	4.62	30.53	45.14	1.02
001	274.00*	2	26.58	145.16	146.77		147.05	0.004246	2.33	11.38	10.40	0.71
001	274.00*	20	49.78	145.16	147.27	147.00	147.72	0.004778	2.98	16.72	11.09	0.77
001	274.00*	50	60.91	145.16	147.43	147.20	147.98	0.005326	3.29	18.53	11.40	0.82
001	274.00*	100	70.80	145.16	147.56	147.37	148.20	0.005787	3.54	19.99	11.62	0.86
001	274.00*	100 +5%	74.34	145.16	147.25	147.43	148.29	0.011077	4.51	16.48	11.03	1.18
001	274.00*	100 +25%	88.50	145.16	147.60	148.04	148.55	0.008475	4.33	20.46	13.64	1.04
001	274.00*	100 +70%	120.36	145.16	147.95	148.34	148.96	0.007516	4.60	31.63	47.43	1.01
001	274.00*	1000	116.46	145.16	147.91	148.32	148.93	0.007617	4.58	30.08	45.40	1.02
001	265.00*	2	26.58	145.15	146.74		147.00	0.004118	2.28	11.65	10.89	0.70

HEC-RAS Plan: Mannings n -20% River: River Trannon Reach: 001 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
001	265.00*	20	49.78	145.15	147.25		147.67	0.004411	2.86	17.39	11.76	0.75
001	265.00*	50	60.91	145.15	147.42		147.92	0.004792	3.13	19.43	12.09	0.79
001	265.00*	100	70.80	145.15	147.55	147.31	148.13	0.005017	3.36	21.09	13.22	0.82
001	265.00*	100 +5%	74.34	145.15	147.60	147.37	148.20	0.005065	3.44	21.77	17.37	0.82
001	265.00*	100 +25%	88.50	145.15	147.59	147.98	148.45	0.007269	4.11	21.65	16.64	0.99
001	265.00*	100 +70%	120.36	145.15	147.88	148.25	148.90	0.007410	4.59	31.01	47.18	1.02
001	265.00*	1000	116.46	145.15	147.84	148.23	148.87	0.007539	4.57	29.37	45.08	1.03
001	256.00*	2	26.58	145.15	146.70		146.96	0.004116	2.25	11.81	11.35	0.70
001	256.00*	20	49.78	145.15	147.23		147.62	0.004157	2.77	18.00	12.43	0.73
001	256.00*	50	60.91	145.15	147.40		147.86	0.004380	3.02	20.21	13.37	0.76
001	256.00*	100	70.80	145.15	147.55	147.26	148.07	0.004398	3.21	22.30	15.39	0.78
001	256.00*	100 +5%	74.34	145.15	147.60	147.32	148.14	0.004392	3.27	23.20	20.96	0.78
001	256.00*	100 +25%	88.50	145.15	147.42	147.53	148.38	0.008921	4.34	20.44	13.56	1.09
001	256.00*	100 +70%	120.36	145.15	147.81	148.22	148.84	0.007392	4.57	30.46	47.49	1.03
001	256.00*	1000	116.46	145.15	147.78	148.19	148.80	0.007465	4.54	28.88	43.92	1.03
001	247.00*	2	26.58	145.14	146.67		146.92	0.004218	2.24	11.88	11.72	0.71
001	247.00*	20	49.78	145.14	147.20		147.57	0.004023	2.69	18.50	13.20	0.72
001	247.00*	50	60.91	145.14	147.38		147.81	0.004028	2.91	21.05	15.17	0.74
001	247.00*	100	70.80	145.14	147.54	147.23	148.02	0.003893	3.06	23.73	17.95	0.74
001	247.00*	100 +5%	74.34	145.14	147.60	147.27	148.09	0.003832	3.10	24.96	25.73	0.74
001	247.00*	100 +25%	88.50	145.14	147.82	147.50	148.30	0.003379	3.14	33.73	52.55	0.70
001	247.00*	100 +70%	120.36	145.14	147.74	148.16	148.77	0.007514	4.56	29.73	43.27	1.04
001	247.00*	1000	116.46	145.14	147.70	148.12	148.73	0.007653	4.54	28.14	38.11	1.05
001	0238	2	26.58	145.14	146.63		146.88	0.004418	2.25	11.82	11.94	0.72
001	0238	20	49.78	145.14	147.18		147.53	0.003878	2.63	19.00	14.96	0.71
001	0238	50	60.91	145.14	147.37		147.77	0.003755	2.82	22.11	18.24	0.72
001	0238	100	70.80	145.14	147.55	147.19	147.97	0.003392	2.88	25.90	23.99	0.69
001	0238	100 +5%	74.34	145.14	147.62	147.25	148.03	0.003254	2.89	27.79	33.73	0.68
001	0238	100 +25%	88.50	145.14	147.88	147.47	148.23	0.002509	2.78	40.70	60.94	0.61
001	0238	100 +70%	120.36	145.14	147.65	148.08	148.69	0.008000	4.59	28.84	37.37	1.07
001	0238	1000	116.46	145.14	147.60	148.04	148.65	0.008368	4.60	27.09	30.53	1.09
001	229.50*	2	26.58	145.06	146.54		146.84	0.005083	2.44	10.91	10.87	0.78
001	229.50*	20	49.78	145.06	147.09		147.49	0.004687	2.81	17.74	13.90	0.78
001	229.50*	50	60.91	145.06	147.27		147.73	0.004604	3.01	20.45	15.83	0.79
001	229.50*	100	70.80	145.06	147.42	147.20	147.93	0.004483	3.16	22.99	18.51	0.79
001	229.50*	100 +5%	74.34	145.06	147.47	147.24	147.99	0.004438	3.21	23.95	19.59	0.79
001	229.50*	100 +25%	88.50	145.06	147.79	147.47	148.21	0.003041	2.98	36.79	54.02	0.67
001	229.50*	100 +70%	120.36	145.06	147.81	148.03	148.55	0.005276	3.96	38.16	55.23	0.89
001	229.50*	1000	116.46	145.06	148.03	148.00	148.45	0.002894	3.13	50.94	66.32	0.67
001	221.00*	2	26.58	144.97	146.46		146.79	0.005841	2.57	10.36	10.67	0.83
001	221.00*	20	49.78	144.97	146.96		147.44	0.005905	3.06	16.28	13.22	0.87
001	221.00*	50	60.91	144.97	147.16	147.01	147.69	0.005547	3.21	19.14	15.04	0.86
001	221.00*	100	70.80	144.97	147.32	147.18	147.89	0.005392	3.35	21.62	17.26	0.86
001	221.00*	100 +5%	74.34	144.97	147.36	147.23	147.95	0.005404	3.41	22.38	18.05	0.86
001	221.00*	100 +25%	88.50	144.97	147.71	147.71	148.17	0.003449	3.11	34.55	48.76	0.71
001	221.00*	100 +70%	120.36	144.97	147.79	147.97	148.51	0.005266	3.94	38.37	51.99	0.89
001	221.00*	1000	116.46	144.97	147.94	147.94	148.42	0.003358	3.31	46.80	58.40	0.72
001	212.50*	2	26.58	144.89	146.37	146.29	146.74	0.006639	2.67	9.94	10.64	0.88
001	212.50*	20	49.78	144.89	146.85	146.76	147.39	0.006696	3.24	15.38	12.42	0.92
001	212.50*	50	60.91	144.89	147.04	146.97	147.64	0.006547	3.42	17.95	14.48	0.93
001	212.50*	100	70.80	144.89	147.20	147.15	147.84	0.006338	3.55	20.36	16.76	0.92
001	212.50*	100 +5%	74.34	144.89	147.27	147.22	147.90	0.006042	3.55	21.57	17.84	0.91
001	212.50*	100 +25%	88.50	144.89	147.58	147.65	148.13	0.004357	3.36	30.74	42.76	0.79
001	212.50*	100 +70%	120.36	144.89	147.74	147.91	148.45	0.005314	3.93	38.31	48.75	0.89
001	212.50*	1000	116.46	144.89	147.82	147.89	148.38	0.004113	3.55	42.12	51.41	0.79
001	204.00*	2	26.58	144.80	146.29	146.23	146.67	0.007256	2.75	9.67	10.66	0.92
001	204.00*	20	49.78	144.80	146.77	146.71	147.32	0.006969	3.29	15.14	12.30	0.94
001	204.00*	50	60.91	144.80	146.96	146.91	147.58	0.006692	3.49	17.62	14.32	0.94
001	204.00*	100	70.80	144.80	147.11	147.10	147.78	0.006612	3.63	20.03	16.98	0.94
001	204.00*	100 +5%	74.34	144.80	147.19	147.18	147.85	0.006234	3.61	21.35	18.06	0.92
001	204.00*	100 +25%	88.50	144.80	147.45	147.58	148.08	0.005256	3.58	28.08	37.78	0.86
001	204.00*	100 +70%	120.36	144.80	147.67	147.85	148.40	0.005647	4.00	37.28	45.49	0.91
001	204.00*	1000	116.46	144.80	147.72	147.83	148.33	0.004667	3.69	39.60	46.96	0.83
001	195.50*	2	26.58	144.72	146.21	146.16	146.60	0.007504	2.77	9.59	10.72	0.94
001	195.50*	20	49.78	144.72	146.74	146.64	147.26	0.006360	3.18	15.67	12.93	0.90
001	195.50*	50	60.91	144.72	146.95	146.83	147.51	0.005765	3.32	18.73	16.02	0.87
001	195.50*	100	70.80	144.72	147.12	147.02	147.71	0.005455	3.42	21.64	18.61	0.86
001	195.50*	100 +5%	74.34	144.72	147.18	147.09	147.77	0.005402	3.46	22.68	19.61	0.86
001	195.50*	100 +25%	88.50	144.72	147.54	147.51	147.99	0.003631	3.12	34.29	41.61	0.72
001	195.50*	100 +70%	120.36	144.72	147.58	147.78	148.35	0.006120	4.09	35.98	42.60	0.93
001	195.50*	1000	116.46	144.72	147.60	147.75	148.28	0.005393	3.87	37.04	43.22	0.88
001	0187	2	26.58	144.63	146.18	146.09	146.53	0.006418	2.62	10.14	10.88	0.87
001	0187	20	49.78	144.63	146.73	146.56	147.19	0.005400	3.00	16.69	14.49	0.83
001	0187	50	60.91	144.63	146.96	146.76	147.44	0.004703	3.09	20.52	17.96	0.79
001	0187	100	70.80	144.63	147.15	146.95	147.64	0.004298	3.15	24.04	20.34	0.76
001	0187	100 +5%	74.34	144.63	147.21	147.01	147.70	0.004206	3.17	25.31	24.39	0.76

