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1 INTRODUCTION

1.1 Background

1.1.1 Asia Infrastructure Solutions Limited was commissioned by Yuba Company Limited to prepare this Drainage Impact Assessment report (“DIA”) in support of the Section 12A Planning Application (“S12A”) / Rezoning Request (“RR”) to amend the Approved Wan Chai Outline Zoning Plan No. S/H5/31 (the “Approved OZP”) at Nos. 1, 1A, 2 and 3 Hill Side Terrace (“HST”), No. 55 Ship Street [a.k.a Nam Koo Terrace (“NKT”)], Nos. 1 - 5 Schooner Street, No. 53 Ship Street, No. 18 Sau Wa Fong, Inland Lot No. 9048 (“IL 9048”) and adjoining Government Land, Wan Chai (the “Site” / “Rezoning Site”).

1.1.2 The Rezoning Site is currently zoned “Comprehensive Development Area” (“CDA”) and “Residential (Group C)” (“R(C)”) and minor encroachment into the “Open Space” (“O”) and “Government, Institution or Community” (“G/IC”) and falls into area shown as ‘Road’ on the Approved OZP. This RR seeks to rezone the Site to “Other Specified Uses (Residential Development with Historical Building Conserved)” (“OU(RDHBC)”) and “Other Specified Uses (Elevated Walkway)” (“OU(EW)”) zone to facilitate a Comprehensive Residential Development with supporting commercial uses and conservation of the NKT in-situ. The RR also

seeks to relax the plot ratio (“PR”) restriction to the level permitted under Building (Planning) Regulations (“B(P)R”) and building height (“BH”) restriction to 120mPD correspondingly. An Indicative Development Scheme (“IDS”) which comprises of one 24-storey residential and commercial building over 3-storey podium with NKT preserved in-situ is put forth to demonstrate the development intention and the feasibility of the Proposed “OU(RDHBC)” zone.

1.1.3 Please refer to Appendix 1 of Supplementary Planning Statement for the Architectural plans.

1.1.4 This Drainage Impact Assessment (DIA) takes into account the public drainage works that was implemented under the Hopewell Centre II Development (HCII) located immediately east of the Site.

1.2 Objectives

1.2.1 The objectives of DIA are as follow:

- Identify any potential drainage impact arising from the Indicative Development Scheme;
- Assess the impact of the Indicative Development Scheme on the existing public drainage system; and
- Demonstrate the feasibility of the proposed drainage connection from the Site to the existing public drainage system.

1.3 Information Available for the Study

1.3.1 The following information was reviewed for DIA:

- a. DSD Drawings No. 11-SW-14B-3, 11-SW-14B-4 and 11-SW-14D-2 showing the as-constructed drainage and sewerage information;
- b. DSD Stormwater Drainage Manual (SDM) (Fifth Edition, January 2018);
- c. DSD Advice Note No. 1, Application of the Drainage Impact Assessment Process for Private Sector Projects (September 2010);
- d. Hopewell Centre II Development DIA Report No. EB000176/HCII2017/R08 V3;
- e. DSD Stormwater Drainage Manual (SDM) Corrigenda Nos. 1/2022 and 1/2024.

2 PROJECT OUTLINE

2.1 Project Title

2.1.1 The tentative project title is “Proposed Amendment To The Approved Wan Chai Outline Zoning Plan No. S/H5/31 From “Comprehensive Development Area”, “Residential (Group C)”, “Open Space” And “Government, Institution Or Community” Zones And Area Shown As ‘Road’ To “Other Specified Uses (Residential Development With Historical Building Conserved)” And “Other Specified Uses (Elevated Walkway)” At Nos. 1, 1a, 2 And 3 Hill Side Terrace, No. 55 Ship Street (A.K.A. Nam Koo Terrace), Nos. 1 - 5 Schooner Street, No. 53

Ship Street, No. 18 Sau Wa Fong, Inland Lot No. 9048 And Adjoining Government Land, Wan Chai.

2.2 Proponent

2.2.1 The proponent of the project is Yuba Company Limited.

2.3 Nature and Description of Project

2.3.1 The Indicative Development Scheme comprises of a 24-storey residential and commercial building with 3 podium levels. The G/F is mainly proposed for retail use whereas the 2/F and 3/F of the podium are reserved for E&M and residential recreational facilities.

2.3.2 The scope of this DIA comprises the drainage downstream of the Indicative Development Scheme at Sik On Street to the drainage system at Queen's Road East, and all of the upstream sewers affected by the works.

2.4 Location

The Rezoning Site is located at southwestern part of Wan Chai. It is bounded by Schooner Street and Greenland House to the north, Ship Street to the east, St. Francis' Canossian College to the south and St. Francis' Canossian School to the west.

2.5 Area of Rezoning Site

2.5.1 The Rezoning Site has a site area of 3,157.6m², in which the Development Site Area is 3,140.7m² after excluding the elevated walkway above Ship Street staircase.

3 PLANNING AND IMPLEMENTATION OF PROGRAMME

3.1 Planning and Implementation

3.1.1 The Indicative Development Scheme will be constructed in one single phase.

3.2 Project Interface

3.2.1 This DIA takes into account the permanent stormwater drainage diversion works, the redefined catchments and the reconstruction works of Ship Street that resulted from the construction of the HCII, located immediately East of the Rezoning Site.

3.2.2 The surface runoff from the site will be discharged to the existing 450 mm diameter drainage pipeline adjacent to the site at Schooner Street. This pipeline is part of the public drainage works implemented under the HCII.

4 EXISTING DRAINAGE SYSTEM

4.1 Existing Drainage System

- 4.1.1 The Site discharges to the existing stormwater manhole SMH7015195(T) along Hill Side Ter. The flow is then conveyed by the 450mm drainage pipeline along Sau Wa Fong St./St Francis St.
- 4.1.2 For reference, the public drainage works implemented under the HCII are shown in drawing no. D006-EA01425-HCII-06 extracted from HCII DIA report no. EB000176/HCII2017/R08/V3 (Refer to Appendix E).

5 DRAINAGE IMPACT ASSESSMENT

5.1 Assessment Criteria

- 5.1.1 The 1 in 50 year 120 minutes storm event is used to assess the hydraulic performance of the urban drainage branch system. The 1 in 10 year 120 minutes storm event is used to assess the hydraulic performance of the urban drainage branch system during the dry season (case without the operation of Hong Kong West Drainage Tunnel). The storm constants presented under the SDM Corrigendum No. 1/2024 are adopted in the assessment.
- 5.1.2 Hydraulic modelling package InfoWorks ICM version 2023.2 developed by HR Wallingford/Innovyze is used to assess surface water runoff and hydraulic performance of existing and proposed drainage systems.
- 5.1.3 The runoff coefficients adopted for paved material, rock slope with underlying rock layer, steep grassland heavy soil, steep grassland heavy soil and flat grassland heavy soil are 1.0/0.9, 0.6, 0.35 and 0.2 respectively.
- 5.1.4 The site will discharge the flows to the existing drainage system along Schooner St/ Ship St stairway which was designed and implemented under the HCII project. With reference to Appendix N of the DIA report prepared under the HCII project (report no. EB000176/HCII2017/R08/V3), the following boundary conditions were adopted in the HCII DIA in consultation with DSD and referenced to HK Island North Drainage Master Plan.

SMH7015271 (mPD)

1 in 10 yrs	5.527
1 in 50 yrs	5.608

For outfall SMH7015271, it adopts the water level at nearby node SMH7015040 assumed to have similar flood level. For reference, the boundary conditions advised by DSD are contained in Appendix D.

The same boundary conditions are adopted for this DIA study.

- 5.1.5 To account for the effect of climate change, an increase of 11.1% was applied to the design rainfall intensities in accordance with item (k) of the DSD SDM Corrigendum No. 1/2022.

5.2 Hydraulic Modelling Details

- 5.2.1 The hydraulic model was developed from the hydraulic model created for the HCII DIA study Rev08 V3.

- 5.2.2 The model network extends from nodes SMH9002105 and SMH7059206 on Kennedy Road to node SMH7015271 on Queen's Road East.
- 5.2.3 Node and conduit references, ground levels, invert levels and pipe diameters were taken from DSD drainage record drawings. Existing network data was inferred or interpolated where values were not present in the records.
- 5.2.4 All manholes were modelled with a stored flood type.
- 5.2.5 A Colebrook White pipe roughness value of 3.0mm was applied to all concrete pipes.
- 5.2.6 Normal and Fixed headloss types were used in the model. A Fixed headloss type was applied for entry to and exit from chambers at backdrop manholes. Normal headloss types were modelled for all other locations. Fixed headloss entry and exit coefficients were modelled as 0.5 and 1.0 respectively. Normal headloss pipe coefficients were derived using the automated inference routine built into the InfoWorks ICM software.
- 5.2.7 The fixed runoff volume model was used for all catchments. The fixed runoff coefficients adopted are detailed in Table 1 & 2.
- 5.2.8 Wallingford routing model was used for all catchments apart from the hillside catchments where large catchment routing model was applied. A routing value of 1 was applied to paved and rock slope surfaces and a routing value of 4 was used for grassland. These are the default values for impervious and pervious surfaces respectively.
- 5.2.9 The unit hydrographs used to simulate the 50-year and 10-year design rainstorm events were derived synthetically using the symmetrically distributed rainfall based on RO (1991) as recommended in Section 4.3.4 of the DSD SDM. The formulation is shown below:

$$F(t) = \begin{cases} \frac{a[b + 2(1 - c)t]}{(2t + b)^{c+1}} & , \quad 0 \leq t \leq \frac{t_d}{2} \\ F(-t) & , \quad -\frac{t_d}{2} \leq t \leq 0 \end{cases}$$

where: $F(t)$ = rate of rainfall or instantaneous intensity in mm/hr at time t (in minutes)

t_d = rainstorm duration (in minutes) ($t_d \leq 240$)

a, b, c = storm constants are given in Table 3 of DSD SDM, which are the same as those given of the algebraic equation of the IDF relationship

- 5.2.10 The 1 in 10-year SDM design rainstorm profile is used to simulate the hydraulic performance of proposed drainage system for the case without the operation of Hong Kong West Drainage Tunnel (Dry Season Scenario).

5.2.11 Rainstorm events were input manually in the model using the formulation presented in Section 5.2.9. The Design Rainstorm Profiles adopted in the hydraulic models are contained in Appendix E1.

