New England Resource Recovery Centre
New England Quarry, Nr Lee Mill

ISIS Modelling Report

Viridor

January 2010
SLR Ref: 402.0036.00350

1.0 INTRODUCTION

1.1 Background

Viridor Waste Management propose to develop a resource recovery centre located at New England Quarry in Devon, at National Grid Reference SX 595 547, 3km south west of Ivybridge and 1km south of the A38 Trunk Road, the principal route between Plymouth and Exeter.

The FRA has shown that two locations along the proposed access road are located in Flood Zones 3a and 2 (FZ3a and FZ2). Measures are therefore required to mitigate impacts from the proposed development.

This report provides details of further ISIS modelling undertaken to confirm that the proposed mitigation measures are effective. The locations of the areas of concern are shown on drawings FRA 1 and FRA2 in the flood risk assessment.

1.2 Report Structure

The report is structured as follows:

- Section 2 provides details of the baseline modelling confirming the extent of FZ3a and FZ2 in the vicinity of the development;
- Section 3 provides details of the modelling of the mitigation measures; and
- Section 4 provides a summary of the conclusions of the study.

This report should be read in conjunction with the FRA.

- Topographic Sections 6 and 7 - A break out is recorded at the north-western corner of Strashleigh Hams landfill site, close to topographic section 6 on drawing FRA1
- Topographic Sections 10 and 11 - A larger area of the proposed road is flooded to the south of Strashleigh Hams landfill site, the deepest flood levels are predicted between the river and the pond, between topographic sections 10 and 11. At this location a flow route exists linking the Yealm to the eastern tributary at its northern most extent.

At both locations the proposed road is located within both FZ3a and FZ2.

3.2 Mitigation at Topographic Sections 10 and 11

A flood plain bridge has been designed to cross the main area of conveyance between the River Yealm and the pond and eastern tributary, covering the entire extent of the 100 year flood event.

The bridge has been designed to clear the 100 year flood extent by 1m, creating a soffit level of approximately 41.5mOD and a deck level of approximately 43mOD.

Results from the mitigation models have been compared to results in the baseline model and are summarised in Table 3-2 and 3-3 below. Full results tables are included in Appendix 2. These results show that the proposed bridge design will have minimal impact on flood levels and flows. Downstream of the bridge flood levels drop while a rise is recorded at the bridge which aids conveyance and mitigates any potential impact down-stream.

Table 3-2
ISIS Modelling Results Comparison (River Yealm)

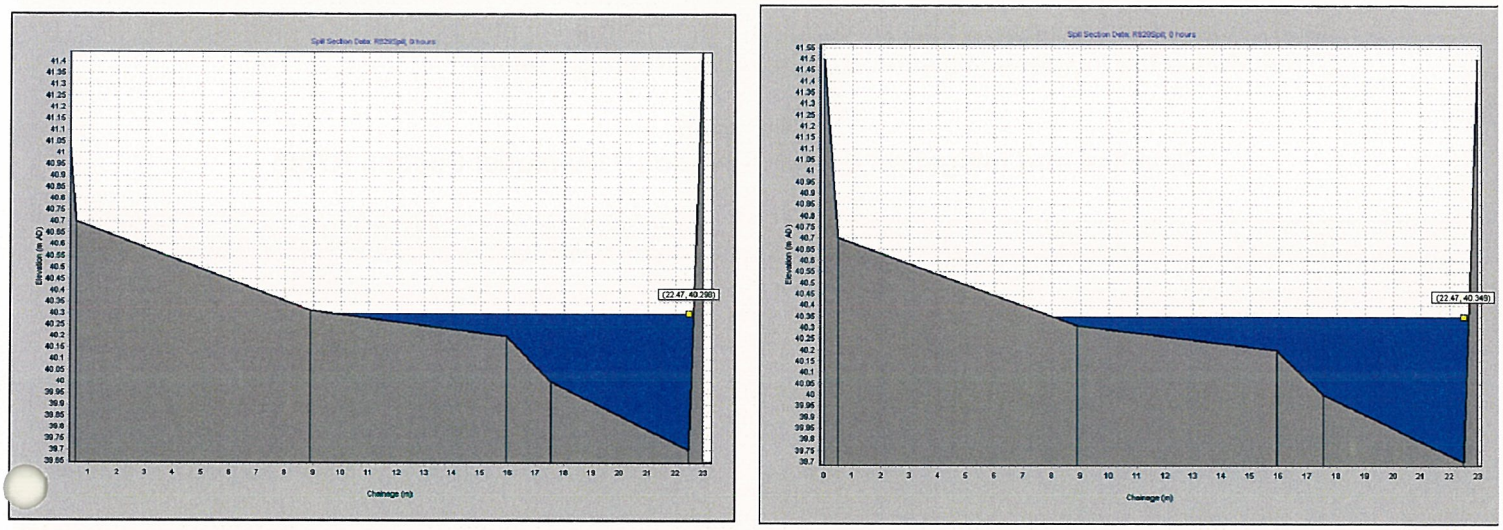
Topographic Section Number (Model Section Number)	Baseline Model		Mitigation Model	
	Maximum stage (mOD)	Maximum Flow (Cumecs)	Maximum stage (mOD)	Maximum Flow (Cumecs)
Section 10 (R852)	40.448	56.253	40.488	56.253
Section 10A (R829)	40.298	56.253	40.349	56.253
Section 10A Spill (R829Spill)	40.298	1.611	40.349	2.535
Section 10A (R829D)	40.298	54.642	40.349	53.718
Section 11 (R813)	40.210	54.642	40.111	53.718
Section 11A (R786)	40.249	54.642	40.212	53.718
Section 12 (R757)	39.667	54.642	39.649	53.718