HEC-RAS Plan: Mannings n -20% River: River Trannon Reach: 001 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
001	0187	100 +25%	88.50	144.63	147.58	147.15	147.93	0.002740	2.81	39.00	42.35	0.62
001	0187	100 +70%	120.36	144.63	147.86	147.71	148.24	0.002676	3.00	51.90	48.52	0.63
001	0187	1000	116.46	144.63	147.82	147.68	148.20	0.002740	3.00	49.96	47.64	0.63
001	177.00*	2	26.58	144.51	146.08	146.01	146.46	0.006998	2.73	9.73	10.45	0.90
001	177.00*	20	49.78	144.51	146.66	146.49	147.13	0.005404	3.05	16.49	14.09	0.83
001	177.00*	50	60.91	144.51	146.87	146.70	147.38	0.005078	3.21	19.66	16.64	0.82
001	177.00*	100	70.80	144.51	147.04	146.89	147.58	0.004823	3.30	22.77	18.96	0.81
001	177.00*	100 +5%	74.34	144.51	147.10	146.98	147.65	0.004715	3.31	23.99	19.89	0.80
001	177.00*	100 +25%	88.50	144.51	147.56	147.08	147.90	0.002579	2.78	39.30	41.02	0.61
001	177.00*	100 +70%	120.36	144.51	147.80	147.65	148.21	0.002756	3.10	50.04	46.24	0.64
001	177.00*	1000	116.46	144.51	147.76	147.62	148.17	0.002821	3.09	48.15	45.39	0.65
001	167.00*	2	26.58	144.39	146.01	145.92	146.39	0.006763	2.73	9.72	10.09	0.89
001	167.00*	20	49.78	144.39	146.55	146.42	147.07	0.005870	3.17	15.82	13.24	0.86
001	167.00*	50	60.91	144.39	146.75	146.64	147.32	0.005785	3.37	18.61	15.55	0.87
001	167.00*	100	70.80	144.39	146.93	146.84	147.52	0.005498	3.45	21.54	17.66	0.86
001	167.00*	100 +5%	74.34	144.39	146.99	146.92	147.59	0.005371	3.47	22.68	18.58	0.85
001	167.00*	100 +25%	88.50	144.39	147.17	147.04	147.84	0.005372	3.68	26.88	30.22	0.87
001	167.00*	100 +70%	120.36	144.39	147.74	147.60	148.17	0.002834	3.20	48.31	44.14	0.66
001	167.00*	1000	116.46	144.39	147.70	147.57	148.14	0.002894	3.19	46.51	43.26	0.66
001	157.00*	2	26.58	144.27	145.90	145.84	146.31	0.007162	2.82	9.42	9.70	0.91
001	157.00*	20	49.78	144.27	146.43	146.35	147.00	0.006649	3.32	15.06	12.61	0.92
001	157.00*	50	60.91	144.27	146.63	146.59	147.25	0.006631	3.52	17.68	14.73	0.93
001	157.00*	100	70.80	144.27	146.81	146.78	147.45	0.006146	3.60	20.49	16.52	0.91
001	157.00*	100 +5%	74.34	144.27	146.87	146.85	147.52	0.005901	3.61	21.57	17.19	0.89
001	157.00*	100 +25%	88.50	144.27	147.05	146.95	147.77	0.005805	3.84	24.91	22.33	0.90
001	157.00*	100 +70%	120.36	144.27	147.62	147.55	148.13	0.003193	3.41	44.84	41.35	0.70
001	157.00*	1000	116.46	144.27	147.58	147.52	148.09	0.003261	3.41	43.12	40.47	0.71
001	147.00*	2	26.58	144.15	145.79	145.75	146.22	0.007728	2.93	9.08	9.32	0.95
001	147.00*	20	49.78	144.15	146.31	146.29	146.92	0.007556	3.46	14.45	12.34	0.97
001	147.00*	50	60.91	144.15	146.50	146.50	147.18	0.007309	3.65	16.98	13.94	0.97
001	147.00*	100	70.80	144.15	146.68	146.68	147.38	0.006558	3.73	19.64	15.73	0.94
001	147.00*	100 +5%	74.34	144.15	146.75	146.75	147.45	0.006272	3.75	20.69	16.41	0.93
001	147.00*	100 +25%	88.50	144.15	146.93	146.86	147.71	0.006118	3.96	23.89	19.05	0.93
001	147.00*	100 +70%	120.36	144.15	147.50	147.50	148.09	0.003605	3.64	41.69	39.97	0.75
001	147.00*	1000	116.46	144.15	147.46	147.46	148.05	0.003673	3.63	40.05	38.41	0.75
001	137.00*	2	26.58	144.03	145.67	145.65	146.14	0.008253	3.03	8.78	8.97	0.98
001	137.00*	20	49.78	144.03	146.20	146.20	146.83	0.008015	3.53	14.13	12.02	1.00
001	137.00*	50	60.91	144.03	146.39	146.42	147.10	0.007440	3.73	16.62	13.60	0.99
001	137.00*	100	70.80	144.03	146.58	146.60	147.31	0.006603	3.80	19.33	15.75	0.95
001	137.00*	100 +5%	74.34	144.03	146.61	146.67	147.38	0.006805	3.91	19.82	16.08	0.96
001	137.00*	100 +25%	88.50	144.03	146.82	146.82	147.63	0.006293	4.06	23.32	17.86	0.95
001	137.00*	100 +70%	120.36	144.03	147.37	147.47	148.04	0.004024	3.86	39.32	39.67	0.79
001	137.00*	1000	116.46	144.03	147.34	147.42	148.00	0.004035	3.82	37.99	38.57	0.79
001	127.00*	2	26.58	143.90	145.56	145.56	146.04	0.008796	3.09	8.61	8.95	1.00
001	127.00*	20	49.78	143.90	146.04	146.09	146.74	0.009066	3.71	13.43	10.94	1.06
001	127.00*	50	60.91	143.90	146.21	146.32	147.01	0.008833	3.99	15.48	12.89	1.07
001	127.00*	100	70.80	143.90	146.37	146.50	147.23	0.008188	4.12	17.73	14.69	1.05
001	127.00*	100 +5%	74.34	143.90	146.44	146.57	147.29	0.007748	4.13	18.76	15.15	1.02
001	127.00*	100 +25%	88.50	143.90	146.63	146.73	147.55	0.007389	4.33	21.75	16.44	1.02
001	127.00*	100 +70%	120.36	143.90	147.18	147.39	147.98	0.004832	4.17	36.25	39.77	0.86
001	127.00*	1000	116.46	143.90	147.15	147.36	147.94	0.004804	4.13	35.13	39.08	0.86
001	117.00*	2	26.58	143.78	145.38	145.46	145.94	0.011403	3.32	8.00	9.05	1.13
001	117.00*	20	49.78	143.78	145.86	145.97	146.64	0.010043	3.89	12.84	10.87	1.11
001	117.00*	50	60.91	143.78	146.05	146.21	146.92	0.009652	4.14	14.97	13.29	1.11
001	117.00*	100	70.80	143.78	146.20	146.38	147.13	0.008986	4.29	17.13	14.12	1.09
001	117.00*	100 +5%	74.34	143.78	146.26	146.45	147.20	0.008707	4.32	17.95	14.42	1.08
001	117.00*	100 +25%	88.50	143.78	146.44	146.58	147.47	0.008448	4.56	20.62	15.45	1.08
001	117.00*	100 +70%	120.36	143.78	146.92	147.24	147.90	0.006309	4.61	32.22	36.37	0.97
001	117.00*	1000	116.46	143.78	146.88	147.20	147.86	0.006332	4.57	31.07	35.40	0.97
001	107.00*	2	26.58	143.66	145.22	145.31	145.81	0.012660	3.39	7.83	9.20	1.17
001	107.00*	20	49.78	143.66	145.68	145.86	146.53	0.011324	4.09	12.29	10.82	1.16
001	107.00*	50	60.91	143.66	145.86	146.08	146.80	0.010861	4.33	14.46	12.42	1.16
001	107.00*	100	70.80	143.66	146.01	146.22	147.01	0.010129	4.48	16.50	13.58	1.14
001	107.00*	100 +5%	74.34	143.66	146.05	146.27	147.10	0.010323	4.58	16.97	13.73	1.15
001	107.00*	100 +25%	88.50	143.66	146.23	146.66	147.37	0.009818	4.81	19.58	15.14	1.15
001	107.00*	100 +70%	120.36	143.66	146.60	147.03	147.80	0.008677	5.11	28.58	30.46	1.11
001	107.00*	1000	116.46	143.66	146.57	147.01	147.76	0.008696	5.07	27.67	30.16	1.11
001	97.00*	2	26.58	143.54	145.04	145.16	145.67	0.014252	3.52	7.56	8.98	1.22
001	97.00*	20	49.78	143.54	145.49	145.70	146.40	0.012527	4.24	12.00	11.78	1.20
001	97.00*	50	60.91	143.54	145.66	145.96	146.68	0.012356	4.52	13.99	12.23	1.21
001	97.00*	100	70.80	143.54	145.80	146.23	146.89	0.011785	4.68	15.85	13.08	1.20
001	97.00*	100 +5%	74.34	143.54	145.83	146.34	146.98	0.012124	4.81	16.24	13.20	1.22
001	97.00*	100 +25%	88.50	143.54	146.01	146.49	147.25	0.011717	5.06	18.96	22.68	1.22
001	97.00*	100 +70%	120.36	143.54	146.30	146.76	147.68	0.011357	5.52	26.90	31.29	1.23
001	97.00*	1000	116.46	143.54	146.27	146.71	147.64	0.011279	5.46	26.17	31.06	1.22

