

Barnham Eastergate Westergate Model Summary

Title	Details
Project	A13294-VAA Barnham Eastergate Westergate
Report Title	ICM Model Summary
Revision	P02
Date	23/06/23
Prepared By	Kristiyan Ivanov

Barnham Eastergate Westergate 1D-2D ICM Model	
BEW Model	Details
Model Build	The model is based on the existing Aidingbourne Rifes and SWS Innovyze ICM model, provided by the Environment Agency (EA) to Pell Frischmann. The purpose of the modelling exercise is to assess the impact of a proposed development of the A29 road, namely the introduction of a new bridge crossing over Lidsey Fife and the impact of its embankments on the existing floodplain. It has been assumed that the existing Aidingbourne model has been quality checked by EA and is used as a baseline scenario when undertaking comparative analysis between the proposed and existing scenarios. The model database was upgraded to ICM v. 2023.0.1 and the simulations were run in that version of the software. The incoming hydraulic model was assessed for suitability to the projects. The main purposes of the study are to determine the impact of the proposed infrastructure to the wider catchment, hence it was determined that the scale of the model is appropriate. Additional interpolated cross-sections were added to the model to aid stability, specifically around the area of interest. Bank lines were compared against most recent LiDAR information and updated where required. Some existing cross-sections based on older LiDAR information were updated to aid the model's accuracy. The floodplain extents within the area of interest were found to compare well with existing flood mapping.
Scenarios	The model has three modelled scenarios – baseline, proposed and multi-span: Baseline scenario The baseline scenario is developed from the existing model provided by the EA (version 104 of the network, dated 23/10/2017). The attempted rerun of the existing failed, which required alterations to the model as it was failing to converge in certain sections with some instabilities caused by negative river reach slopes and mismatched culvert inverts. The failure of the existing model to run may be due to upgrading the database to the most recent version of ICM, whereby the existing network and runs provided by the EA could have run in previous versions of the software.

Barnham Eastergate Westergate Model Summary

Barnham Eastergate Westergate 1D-2D ICM Model

BEW Model	Details
	The alterations to the model in order to remove instabilities and aid convergence are detailed in the attached modelling log in Appendix A. Proposed scenario The proposed scenario consists of two bridge embankments located within the floodplain at Lidsey Fife. The embankments are represented as porous polygons with infinite crest levels. Their location and shape is based on drawing 13394-PEF-ZZ-XX-M2-S-000003 and Technical Note 3394-PEF-XX-BP-RP-S-000002. Multi-span scenario A multi-span option has been developed for the bridge crossing. Each individual pillar has been modelled as a porous polygon with infinite crest level as shown on drawing 13394-PEF-ZZ-XX-M2-S-000002. The drawings are shown in Appendix B
Data Sources	LIDAR: 1m resolution obtained through Defra's website, dated 2022 Proposed Bridge Abutments and Pillar Location: Pell Frischmann Design Drawings No other survey was made available for the purposes of this study.
2D Domain	Maximum element area: 100m² (from incoming model) Ground model grid: Latest 1m resolution LIDAR Minimum element area: 25m² (from incoming model) Mesh generation: Classic (from incoming model) Boundary: Normal condition (from incoming model) Terrain-sensitive meshing: enabled Max height variation: 1.5 (from incoming model) Minimum angle: 15 (from incoming model) Manning's n for mesh: 0.06 (from incoming model) Rainfall: applied outside subcatchments Mesh Zones: These have remained unaltered from the incoming mode. Minor vertex adjustment has been undertaken for some elements to decrease number of small triangles within the mesh. Roughness Zones: These have remained unaltered from the incoming model. General lines: These have remained unaltered from the incoming model.

Barnham Eastergate Westergate Model Summary

Barnham Eastergate Westergate 1D-2D ICM Model	
BEW Model	Details
	Structures: No additional structures were added to the 2D domain. The only structures within the floodplain are the abutments and piers of the proposed bridge across Lydsey Rife. Flexible meshing has been enabled in the model
1D Domain	Cross-sections: - Manning's roughness remained unaltered from incoming model 35 cross-sections were identified as having Manning's n values of "0" upon the first review of the model by the EA. These values have been altered in accordance with existing Manning's n roughness values within the sections and upstream and downstream values within the reach. A summary of the identified cross-sections has been provided Appendix C - Panel markers have been added on certain sections to help with model stability - Based on SurveyHub survey, previous ISIS model supplied by EA and inferred from LIDAR or interpolated Conduits and Structures: - No additional conduits or manholes were added to the model - Some conduits were altered/removed as they were causing the model runs to crash due to negative slope or inappropriate placement. The changes to the structures is recorded within the modelling log Appendix A. - No additional structures were added to the model. Bank lines: - Default discharge coefficient assumed for bank lines: 0.9 - Default modular ratio assumed for bank lines: 0.6
Hydrology/US Boundary	The hydrological inputs to the model remain unaltered. Climate change allowances were used in line with existing guidance. Actual values were modified in the guidance during the preparation of the work, and so the values presented are slightly conservative (higher) than current values but would represent negligible change to flows. A baseflow of 0.02m³/s has been added to two river reaches to aid model stability by preventing the channels from running dry within the simulation. The magnitude of the baseflow will not present a material difference to the results. The 2D initial conditions have not been altered from the incoming model. The peak river flow allowance used in the assessment is 35% climate change uplift. The higher allowance for the 1% AEP for the 2050s epoch is 19% and for the 2070s epoch is 36%. Based on the lifespan and type of infrastructure, we deemed 35% as appropriate uplift.
Downstream Boundary	The downstream model boundaries have remained unaltered from the incoming Aidingbourne model.

Barnham Eastergate Westergate Model Summary

Barnham Eastergate Westergate 1D-2D ICM Model

BEW Model	Details
Simulation Run Parameters	The simulation run parameters have not been altered from the incoming model, apart from the addition of the baseflow to the watercourses to aid model stability.

Modelled Sensitivity Scenarios

Title	Details
Manning's n	+/- 20% Manning's n variation within the channel The sensitivity scenarios show <10% change in flow within the channel when the Manning's n is adjusted. The depth and volume within the floodplain does not show material change.
Flow	+/- 20% Flow variation Upon analysis of the rainfall variation within the model, it was determined that the flood depths increase or decrease by approximately 10-15%, therefore the model is sensitive to flow alterations.

Model summary

Title	Details
Validation errors and warnings	Invert above ground level: Warning for four conduits within the model. These have not been altered as no information is available and the conduits' invert levels may in reality be above existing ground level. Manning's values differ by more than 20 percent within a panel: Warning for four cross-sections within the model. The Manning's values of these cross-sections have not been altered by Pell Frischmann, hence it was assumed that the values are correct and no changes were made. Bank connection for 2D zone overlaps 2D mesh in void region: Warning for three bank connections and the associated storage areas at the start and ending of the river reaches. These have not been altered and kept as is from the incoming model.
Model convergence and stability	The model shows good convergence around the area of interest. The mass balance error is 9.7142m³ considering a final volume of 3574208m³ which is acceptable for the model.
Calibration	No calibration has been undertaken for the model as no data is available.
Model overview	The incoming model from the EA was unstable and was not converging at several locations. It is possible that the issues were related to upgrading the model database to the most recent ICM version.