The increased flow through the spill, as indicate in Table 3-2 and Figure 3, results in increased velocities and flood levels within the eastern tributary of between 33mm and 46mm. This will marginally increase the flood zone along the tributary, although it is a small enough increase as to have no impact upon the access road.

Table 3-3
Isis Modelling Results Comparison (Eastern Tributary)

Model Section Number	Baseline Model		Mitigation Model	
	Maximum stage (mOD)	Maximum Flow (Cumecs)	Maximum stage (mOD)	Maximum Flow (Cumecs)
T310U	40.286	3.808	40.33	3.808
T310D	40.286	5.419	40.33	6.343
T275	40.192	5.419	40.232	6.343
T245	40.065	5.419	40.099	6.343
T220	39.924	5.419	39.970	6.343

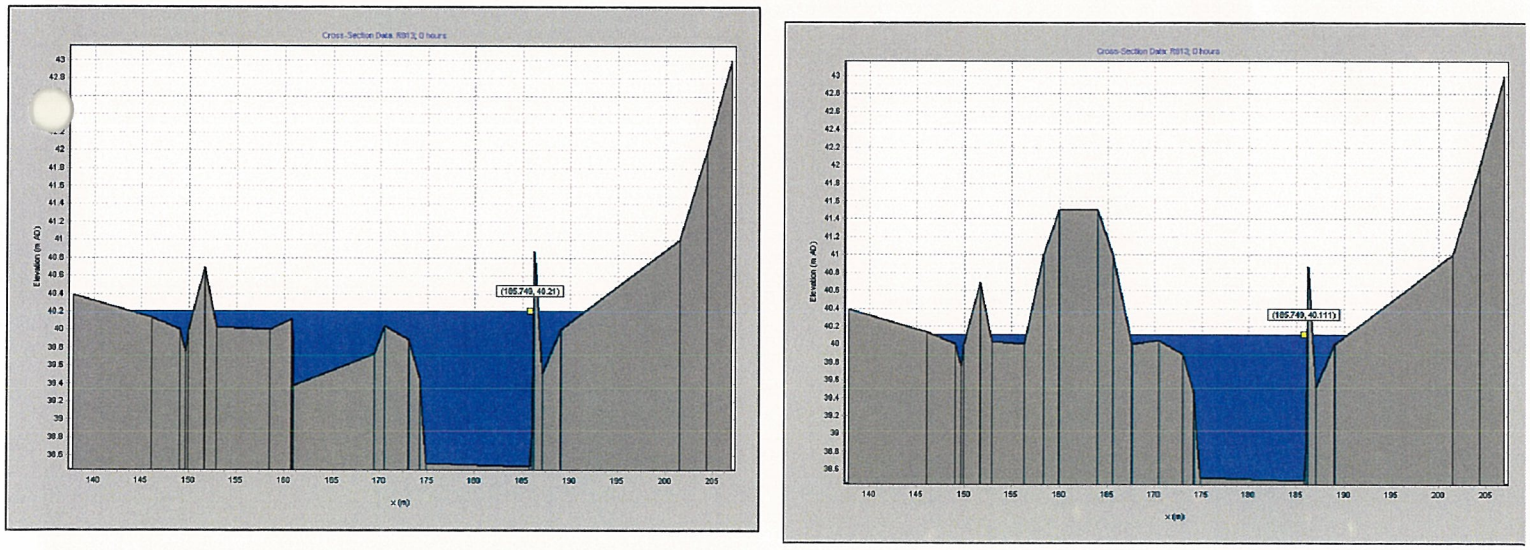
Figure 3
Baseline and mitigation Models (Topographic Section 10A/ Model Section – R829 Spill)