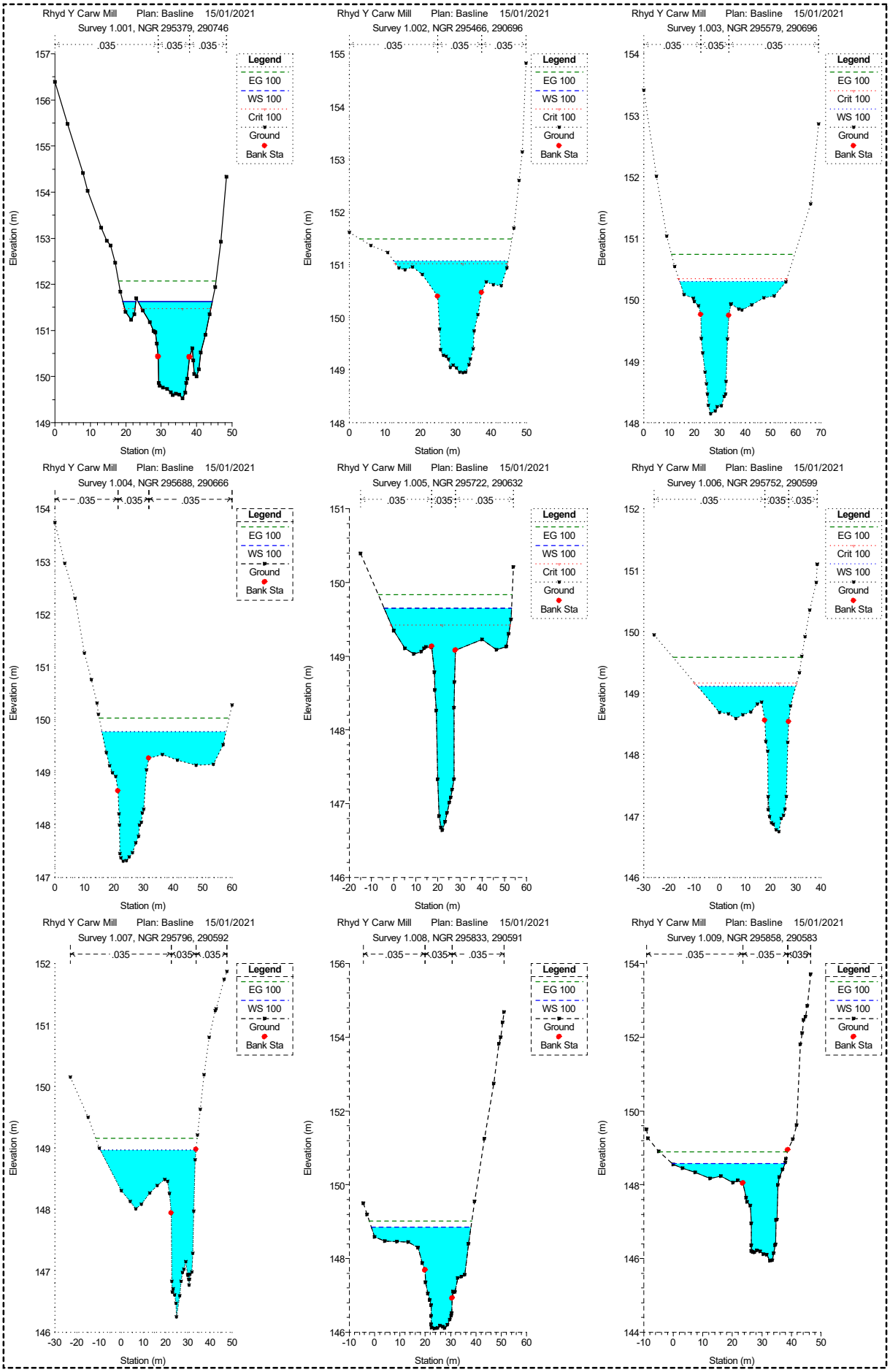
HEC-RAS Plan: Mannings n -20% River: River Trannon Reach: 001 (Continued)

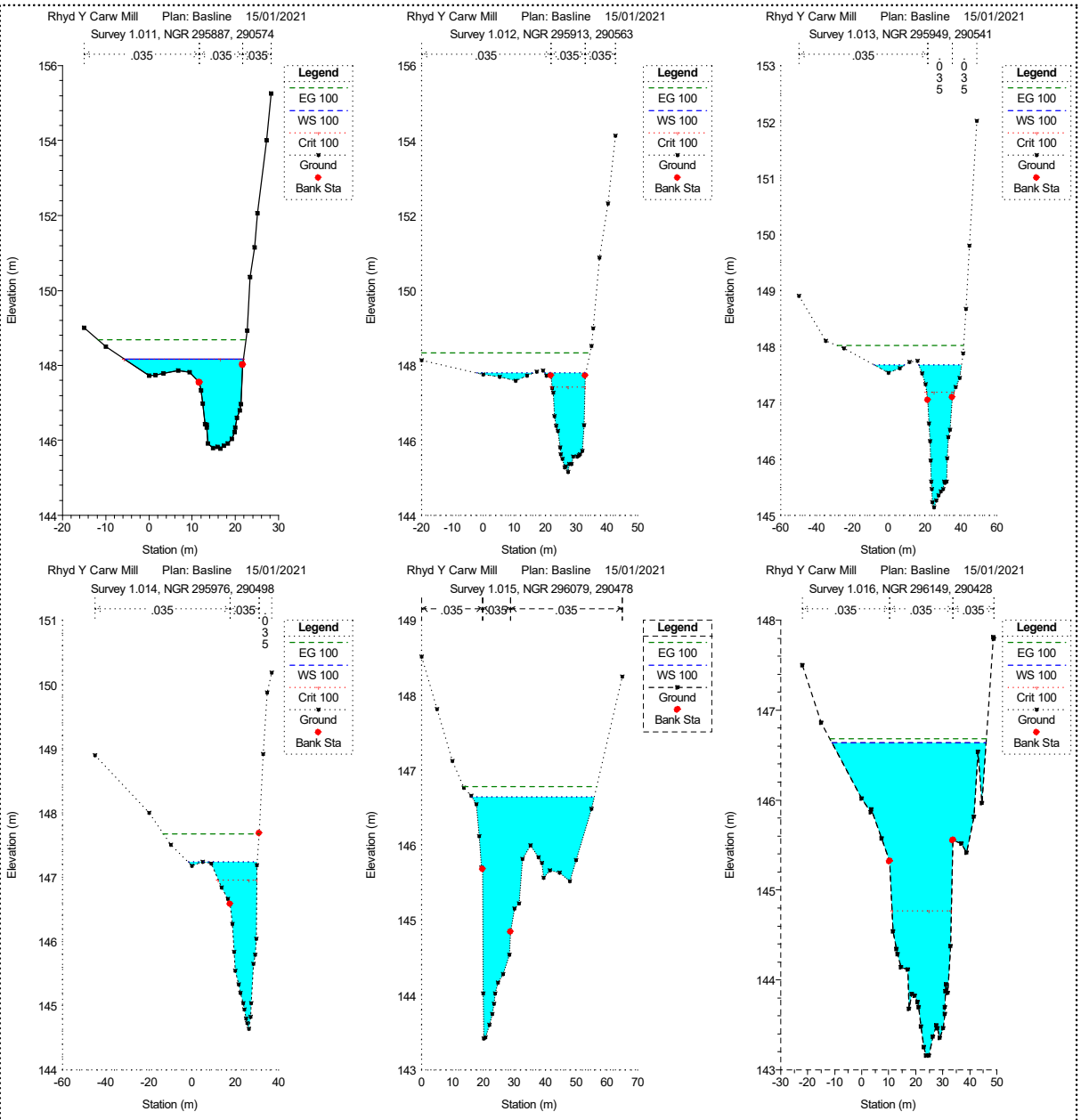
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
001	0087	2	26.58	143.42	145.24	144.99	145.54	0.004646	2.44	11.19	11.77	0.71
001	0087	20	49.78	143.42	145.27	145.54	146.26	0.014819	4.43	11.59	11.83	1.27
001	0087	50	60.91	143.42	145.44	145.80	146.53	0.014270	4.68	13.62	12.15	1.26
001	0087	100	70.80	143.42	145.57	146.09	146.75	0.014167	4.91	15.25	14.48	1.26
001	0087	100 +5%	74.34	143.42	145.59	146.12	146.84	0.014738	5.05	15.64	16.07	1.29
001	0087	100 +25%	88.50	143.42	145.73	146.25	147.10	0.015127	5.38	18.42	23.63	1.32
001	0087	100 +70%	120.36	143.42	147.02	146.47	147.23	0.001460	2.43	65.13	47.02	0.45
001	0087	1000	116.46	143.42	146.97	146.45	147.18	0.001493	2.43	62.96	46.28	0.45
001	77.333*	2	26.58	143.39	145.26		145.48	0.002916	2.08	13.06	13.00	0.60
001	77.333*	20	49.78	143.39	145.86	145.40	146.13	0.002416	2.41	24.00	28.58	0.57
001	77.333*	50	60.91	143.39	146.10	145.69	146.35	0.002031	2.40	31.62	33.55	0.53
001	77.333*	100	70.80	143.39	146.29	145.87	146.53	0.001744	2.36	38.28	35.79	0.50
001	77.333*	100 +5%	74.34	143.39	146.35	146.01	146.58	0.001672	2.35	40.54	36.51	0.49
001	77.333*	100 +25%	88.50	143.39	146.59	146.13	146.80	0.001441	2.33	49.44	40.47	0.47
001	77.333*	100 +70%	120.36	143.39	147.01		147.21	0.001188	2.34	68.29	48.42	0.43
001	77.333*	1000	116.46	143.39	146.96		147.17	0.001210	2.34	66.06	47.66	0.44
001	67.667*	2	26.58	143.36	145.28		145.44	0.002026	1.78	15.08	14.01	0.51
001	67.667*	20	49.78	143.36	145.89		146.10	0.001709	2.09	27.32	31.26	0.49
001	67.667*	50	60.91	143.36	146.12		146.32	0.001477	2.11	34.96	33.85	0.47
001	67.667*	100	70.80	143.36	146.30		146.50	0.001340	2.13	41.42	36.69	0.45
001	67.667*	100 +5%	74.34	143.36	146.36		146.56	0.001298	2.13	43.68	37.57	0.45
001	67.667*	100 +25%	88.50	143.36	146.59		146.78	0.001155	2.14	52.89	43.09	0.43
001	67.667*	100 +70%	120.36	143.36	147.01		147.20	0.000983	2.19	72.35	49.91	0.41
001	67.667*	1000	116.46	143.36	146.97		147.15	0.000998	2.18	70.05	49.26	0.41
001	58.000*	2	26.58	143.33	145.29		145.41	0.001472	1.55	17.27	14.76	0.44
001	58.000*	20	49.78	143.33	145.91		146.07	0.001253	1.83	30.82	31.87	0.43
001	58.000*	50	60.91	143.33	146.14		146.30	0.001119	1.87	38.40	33.84	0.41
001	58.000*	100	70.80	143.33	146.31		146.48	0.001058	1.92	44.85	38.35	0.41
001	58.000*	100 +5%	74.34	143.33	146.37		146.54	0.001032	1.93	47.19	39.45	0.40
001	58.000*	100 +25%	88.50	143.33	146.60		146.76	0.000935	1.96	56.87	44.80	0.39
001	58.000*	100 +70%	120.36	143.33	147.02		147.18	0.000822	2.03	76.91	51.49	0.38
001	58.000*	1000	116.46	143.33	146.97		147.13	0.000832	2.02	74.55	50.82	0.38
001	48.333*	2	26.58	143.30	145.30		145.39	0.001097	1.36	19.64	15.98	0.38
001	48.333*	20	49.78	143.30	145.92		146.05	0.000947	1.62	34.35	32.38	0.38
001	48.333*	50	60.91	143.30	146.15		146.28	0.000874	1.68	41.95	34.46	0.37
001	48.333*	100	70.80	143.30	146.32		146.46	0.000845	1.74	48.62	40.54	0.37
001	48.333*	100 +5%	74.34	143.30	146.38		146.52	0.000830	1.75	51.09	42.18	0.36
001	48.333*	100 +25%	88.50	143.30	146.61		146.75	0.000764	1.79	61.22	46.60	0.36
001	48.333*	100 +70%	120.36	143.30	147.02		147.17	0.000691	1.88	81.91	53.23	0.35
001	48.333*	1000	116.46	143.30	146.98		147.12	0.000697	1.87	79.48	52.54	0.35
001	38.667*	2	26.58	143.27	145.30		145.37	0.000831	1.20	22.20	17.24	0.33
001	38.667*	20	49.78	143.27	145.93		146.03	0.000732	1.44	37.98	33.01	0.33
001	38.667*	50	60.91	143.27	146.16		146.26	0.000694	1.51	45.76	36.01	0.33
001	38.667*	100	70.80	143.27	146.33		146.45	0.000682	1.58	52.80	43.22	0.33
001	38.667*	100 +5%	74.34	143.27	146.39		146.51	0.000671	1.60	55.41	44.41	0.33
001	38.667*	100 +25%	88.50	143.27	146.62		146.74	0.000628	1.64	65.94	48.50	0.32
001	38.667*	100 +70%	120.36	143.27	147.03		147.16	0.000582	1.74	87.34	55.16	0.32
001	38.667*	1000	116.46	143.27	146.98		147.11	0.000586	1.73	84.82	54.43	0.32
001	29.000*	2	26.58	143.25	145.30		145.36	0.000637	1.06	24.96	18.44	0.29
001	29.000*	20	49.78	143.25	145.94		146.02	0.000576	1.30	41.77	33.91	0.30
001	29.000*	50	60.91	143.25	146.16		146.25	0.000558	1.37	49.90	38.90	0.30
001	29.000*	100	70.80	143.25	146.34		146.44	0.000552	1.44	57.37	45.20	0.30
001	29.000*	100 +5%	74.34	143.25	146.40		146.50	0.000546	1.45	60.09	46.31	0.30
001	29.000*	100 +25%	88.50	143.25	146.63		146.73	0.000519	1.51	71.02	50.45	0.29
001	29.000*	100 +70%	120.36	143.25	147.04		147.15	0.000493	1.61	93.20	57.28	0.29
001	29.000*	1000	116.46	143.25	146.99		147.10	0.000495	1.60	90.59	56.52	0.29
001	19.333*	2	26.58	143.22	145.31		145.35	0.000491	0.95	27.92	20.06	0.26
001	19.333*	20	49.78	143.22	145.94		146.01	0.000460	1.18	45.82	35.57	0.26
001	19.333*	50	60.91	143.22	146.17		146.24	0.000451	1.25	54.47	41.71	0.27
001	19.333*	100	70.80	143.22	146.35		146.43	0.000443	1.30	62.35	46.72	0.27
001	19.333*	100 +5%	74.34	143.22	146.41		146.49	0.000447	1.33	65.13	48.30	0.27
001	19.333*	100 +25%	88.50	143.22	146.63		146.72	0.000430	1.38	76.51	52.43	0.27
001	19.333*	100 +70%	120.36	143.22	147.04		147.14	0.000417	1.50	99.56	59.66	0.27
001	19.333*	1000	116.46	143.22	147.00		147.09	0.000418	1.49	96.85	58.86	0.27
001	9.667*	2	26.58	143.19	145.31		145.35	0.000382	0.86	31.06	21.70	0.23
001	9.667*	20	49.78	143.19	145.95		146.00	0.000370	1.07	50.16	37.20	0.24
001	9.667*	50	60.91	143.19	146.17		146.24	0.000367	1.14	59.42	43.92	0.24
001	9.667*	100	70.80	143.19	146.35		146.42	0.000364	1.19	67.67	48.53	0.24
001	9.667*	100 +5%	74.34	143.19	146.41		146.48	0.000363	1.21	70.59	50.06	0.24
001	9.667*	100 +25%	88.50	143.19	146.64		146.71	0.000359	1.28	82.39	54.64	0.25
001	9.667*	100 +70%	120.36	143.19	147.05		147.13	0.000354	1.39	106.44	61.93	0.25
001	9.667*	1000	116.46	143.19	147.00		147.08	0.000354	1.38	103.61	61.33	0.25
001	0000	2	26.58	143.16	145.31	144.23	145.34	0.000300	0.77	34.38	23.32	0.20
001	0000	20	49.78	143.16	145.95	144.55	146.00	0.000300	0.97	54.86	40.30	0.21
001	0000	50	60.91	143.16	146.18	144.67	146.23	0.000300	1.04	64.73	46.17	0.22
001	0000	100	70.80	143.16	146.36	144.77	146.41	0.000300	1.10	73.37	50.58	0.22