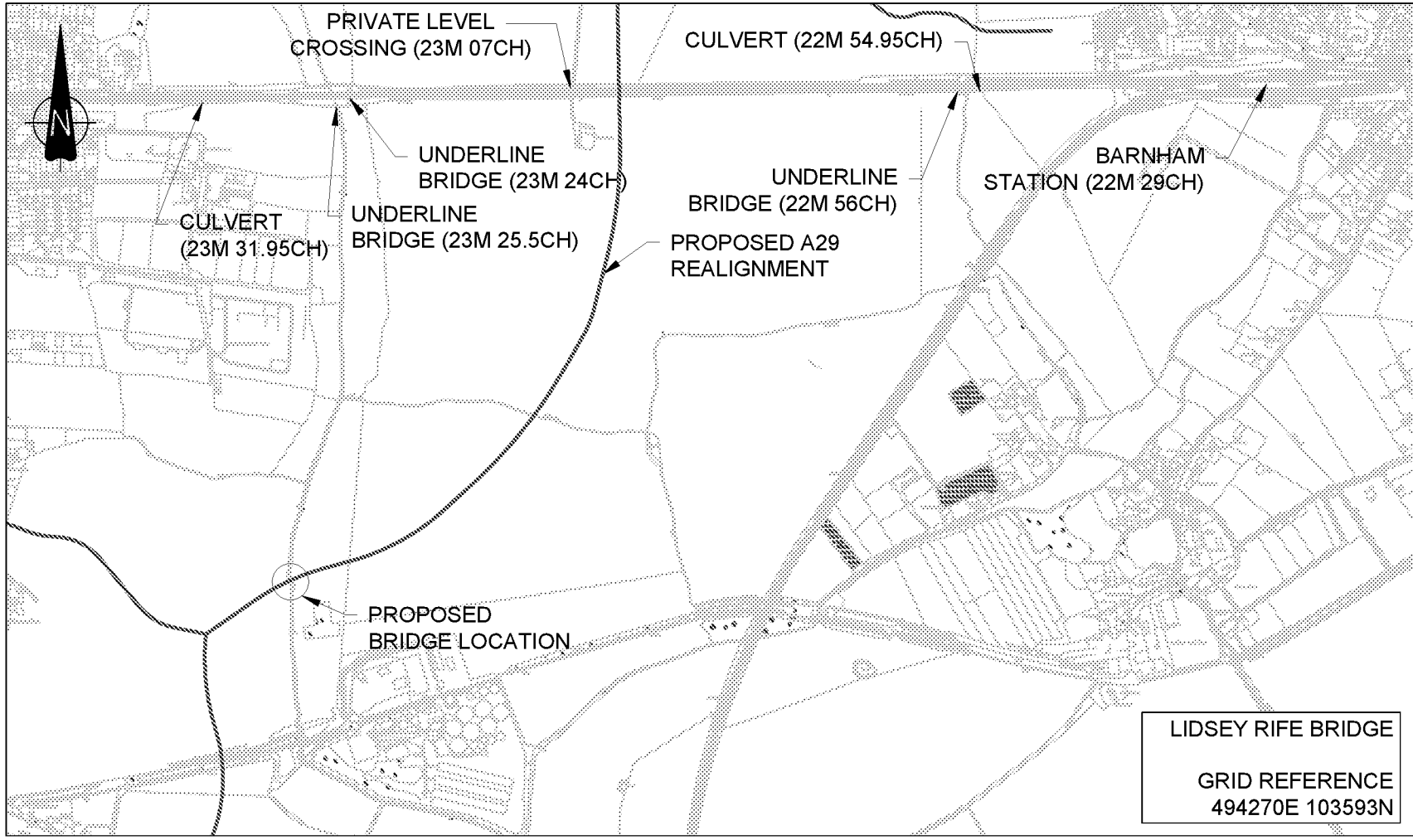
Barnham Eastergate Westergate Model Summary

Model summary	
Title	Details
	Given the size of the proposed scheme and the requirement to estimate changes within the large floodplain, it is considered that the existing model has sufficient resolution, and the obtained results give a good representation of the impact from the embankments and the proposed pillars.
Model Uncertainty	Due to the size of the hydraulic model, estimation of risk of flooding from rivers is considered robust for the level of assessment required in the SFRA. The greatest uncertainties in the hydraulic modelling occur as a result of: ➤ Models not having been fully calibrated or verified (they were only sensibility checked the EA). ➤ Hydrological estimates not having been generated through a detailed study. However due to the methods employed, hydrological estimates are considered conservative. ➤ Joint probability of storm surges with high river flows has not been assessed. ➤ The models assume that flood defences do not fail and the conditions of the defences do not change (i.e. the crest levels remain constant). The discrepancies of the modelled results and the existing Flood Zone mapping are due to the difference in return period and the inherent uncertainty within the GIS interpolation points. The current hydraulic model utilises latest available LIDAR information while the flood zone Mapping within the wider area has been developed in 2010-2011.
Overview of Results	A network results polygon is created within the area of interest. Upon comparison of the enclosed flood water volume, it is found that the single-span proposed scenario and the multi-span option do not increase the flood volume within the network results polygon. The volumes are as follows: Baseline: 143264 m³ Proposed single span: 139516 m³ Proposed multi span: 139784 m³ Further higher-resolution analysis will be undertaken to develop an impact mitigation option Upon further inspection Flood mapping of the generally conform the Risk of Flooding from Rivers and Sea (RoFRS) mapping. The main floodplains are well defined. Discrepancies between the RoFRS mapping and the modelled results are due to the differences in the return periods. It is therefore difficult to compare like-for-like of the outputs. The modelling, undertaken by Pell Frischmann also captures the smaller drainage routes which are not shown in RoFRS mapping, as the results have not been filtered for lower depths. Furthermore, water depths within the channel were compared between the existing and proposed scenarios, and it was found that the proposed bridge infrastructure does not have a tangible impact on the existing floodplain. The hydraulic modelling results mapping and cross-section comparison are shown in Appendix D.