5.2.12 Model data and results outputs are included in Appendix E.

5.3 Review of the Existing Drainage Catchments

5.3.1 The Site falls within the storm water catchment of the drainage diversion and upgrading works implemented under the HCII project at Ship Street stairway.

5.3.2 The storm water catchments were identified based on topography and DSD drainage record plans. The before development drainage catchments are presented in drawing no. D003-EA01425-NKT-01 in Appendix C and summarized in Table 1.

Table 1 – Area and surface characteristics of the Before Development Drainage Catchments

Catchment	Area (m ²)	Surface Characteristics (percentage of area)	Runoff Coefficient (C)
(A) Existing footpath & elevated road	301 m ²	Paved Material (100%)	1.0
(B) + (D) Existing Kennedy Road	1,684 +1,290 m ²	Paved Material (100%)	1.0
(C) Existing Hillside Catchment	64,526 m ²	Paved Material (10%)	1.0
		Steep Grassland – Heavy Soil (90%)	0.35
	Assumed area upstream of West Drainage Tunnel Intake Structure: 50,602 m ²		
	Assumed area intercepted by West Drainage Tunnel Intake Structure: 40% of 50,602 m ² = 20,240 m ²		
	Contributing area during wet seasons:		
	64,526 m ² – 20,240 m ² =		
	44,285 m ²		
	Contributing area during dry seasons: 64,526 m ²		

(E1a) to (E1h) The Site	Refer to Table 3 for details.		
(E2) Existing Stairway catchment	1,042 m ²	Paved Material (100%)	1.0
(E3) Existing Schooner Street Catchment	359 m ²	Paved Material (100%)	1.0
(E4) Existing St Francis C College	531 m ²	Paved Material (100%)	0.9
(F) Proposed HCII Public Park	2,030 m ²	Paved Material (70%)	1.0
		Flat Grassland – Heavy Soil (30%)	0.2
(H1) Proposed HCII Building	5,240 m ²	Paved Material (90%)	1.0
		Flat Grassland Heavy Soil (10%)	0.9
(H2) +(H3) HCII Building Pedestrian Passage	417 m ²	Paved Material (100%)	1.0
(N) QRE Backlane	847 m ²	Paved Material (100%)	1.0
(G) Greatmany Centre	266 m ²	Paved Material (100%)	1.0
(J) Proposed HCII Private Park	4,126 m ²	Paved Material (60%)	1.0
		Flat Grassland – Heavy Soil (40%)	0.2
(K2) Flyover	319 m ²	Paved Material (100%)	1.0

5.4 Change in Drainage Catchments

5.4.1 The development of the Site will change the characteristics of catchment (E1a) to (E1h) as summarized in Tables 2 and 3.

The after-development drainage catchments are presented in drawing no. D004-EA01425-NKT-01 in Appendix C.

Table 2 – Area and surface characteristics of the Before Development Drainage Catchments

Catchment	Area (m ²)	Previous Use	Surface Characteristics (percentage of area)	Runoff Coefficient (C)	Effective Area (Area x Runoff Coefficient, m ²)	Discharge Into
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(E1a)	1,101 m ²	Developed Hill Side Terrace (HST)	Paved Material (100%)	1.0	1,101 m ²	SMH7015208
(E1b)	685 m ²	Historical Building Nam Koo Terrace (NKT)	Paved Material (100%)	1.0	685 m ²	SMH7015208
(E1c)	342 m ²	Developed Miu Kang Terrace (MKT)	Paved Material (100%)	1.0	342 m ²	SMH7015208
(E1d)	270 m ²	Vacant I.L. 9048 (Schooner Street)	Steep Grassland – Heavy Soil (100%)	0.35	94.5 m ²	SMH7015208
(E1e)	130 m ²	Steps (Rt of way to HST)	Paved Material (100%)	1.0	130 m ²	SMH7015208
(E1f)	44 m ²	West Slopes (Gov't)	Steep Grassland – Heavy Soil (100%)	0.35	15.4 m ²	SMH7015208
(E1g)	257 m ²	South Slopes (Gov't)	Steep Grassland – Heavy Soil (100%)	0.35	89.95 m ²	SMH7015208
(E1h)	312 m ²	I.L. 199 RP (Sau Wa Fong)	Paved Material (100%)	1.0	312 m ²	SMH7015195
Total Paved Area = 2,570 m ²				Total Effective Area = 2,769.85 m ²		
Total Steep Grassland Area = 571 m ²						

Table 3 – Area and surface characteristics of the After Development Drainage Catchment E1

Catchment	Area (m ²)	Surface Characteristics	Runoff Coefficient (C)	Effective Area (Area x Runoff Coefficient, m ²)	Discharge Into
(E1) Indicative Development Scheme	3,157.6 m ² (including 16.9 m ² Elevated Walkway)	Paved Material (77%) 2,431.35 m ²	1.0	2,431.35 m ²	SMH7015208
		Flat Grassland – Heavy Soil (23%) 726.25 m ²	0.2	145.25 m ²	
Total				2,576.6 m ²	

5.4.2 Overall, the proposed development would not increase the surface runoff from the Site.

5.5 Proposed Drainage Connection from the Site to the Public Drainage System and Drainage Impact to Existing System

Drainage Impact to existing DSD drainage system along Schooner St/ Ship St stairway

5.5.1 Table 4 compares the freeboard of the drainage system downstream before and after the development.

Table 4 – Freeboard Comparison of the Drainage System Before and After Development

Manhole	Ground Level (mPD)	Before Development		After Development	
		(1in10 yr) - Freeboard (m)	(1in50 yr) - Freeboard (m)	(1in 10 yr) - Freeboard (m)	(1in50 yr) - Freeboard (m)
SMH7015208	19.39	-0.810	-0.803	-0.807	-0.800
SMH9002121	19.58	-6.148	-6.117	-6.147	-6.115
SMH9002090	13.6	-0.876	-0.795	-0.873	-0.793
SMH9002091	13.55	-2.307	-2.227	-2.305	-2.225
SMH9002092	13.6	-5.467	-5.403	-5.465	-5.400
SMH9002093	9.2	-3.082	-2.903	-3.079	-2.897
SMH9002094	7.39	-1.477	-1.216	-1.472	-1.210
SMH9001989	6.57	-0.734	-0.514	-0.730	-0.509
SMH9002123	6.38	-0.603	-0.429	-0.600	-0.426
SMH7015055	6.06	-0.336	-0.186	-0.334	-0.184
SMH7015040	5.26	0.293	0.382	0.294	0.382

* Negative freeboard implies the water level is below ground level

** Negative difference implies the water level of proposed manholes is lower than the water level of existing manhole.

5.5.2 The results of the hydraulic model show that the proposed 450mm diameter pipe connecting existing manhole SMH7015208 to SMH9002121 has sufficient hydraulic capacity to cater for the peak design flows estimated from the upstream catchments.

5.5.3 The hydraulic model result of the existing pipe connecting manhole SMH7015208 to SMH9002121 and the downstream is shown in the InfoWorks' longitudinal section contained in Appendix E.

5.5.4 The existing surface runoff is 0.239 m³/s while that after the development will become 0.249 m³/s.

Drainage Impact to existing DSD drainage system along St. Francis St

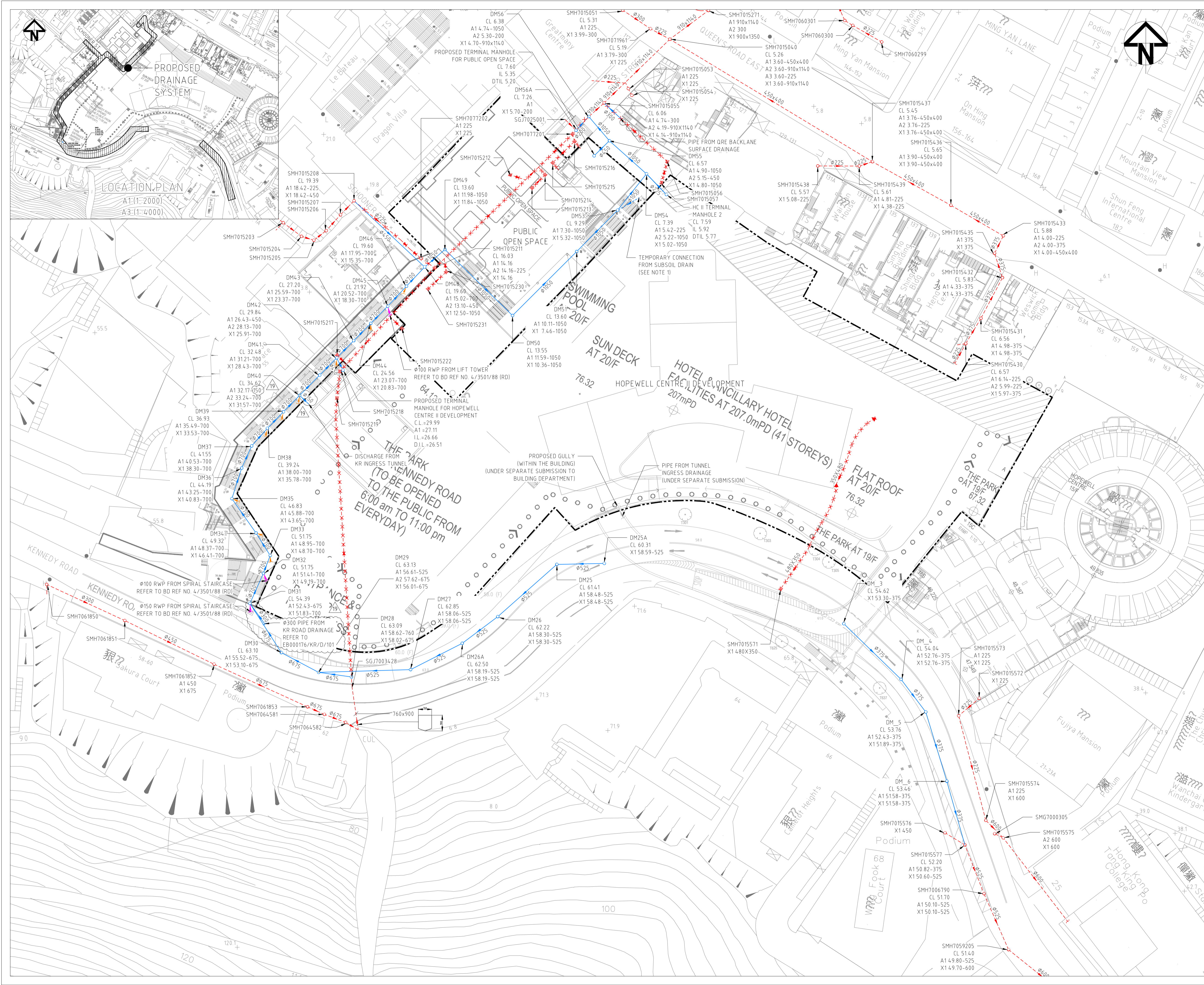
- 5.5.5 Before the development, House No. 18 Sau Wa Fong discharges to the existing drainage system along Sau Wa Fong Road and ultimately St. Francis St.
- 5.5.6 After the development of the site, the surface runoff from this portion of the site (catchment E1h) would be conveyed to DSD manhole SMH7015208 along Schooner St and ultimately Ship St. stairway.
- 5.5.7 Therefore, the development of the site will have a minor reduction in the peak flows of the existing drainage system along St. Francis St.