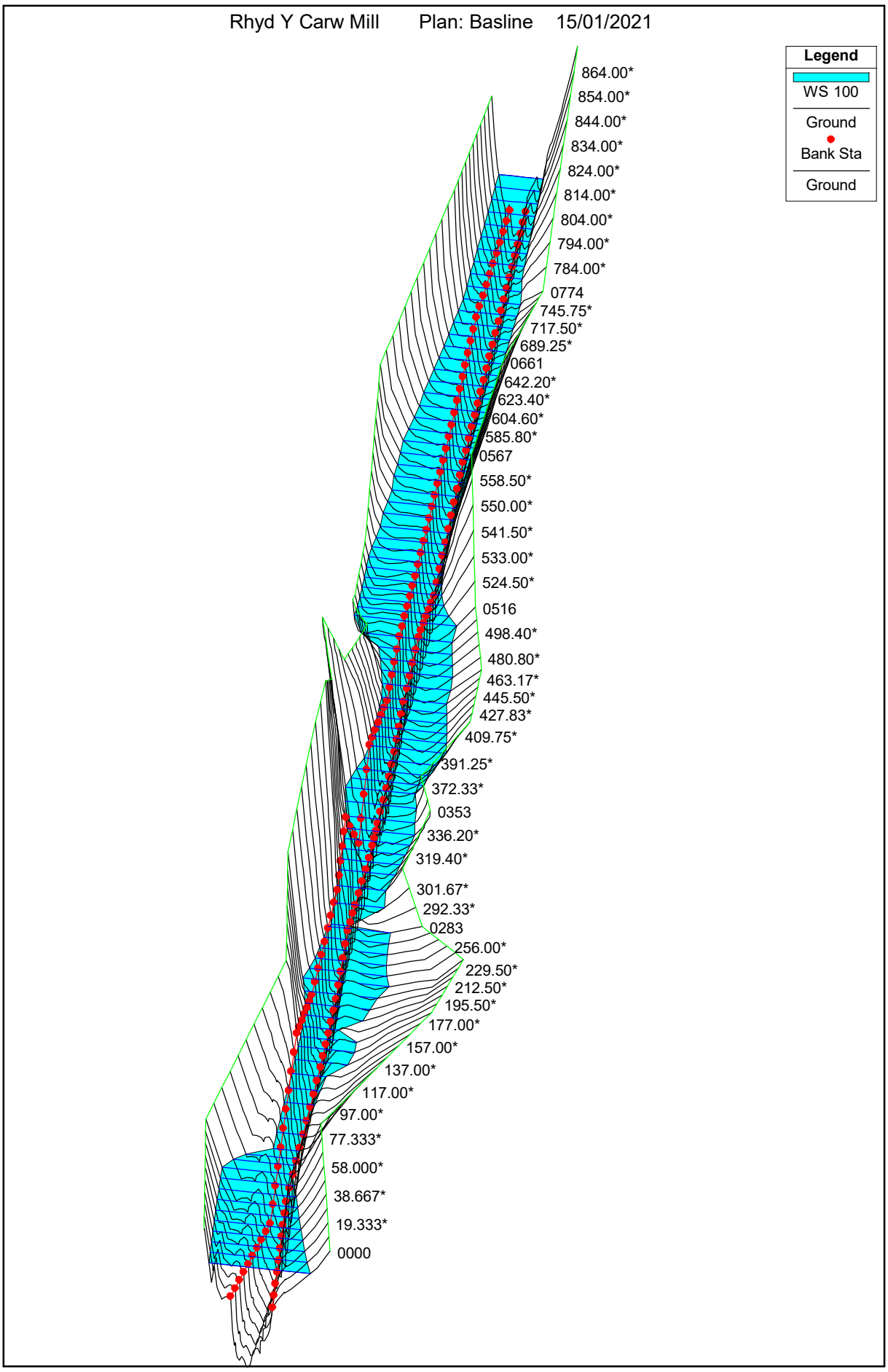
HEC-RAS Plan: Mannings n -20% River: River Trannon Reach: 001 (Continued)