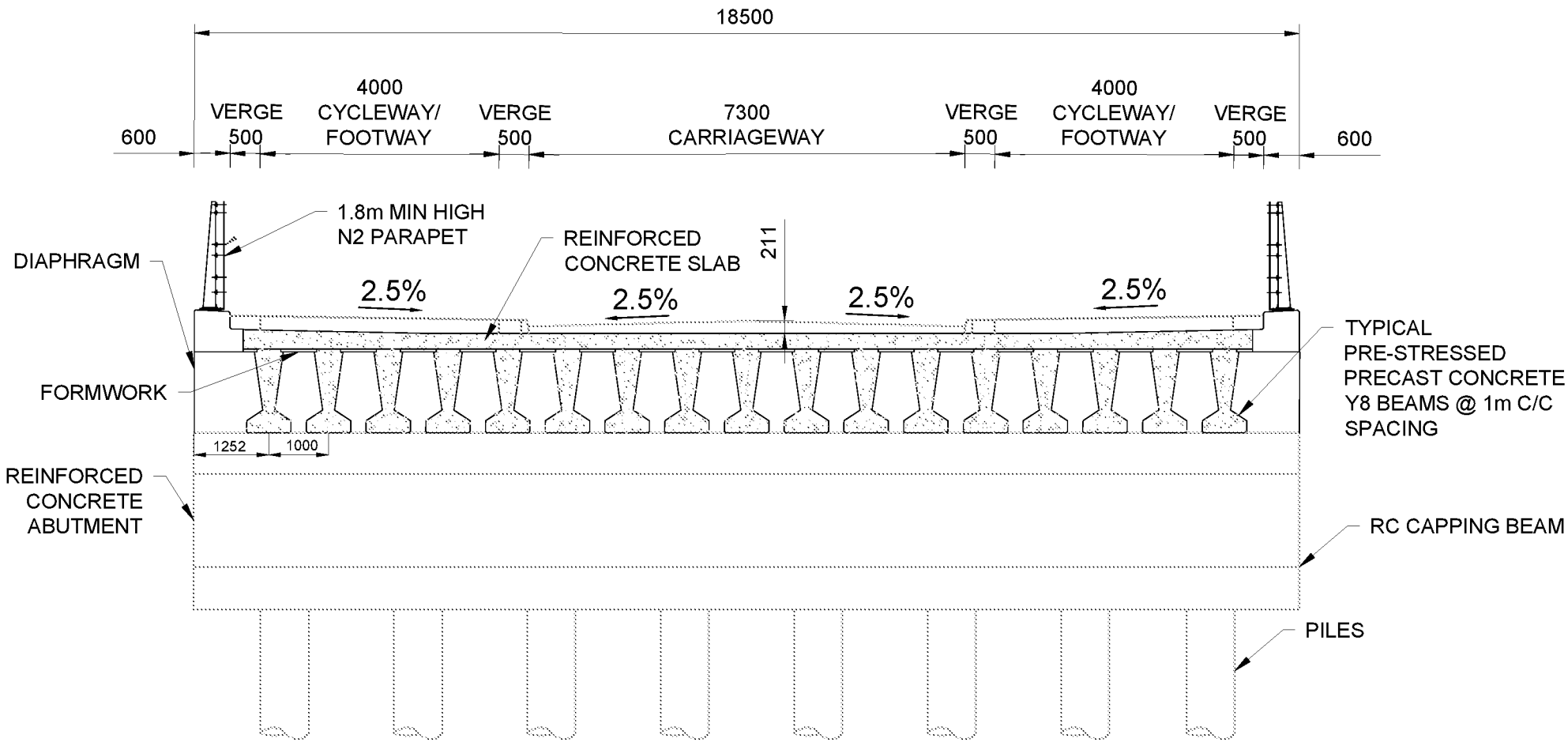
Version Number	Date	User	Changes Made	Comments
188	21/06/2022 16:32	TSharples	16	Added inflows at head of rivers
187	21/06/2022 15:20	TSharples	7	
186	21/06/2022 14:46	TSharples	3	Added inflow at 2.011 river reach of 50l/s
185	20/06/2022 20:26	TSharples	14	remeshed
184	20/06/2022 16:12	TSharples	3	
183	20/06/2022 14:56	TSharples	7	Ticked Terrain-Sensitive Meshing. Replaced flap with culvert outlet at 1.016!!!!
182	20/06/2022 07:36	TSharples	274	set discharge coefficient and discharge ration where this was missing
181	17/06/2022 15:34	TSharples	9	added bank connections and remeshed
180	17/06/2022 14:05	TSharples	12	remeshed
179	17/06/2022 10:19	TSharples	12	re-meshed, unticked lower mesh element to banks. Set min element back to 20m2. filled gap in cross sections at 1.006.
178	17/06/2022 08:24	TSharples	134	reduced 2d zone min grid size from 20 to 10
177	16/06/2022 14:50	TSharples	17	removed culvert at 1.009, re-meshed
176	16/06/2022 12:34	TSharples	14	removed bridge 1.006 and re-meshed
175	16/06/2022 08:25	TSharples	14	remeshed
174	15/06/2022 14:38	TSharples	5	removed irregular weir at 1.016!!!! due to model instability.
173	15/06/2022 11:18	TSharples	5	no changes
172	15/06/2022 08:03	TSharples	16	Convergence error at 1.016!!!!. Adjusted invert level of flap and ground level
171	14/06/2022 15:54	TSharples	129	Added embankments scenario. Modelled Embankments as mesh level zones
170	14/06/2022 14:50	TSharples	17	Added results polygons
169	14/06/2022 11:55	TSharples	39	Resolved some of the invert above ground level issues. Some still remain but these are at outfalls so shouldnt cause errors. Remeshed following rebuilding of river reach 1.006.
168	14/06/2022 10:01	TSharples	3	Committed with no changes
167	08/10/2021 10:39	TSharples	323	Deleted scenario s1 embankment, will re-add when baseline is running
166	08/10/2021 08:52	TSharples	14800	remeshed
165	07/10/2021 11:22	TSharples	57	moved break nodes into storage area to prevent convergence issues
164	07/10/2021 10:57	TSharples	303	
163	06/10/2021 15:59	TSharples	302	Edited storage areas and invert levels above ground, remeshed
162	06/10/2021 12:27	TSharples	266	remeshed model
161	06/10/2021 10:29	TSharples	17	remeshed and removed storage area at 14.002 DS
160	06/10/2021 09:03	TSharples	299	changed headloss to FIXED at 14.002
159	05/10/2021 17:33	TSharples	20	adjusted weir at 7.013
158	05/10/2021 16:57	TSharples	302	Adjusted 14.002 DS.1
157	05/10/2021 09:19	TSharples	8	updated culvert diameter
156	05/10/2021 09:16	TSharples	287	Remeshed and adjusted cross section around 7.013 U
155	04/10/2021 15:59	TSharples	14	Adjusted invert levels of culvert
154	04/10/2021 15:16	TSharples	291	
153	04/10/2021 08:42	TSharples	21	removed watercourse around 7.013 as this was causing errors in simulations. Replaced with culvert.
152	01/10/2021 15:12	TSharples	22	
151	01/10/2021 14:16	TSharples	16	
150	01/10/2021 12:59	TSharples	409	remeshed
149	30/09/2021 15:28	TSharples	129	created new scenario for embankments
148	30/09/2021 14:01	TSharples	141	remeshed embankment scenario
147	29/09/2021 08:56	TSharples	10	re-meshed removed overlaps
146	28/09/2021 16:40	TSharples	9	
145	23/09/2021 12:27	TSharples	1728	Removed bank and channel roughness zones
144	23/09/2021 11:13	TSharples	15445	created 1d version of model scenario
143	23/09/2021 09:02	TSharples	143	Culvert inlet and outlet at 1.003!!!! model run failure. Set reverse flow conditions to set inlet as outlet and outlet as inlet.
142	09/09/2021 13:09	TSharples	1	added 2d result points
141	15/06/2021 15:04	TSharples	135	added weir at 1.005 as pipes under capacity
140	15/06/2021 14:25	TSharples	5	adjusted weir at 1.016!!!!.1
139	15/06/2021 13:43	TSharples	148	adjusted 1.016!!!!.1 as it was causing convergence errors
138	15/06/2021 10:57	TSharples	158	updated mesh zones and re-meshed
137	15/06/2021 09:19	TSharples	9	adjusted mesh zones and re-meshed
136	14/06/2021 14:12	TSharples	435	Added scenario for embankments
135	14/06/2021 08:27	TSharples	1236	Removed scenarios not needed
134	14/06/2021 08:24	TSharples	15	Re-applied inflows and pipe size returned to original, revert back to v131 as version 131 ran successfully.
133	11/06/2021 19:30	TSharples	9	
132	11/06/2021 19:09	TSharples	14	

131	11/06/2021 18:46	TSharples	425	Incrased size of culvert 1.005_ub.1 as this was causing significant backing up of flows upstream
130	11/06/2021 18:29	TSharples	141	
129	11/06/2021 13:57	TSharples	300	
128	11/06/2021 11:53	TSharples	301	updated invert level of outfall orifices
127	11/06/2021 09:20	TSharples	343	replaced flap valves with orifices on river reach outfalls.
126	10/06/2021 13:05	TSharples	10	Added culvert inlet to 1.016!!!!
125	10/06/2021 10:41	TSharples	301	Added sections of culvert between river reaches where there was only an irregular weir. Hope that this improves model stability.
124	10/06/2021 09:32	TSharples	11	Flattened steep negative gradient from 19.024.1
123	10/06/2021 08:10	TSharples	14	updated infiltration zone boundaries as it was crossing a watercourse.
122	09/06/2021 15:53	TSharples	323	Remvoed river reach 5.014D5 as it was causing fails during simulations
121	09/06/2021 09:03	TSharples	7	Culvert inlet 1.004!! values for K and M look to have been swapped. These have been corrected.
120	08/06/2021 18:15	TSharples	142	created new scenario for embankment
119	08/06/2021 16:52	TSharples	157	
118	08/06/2021 16:41	TSharples	63	updated outfalls to 2D maholes where they lie in the 2D zone
117	08/06/2021 15:23	TSharples	23	
116	08/06/2021 14:13	TSharples	23	Adjusted 2D zone to prevent small elements.
115	08/06/2021 11:26	TSharples	6	adjusted roughness values 19.016_ds
114	08/06/2021 10:52	TSharples	1251	rebuilt river sections where adjustments had been made and re-meshed to remove yellow validation errors
113	07/06/2021 12:54	TSharples	4	Re-meshed s01 with mesh lowering unticked.
112	07/06/2021 10:55	TSharples	11	Adjusted culvert invert levels at 19.018 as this was much higher than the river bed and causing instabilities.
111	07/06/2021 10:06	TSharples	6	unticked lower banks to mesh elements during meshing
110	07/06/2021 08:50	TSharples	159	terrain sensitise meshing applied, re-meshed
109	04/06/2021 15:03	TSharples	282	re-built 7.050 river reach and re-meshed
108	04/06/2021 10:41	TSharples	176	
107	03/06/2021 16:27	TSharples	271	adjustments to 7.050 river roughness zones and re-meshed
106	03/06/2021 13:56	TSharples	140	added scenario for embankments and remeshed.
105	03/06/2021 12:27	TSharples	23	added embankments using mesh level zones. re-meshed. corrected errors on RB177 where roughness zones werent lined up