6 CONCLUSIONS

- 6.1.1 The surface runoff from the Site will be discharged to the 450mm diameter public drainage pipeline adjacent to the Site at Schooner Street.
- 6.1.2 Taking into account the Master Layout Plan of the Indicative Development Scheme, the stormwater runoff from the Site is recommended to be discharged to the existing drainage manhole SMH7015208 at Schooner Street in accordance with the design assumptions implemented under the HCII project.
- 6.1.3 From the assessment carried out, the proposed development would not increase the surface runoff from the Site nor cause any adverse drainage impact to the downstream drainage system.
- 6.1.4 Moreover, the existing public drainage system serving the Site (drains at Schooner St/ Ship St stairway) has adequate hydraulic capacity to convey the associated peak design flows.

APPENDIX B

Existing Drainage System in the Vicinity of the Site Implemented under HCII (For Information, extracted from HCII DIA report no. EB000176/HCII2017/R08v3)

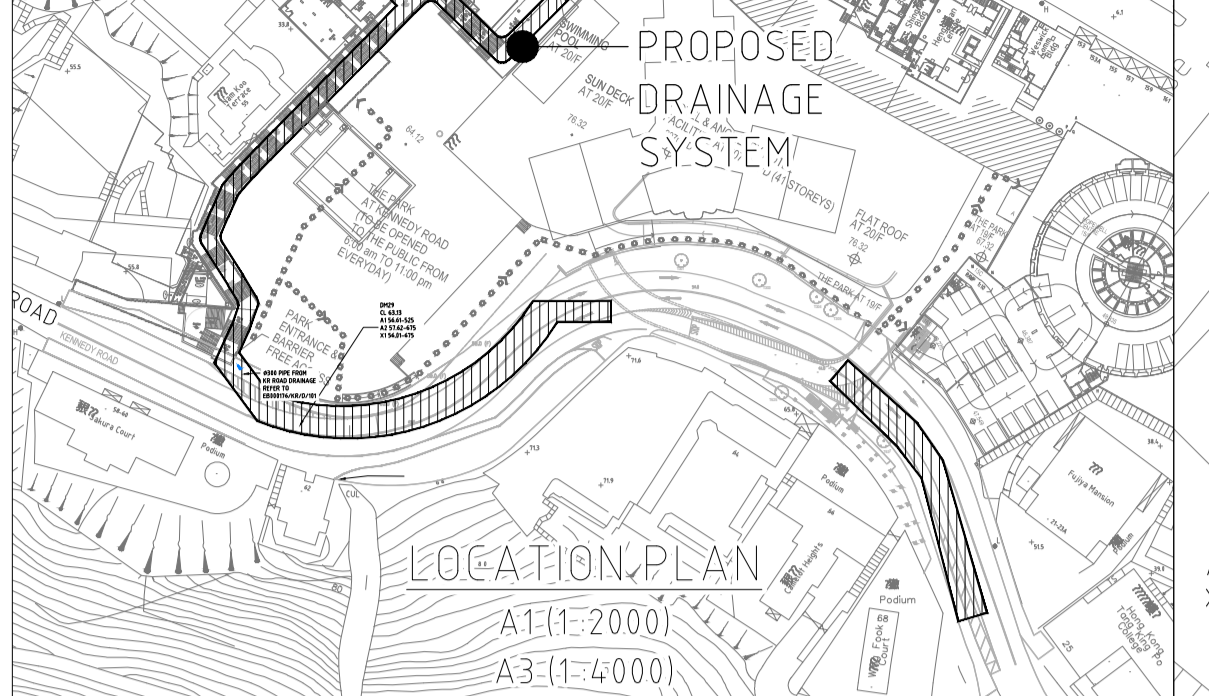


LEGEND:

- PROPOSED STORMWATER PIPE AND MANHOLE
- - - EXISTING STORMWATER PIPE AND MANHOLE
- x-x- EXISTING STORMWATER PIPE AND MANHOLE TO BE ABANDONED/ DEMOLISH
- PIPE FROM SURFACE DRAINAGE (REFER TO DRAWING NO. 001/EB000176/SS/SD/07 UNDER SEPARATE SUBMISSION)

NOTE:

- PIPE CONNECTION FROM SUBSOIL DRAIN IS FOR TEMPORARY DIVERSION ONLY. FLOW FROM TEMPORARY SUBSOIL DRAINS SHALL BE REDIRECTED TO HCII TERMINAL MANHOLE 2 ONCE COMPLETED AND IN COMMISSION.



Issue	Description	Date
19	AMENDMENT	03-07-23
18	ISSUE FOR DIA R08V3	31-03-23
17	ISSUE FOR DIA	06-12-22
16	AMENDMENT	22-07-22
15	AMENDMENT	25-04-22
14	ISSUE FOR DIA R08	04-03-22
13	MINOR AMENDMENT	23-11-21
12	ISSUE FOR DIA	22-10-21
11	ISSUE FOR DIA	02-02-21
10	ISSUE FOR DIA	18-09-20
09	ISSUE FOR DIA	06-05-20
08	ISSUE FOR DIA	20-01-20
07	ISSUE FOR DIA	18-10-19
06	ISSUE FOR DIA	13-08-19
05	ISSUE FOR DIA	17-12-18
04	ISSUE FOR DIA	11-04-18
03	PRELIMINARY - FOR CLIENT ONLY	01-03-18
02	MINOR AMENDMENTS	18-12-17
01	FIRST ISSUE FOR DIA	16-10-17

PRELIMINARY NOT TO BE USED FOR CONSTRUCTION			
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Height Datum	HKPD	Checker	L. LEUNG
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Filename: EA01425-HCII-DIA-006-19.DWG
Client:

WETHERALL INVESTMENTS LIMITED



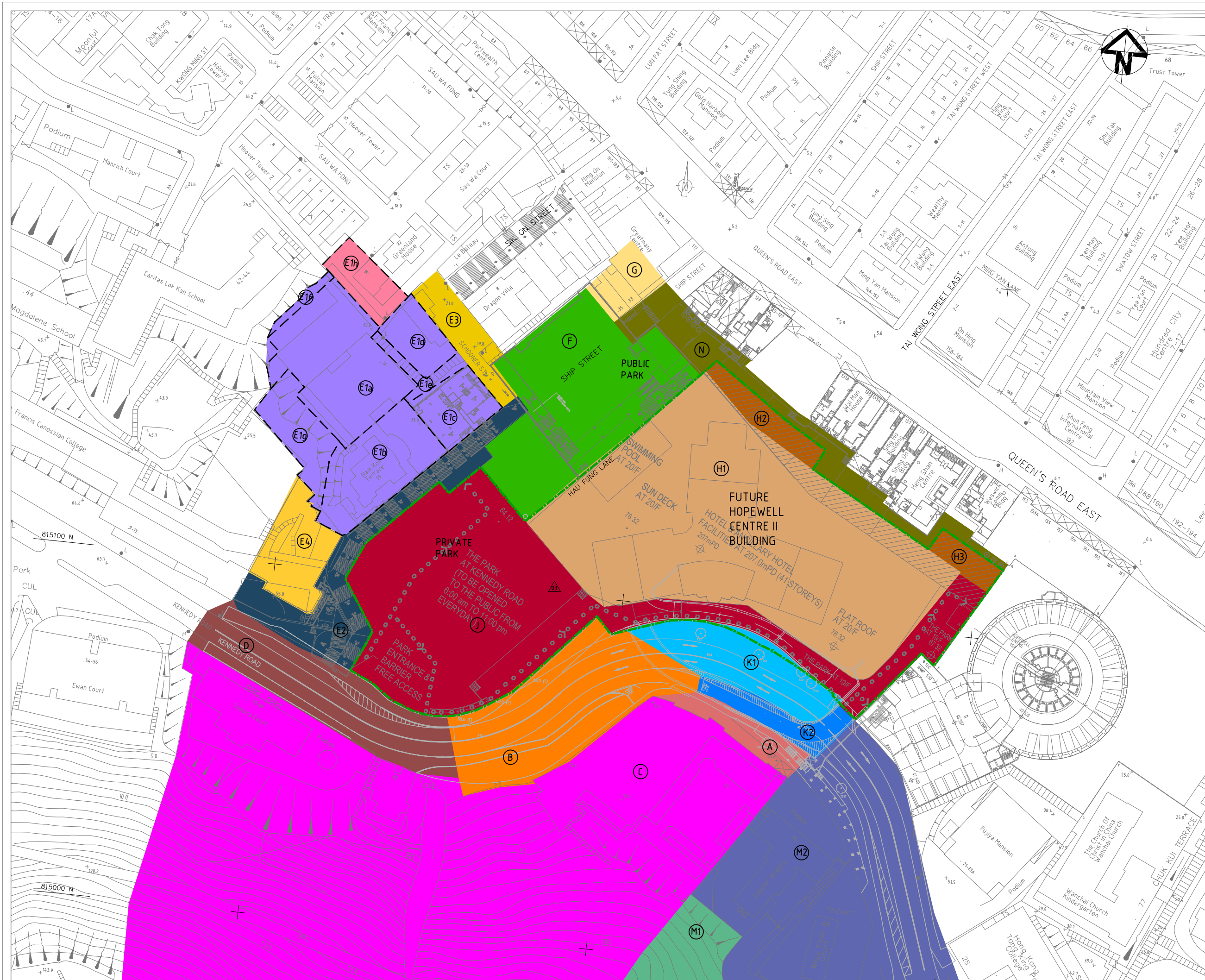
Project: HOPEWELL CENTRE II DEVELOPMENT


Title: PROPOSED DIVERTED PUBLIC DRAINAGE SYSTEM

Drawing No. D006 Project No. EA01425-HCII-19 Issue

APPENDIX C

Stormwater Catchments and Surface Type



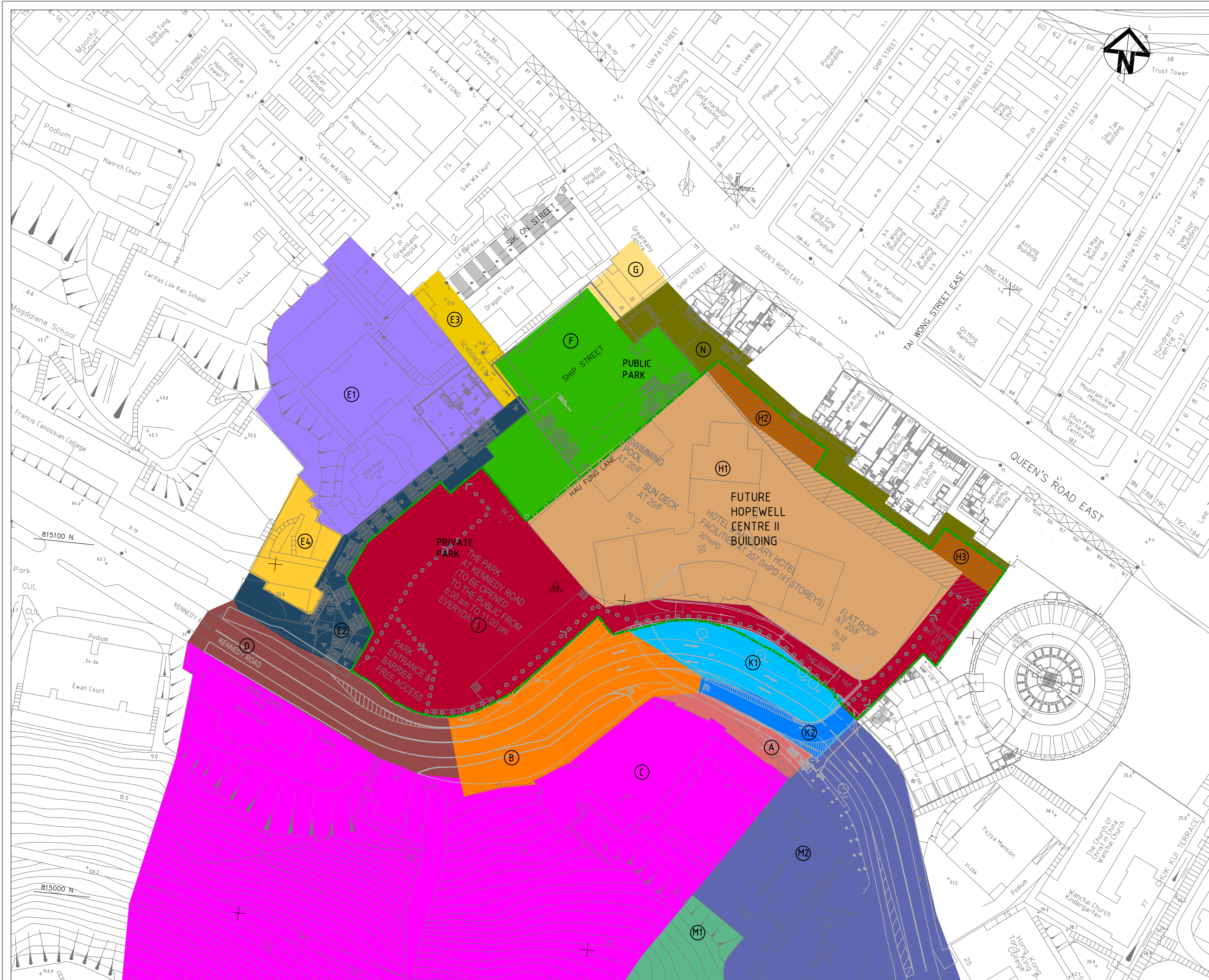
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Issue	Description	Date

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Project	HOPEWELL CENTRE II DEVELOPMENT	
Title	EXISTING CATCHMENTS AND SURFACE TYPE	
Drawing No.	Project No.	Issue
D003	EA01425-NKT	01





LEGENDS:
 SITE BOUNDARY

Issue	Description	Date
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PRELIMINARY
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Client
WETHERALL INVESTMENTS LIMITED



Project
HOPEWELL CENTRE II DEVELOPMENT

Title
PROPOSED CATCHMENTS AND SURFACE TYPE

Drawing No.	Project No.	Issue
D004	EA01425-HCII	01

APPENDIX E

Hydraulic Modelling Results

E1 – Design Rainfall Profile

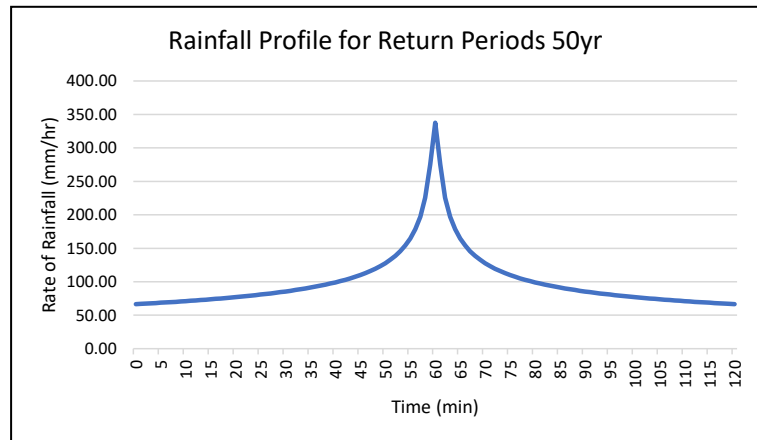
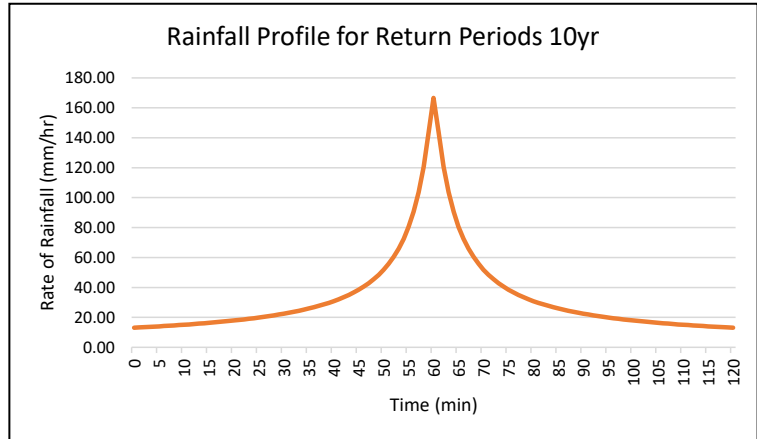
E2 – InfoWorks Model Output



From Table 3a - Storm Constants for Different Return Periods of HKO Headquarters

Return Period	a	b	c
10 years	485.0	3.11	0.397
50 years	505.5	3.29	0.355

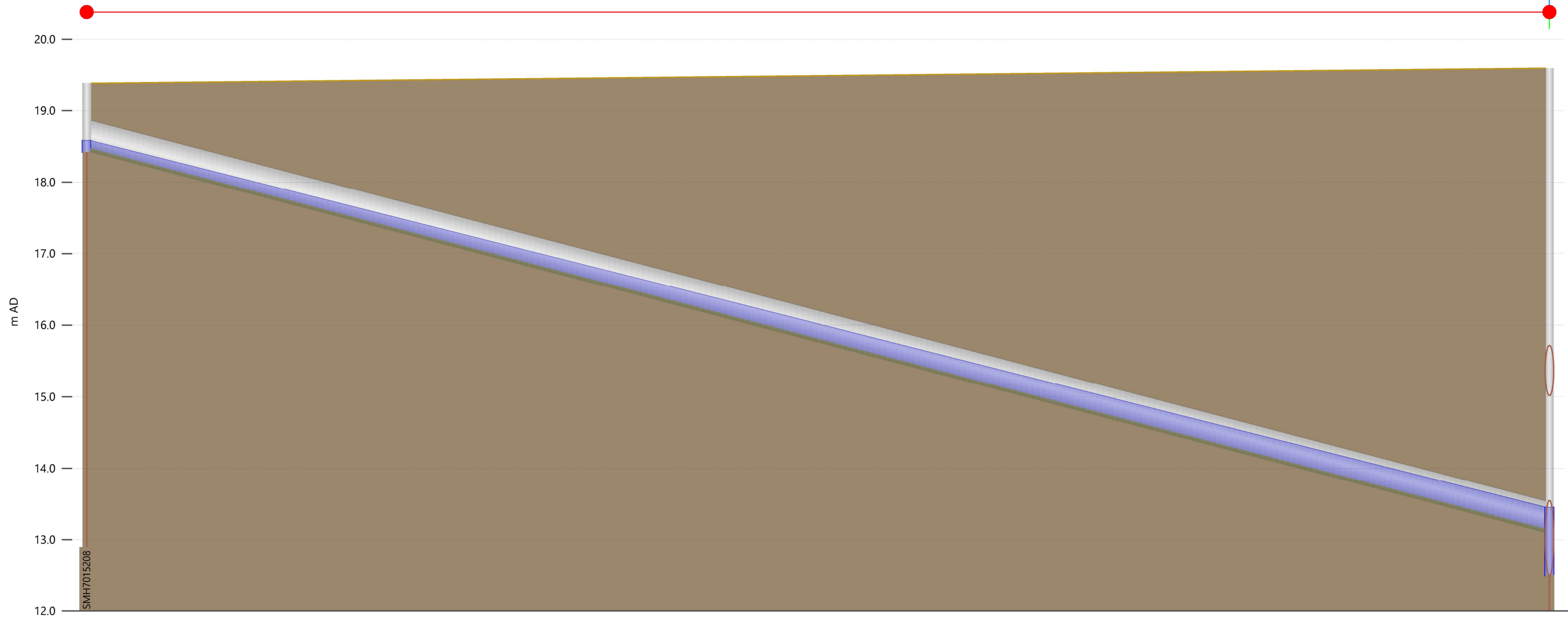
Duration Interval (min)		*Rate of Rainfall (mm/hr) for Return Periods T (years)	
From	To	10yr	50yr
-60.5	-59.5	48.88	66.54
-59.5	-58.5	49.21	66.94
-58.5	-57.5	49.55	67.35
-57.5	-56.5	49.90	67.77
-56.5	-55.5	50.25	68.21
-55.5	-54.5	50.62	68.65
-54.5	-53.5	51.00	69.11
-53.5	-52.5	51.38	69.57
-52.5	-51.5	51.78	70.05
-51.5	-50.5	52.19	70.54
-50.5	-49.5	52.61	71.05
-49.5	-48.5	53.04	71.57
-48.5	-47.5	53.48	72.10
-47.5	-46.5	53.94	72.65
-46.5	-45.5	54.41	73.22
-45.5	-44.5	54.90	73.80
-44.5	-43.5	55.40	74.40
-43.5	-42.5	55.92	75.02
-42.5	-41.5	56.45	75.66
-41.5	-40.5	57.01	76.32
-40.5	-39.5	57.58	77.01
-39.5	-38.5	58.17	77.72
-38.5	-37.5	58.79	78.45
-37.5	-36.5	59.43	79.21
-36.5	-35.5	60.09	80.00
-35.5	-34.5	60.78	80.82
-34.5	-33.5	61.51	81.67
-33.5	-32.5	62.26	82.56
-32.5	-31.5	63.04	83.49
-31.5	-30.5	63.86	84.46
-30.5	-29.5	64.72	85.47
-29.5	-28.5	65.62	86.53
-28.5	-27.5	66.57	87.64
-27.5	-26.5	67.56	88.80
-26.5	-25.5	68.61	90.03
-25.5	-24.5	69.72	91.33
-24.5	-23.5	70.89	92.69
-23.5	-22.5	72.14	94.14
-22.5	-21.5	73.47	95.68
-21.5	-20.5	74.88	97.32
-20.5	-19.5	76.40	99.07
-19.5	-18.5	78.02	100.95
-18.5	-17.5	79.78	102.96
-17.5	-16.5	81.68	105.14
-16.5	-15.5	83.75	107.50
-15.5	-14.5	86.01	110.08