3.2.2 Topographic Section 11 (Model Section R813)

Section 11, located south of the bridge includes the access road within the mitigation model. This results in the loss of potential floodplain on the eastern side of the river and results in a rise in river level up-stream; however a fall in water level of 9mm, as indicated in Figure 4 below, is recorded at this location due to the extra conveyance at the bridge.

Figure 4
Baseline and mitigation Models (Topographic Section 11/ Model Section R813)



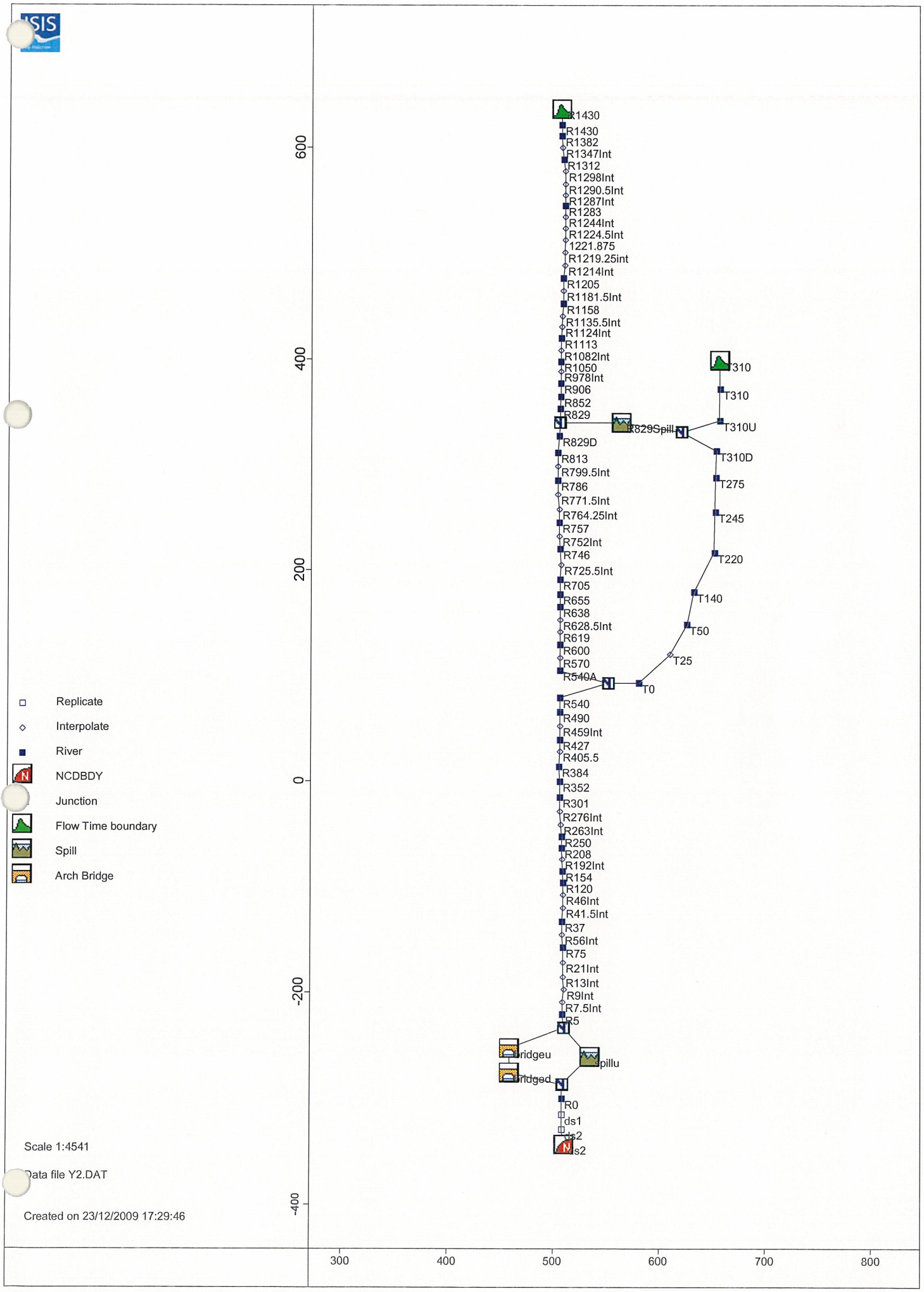
4.0 CONCLUSIONS AND RECOMMENDATIONS

The baseline modelling of the River Yealm from the A38 Lee Mill junction to Popples Bridge indicates two key areas of concern regarding the proposed access road. A small area of flooding is recorded at the north-west corner of Strashleigh Hams landfill site (topographic sections 6 and 7) while a larger area is recorded south of Strashleigh Hams which potentially connects the River Yealm with the un-named tributary to the east during a 1 in 100 year and 1 in 1000 year flood event (topographic sections 10 and 11).

The proposed mitigation at topographic sections 6 and 7 is to raise the road level beyond that of the flood zone. The relatively small flooded area and the minimal depth of flooding in the baseline model means that a raise in ground levels has minimal impact on river levels in the mitigation model.

At topographic sections 10 and 11, the southern location, it is proposed to construct a raised access road on a bridge spanning the main area of conveyance from the River Yealm to the pond and eastern tributary. The proposed mitigation is shown not to increase flood risk in the River Yealm.