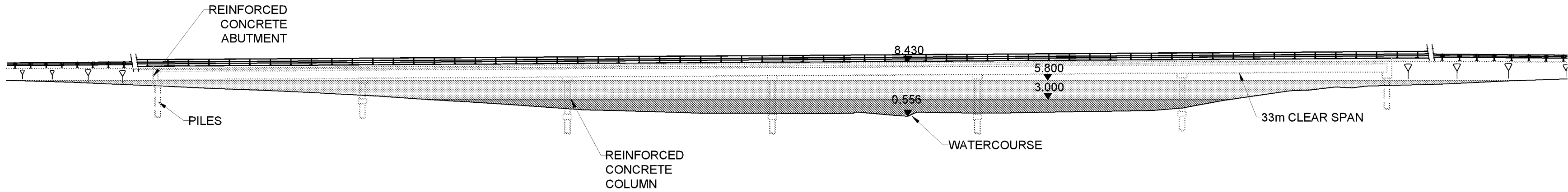
Version Number	Date	User	Changes Made	Comments
12	17/04/2022 17:57	Klvanov	1143	Amendments as per EA's review
11	27/09/2022 13:29	Klvanov	449	validates
10	22/09/2022 22:10	Klvanov	160	Multi-pier changed to mesh zones
9	17/09/2022 17:14	Klvanov	7	two new scenarios added
8	17/09/2022 16:51	Klvanov	309	added 2 scenarios
7	18/08/2022 09:08	Klvanov	139	Adjusted levels in 1.020!!!.1 river reach.
6	05/08/2022 13:59	Klvanov	164	Added floodplain results polygon and remeshed
5	19/07/2022 23:03	Klvanov	155	Remeshed again
4	14/07/2022 22:50	Klvanov	161	
3	14/07/2022 15:44	Klvanov	141	
2	14/07/2022 14:34	Klvanov	127	
1	14/07/2022 11:40	Klvanov	0	Created from copy