Duration Interval (min)		*Rate of Rainfall (mm/hr) for Return Periods T (years)	
-14.5	-13.5	88.50	112.90
-13.5	-12.5	91.26	116.02
-12.5	-11.5	94.33	119.48
-11.5	-10.5	97.80	123.37
-10.5	-9.5	101.75	127.77
-9.5	-8.5	106.30	132.82
-8.5	-7.5	111.64	138.70
-7.5	-6.5	118.00	145.67
-6.5	-5.5	125.79	154.12
-5.5	-4.5	135.61	164.67
-4.5	-3.5	148.54	178.38
-3.5	-2.5	166.61	197.26
-2.5	-1.5	194.37	225.58
-1.5	-0.5	244.60	275.02
-0.5	0.5	310.58	337.59
0.5	1.5	244.60	275.02
1.5	2.5	194.37	225.58
2.5	3.5	166.61	197.26
3.5	4.5	148.54	178.38
4.5	5.5	135.61	164.67
5.5	6.5	125.79	154.12
6.5	7.5	118.00	145.67
7.5	8.5	111.64	138.70
8.5	9.5	106.30	132.82
9.5	10.5	101.75	127.77
10.5	11.5	97.80	123.37
11.5	12.5	94.33	119.48
12.5	13.5	91.26	116.02
13.5	14.5	88.50	112.90
14.5	15.5	86.01	110.08
15.5	16.5	83.75	107.50
16.5	17.5	81.68	105.14
17.5	18.5	79.78	102.96
18.5	19.5	78.02	100.95
19.5	20.5	76.40	99.07
20.5	21.5	74.88	97.32
21.5	22.5	73.47	95.68
22.5	23.5	72.14	94.14
23.5	24.5	70.89	92.69
24.5	25.5	69.72	91.33
25.5	26.5	68.61	90.03
26.5	27.5	67.56	88.80
27.5	28.5	66.57	87.64
28.5	29.5	65.62	86.53
29.5	30.5	64.72	85.47
30.5	31.5	63.86	84.46
31.5	32.5	63.04	83.49
32.5	33.5	62.26	82.56
33.5	34.5	61.51	81.67
34.5	35.5	60.78	80.82
35.5	36.5	60.09	80.00
36.5	37.5	59.43	79.21
37.5	38.5	58.79	78.45
38.5	39.5	58.17	77.72
39.5	40.5	57.58	77.01
40.5	41.5	57.01	76.32
41.5	42.5	56.45	75.66
42.5	43.5	55.92	75.02

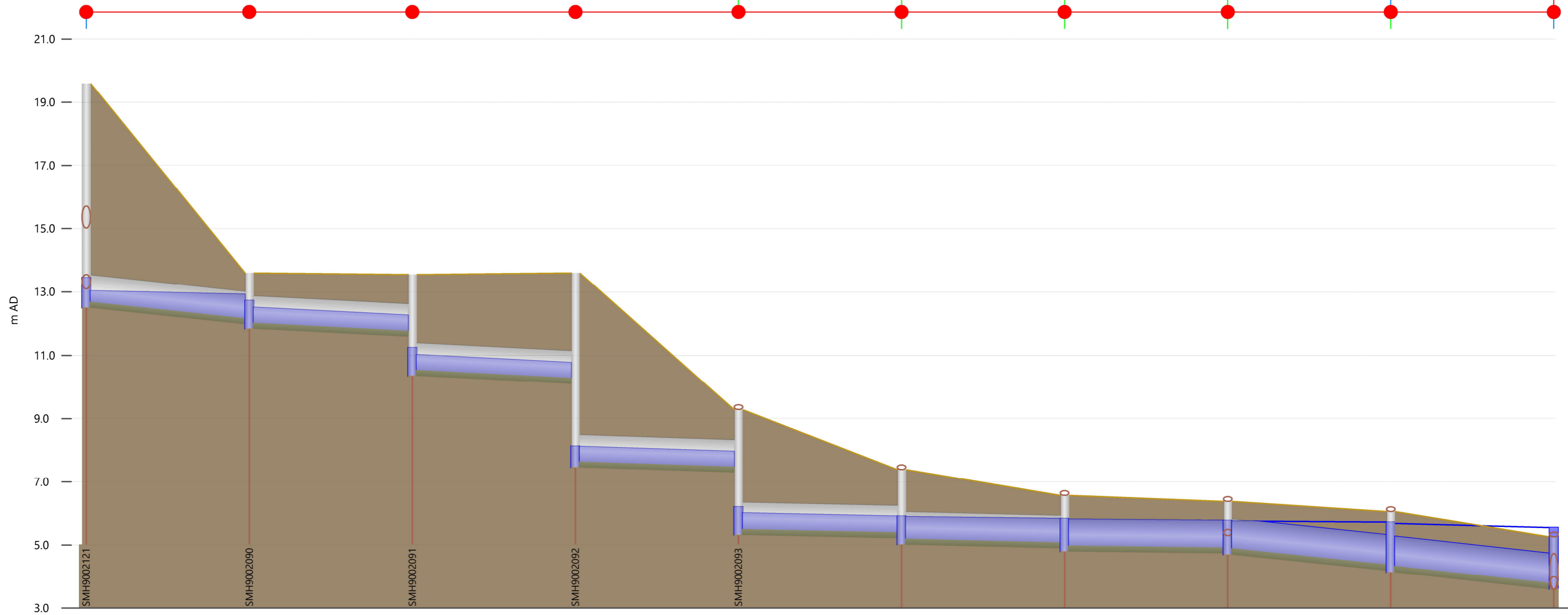
Duration Interval (min)		*Rate of Rainfall (mm/hr) for Return Periods T (years)	
43.5	44.5	55.40	74.40
44.5	45.5	54.90	73.80
45.5	46.5	54.41	73.22
46.5	47.5	53.94	72.65
47.5	48.5	53.48	72.10
48.5	49.5	53.04	71.57
49.5	50.5	52.61	71.05
50.5	51.5	52.19	70.54
51.5	52.5	51.78	70.05
52.5	53.5	51.38	69.57
53.5	54.5	51.00	69.11
54.5	55.5	50.62	68.65
55.5	56.5	50.25	68.21
56.5	57.5	49.90	67.77
57.5	58.5	49.55	67.35
58.5	59.5	49.21	66.94
59.5	60.5	48.88	66.54

Before Development Scenario 1in10 yrs



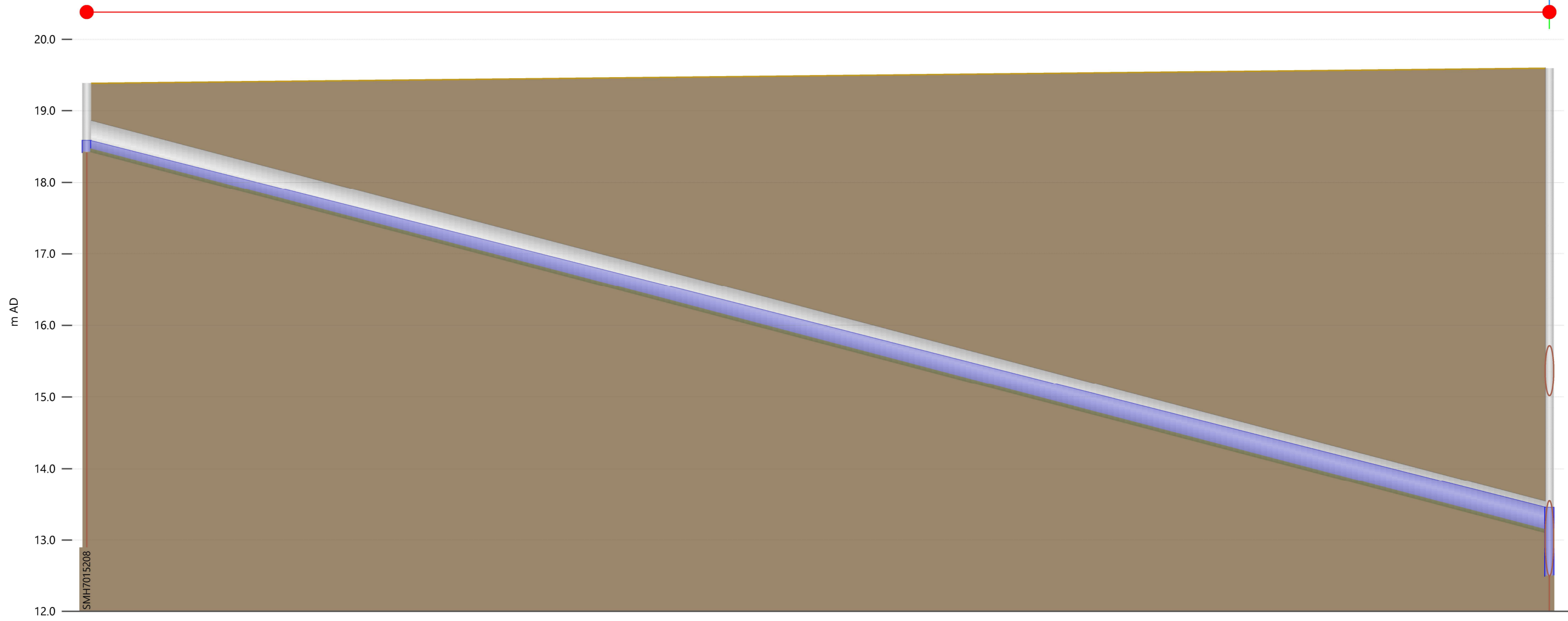
Link	SMH7015208.1	
US node ID	SMH7015208	
ds node	SMH9002121	
length (m)	22.2	
Shape ID	CIRC	
width (mm)	450	
height (mm)	450	
Rough type	CW	
Bot rough CW (mm)	3.000	
Top rough CW (mm)	3.000	
Sed depth (mm)	45	
us inv (m AD)	18.420	
ds inv (m AD)	13.100	
grad (m/m)	0.23969	
r.pfc (m ³ /s)	1.173	
surc	0.79	
US depth (m)	0.159	
US flow (m ³ /s)	0.21358	
US velocity (m/s)	5.088	
DS depth (m)	0.355	
DS flow (m ³ /s)	0.21347	
DS velocity (m/s)	3.044	
Node	SMH7015208	SMH9002121
ground (m AD)	19.390	19.598
flood dep (m)	-0.810	-6.148