Appendix 1 ISIS Model layout and Section Defences


R1430
R1430
R1382
R1347Int
R1312
R1298Int
R1290.5Int
R1287Int
R1283
R1244Int
R1224.5Int
1221.875
R1219.25int
R1214Int
R1205
R1181.5Int
R1158
R1135.5Int
R1124Int
R1113
R1082Int
R1050
R978Int
R906
R852
R829
R829Spill
R829D
R813
R799.5Int
R786
R771.5Int
R764.25Int
R757
R752Int
R746
R725.5Int
R705
R655
R638
R628.5Int
R619
R600
R570
R540A
R540
R490
R459Int
R427
R405.5
R384
R352
R301
R276Int
R263Int
R250
R208
R192Int
R154
R120
R46Int
R41.5Int
R37
R56Int
R75
R21Int
R13Int
R9Int
R7.5Int
R5
Bridgeu
Spillu
Bridged
R0
ds1
ds2
ds2
T310
T310
T310U
T310D
T275
T245
T220
T140
T50
T25
T0
Replicate
Interpolate
River
NCDBDY
Junction
Flow Time boundary
Spill
Arch Bridge
Scale 1:4541
Data file Y2.DAT
Created on 23/12/2009 17:29:46
600
400
200
0
-200
-400
300
400
500
600
700
800

Appendix 1: Topographic Section and ISIS Model Sections

Topographic Section Number	ISIS Model Section Number	Notes
1	R1430	
2	R1382	
3	R1312	
4	R1283	
5	R1205	
6	R1158	Location of northern breakout
7	R1113	
8	R1050	
9	R906	
10	R852	
10a	R829	Beginning of bridge in flood plain
	R829Spill	Spill connecting River Yealm into adjacent pond / eastern tributary during flood
	R829D	Section through the flood plain bridge
11	R813	Raised access road through flood plain
11a	R786	
12	R757	
13	R746	
14	R705	
15	R655	
16	R638	Yealm Bridge crossing located between sections 16 and 17
17	R600	
18	R540A	Junction where T series (Tributary) join the River Yealm
	R540	
19	R490	
20	R427	
21	R384	
22	R352	
23	R301	
24	R250	
25	R208	
26	R154	
27	R120	
28	R75	
29	R37	
30	R5	North of Popples Bridge
31	R0	South of Popples Bridge