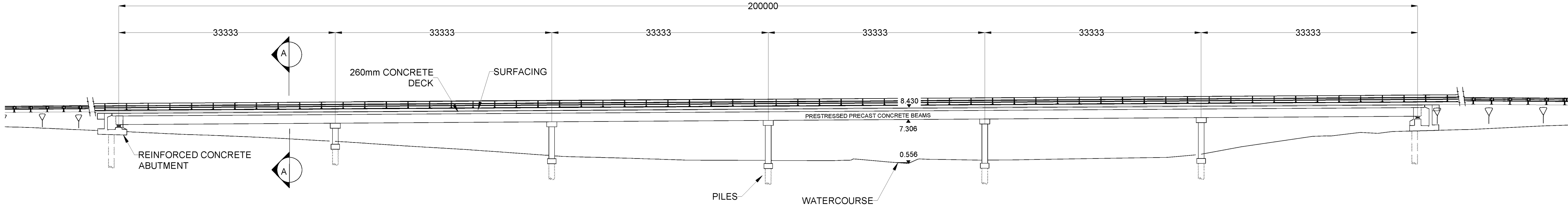
LOCATION PLAN
SCALE 1:10000



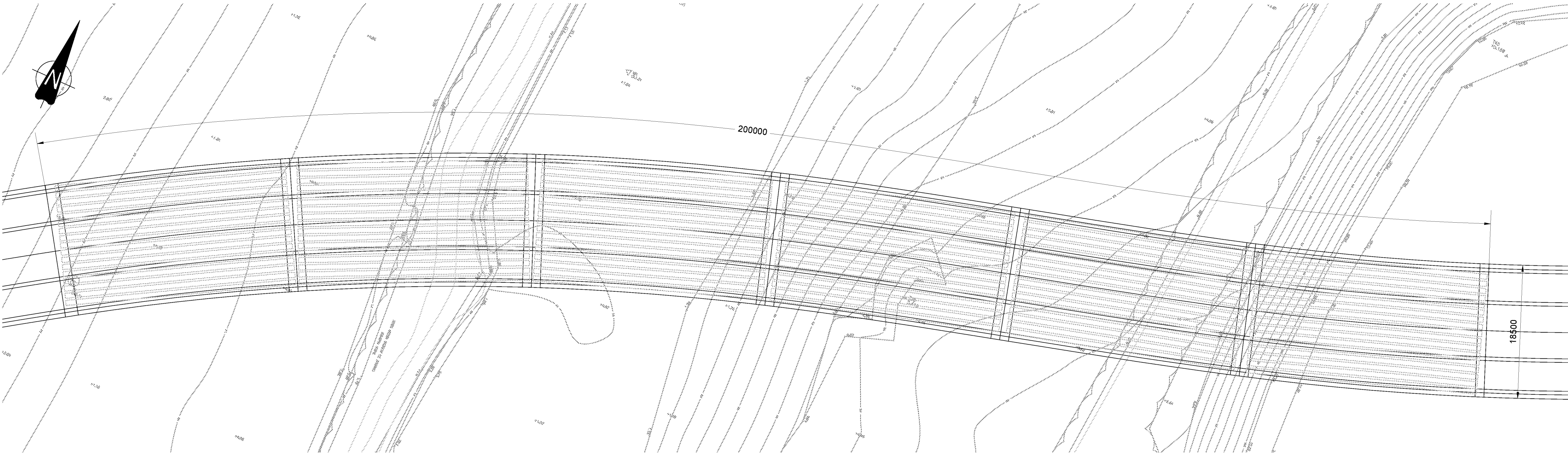
SECTION A-A
SCALE 1:100



WEST ELEVATION
SCALE 1:500



WEST ELEVATION
SCALE 1:350



PLAN
SCALE 1:350

- GENERAL NOTES
- DO NOT SCALE FROM THIS DRAWING.
 - ANY DIMENSIONAL DISCREPANCIES SHOULD BE NOTIFIED TO THE DESIGNER IMMEDIATELY.
 - ALL DIMENSIONS ARE IN MILLIMETRES - (mm) AND ALL LEVELS ARE IN METRES - (m) UNLESS NOTED OTHERWISE.
 - NORTH SHOWN INDICATIVE ONLY
 - THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT SPECIFICATIONS, DRAWINGS, DETAILS AND OTHER DESIGN INFORMATION.
 - ALL DRAWINGS AND WRITTEN MATERIAL CONTAINED WITHIN, CONSTITUTE ORIGINAL AND UNPUBLISHED WORK OF THE DESIGNER AND MAY NOT BE DUPLICATED, USED, REPRODUCED OR DISCLOSED WITHOUT WRITTEN CONSENT OR EXPRESS PERMISSION FROM THE DESIGNER.
 - ALL INFORMATION CONTAINED IN THIS DOCUMENT IS COPYRIGHT ©
 - ALL EQUIPMENT SHALL BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURES RECOMMENDATIONS.
 - WHERE THE CONTRACTOR UNDERTAKES OR ENGAGES A THIRD PARTY TO UNDERTAKE TEMPORARY WORKS DESIGN, OR VARIES THE PELL FRISCHMANN DESIGN IN ANY WAY, THEN THE CONTRACTOR WILL TAKE FULL RESPONSIBILITY AND LIABILITY FOR ALL DESIGN ASPECTS, INCLUDING A DESIGN RISK ASSESSMENT. THE CONTRACTOR SHALL INFORM PELL FRISCHMANN OF ANY PROPOSED VARIANCES TO THE DESIGN.
 - PROPOSED DESIGN SHALL BE IN ACCORDANCE WITH THE DEPARTMENT FOR TRANSPORT'S MANUAL OF CONTRACT DOCUMENTS FOR HIGHWAY WORKS (MCHW) SPECIFICATION.
 - PROPOSED DESIGN SHALL BE IN ACCORDANCE WITH THE DEPARTMENT FOR TRANSPORT'S DESIGN MANUAL FOR ROADS AND BRIDGES (DMRB) AND EUROCODES.
 - ALL WORKS TO BE UNDERTAKEN IN ACCORDANCE WITH THE DEPARTMENT FOR TRANSPORT'S MANUAL OF CONTRACT DOCUMENTS FOR HIGHWAY WORKS (MCHW) SPECIFICATION.
 - BACKFILL MATERIAL TO THE STRUCTURE SHALL BE OF CLASS 6I OR 6J IN ACCORDANCE WITH SPECIFICATION FOR HIGHWAY WORKS..
 - PROPOSED WATERPROOFING SYSTEM SHALL BE IN ACCORDANCE WITH APP 20/01 OF THE SPECIFICATION.
 - AN ADDITIONAL PROTECTIVE LAYER (APL) SHOULD ONLY BE USED WHEN REQUIRED BY INDIVIDUAL WATERPROOFING SYSTEM. WHERE APL IS USED IT SHOULD BE APPLIED IMMEDIATELY ABOVE THE PROPRIETARY WATERPROOFING SYSTEM. IN SUCH CASES A SEPARATE BBA ASSESSMENT OF THE SYSTEMS RESISTANCE TO AGGREGATE INDENTATION IS REQUIRED IN ACCORDANCE WITH IAN 98/07.
 - THE LAND LOCATED NORTH AND SOUTH OF THE NETWORK RAIL BOUNDARY FENCE IS OWNED BY THE CHURCH COMMISSIONERS FOR ENGLAND AND IT IS REGISTERED UNDER THE FOLLOWING TITLE NUMBERS:
NORTHERN AREA: WSX309559 (74.60HA)
SOUTHERN AREA: WSX309592 (49.13HA)

KEY

	1:100YR+ 105% CLIMATE CHANGE FLOOD LEVEL = 5.8 AOD
	1:100YR FLOOD LEVEL = 3.0M AOD

P02	ISSUE FOR INFORMATION	AG	AK	AK	05/05/2021
P01	DRAFT	KK	AK	AK	16/10/2020
REV	DESCRIPTION	DRN	CHK	APP	DATE

Pell Frischmann

MILLARS THREE SOUTHMILL ROAD BISHOPS STORTFORD CM23 3DH
Telephone +44 (0)1279 507 346 Fax +44 (0)1279 758 219
Email: pflstortford@pellfrischmann.com

Client

BEW CONSORTIUM

Project

A29 REALIGNMENT
LIDSEY RIFE

Drawing Title

INITIAL BRIDGE OPTIONS
MULTI SPAN

OS Ref:	Structure Type: Over Flood plain	ELR/Mileage:
Drawn	Name	Date
Designed	AK	16/10/2020
Checked	AK	16/10/2020
Approved	AK	16/10/2020
Drawing No.	13394-PEF-ZZ-XX-M2-S-000002	Revision
		P02

GENERAL NOTES

1. DO NOT SCALE FROM THIS DRAWING.
2. ANY DIMENSIONAL DISCREPANCIES SHOULD BE NOTIFIED TO THE DESIGNER IMMEDIATELY.
3. ALL DIMENSIONS ARE IN MILLIMETRES - (mm) AND ALL LEVELS ARE IN METRES - (m) UNLESS NOTED OTHERWISE.
4. NORTH SHOWN INDICATIVE ONLY

5. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT SPECIFICATIONS; DRAWINGS; DETAILS AND OTHER DESIGN INFORMATION

6. ALL DRAWINGS AND WRITTEN MATERIAL CONTAINED WITHIN, CONSTITUTE ORIGINAL AND UNPUBLISHED WORK OF THE DESIGNER AND MAY NOT BE DUPLICATED, USED, REPRODUCED OR DISCLOSED WITHOUT WRITTEN CONSENT OR EXPRESS PERMISSION FROM THE DESIGNER.

7. ALL INFORMATION CONTAINED IN THIS DOCUMENT IS
COPYRIGHT ©

8. ALL EQUIPMENT SHALL BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS.

9. WHERE THE CONTRACTOR UNDERTAKES OR ENGAGES A THIRD PARTY TO UNDERTAKE TEMPORARY WORKS DESIGN, OR VARIES THE PELL FRISCHMANN DESIGN IN ANY WAY, THEN THE CONTRACTOR WILL TAKE FULL RESPONSIBILITY AND LIABILITY FOR ALL DESIGN ASPECTS, INCLUDING A DESIGN RISK ASSESSMENT. THE CONTRACTOR SHALL INFORM PELL FRISCHMANN OF ANY PROPOSED VARIANCES TO THE DESIGN.

9. PROPOSED DESIGN SHALL BE IN ACCORDANCE WITH THE DEPARTMENT FOR TRANSPORT'S MANUAL OF CONTRACT DOCUMENTS FOR HIGHWAY WORKS (MCH-W) SPECIFICATION.

S1. ALL WORKS TO BE UNDERTAKEN IN ACCORDANCE WITH THE DEPARTMENT FOR TRANSPORT'S MANUAL OF

S2. BACKFILL MATERIAL TO THE STRUCTURE SHALL BE OF CLASS B OR C IN ACCORDANCE WITH SPECIFICATION FOR HIGHWAY WORKS.

S3. PROPOSED WATERPROOFING SYSTEM SHALL BE IN ACCORDANCE WITH APP 2001 OF THE SPECIFICATION.

BE USED WHEN REQUIRED BY INDIVIDUAL WATERPROOFING SYSTEM. WHERE APL IS USED IT SHOULD BE APPLIED IMMEDIATELY ABOVE THE PROPRIETARY WATERPROOFING SYSTEM. IN SUCH CASES A SEPARATE BBA ASSESSMENT OF THE SYSTEMS RESISTANCE TO AGGREGATE INDENTATION IS

85. THE LAND LOCATED NORTH AND SOUTH OF THE NETWORK RAIL BOUNDARY FENCE IS OWNED BY THE CHURCH COMMISSIONERS FOR ENGLAND AND IT IS REGISTERED UNDER THE FOLLOWING TITLE NUMBERS:
NORTHERN AREA: WS3209669 (74.80HA)

VIEW

1:100YR+ 35% CLIMATE CHANGE
FLOOD LEVEL = 2.2m AOD

[illegible]

Pell Frischmann

WILLIAM THREE SOUTHWELL ROAD BISHOPS STORT FORD CM23 3DH
 telephone +44 (0)1279 507 346 Fax +44 (0)1279 756 219
 email: sales@ford3.com info@ford3.com