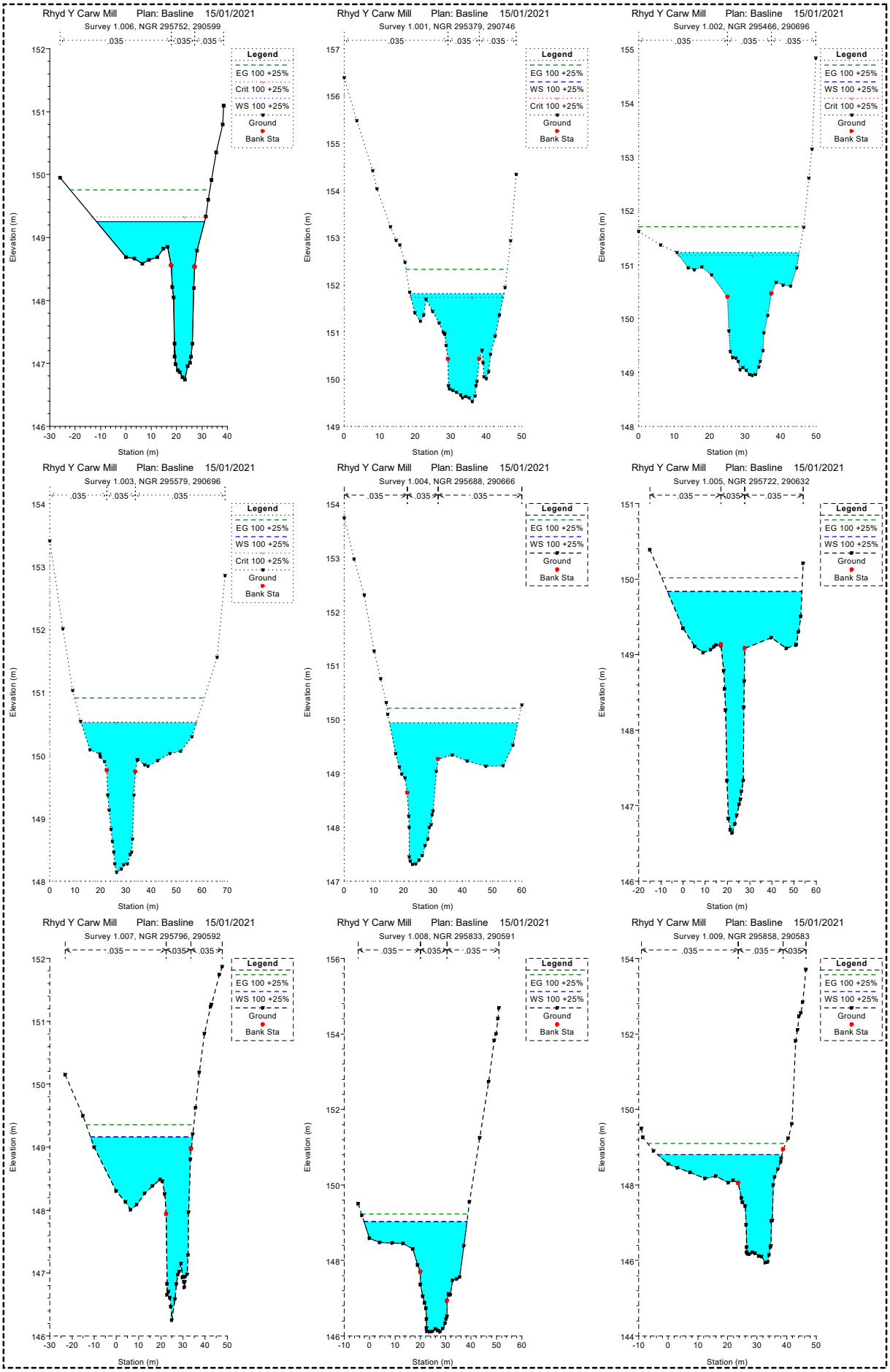
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
001	0000	100 +5%	74.34	143.16	146.41	144.81	146.47	0.000301	1.11	76.42	52.04	0.22
001	0000	100 +25%	88.50	143.16	146.64	144.94	146.70	0.000300	1.18	88.72	57.11	0.23
001	0000	100 +70%	120.36	143.16	147.05	145.22	147.12	0.000300	1.29	113.81	64.04	0.23
001	0000	1000	116.46	143.16	147.01	145.18	147.08	0.000300	1.28	110.88	63.44	0.23

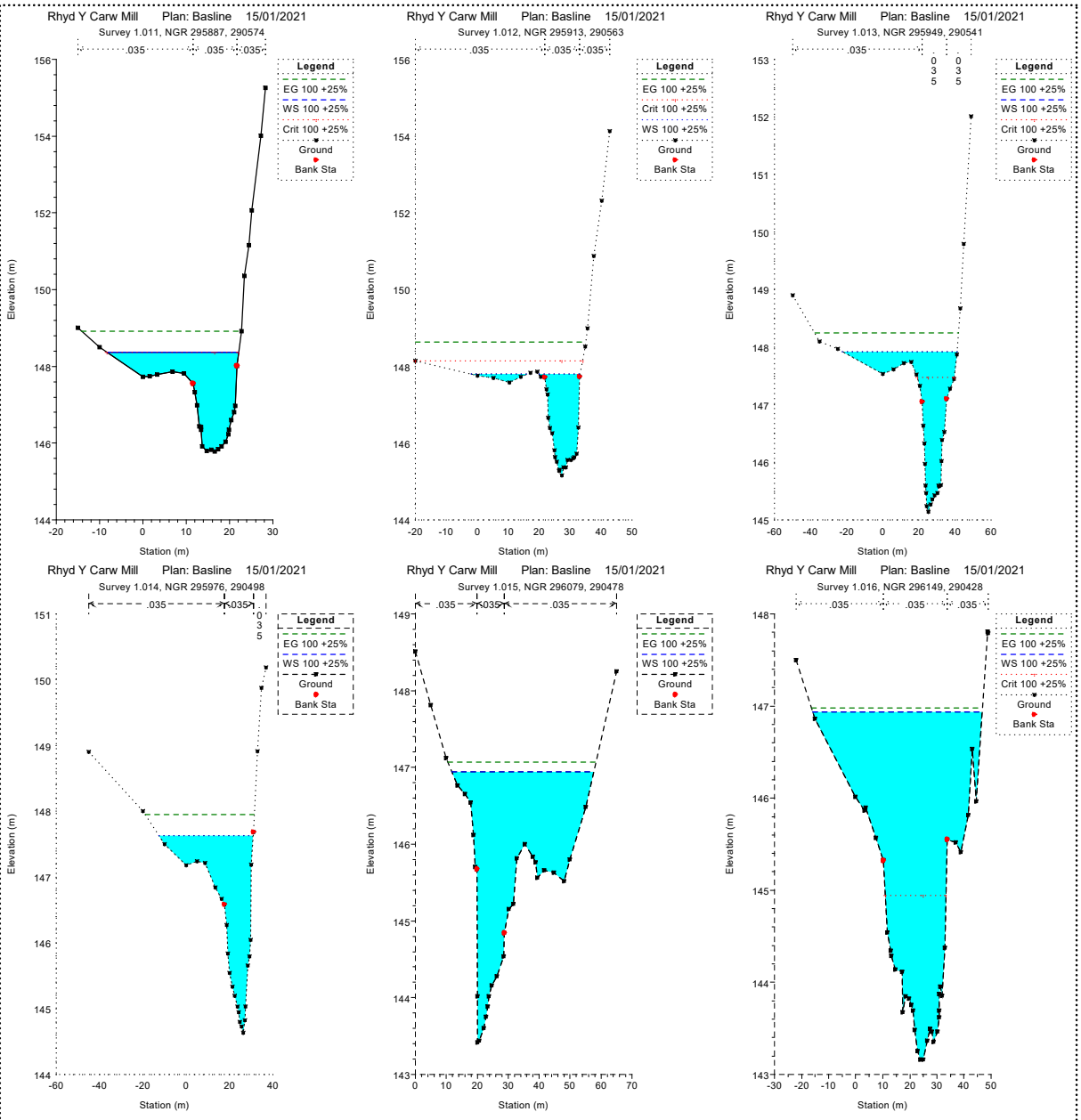
APPENDIX 11 – HEC-RAS Model Result Cross Sections & Long Sections