Note: Topographic Section locations are shown on drawings FRA1 and FRA2, included within Appendix 2
ISIS model Layout includes additional interpolated sections and Tributary sections (T0 – T310)

Output data from file S:\0036 - VIRIDOR\00350 - NEW ENGLAND QUARRY ES\TECHNICAL FILES\HYDRO\WORKING FILES\ISIS\MITIGATION\Y2.ZZN
Selected output data from time (hr): 0
to time (hr): 0.001

Label	Max Flow	Max Stage	Max Fr	Max Velocity	Min Flow	Min Stage	Min Fr	Min Velocity
R1430	56.253	43.751	0.893	3.269	56.253	43.751	0.893	3.269
R1382	56.253	43.195	1.102	3.881	56.253	43.195	1.102	3.881
R1347Int	56.253	42.832	1.069	2.766	56.253	42.832	1.069	2.766
R1312	56.253	42.799	0.463	1.962	56.253	42.799	0.463	1.962
R1298Int	56.253	42.891	0.461	1.255	56.253	42.891	0.461	1.255
R1290.5Int	56.253	42.739	1.023	2.254	56.253	42.739	1.023	2.254
R1287Int	56.253	42.707	1.028	2.801	56.253	42.707	1.028	2.801
R1283	56.253	42.656	1.156	3.489	56.253	42.656	1.156	3.489
R1244Int	56.253	42.121	1.155	2.554	56.253	42.121	1.155	2.554
R1224.5Int	56.253	42.078	0.591	1.771	56.253	42.078	0.591	1.771
1221.875	56.253	42.066	0.573	1.781	56.253	42.066	0.573	1.781
R1219.25Ir	56.253	42.05	0.564	1.813	56.253	42.05	0.564	1.813
R1214Int	56.253	42.003	0.574	1.962	56.253	42.003	0.574	1.962
R1205	56.253	41.627	0.859	3.229	56.253	41.627	0.859	3.229
R1181.5Int	56.253	41.855	0.572	1.898	56.253	41.855	0.572	1.898
R1158	56.253	41.806	0.519	1.812	56.253	41.806	0.519	1.812
R1135.5Int	56.253	41.735	0.585	1.762	56.253	41.735	0.585	1.762
R1124Int	56.253	41.666	0.651	1.836	56.253	41.666	0.651	1.836
R1113	56.253	41.508	0.9	2.345	56.253	41.508	0.9	2.345
R1082Int	56.253	41.43	0.597	1.634	56.253	41.43	0.597	1.634
R1050	56.253	41.27	0.575	1.962	56.253	41.27	0.575	1.962
R978Int	56.253	41.121	0.627	1.416	56.253	41.121	0.627	1.416
R906	56.253	40.548	0.886	3.359	56.253	40.548	0.886	3.359
R852	56.253	40.448	0.762	2.316	56.253	40.448	0.762	2.316
R829	56.253	40.298	0.624	1.616	56.253	40.298	0.624	1.616
R829D	54.642	40.298	0.606	1.57	54.642	40.298	0.606	1.57
R829Spill	1.611	40.298	0.967	2.971	1.611	40.298	0.967	2.971
R813	54.642	40.21	0.767	1.746	54.642	40.21	0.767	1.746
R799.5Int	54.642	40.243	0.498	1.177	54.642	40.243	0.498	1.177
R786	54.642	40.249	0.357	0.851	54.642	40.249	0.357	0.851
R771.5Int	54.642	40.157	0.513	1.22	54.642	40.157	0.513	1.22
R764.25Int	54.642	40.011	0.76	1.817	54.642	40.011	0.76	1.817
R757	54.642	39.667	1.082	3.501	54.642	39.667	1.082	3.501
R752Int	54.642	39.748	0.787	2.6	54.642	39.748	0.787	2.6
R746	54.642	39.858	0.647	2.078	54.642	39.858	0.647	2.078
R725.5Int	54.642	39.773	0.686	2.103	54.642	39.773	0.686	2.103
R705	54.642	39.515	0.818	2.607	54.642	39.515	0.818	2.607
R655	54.642	39.481	0.499	1.695	54.642	39.481	0.499	1.695