10

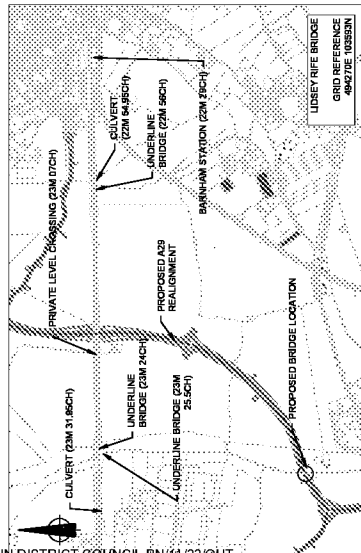
**CC PROJECTS
ASHMARDEN Ltd
AND HANBURY (PM) Ltd**

BEW PARCEL SC1
WSCC STRUCTURE REF

INITIAL BRIDGE OPTIONS 30m SINGLE SPAN FRAME ABUTMENT

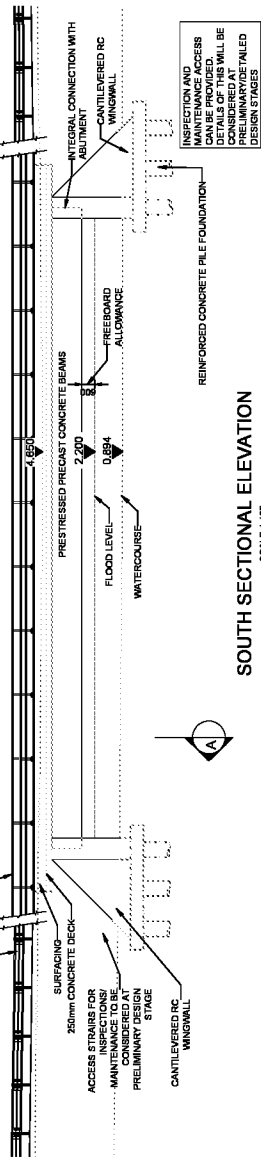
OS Ref Structure Type: Over Flood plain Elevation:	Drawn	KK	Date	16/10/2020	Scale	NOT TO SCALE
	Designed	AK		16/10/2020	Stability	82
	Checked	AK		16/10/2020		
	Approved	AK		16/10/2020	Drawing Issue	FOR INFORMATION

S-000003	P06
----------	-----



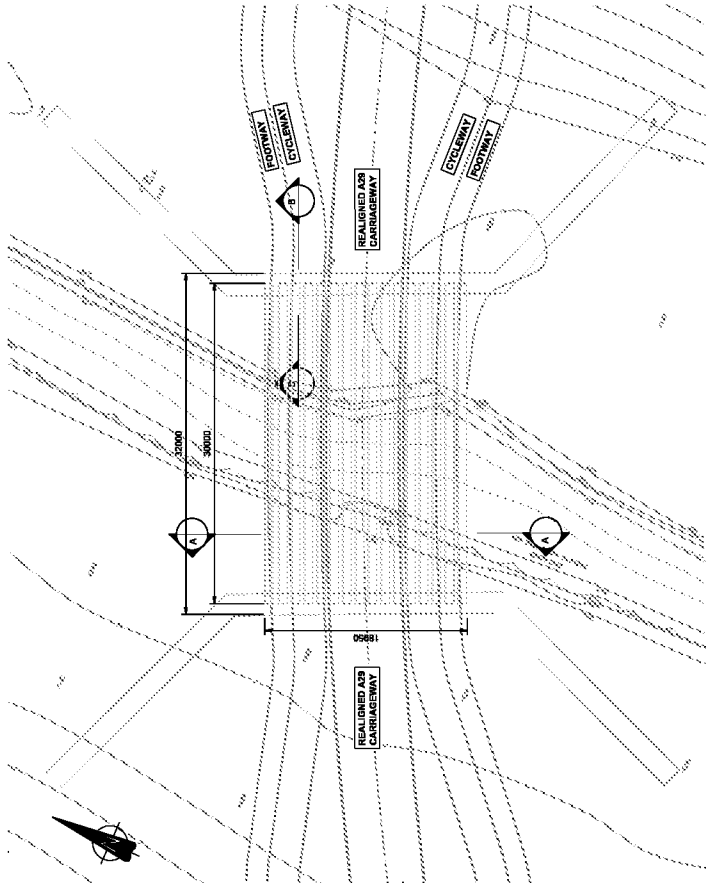
LOCATION PLAN

SCALE 1:100000



SOUTH SECTIONAL ELEVATION

SCALE 1:125

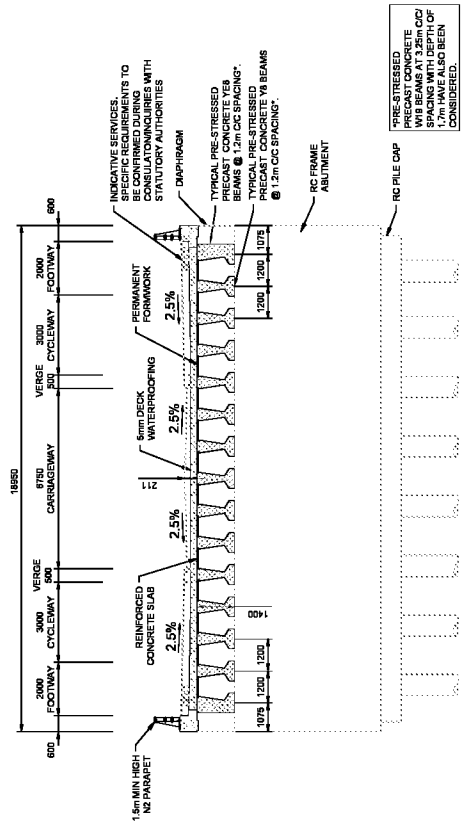


PLAN

SCALE 1:250

SECTION B-B

CASE 4:20-cv-01001-UNA Document 1-1 Filed 07/20/21 Page 1 of 1



SECTION A-A

1000



Appendix C Cross-sections with 'Zero' Manning's n

Manning's Roughness at Cross-Section Vertex	Cross-section name
0	1.002!!!
0	1.002!!!
0	1.002!!!
0	1.002!!!
0	1.002!!!
0	1.002!!!
0	1.002!!!
0	1.002!!!
0	1.001!!!
0	1.001!!!
0	2.001ds
0	2.003us
0	2.003us
0	2.003us
0	2.003us
0	2.003us
0	1.004!ds
0	1.004!ds
0	1.004!ds
0	1.004!ds
0	1.004!ds
0	1.004!ds
0	1.001!
0	1.001!
0	1.001!
0	1.001!
0	1.001!
0	1.001!
0	1.001!
0	1.001!
0	1.001!
0	1.001!
0	1.001!
0	1.006!!_ds
0	1.006!!_ds
0	1.006!!_ds
0	1.006!!_ds
0	1.006!!_ds
0	1.006!!_ds
0	1.006!!_ds
0	1.006!!_ds
0	1.004!!
0	1.004!!
0	1.004!!
0	1.004!!
0	1.004!!
0	1.004!!
0	1.004!!

0	1.004!!
0	1.013!
0	1.013!
0	1.013!
0	1.013!
0	1.013!
0	1.013!
0	1.013!
0	1.009!_d
0	1.009!_d
0	1.014!us!
0	1.014!us!
0	1.014!us!
0	1.010!!
0	1.010!!
0	1.010!!
0	1.010!!
0	1.016!!!!
0	1.016!!!!
0	1.016!!!!
0	1.016!!!!
0	1.016!!!!
0	1.016!!!!
0	1.016!!!!
0	1.016!!!!
0	1.016!!!!
0	1.016!!!!
0	1.012!!!
0	1.012!!!
0	1.017_ds!
0	1.017_ds!
0	1.017_ds!
0	1.017_ds!
0	1.017_ds!
0	1.017_ds
0	1.017_ds
0	1.017_ds
0	1.017_ds
0	1.017_ds
0	1.025
0	1.025
0	1.025
0	1.023!
0	1.023!
0	1.023!
0	1.023!
0	1.027
0	1.027
0	1.027
0	1.027

0	3.012ds-1-3.011
0	3.011
0	3.011-3.010
0	3.01
0	3.01
0	3.01
0	3.01
0	3.01
0	3.01
0	6.01
0	6.01
0	6.016
0	6.011!
0	6.011!
0	6.011!
0	6.011!
0	1.018!
0	1.018!