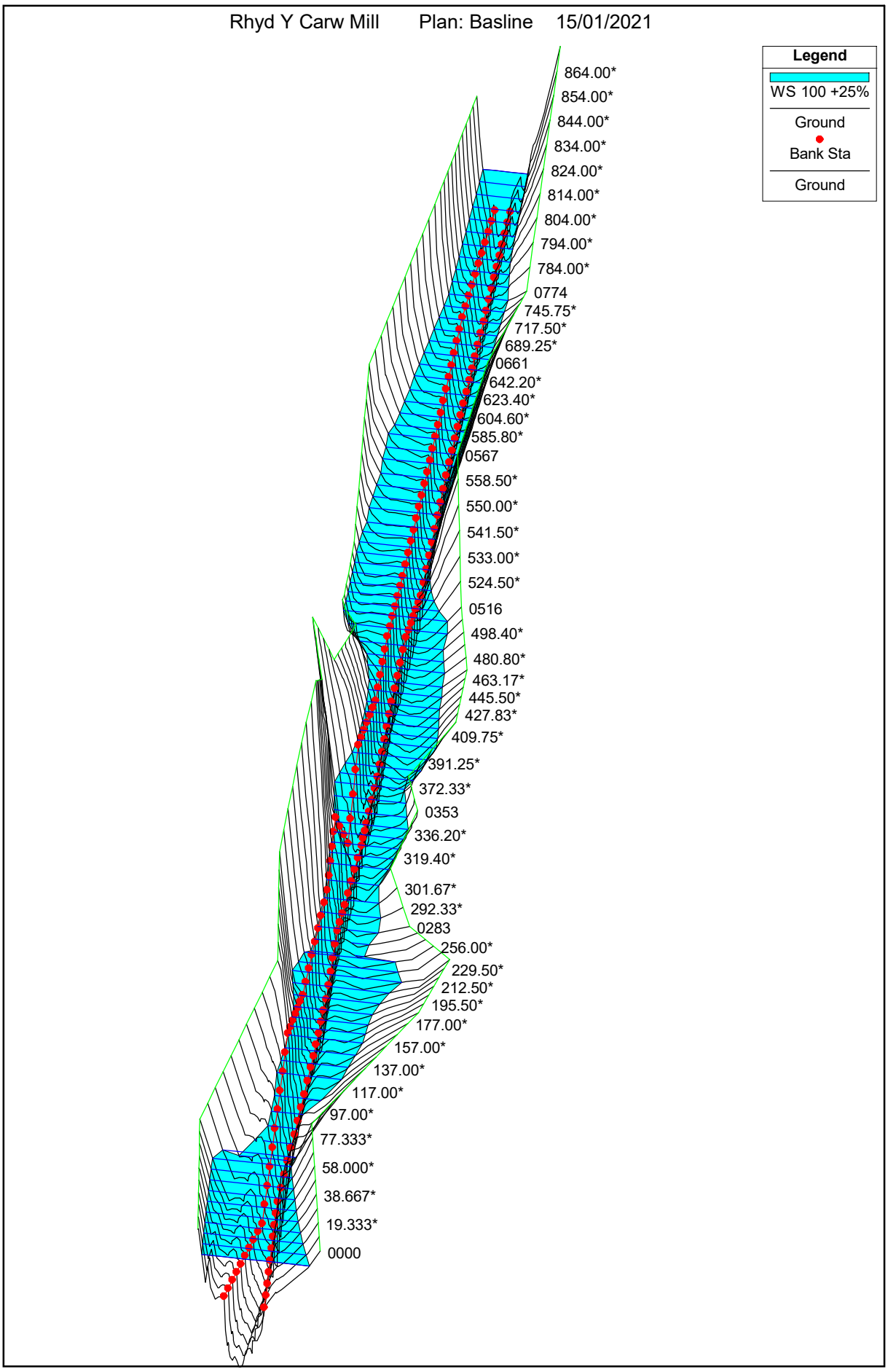

Rhyd Y Carw Mill Plan: Basline 15/01/2021
Survey 1.001, NGR 295379, 290746
Survey 1.002, NGR 295466, 290696
Survey 1.003, NGR 295579, 290696
Survey 1.004, NGR 295688, 290666
Survey 1.005, NGR 295722, 290632
Survey 1.006, NGR 295752, 290599
Survey 1.007, NGR 295796, 290592
Survey 1.008, NGR 295833, 290591
Survey 1.009, NGR 295858, 290583
.035
Legend
EG 100
WS 100
Crit 100
Ground
Bank Sta
Elevation (m)
Station (m)

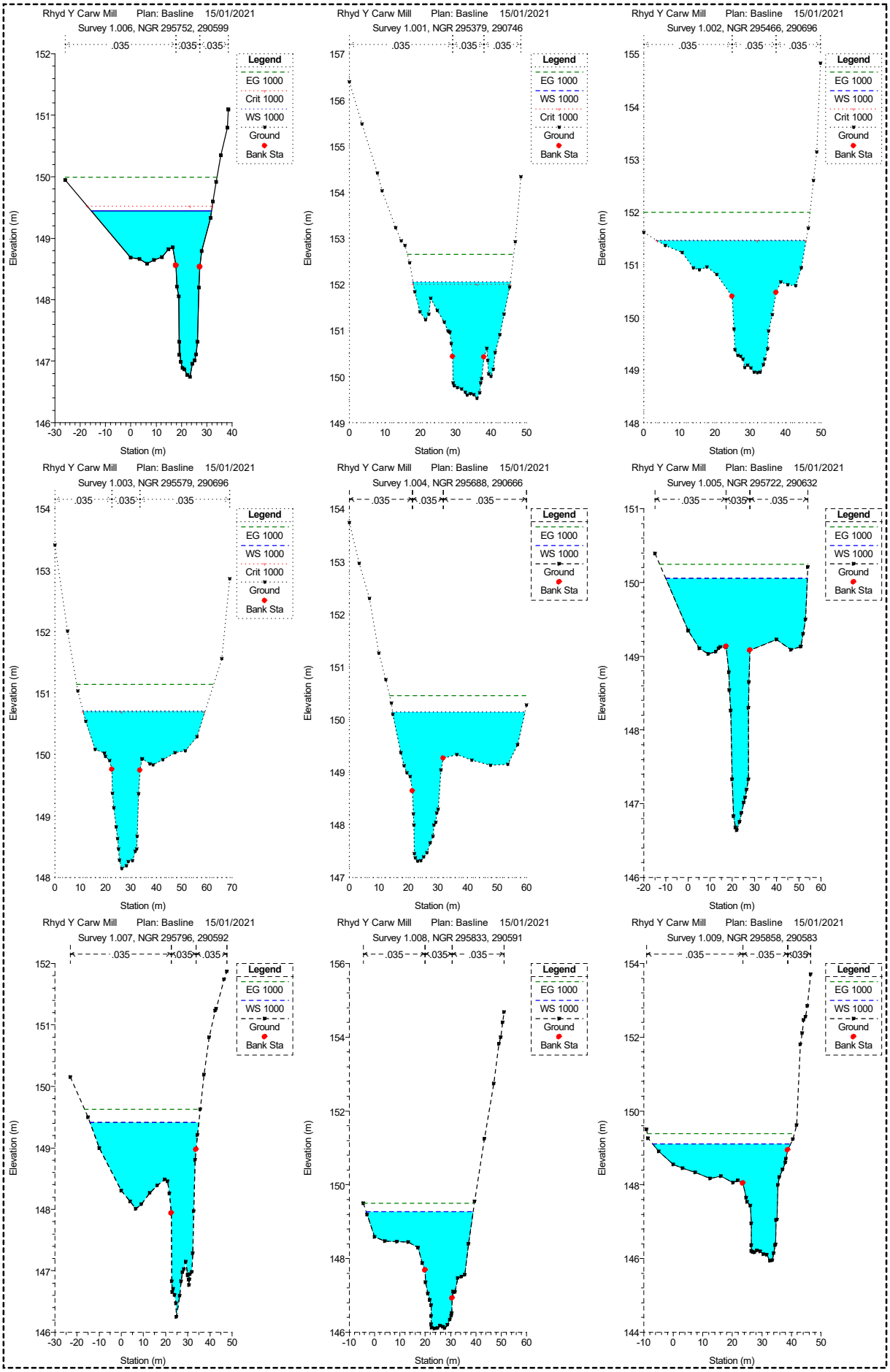

Rhyd Y Carw Mill Plan: Basline 15/01/2021
Survey 1.011, NGR 295887, 290574
Survey 1.012, NGR 295913, 290563
Survey 1.013, NGR 295949, 290541
Survey 1.014, NGR 295976, 290498
Survey 1.015, NGR 296079, 290478
Survey 1.016, NGR 296149, 290428
Legend
EG 100
WS 100
Crit 100
Ground
Bank Sta
Elevation (m)
Station (m)

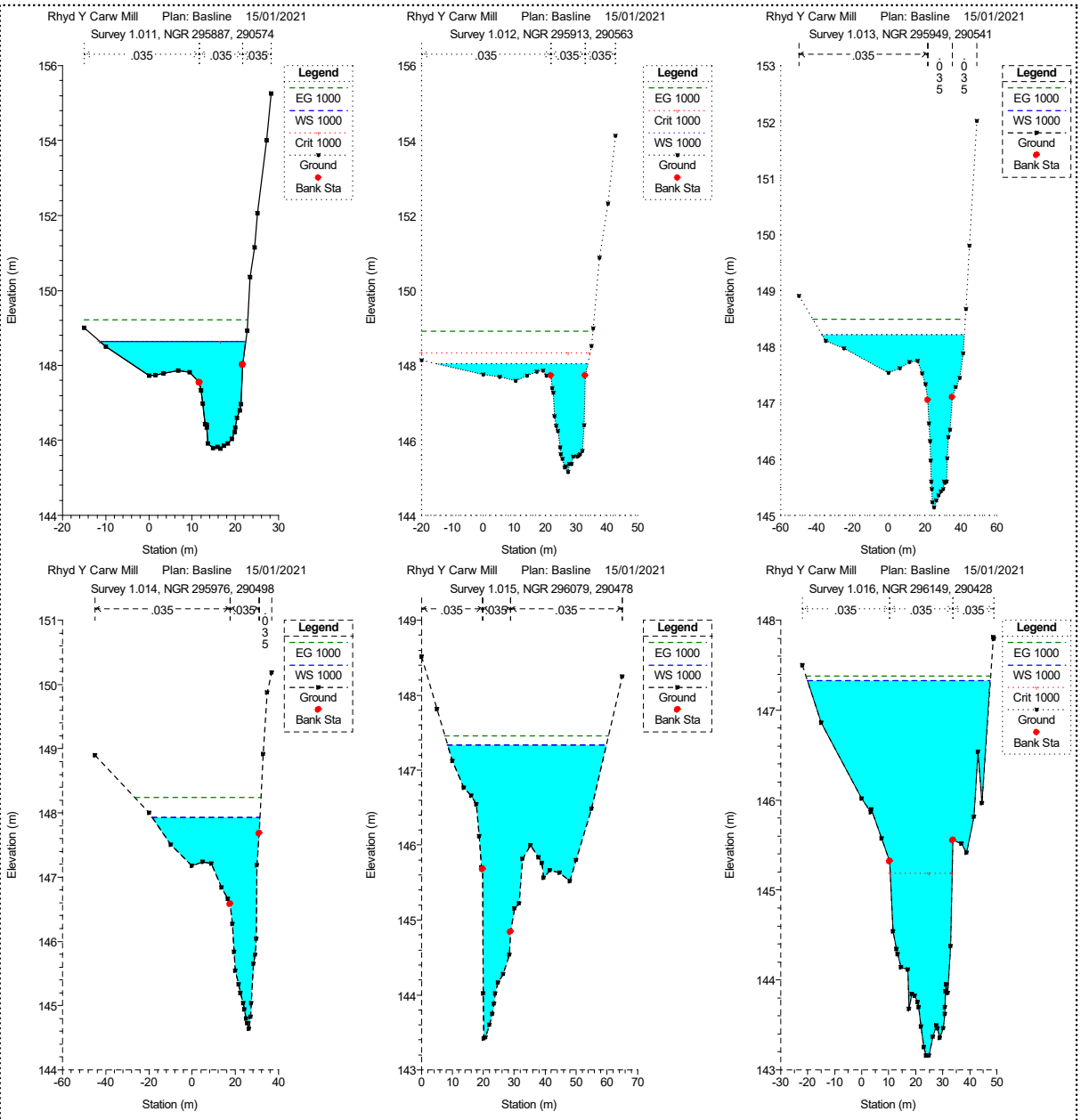

Rhyd Y Carw Mill Plan: Basline 15/01/2021
Legend
WS 100
Ground
Bank Sta
Ground
864.00*
854.00*
844.00*
834.00*
824.00*
814.00*
804.00*
794.00*
784.00*
0774
745.75*
717.50*
689.25*
0661
642.20*
623.40*
604.60*
585.80*
0567
558.50*
550.00*
541.50*
533.00*
524.50*
0516
498.40*
480.80*
463.17*
445.50*
427.83*
409.75*
391.25*
372.33*
0353
336.20*
319.40*
301.67*
292.33*
0283
256.00*
229.50*
212.50*
195.50*
177.00*
157.00*
137.00*
117.00*
97.00*
77.333*
58.000*
38.667*
19.333*
0000