Before Development Scenario 1in10 yrs



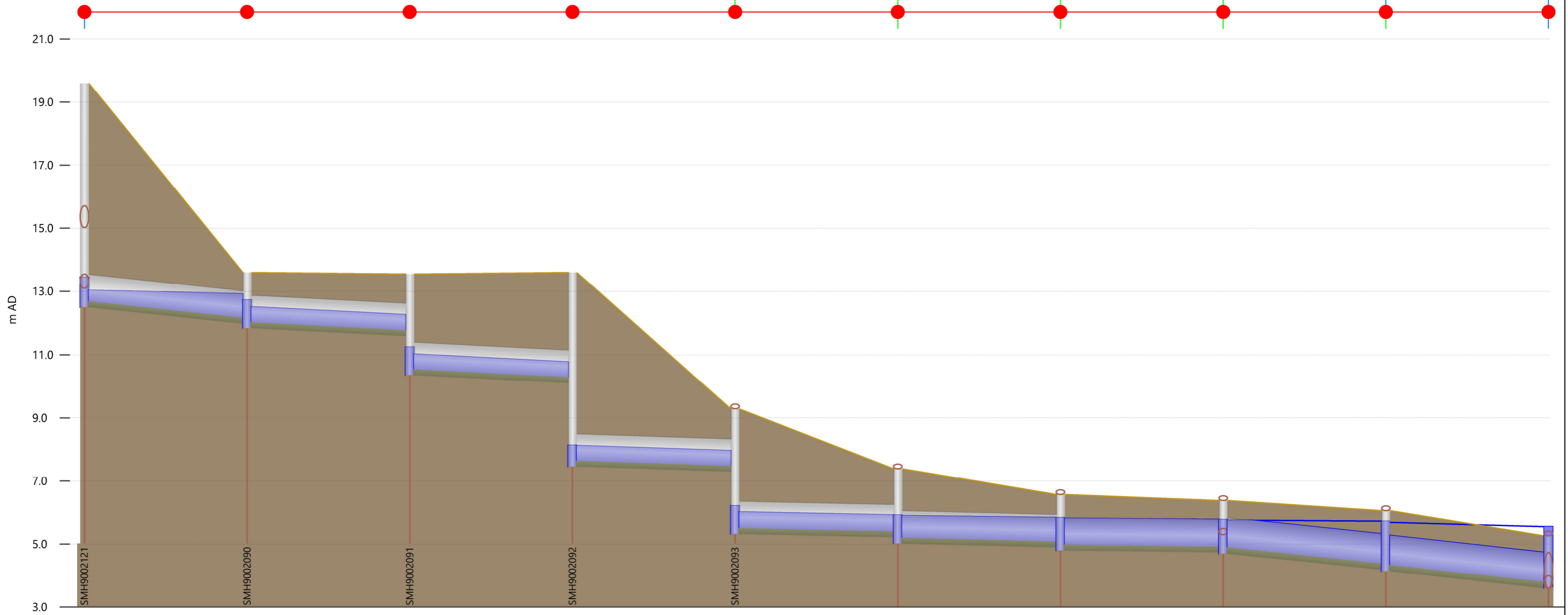
Link	SMH9002121.1	SMH9002090.1	SMH9002091.1	SMH9002092.1	SMH9002093.1	SMH9002094.3	SMH9001989.1	SMH9002123.3	SMH7015055.1	
US node ID	SMH9002121	SMH9002090	SMH9002091	SMH9002092	SMH9002093	SMH9002094	SMH9001989	SMH9002123	SMH7015055	
ds node	SMH9002090	SMH9002091	SMH9002092	SMH9002093	SMH9002094	SMH9001989	SMH9002123	SMH7015055	SMH7015040	
length (m)	6.1	21.7	20.8	13.3	10.6	11.4	7.3	4.7	21.1	
Shape ID	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	RECT	RECT	
width (mm)	1050	1050	1050	1050	1050	1050	1050	910	910	
height (mm)	1050	1050	1050	1050	1050	1050	1050	1140	1140	
Rough type	CW	CW	CW	CW	CW	CW	CW	CW	CW	
Bot rough CW (mm)	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	
Top rough CW (mm)	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	
Sed depth (mm)	168	168	168	168	168	168	168	182	182	
us inv (m AD)	12.500	11.840	10.360	7.460	5.320	5.020	4.800	4.700	4.140	
ds inv (m AD)	11.980	11.590	10.110	7.300	5.220	4.900	4.740	4.190	3.600	
grad (m/m)	0.08464	0.01154	0.01204	0.01200	0.00940	0.01053	0.00824	0.10877	0.02556	
r.pfc (m3/s)	6.062	2.237	2.284	2.281	2.019	2.137	1.890	7.526	3.647	
surc	0.90	0.64	0.63	0.63	0.66	0.89	0.99	1.00	1.00	
US depth (m)	0.536	0.674	0.666	0.667	0.695	0.877	1.016	1.060	1.547	
US flow (m3/s)	1.42994	1.42971	1.42927	1.42891	1.42875	1.44417	1.54319	1.55933	1.61014	
US velocity (m/s)	4.226	2.875	2.919	2.914	2.752	2.123	2.009	1.956	1.757	
DS depth (m)	0.941	0.674	0.666	0.667	0.695	0.938	1.039	1.537	1.957	
DS flow (m3/s)	1.42975	1.42930	1.42896	1.42877	1.42863	1.44666	1.54457	1.55934	1.61014	
DS velocity (m/s)	2.975	2.873	2.917	2.914	2.751	1.998	1.984	1.702	1.740	
Node	-	SMH9002090	SMH9002091	SMH9002092	SMH9002093	SMH9002094	SMH9001989	SMH9002123	SMH7015055	-
ground (m AD)	19.598	13.600	13.550	13.600	9.290	7.390	6.570	6.380	6.060	5.260
flood dep (m)	-6.148	-0.876	-2.307	-5.467	-3.082	-1.477	-0.734	-0.603	-0.336	0.293

After Development Scenario 1in10 years



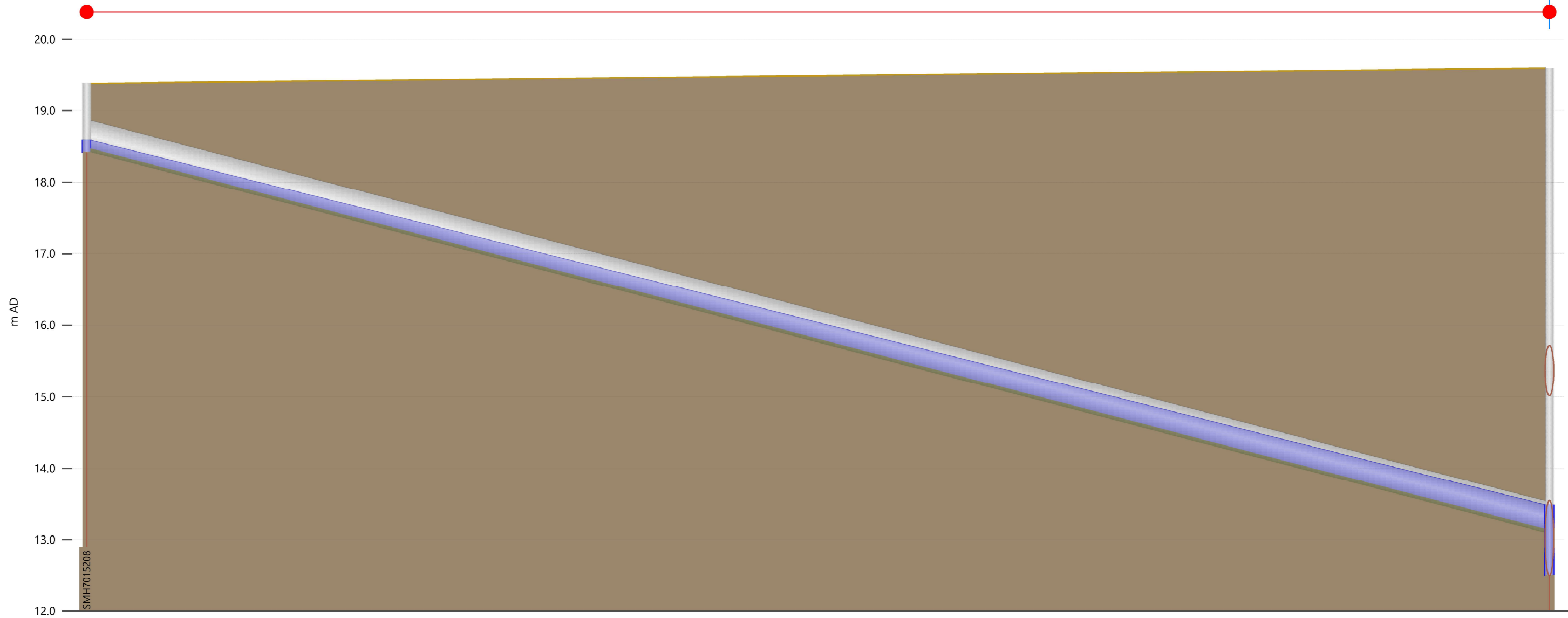
Link	SMH7015208.1	
US node ID	SMH7015208	
ds node	SMH9002121	
length (m)	22.2	
Shape ID	CIRC	
width (mm)	450	
height (mm)	450	
Rough type	CW	
Bot rough CW (mm)	3.000	
Top rough CW (mm)	3.000	
Sed depth (mm)	45	
us inv (m AD)	18.420	
ds inv (m AD)	13.100	
grad (m/m)	0.23969	
r.pfc (m ³ /s)	1.173	
surc	0.79	
US depth (m)	0.161	
US flow (m ³ /s)	0.22187	
US velocity (m/s)	5.169	
DS depth (m)	0.357	
DS flow (m ³ /s)	0.22176	
DS velocity (m/s)	3.101	
Node	SMH7015208	SMH9002121
ground (m AD)	19.390	19.598
flood dep (m)	-0.807	-6.147