Pell Frischmann

BLOCK B, BLENHEIM COURT
86-88 MANSFIELD ROAD,
NOTTINGHAM, NG1 3HD

Legend

Site Boundary

Water Depth (m)

- <= 0
- 0 - 0.1
- 0.1-0.25
- 0.25-0.5
- 0.5-1
- 1-1.5
- 1.5-2
- 2-2.5
- >2.5

© Environment Agency copyright and/or database right 2018. All rights reserved. Some features of this map are based on digital spatial data from the Centre for Ecology & Hydrology, © NERC (CEH). © Environment Agency copyright and/or database right 2018. All rights reserved. © Crown copyright and database rights 2018 Ordnance Survey 100024198.

This information is licensed under the Open Government Licence v3.0. To view this licence, visit <http://www.nationalarchives.gov.uk/doc/open-government-licence>

Project Name:
Barnham Eastergate Westergate

SCALE 1:12500

Drawing Title:
WATER DEPTH BASELINE
1% AEP + 35% CLIMATE
CHANGE

Drawing Reference:

PROJECT-ORIGINATOR-VOLUME-LEVEL-TYPE-ROLE-NUMBER
A13394-PEF-ZZ-XX-SK-YE-0801



Pell Frischmann

BLOCK B. BLENHEIM COURT
86-88 MANSFIELD ROAD,
NOTTINGHAM, NG1 3HD

Legend

- Site Boundary
- Proposed Bridge Embankments
- Water Depth (m)
 - <= 0
 - 0 - 0.1
 - 0.1-0.25
 - 0.25-0.5
 - 0.5-1
 - 1-1.5
 - 1.5-2
 - 2-2.5
 - >2.5

© Environment Agency copyright and/or database right 2018. All rights reserved. Some features of this map are based on digital spatial data from the Centre for Ecology & Hydrology, © NERC (CEH). © Environment Agency copyright and/or database right 2018. All rights reserved. © Crown copyright and database rights 2018 Ordnance Survey 100024198.
This information is licensed under the Open Government Licence v3.0. To view this licence, visit <http://www.nationalarchives.gov.uk/doc/open-government-licence>

Project Name:
Barnham Eastergate Westergate

SCALE 1:12500

Drawing Title:
WATER DEPTH PROPOSED
EMBANKMENTS
1% AEP + 35% CLIMATE

Drawing Reference:

PROJECT-ORIGINATOR-VOLUME-LEVEL-TYPE-ROLE-NUMBER
A13394-PEF-ZZ-XX-SK-YE-0802



Pell Frischmann

BLOCK B. BLENHEIM COURT
86-88 MANSFIELD ROAD,
NOTTINGHAM, NG1 3HD

Legend

- Site Boundary
- Proposed Bridge Piers
- Water Depth (m)
 - <= 0
 - 0 - 0.1
 - 0.1-0.25
 - 0.25-0.5
 - 0.5-1
 - 1-1.5
 - 1.5-2
 - 2-2.5
 - >2.5

© Environment Agency copyright and/or database right 2018. All rights reserved. Some features of this map are based on digital spatial data from the Centre for Ecology & Hydrology, © NERC (CEH). © Environment Agency copyright and/or database right 2018. All rights reserved. © Crown copyright and database rights 2018 Ordnance Survey 100024198.
This information is licensed under the Open Government Licence v3.0. To view this licence, visit <http://www.nationalarchives.gov.uk/doc/open-government-licence>

Project Name:
Barnham Eastergate Westergate

SCALE 1:12500

Drawing Title:
WATER DEPTH PROPOSED
BRIDGE PIERS
1% AEP + 35% CLIMATE

Drawing Reference:
PROJECT-ORIGINATOR-VOLUME-LEVEL-TYPE-ROLE-NUMBER
A13394-PEF-ZZ-XX-SK-YE-0803



Pell Frischmann

BLOCK B, BLENHEIM COURT
86-88 MANSFIELD ROAD,
NOTTINGHAM, NG1 3HD

Legend

- Site Boundary
- Proposed Bridge Embankments
- Water Depth Difference
 - 0.0600
 - 0.0400
 - 0.0200
 - 0.0000
 - 0.0200
 - 0.0400
 - 0.0600

© Environment Agency copyright and/or database right 2018. All rights reserved. Some features of this map are based on digital spatial data from the Centre for Ecology & Hydrology, © NERC (CEH). © Environment Agency copyright and/or database right 2018. All rights reserved. © Crown copyright and database rights 2018 Ordnance Survey 100024198. This information is licensed under the Open Government Licence v3.0. To view this licence, visit <http://www.nationalarchives.gov.uk/doc/open-government-licence>

Project Name:
Barnham Eastergate Westergate

SCALE 1:12500

Drawing Title:
WATER DEPTH DIFFERENCE
EMBANKMENTS - BASELINE
1% AEP + 35% CLIMATE

Drawing Reference:
PROJECT-ORIGINATOR-VOLUME-LEVEL-TYPE-ROLE-NUMBER
A13394-PEF-ZZ-XX-SK-YE-0804



Pell Frischmann

BLOCK B. BLENHEIM COURT
86-88 MANSFIELD ROAD,
NOTTINGHAM, NG1 3HD

Legend

- Site Boundary
- Proposed Bridge Piers
- Water Depth Difference
 - 0.0600
 - 0.0400
 - 0.0200
 - 0.0000
 - 0.0200
 - 0.0400
 - 0.0600

© Environment Agency copyright and/or database right 2018. All rights reserved. Some features of this map are based on digital spatial data from the Centre for Ecology & Hydrology, © NERC (CEH). © Environment Agency copyright and/or database right 2018. All rights reserved. © Crown copyright and database rights 2018 Ordnance Survey 100024198.

This information is licensed under the Open Government Licence v3.0. To view this licence, visit <http://www.nationalarchives.gov.uk/doc/open-government-licence>

Project Name:
Barnham Eastergate Westergate

SCALE 1:12500

Drawing Title:
WATER DEPTH DIFFERENCE
BRIDGE PIERS - BASELINE
1% AEP + 35% CLIMATE

Drawing Reference:
PROJECT-ORIGINATOR-VOLUME-LEVEL-TYPE-ROLE-NUMBER

A13394-PEF-ZZ-XX-SK-YE-0804



Pell Frischmann

BLOCK B, BLENHEIM COURT
86-88 MANSFIELD ROAD,
NOTTINGHAM, NG1 3HD

Legend

- Site Boundary
- Location of cross sections
for water level comparison
between scenarios
- Area of floodplain where impact
is analysed

© Environment Agency copyright and/or database right 2018. All rights reserved. Some features of this map are based on digital spatial data from the Centre for Ecology & Hydrology, © NERC (CEH). © Environment Agency copyright and/or database right 2018. All rights reserved. © Crown copyright and database rights 2018 Ordnance Survey 100024198. This information is licensed under the Open Government Licence v3.0. To view this licence, visit <http://www.nationalarchives.gov.uk/doc/open-government-licence>