R638	54.642	39.38	0.54	2.007	54.642	39.38	0.54	2.007
R628.5Int	54.642	39.401	0.583	1.704	54.642	39.401	0.583	1.704
R619	54.642	39.369	0.688	1.684	54.642	39.369	0.688	1.684
R600	54.642	39.095	1.125	3.116	54.642	39.095	1.125	3.116
R570	54.642	38.981	0.695	1.443	54.642	38.981	0.695	1.443
R540A	54.642	38.901	0.422	0.81	54.642	38.901	0.422	0.81
R540	60.061	38.901	0.464	0.891	60.061	38.901	0.464	0.891
R490	60.061	38.702	0.408	0.755	60.061	38.702	0.408	0.755
R459Int	60.061	38.562	0.481	0.837	60.061	38.562	0.481	0.837
R427	60.061	38.361	0.665	1.033	60.061	38.361	0.665	1.033
R405.5	60.061	38.245	0.501	1.014	60.061	38.245	0.501	1.014
R384	60.061	38.182	0.439	1.06	60.061	38.182	0.439	1.06
R352	60.061	38.048	0.531	1.436	60.061	38.048	0.531	1.436
R301	60.061	37.636	1.016	2.365	60.061	37.636	1.016	2.365
R276Int	60.061	37.547	0.846	1.936	60.061	37.547	0.846	1.936
R263Int	60.061	37.493	0.804	1.812	60.061	37.493	0.804	1.812
R250	60.061	37.433	0.78	1.726	60.061	37.433	0.78	1.726
R208	60.061	37.304	0.66	1.245	60.061	37.304	0.66	1.245
R192Int	60.061	37.251	0.592	1.152	60.061	37.251	0.592	1.152
R154	60.061	37.135	0.437	0.945	60.061	37.135	0.437	0.945
R120	60.061	36.836	0.751	2.112	60.061	36.836	0.751	2.112
R75	60.061	36.064	1.169	2.323	60.061	36.064	1.169	2.323
R46Int	60.061	36.628	0.734	1.97	60.061	36.628	0.734	1.97
R41.5Int	60.061	36.526	0.85	2.148	60.061	36.526	0.85	2.148
R37	60.061	36.294	1.119	2.828	60.061	36.294	1.119	2.828
R56Int	60.061	36.166	1.188	2.507	60.061	36.166	1.188	2.507
R21Int	60.061	35.831	1.222	2.051	60.061	35.831	1.222	2.051
R13Int	60.061	35.713	1.134	1.938	60.061	35.713	1.134	1.938
R9Int	60.061	35.655	1.086	1.883	60.061	35.655	1.086	1.883
R7.5Int	60.061	35.627	1.059	1.853	60.061	35.627	1.059	1.853
R5	60.061	35.599	1.03	1.821	60.061	35.599	1.03	1.821
bridgeu	32.063	35.599	0	0	32.063	35.599	0	0
bridged	32.063	35.582	0	0	32.063	35.582	0	0
spillu	27.998	35.599	0	0	27.998	35.599	0	0
spilld	27.998	35.526	0	0	27.998	35.526	0	0
J1	32.063	35.526	0	0	32.063	35.526	0	0
R0	60.061	35.526	0.992	1.77	60.061	35.526	0.992	1.77
ds1	60.061	34.526	0.992	1.769	60.061	34.526	0.992	1.769
ds2	60.061	33.489	1.132	1.943	60.061	33.489	1.132	1.943
T0	5.419	38.901	0.873	1.614	5.419	38.901	0.873	1.614
T50	5.419	39.15	0.337	0.379	5.419	39.15	0.337	0.379
T25	5.419	39.117	0.469	0.51	5.419	39.117	0.469	0.51
T140	5.419	39.417	0.388	0.452	5.419	39.417	0.388	0.452
T310	3.808	40.286	0.293	0.403	3.808	40.286	0.293	0.403
T310U	3.808	40.286	0.293	0.403	3.808	40.286	0.293	0.403
T275	5.419	40.192	0.327	0.328	5.419	40.192	0.327	0.328
T245	5.419	40.065	0.638	0.551	5.419	40.065	0.638	0.551
T220	5.419	39.924	0.557	0.511	5.419	39.924	0.557	0.511
T310D	5.419	40.286	0.417	0.573	5.419	40.286	0.417	0.573
T310Spill	1.611	40.286	0.381	0.46	1.611	40.286	0.381	0.46