After Development Scenario 1in10 years



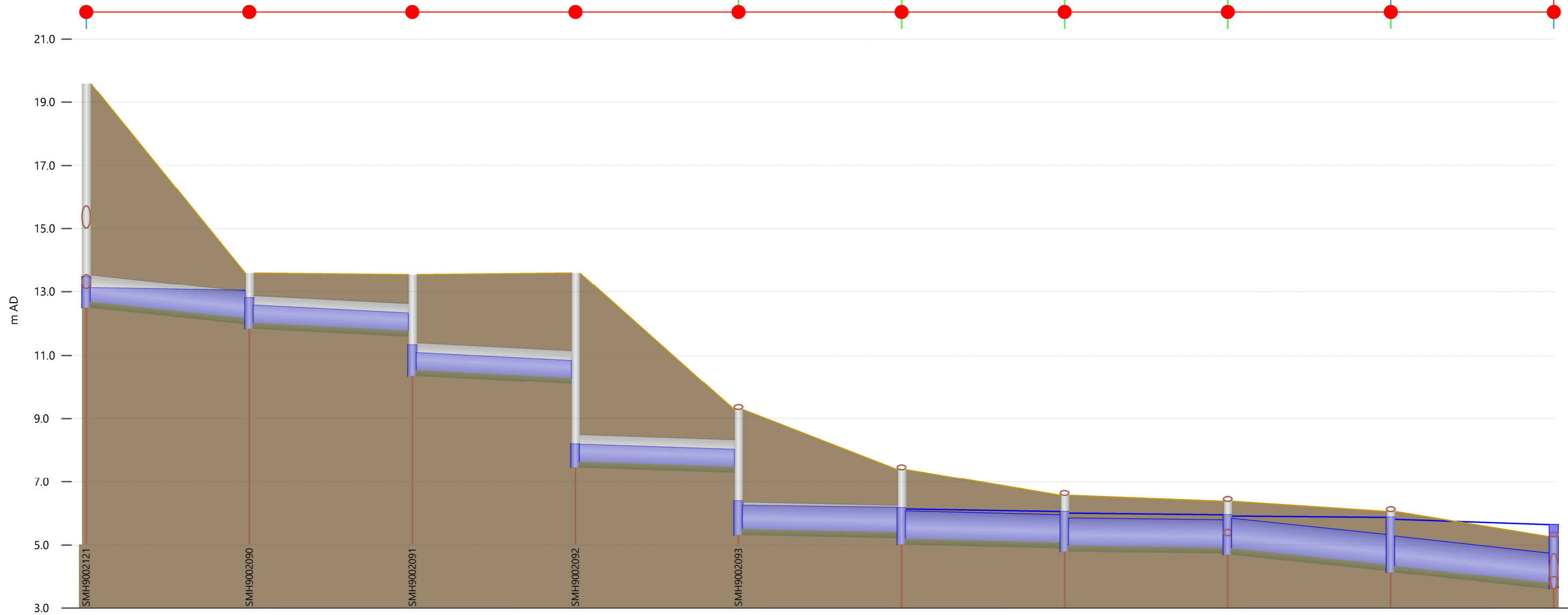
Link	SMH9002121.1	SMH9002090.1	SMH9002091.1	SMH9002092.1	SMH9002093.1	SMH9002094.3	SMH9001989.1	SMH9002123.3	SMH7015055.1	
US node ID	SMH9002121	SMH9002090	SMH9002091	SMH9002092	SMH9002093	SMH9002094	SMH9001989	SMH9002123	SMH7015055	
ds node	SMH9002090	SMH9002091	SMH9002092	SMH9002093	SMH9002094	SMH9001989	SMH9002123	SMH7015055	SMH7015040	
length (m)	6.1	21.7	20.8	13.3	10.6	11.4	7.3	4.7	21.1	
Shape ID	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	RECT	RECT	
width (mm)	1050	1050	1050	1050	1050	1050	1050	910	910	
height (mm)	1050	1050	1050	1050	1050	1050	1050	1140	1140	
Rough type	CW	CW	CW	CW	CW	CW	CW	CW	CW	
Bot rough CW (mm)	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	
Top rough CW (mm)	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	
Sed depth (mm)	168	168	168	168	168	168	168	182	182	
us inv (m AD)	12.500	11.840	10.360	7.460	5.320	5.020	4.800	4.700	4.140	
ds inv (m AD)	11.980	11.590	10.110	7.300	5.220	4.900	4.740	4.190	3.600	
grad (m/m)	0.08464	0.01154	0.01204	0.01200	0.00940	0.01053	0.00824	0.10877	0.02556	
r.pfc (m3/s)	6.062	2.237	2.284	2.281	2.019	2.137	1.890	7.526	3.647	
surc	0.90	0.64	0.64	0.64	0.67	0.90	0.99	1.00	1.00	
US depth (m)	0.538	0.675	0.668	0.668	0.701	0.882	1.019	1.062	1.549	
US flow (m3/s)	1.43710	1.43686	1.43641	1.43605	1.43589	1.46115	1.55453	1.56982	1.61825	
US velocity (m/s)	4.226	2.879	2.923	2.918	2.755	2.129	2.017	1.961	1.766	
DS depth (m)	0.944	0.675	0.668	0.668	0.704	0.941	1.042	1.539	1.957	
DS flow (m3/s)	1.43690	1.43644	1.43610	1.43591	1.44918	1.45527	1.55379	1.56971	1.61824	
DS velocity (m/s)	2.973	2.877	2.921	2.918	2.760	2.005	1.992	1.713	1.749	
Node	-	SMH9002090	SMH9002091	SMH9002092	SMH9002093	SMH9002094	SMH9001989	SMH9002123	SMH7015055	-
ground (m AD)	19.598	13.600	13.550	13.600	9.290	7.390	6.570	6.380	6.060	5.260
flood dep (m)	-6.147	-0.873	-2.305	-5.465	-3.079	-1.472	-0.730	-0.600	-0.334	0.294

Before Development Scenario 1in50 yrs



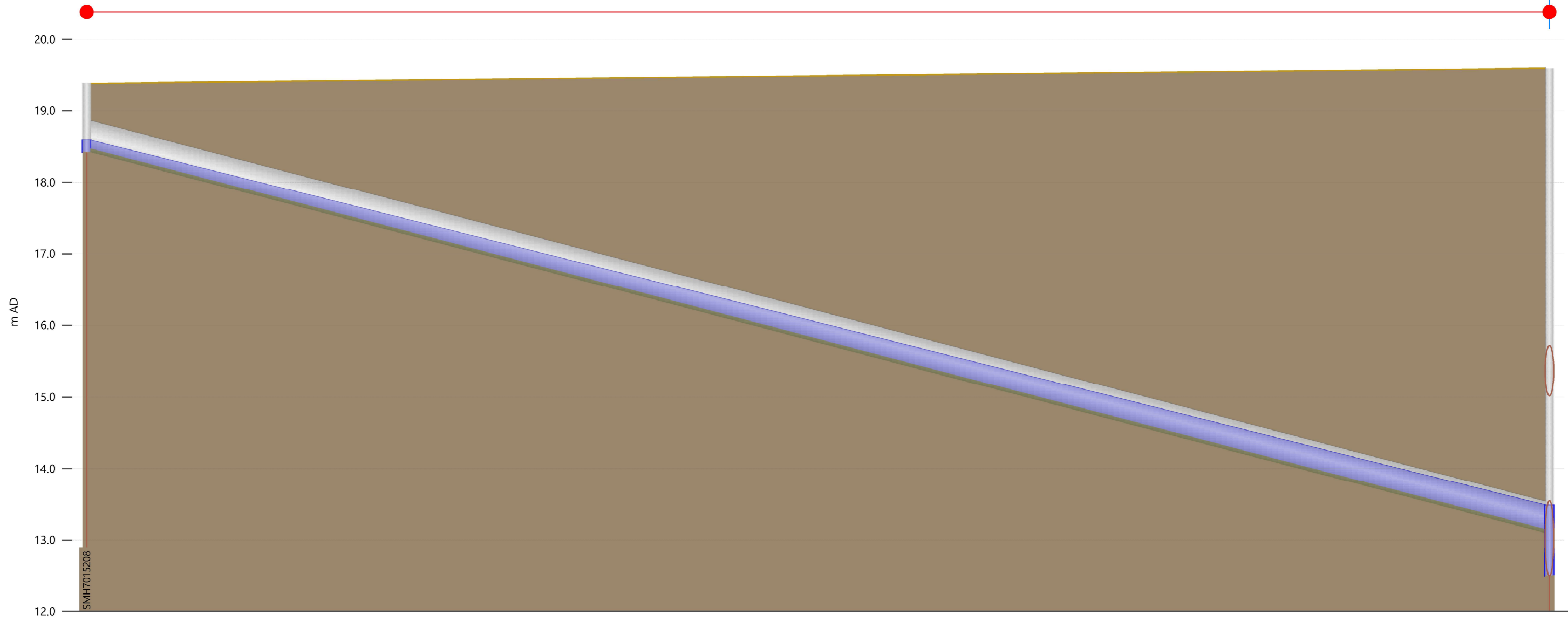
Link	SMH7015208.1	
US node ID	SMH7015208	
ds node	SMH9002121	
length (m)	22.2	
Shape ID	CIRC	
width (mm)	450	
height (mm)	450	
Rough type	CW	
Bot rough CW (mm)	3.000	
Top rough CW (mm)	3.000	
Sed depth (mm)	45	
us inv (m AD)	18.420	
ds inv (m AD)	13.100	
grad (m/m)	0.23969	
r.pfc (m3/s)	1.173	
surc	0.86	
US depth (m)	0.166	
US flow (m3/s)	0.23964	
US velocity (m/s)	5.334	
DS depth (m)	0.387	
DS flow (m3/s)	0.23953	
DS velocity (m/s)	2.995	
Node	SMH7015208	SMH9002121
ground (m AD)	19.390	19.598
flood dep (m)	-0.803	-6.117