Project Name:
Barnham Eastergate Westergate

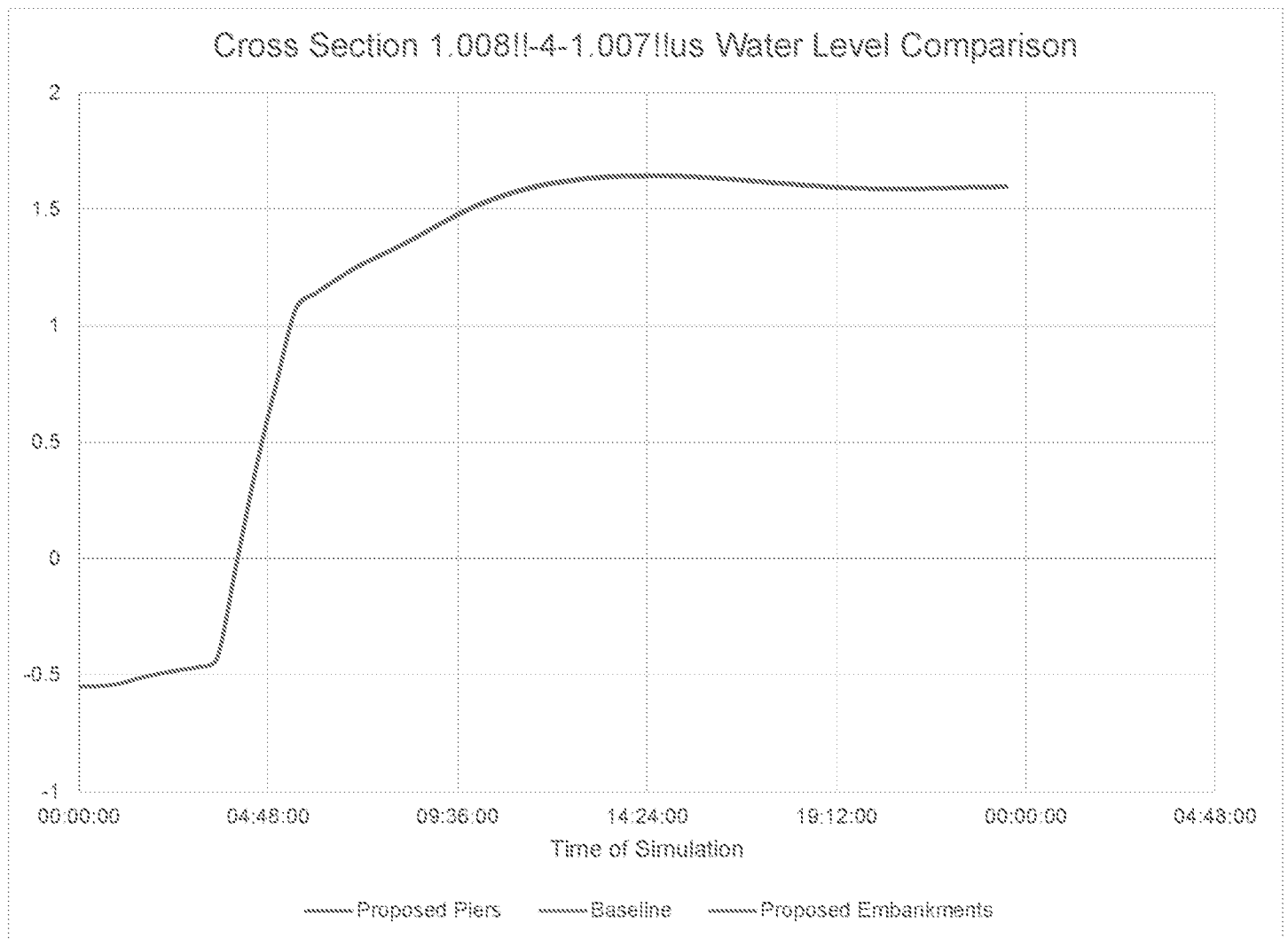
SCALE 1:12500

Drawing Title:
WATER DEPTH BASELINE
1%AEP + 35% CLIMATE
CHANGE

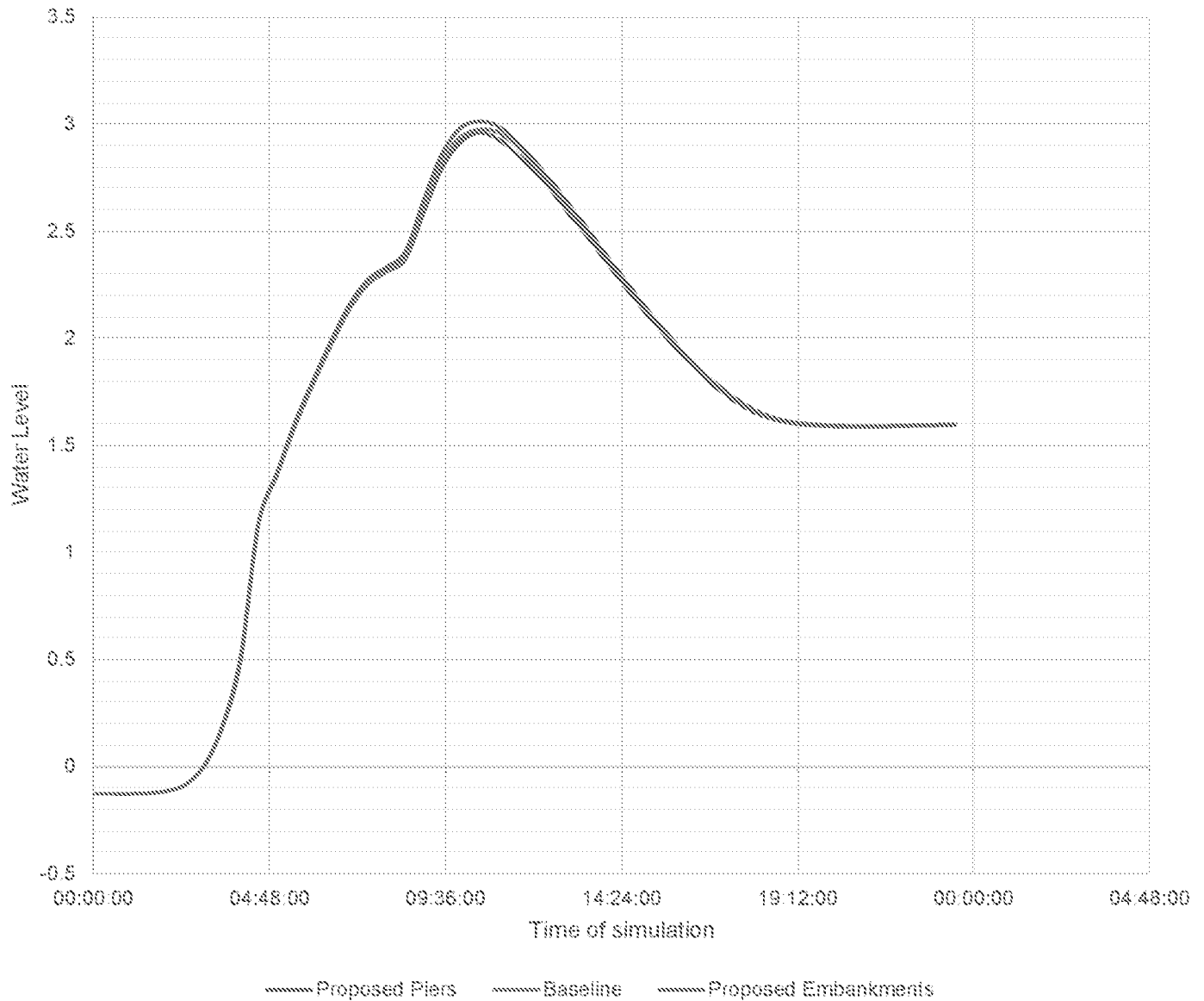
Drawing Reference:
PROJECT-ORIGINATOR-VOLUME-LEVEL-TYPE-ROLE-NUMBER

A13394-PEF-ZZ-XX-SK-YE-0806

Appendix D Flood Mapping and Water Depth Comparison



Cross Section 1.012!!-1-1.011!! Water Level Comparison



Cross Section 1.013!! Water Level Comparison