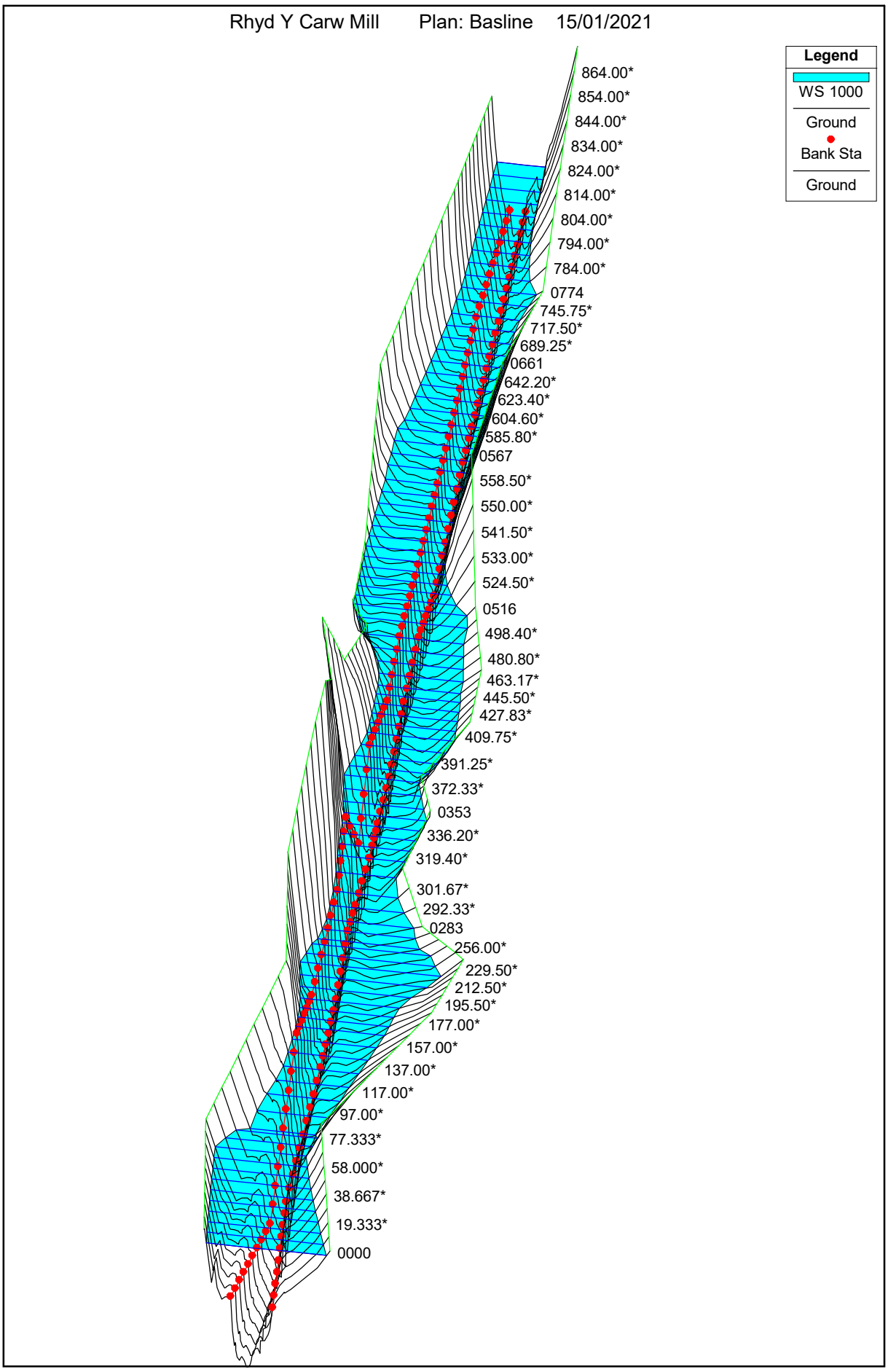

Rhyd Y Carw Mill Plan: Basline 15/01/2021
Survey 1.006, NGR 295752, 290599
Survey 1.001, NGR 295379, 290746
Survey 1.002, NGR 295466, 290696
Survey 1.003, NGR 295579, 290696
Survey 1.004, NGR 295688, 290666
Survey 1.005, NGR 295722, 290632
Survey 1.007, NGR 295796, 290592
Survey 1.008, NGR 295833, 290591
Survey 1.009, NGR 295858, 290583
.035
Legend
EG 100 +25%
WS 100 +25%
Crit 100 +25%
Ground
Bank Sta
Elevation (m)
Station (m)


Rhyd Y Carw Mill Plan: Basline 15/01/2021
Survey 1.011, NGR 295887, 290574
Survey 1.012, NGR 295913, 290563
Survey 1.013, NGR 295949, 290541
Survey 1.014, NGR 295976, 290498
Survey 1.015, NGR 296079, 290478
Survey 1.016, NGR 296149, 290428
Legend
EG 100 +25%
WS 100 +25%
Crit 100 +25%
Ground
Bank Sta
Elevation (m)
Station (m)

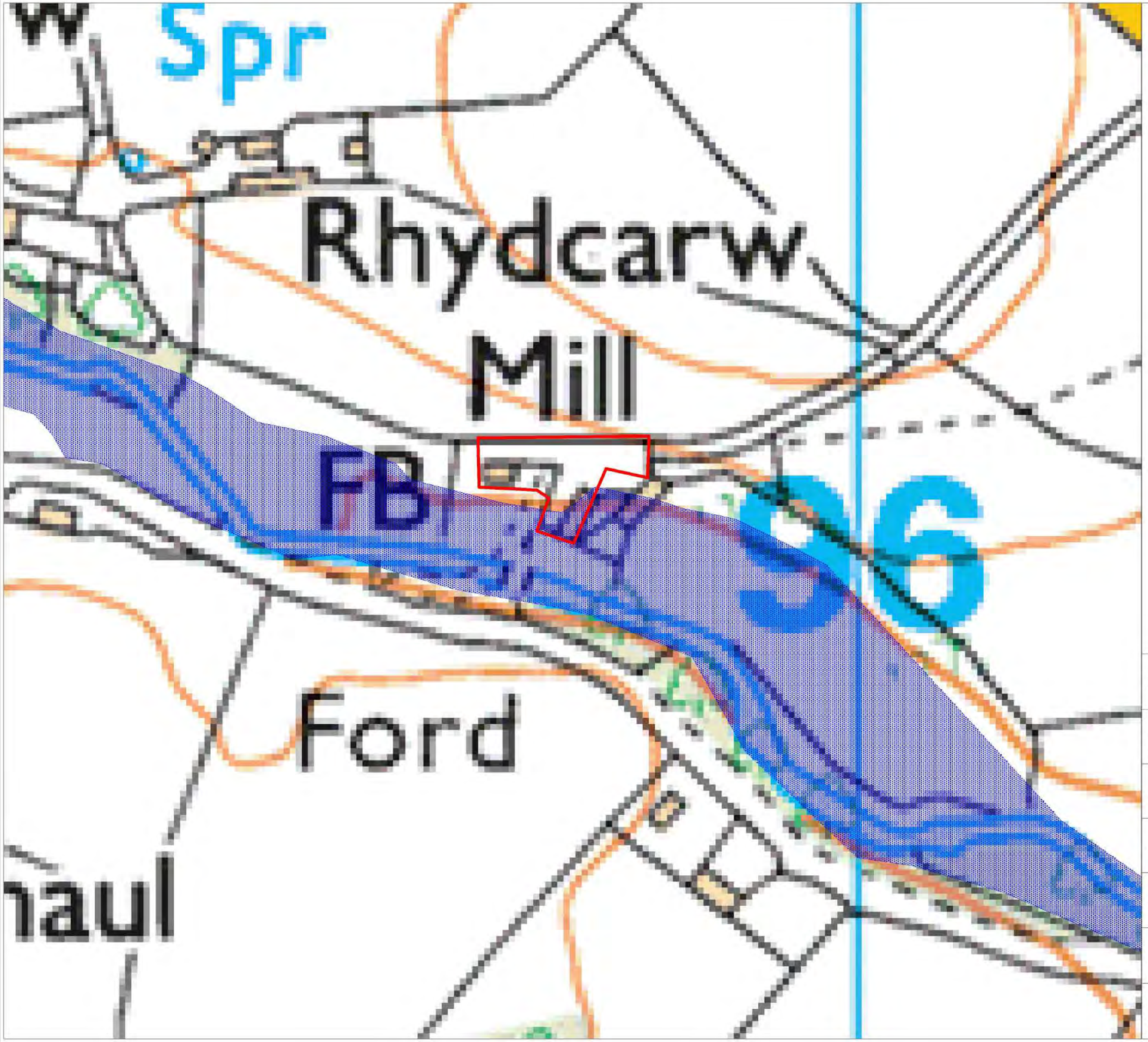

Rhyd Y Carw Mill Plan: Basline 15/01/2021
Legend
WS 100 +25%
Ground
Bank Sta
Ground
864.00*
854.00*
844.00*
834.00*
824.00*
814.00*
804.00*
794.00*
784.00*
0774
745.75*
717.50*
689.25*
0661
642.20*
623.40*
604.60*
585.80*
0567
558.50*
550.00*
541.50*
533.00*
524.50*
0516
498.40*
480.80*
463.17*
445.50*
427.83*
409.75*
391.25*
372.33*
0353
336.20*
319.40*
301.67*
292.33*
0283
256.00*
229.50*
212.50*
195.50*
177.00*
157.00*
137.00*
117.00*
97.00*
77.333*
58.000*
38.667*
19.333*
0000


Rhyd Y Carw Mill Plan: Basline 15/01/2021
Survey 1.006, NGR 295752, 290599
Survey 1.001, NGR 295379, 290746
Survey 1.002, NGR 295466, 290696
Survey 1.003, NGR 295579, 290696
Survey 1.004, NGR 295688, 290666
Survey 1.005, NGR 295722, 290632
Survey 1.007, NGR 295796, 290592
Survey 1.008, NGR 295833, 290591
Survey 1.009, NGR 295858, 290583
.035
Legend
EG 1000
WS 1000
Crit 1000
Ground
Bank Sta
Elevation (m)
Station (m)