Appendix 3 Mitigation Modelling Results

Output data from file S:\0036 - VIRIDOR\00350 - NEW ENGLAND QUARRY ES\TECHNICAL FILES\HYDRO\WORKING FILES\ISIS\MITIGATION\Y2 - BOTH ROADS ALTERED.ZZN
Selected output data from time (hr): 0
to time (hr): 0.001

Label	Max Flow	Max Stage	Max Fr	Max Velocity	Min Flow	Min Stage	Min Fr	Min Velocity
R1430	56.253	43.751	0.893	3.269	56.253	43.751	0.893	3.269
R1382	56.253	43.195	1.102	3.881	56.253	43.195	1.102	3.881
R1347Int	56.253	42.832	1.069	2.766	56.253	42.832	1.069	2.766
R1312	56.253	42.799	0.463	1.962	56.253	42.799	0.463	1.962
R1298Int	56.253	42.891	0.461	1.255	56.253	42.891	0.461	1.255
R1290.5Int	56.253	42.739	1.023	2.254	56.253	42.739	1.023	2.254
R1287Int	56.253	42.707	1.028	2.801	56.253	42.707	1.028	2.801
R1283	56.253	42.656	1.155	3.489	56.253	42.656	1.155	3.489
R1244Int	56.253	42.121	1.155	2.553	56.253	42.121	1.155	2.553
R1224.5Int	56.253	42.078	0.591	1.77	56.253	42.078	0.591	1.77
1221.875	56.253	42.066	0.573	1.78	56.253	42.066	0.573	1.78
R1219.25Ir	56.253	42.051	0.564	1.813	56.253	42.051	0.564	1.813
R1214Int	56.253	42.004	0.574	1.962	56.253	42.004	0.574	1.962
R1205	56.253	41.628	0.858	3.227	56.253	41.628	0.858	3.227
R1181.5Int	56.253	41.832	0.554	2.019	56.253	41.832	0.554	2.019
R1158	56.253	41.806	0.517	1.815	56.253	41.806	0.517	1.815
R1135.5Int	56.253	41.735	0.585	1.762	56.253	41.735	0.585	1.762
R1124Int	56.253	41.666	0.65	1.836	56.253	41.666	0.65	1.836
R1113	56.253	41.508	0.899	2.344	56.253	41.508	0.899	2.344
R1082Int	56.253	41.432	0.594	1.63	56.253	41.432	0.594	1.63
R1050	56.253	41.273	0.574	1.957	56.253	41.273	0.574	1.957
R978Int	56.253	41.126	0.619	1.403	56.253	41.126	0.619	1.403
R906	56.253	40.538	0.892	3.381	56.253	40.538	0.892	3.381
R852	56.253	40.488	0.732	2.207	56.253	40.488	0.732	2.207
R829	56.253	40.349	0.582	1.538	56.253	40.349	0.582	1.538
R829D	53.718	40.349	0.556	1.469	53.718	40.349	0.556	1.469
R829Spill	2.535	40.349	0.967	2.971	2.535	40.349	0.967	2.971
R813	53.718	40.111	0.96	2.478	53.718	40.111	0.96	2.478
R799.5Int	53.718	40.202	0.595	1.632	53.718	40.202	0.595	1.632
R786	53.718	40.212	0.417	1.342	53.718	40.212	0.417	1.342
R771.5Int	53.718	40.097	0.568	1.691	53.718	40.097	0.568	1.691
R764.25Int	53.718	39.908	0.797	2.332	53.718	39.908	0.797	2.332
R757	53.718	39.649	1.086	3.496	53.718	39.649	1.086	3.496
R752Int	53.718	39.726	0.779	2.605	53.718	39.726	0.779	2.605
R746	53.718	39.837	0.586	2.08	53.718	39.837	0.586	2.08
R725.5Int	53.718	39.756	0.68	2.092	53.718	39.756	0.68	2.092
R705	53.718	39.506	0.81	2.583	53.718	39.506	0.81	2.583
R655	53.718	39.473	0.493	1.679	53.718	39.473	0.493	1.679
R638	53.718	39.376	0.531	1.977	53.718	39.376	0.531	1.977