Before Development Scenario 1in50 yrs



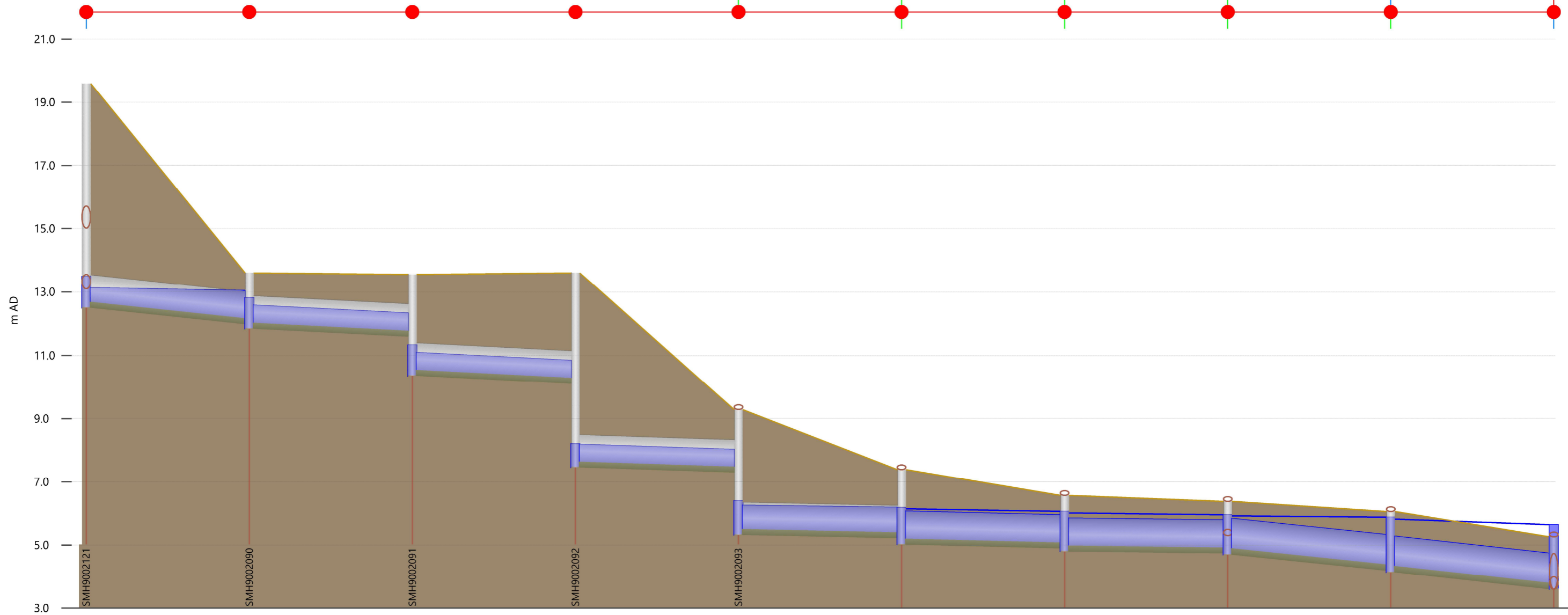
Link	SMH9002121.1	SMH9002090.1	SMH9002091.1	SMH9002092.1	SMH9002093.1	SMH9002094.3	SMH9001989.1	SMH9002123.3	SMH7015055.1	
US node ID	SMH9002121	SMH9002090	SMH9002091	SMH9002092	SMH9002093	SMH9002094	SMH9001989	SMH9002123	SMH7015055	
ds node	SMH9002090	SMH9002091	SMH9002092	SMH9002093	SMH9002094	SMH9001989	SMH9002123	SMH7015055	SMH7015040	
length (m)	6.1	21.7	20.8	13.3	10.6	11.4	7.3	4.7	21.1	
Shape ID	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	RECT	RECT	
width (mm)	1050	1050	1050	1050	1050	1050	1050	910	910	
height (mm)	1050	1050	1050	1050	1050	1050	1050	1140	1140	
Rough type	CW	CW	CW	CW	CW	CW	CW	CW	CW	
Bot rough CW (mm)	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	
Top rough CW (mm)	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	
Sed depth (mm)	168	168	168	168	168	168	168	182	182	
us inv (m AD)	12.500	11.840	10.360	7.460	5.320	5.020	4.800	4.700	4.140	
ds inv (m AD)	11.980	11.590	10.110	7.300	5.220	4.900	4.740	4.190	3.600	
grad (m/m)	0.08464	0.01154	0.01204	0.01200	0.00940	0.01053	0.00824	0.10877	0.02556	
r.pfc (m3/s)	6.062	2.237	2.284	2.281	2.019	2.137	1.890	7.526	3.647	
surc	1.00	0.70	0.69	0.69	0.92	1.00	1.00	1.00	1.00	
US depth (m)	0.625	0.737	0.727	0.728	0.931	1.122	1.211	1.222	1.679	
US flow (m3/s)	1.67381	1.67354	1.67302	1.67261	1.67257	1.69168	1.80089	1.82004	1.87785	
US velocity (m/s)	4.216	2.993	3.040	3.036	2.534	2.109	2.223	2.024	2.043	
DS depth (m)	1.056	0.737	0.727	0.728	0.967	1.159	1.215	1.689	2.047	
DS flow (m3/s)	1.67359	1.67305	1.67267	1.67246	1.67416	1.69208	1.80089	1.82004	1.87784	
DS velocity (m/s)	2.974	2.990	3.039	3.035	2.480	2.096	2.223	1.979	2.025	
Node	-	SMH9002090	SMH9002091	SMH9002092	SMH9002093	SMH9002094	SMH9001989	SMH9002123	SMH7015055	-
ground (m AD)	19.598	13.600	13.550	13.600	9.290	7.390	6.570	6.380	6.060	5.260
flood dep (m)	-6.117	-0.795	-2.227	-5.403	-2.903	-1.216	-0.514	-0.429	-0.186	0.382

After Development Scenario 1in50 years



Link	SMH7015208.1	
US node ID	SMH7015208	
ds node	SMH9002121	
length (m)	22.2	
Shape ID	CIRC	
width (mm)	450	
height (mm)	450	
Rough type	CW	
Bot rough CW (mm)	3.000	
Top rough CW (mm)	3.000	
Sed depth (mm)	45	
us inv (m AD)	18.420	
ds inv (m AD)	13.100	
grad (m/m)	0.23969	
r.pfc (m ³ /s)	1.173	
surc	0.86	
US depth (m)	0.168	
US flow (m ³ /s)	0.24882	
US velocity (m/s)	5.415	
DS depth (m)	0.389	
DS flow (m ³ /s)	0.24871	
DS velocity (m/s)	3.053	
Node	SMH7015208	SMH9002121
ground (m AD)	19.390	19.598
flood dep (m)	-0.800	-6.115

After Development Scenario 1in50 years



Link	SMH9002121.1	SMH9002090.1	SMH9002091.1	SMH9002092.1	SMH9002093.1	SMH9002094.3	SMH9001989.1	SMH9002123.3	SMH7015055.1	
US node ID	SMH9002121	SMH9002090	SMH9002091	SMH9002092	SMH9002093	SMH9002094	SMH9001989	SMH9002123	SMH7015055	
ds node	SMH9002090	SMH9002091	SMH9002092	SMH9002093	SMH9002094	SMH9001989	SMH9002123	SMH7015055	SMH7015040	
length (m)	6.1	21.7	20.8	13.3	10.6	11.4	7.3	4.7	21.1	
Shape ID	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	RECT	RECT	
width (mm)	1050	1050	1050	1050	1050	1050	1050	910	910	
height (mm)	1050	1050	1050	1050	1050	1050	1050	1140	1140	
Rough type	CW	CW	CW	CW	CW	CW	CW	CW	CW	
Bot rough CW (mm)	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	
Top rough CW (mm)	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	
Sed depth (mm)	168	168	168	168	168	168	168	182	182	
us inv (m AD)	12.500	11.840	10.360	7.460	5.320	5.020	4.800	4.700	4.140	
ds inv (m AD)	11.980	11.590	10.110	7.300	5.220	4.900	4.740	4.190	3.600	
grad (m/m)	0.08464	0.01154	0.01204	0.01200	0.00940	0.01053	0.00824	0.10877	0.02556	
r.pfc (m3/s)	6.062	2.237	2.284	2.281	2.019	2.137	1.890	7.526	3.647	
surc	1.00	0.70	0.69	0.70	0.93	1.00	1.00	1.00	1.00	
US depth (m)	0.628	0.739	0.729	0.730	0.937	1.128	1.215	1.225	1.681	
US flow (m3/s)	1.68179	1.68151	1.68098	1.68056	1.68052	1.69967	1.80967	1.82884	1.88672	
US velocity (m/s)	4.216	2.997	3.044	3.039	2.535	2.116	2.234	2.032	2.052	
DS depth (m)	1.060	0.739	0.729	0.730	0.974	1.164	1.218	1.691	2.047	
DS flow (m3/s)	1.68156	1.68101	1.68062	1.68040	1.68211	1.70006	1.80967	1.82884	1.88671	
DS velocity (m/s)	2.980	2.994	3.042	3.038	2.480	2.105	2.234	1.989	2.035	
Node	-	SMH9002090	SMH9002091	SMH9002092	SMH9002093	SMH9002094	SMH9001989	SMH9002123	SMH7015055	-
ground (m AD)	19.598	13.600	13.550	13.600	9.290	7.390	6.570	6.380	6.060	5.260
flood dep (m)	-6.115	-0.793	-2.225	-5.400	-2.897	-1.210	-0.509	-0.426	-0.184	0.382