Rhyd Y Carw Mill Plan: Basline 15/01/2021
Survey 1.011, NGR 295887, 290574
Survey 1.012, NGR 295913, 290563
Survey 1.013, NGR 295949, 290541
Survey 1.014, NGR 295976, 290498
Survey 1.015, NGR 296079, 290478
Survey 1.016, NGR 296149, 290428
Legend
EG 1000
WS 1000
Crit 1000
Ground
Bank Sta
Elevation (m)
Station (m)


Rhyd Y Carw Mill Plan: Basline 15/01/2021
Legend
WS 1000
Ground
Bank Sta
Ground
864.00*
854.00*
844.00*
834.00*
824.00*
814.00*
804.00*
794.00*
784.00*
0774
745.75*
717.50*
689.25*
0661
642.20*
623.40*
604.60*
585.80*
0567
558.50*
550.00*
541.50*
533.00*
524.50*
0516
498.40*
480.80*
463.17*
445.50*
427.83*
409.75*
391.25*
372.33*
0353
336.20*
319.40*
301.67*
292.33*
0283
256.00*
229.50*
212.50*
195.50*
177.00*
157.00*
137.00*
117.00*
97.00*
77.333*
58.000*
38.667*
19.333*
0000

APPENDIX 12 – Modelled Flood Outlines



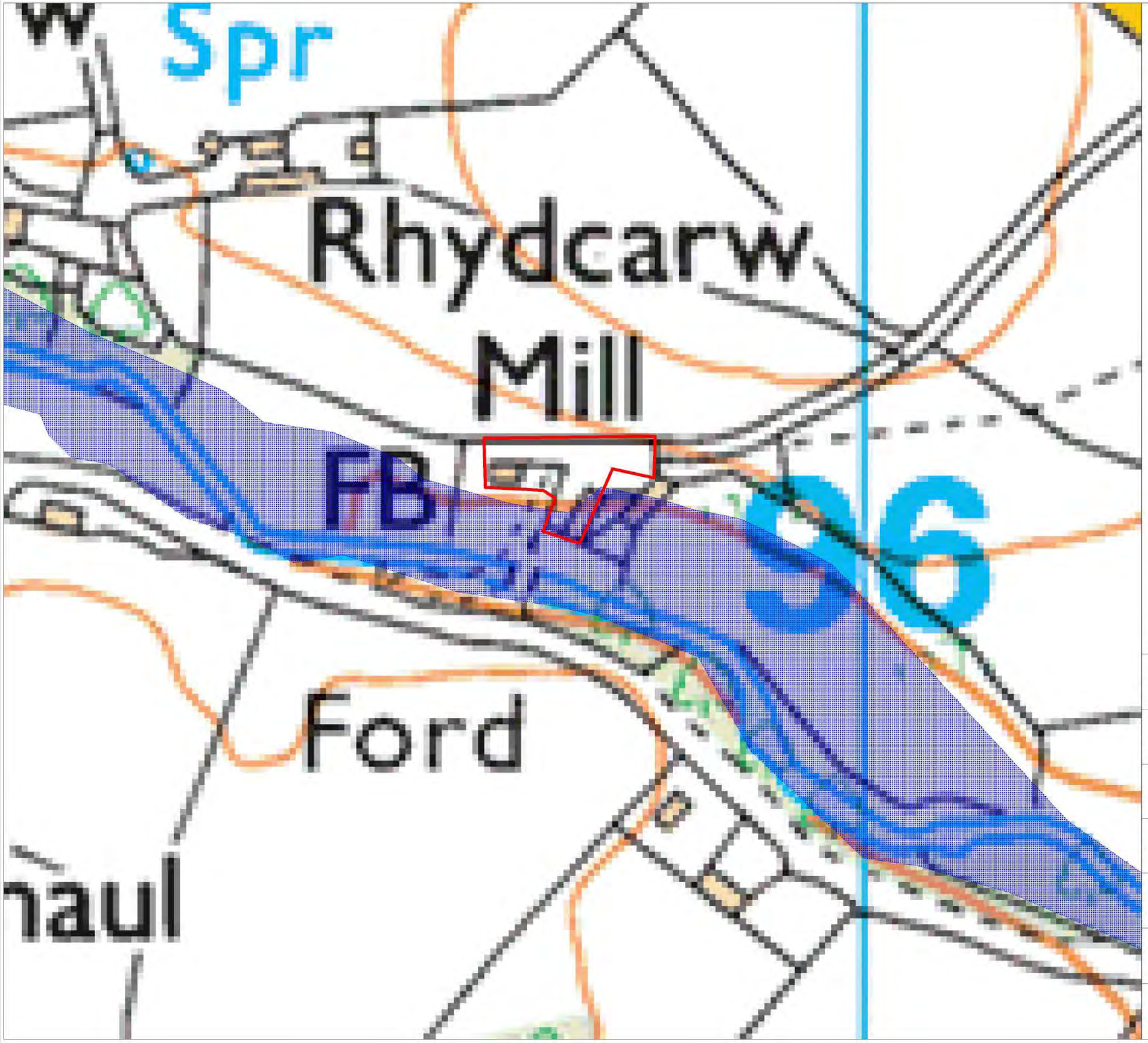
KEY

Site Boundary

1 in 100 Year Flood Outline

KRS Environmental

PROJECT	Rhyd Y Carw Mill, Trefeglwys, Caersws SY17 5PU
CLIENT	Straightforward Properties Ltd
TITLE	1 in 100 Year Modelled Flood Outline
PROJECT REF	KRS.0507.001
DRAWING NO	1
SCALE	1:1,500@A3
DATE	January 2021



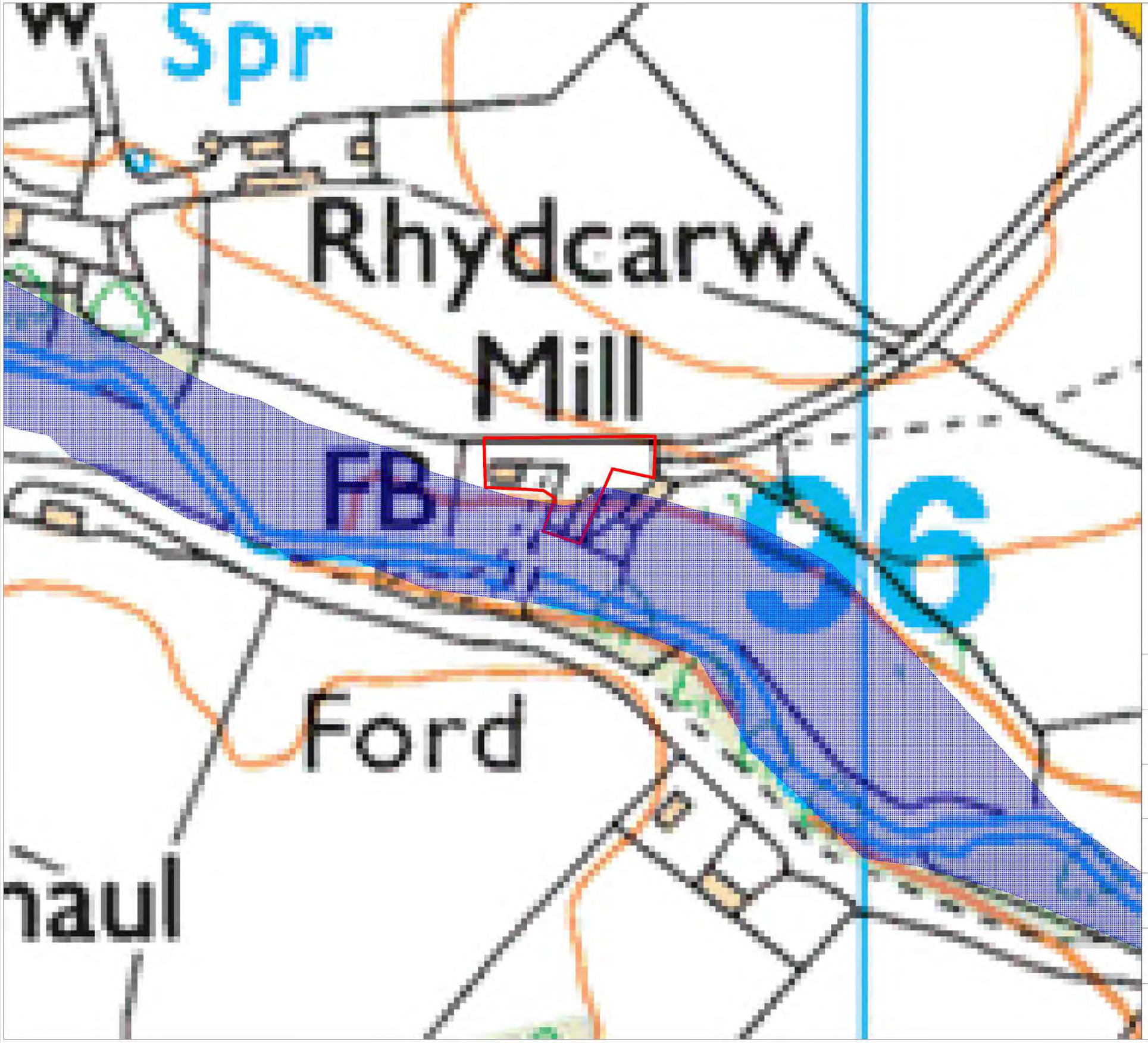
KEY

Site Boundary

1 in 100 Year (+25%) Flood Outline

KRS Environmental

PROJECT	Rhyd Y Carw Mill, Trefeglwys, Caersws SY17 5PU
CLIENT	Straightforward Properties Ltd
TITLE	1 in 100 Year (+25%) Modelled Flood Outline
PROJECT REF	KRS.0507.001
DRAWING NO	2
SCALE	1:1,500@A3
DATE	January 2021



KEY

Site Boundary

1 in 1000 Year Flood Outline

KRS Environmental

PROJECT	Rhyd Y Carw Mill, Trefeglwys, Caersws SY17 5PU
CLIENT	Straightforward Properties Ltd
TITLE	1 in 1000 Year Modelled Flood Outline
PROJECT REF	KRS.0507.001
DRAWING NO	3
SCALE	1:1,500@A3
DATE	January 2021

KRS Environmental Ltd

Mob: 07857 264 376

Tel: 01686 668957

Tel: 01484 437420

Email: keelan@krsenvironmental.com

Web: www.krsenvironmental.com