R628.5Int	53.718	39.396	0.575	1.683	53.718	39.396	0.575	1.683
R619	53.718	39.365	0.68	1.665	53.718	39.365	0.68	1.665
R600	53.718	39.082	1.112	3.108	53.718	39.082	1.112	3.108
R570	53.718	38.978	0.686	1.425	53.718	38.978	0.686	1.425
R540A	53.718	38.901	0.415	0.797	53.718	38.901	0.415	0.797
R540	60.061	38.901	0.464	0.891	60.061	38.901	0.464	0.891
R490	60.061	38.702	0.408	0.755	60.061	38.702	0.408	0.755
R459Int	60.061	38.562	0.481	0.837	60.061	38.562	0.481	0.837
R427	60.061	38.361	0.665	1.033	60.061	38.361	0.665	1.033
R405.5	60.061	38.245	0.501	1.014	60.061	38.245	0.501	1.014
R384	60.061	38.182	0.439	1.06	60.061	38.182	0.439	1.06
R352	60.061	38.048	0.531	1.436	60.061	38.048	0.531	1.436
R301	60.061	37.636	1.016	2.365	60.061	37.636	1.016	2.365
R276Int	60.061	37.547	0.846	1.936	60.061	37.547	0.846	1.936
R263Int	60.061	37.493	0.804	1.812	60.061	37.493	0.804	1.812
R250	60.061	37.433	0.78	1.726	60.061	37.433	0.78	1.726
R208	60.061	37.304	0.66	1.245	60.061	37.304	0.66	1.245
R192Int	60.061	37.251	0.592	1.152	60.061	37.251	0.592	1.152
R154	60.061	37.135	0.437	0.945	60.061	37.135	0.437	0.945
R120	60.061	36.836	0.751	2.112	60.061	36.836	0.751	2.112
R75	60.061	36.064	1.169	2.323	60.061	36.064	1.169	2.323
R46Int	60.061	36.628	0.734	1.97	60.061	36.628	0.734	1.97
R41.5Int	60.061	36.526	0.85	2.148	60.061	36.526	0.85	2.148
R37	60.061	36.294	1.119	2.828	60.061	36.294	1.119	2.828
R56Int	60.061	36.166	1.188	2.507	60.061	36.166	1.188	2.507
R21Int	60.061	35.831	1.222	2.05	60.061	35.831	1.222	2.05
R13Int	60.061	35.713	1.134	1.938	60.061	35.713	1.134	1.938
R9Int	60.061	35.655	1.086	1.883	60.061	35.655	1.086	1.883
R7.5Int	60.061	35.627	1.059	1.853	60.061	35.627	1.059	1.853
R5	60.061	35.599	1.03	1.821	60.061	35.599	1.03	1.821
bridgeu	32.063	35.599	0	0	32.063	35.599	0	0
bridged	32.063	35.582	0	0	32.063	35.582	0	0
spillu	27.998	35.599	0	0	27.998	35.599	0	0
spilld	27.998	35.526	0	0	27.998	35.526	0	0
J1	32.063	35.526	0	0	32.063	35.526	0	0
R0	60.061	35.526	0.992	1.77	60.061	35.526	0.992	1.77
ds1	60.061	34.526	0.992	1.769	60.061	34.526	0.992	1.769
ds2	60.061	33.489	1.132	1.943	60.061	33.489	1.132	1.943
T0	6.343	38.901	1.021	1.889	6.343	38.901	1.021	1.889
T50	6.343	39.169	0.344	0.404	6.343	39.169	0.344	0.404
T25	6.343	39.132	0.488	0.55	6.343	39.132	0.488	0.55
T140	6.343	39.451	0.384	0.467	6.343	39.451	0.384	0.467
T310	3.808	40.33	0.248	0.339	3.808	40.33	0.248	0.339
T310U	3.808	40.33	0.248	0.339	3.808	40.33	0.248	0.339
T275	6.343	40.232	0.314	0.326	6.343	40.232	0.314	0.326
T245	6.343	40.099	0.564	0.526	6.343	40.099	0.564	0.526
T220	6.343	39.97	0.536	0.499	6.343	39.97	0.536	0.499
T310D	6.343	40.33	0.412	0.564	6.343	40.33	0.412	0.564
T310Spill	2.535	40.33	0.381	0.46	2.535	40.33	0.381	0.46