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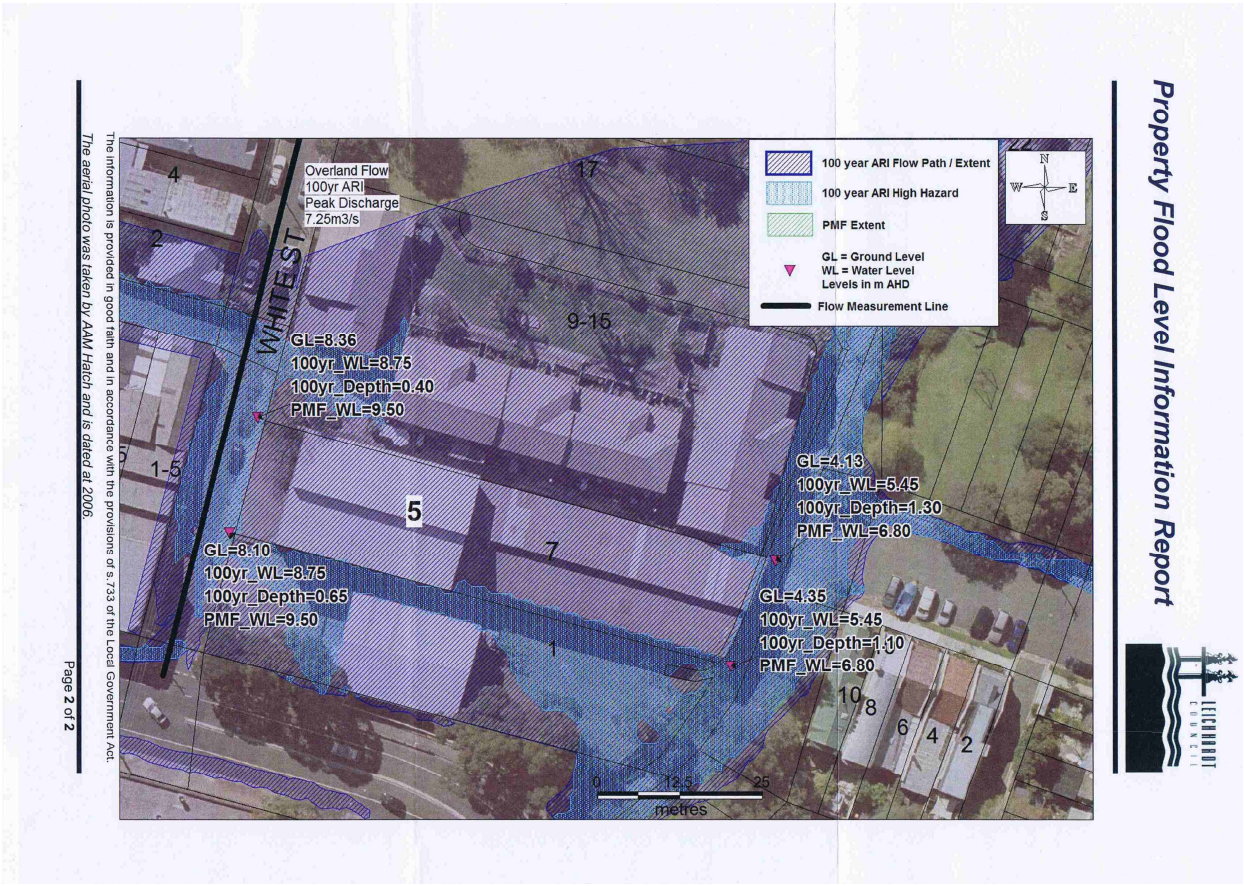
Flood Study and Flood Risk Management Report for No. 1-3 White Street, Lilyfield

Introduction

The subject site is affected by flooding. The Council issued a flood advice for No. 5 White Street indicating a peak discharge value of 7.25 m3/s for the 100 year ARI flood and the 100 year and the Probable Maximum Flood (PMF) levels as indicated in Table 1.

Table 1, Design Flood Levels (m AHD)/depth of flood (m)

Location	1 in 100 year ARI	PMF
South Western corner	8.75/0.65	9.50/1.40
South Eastern corner	5.45/1.10	6.80/2.45



A multi-unit development application for was lodged with the Council for No. 5 White Street, which was subsequently approved. A drainage easement is running between No. 5 and No. 3. The Council requested that a new 1500 mm diameter pipe is constructed to carry the 1 in 20 year flood flow. The new pipe would be fully contained within the property of No. 5 White Street.

Hydrology

The catchment draining to White Street has an area of some 24.6ha. The design floods' peak discharge values were calculated using rational formula, with the time of concentration calculated by the kinematic wave approach (Table 2).

Table 2, peak design flood discharge values

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Catchment Area (Ha.) : 24.60
Impervious Area  (%) : 60.0
Gutter Flow   (mins) : 0.00
Length (m)   Slope (%)  Roughness
      790.0       3.00      0.050
Average Recurrence Interval (ARI) years : 5
Co-efficient  "C"     0.73
Intensity  (mm/hr)    72.8
Time       (mins)     32.5
Runoff     (l/s)      3631
Average Recurrence Interval (ARI) years : 20
Co-efficient  "C"     0.81
Intensity  (mm/hr)   102.7
Time       (mins)     28.3
Runoff     (l/s)      5661
Average Recurrence Interval (ARI) years : 100
Co-efficient  "C"     0.92
Intensity  (mm/hr)   143.8
Time       (mins)     24.7
Runoff     (l/s)      9055
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The drainage systems were designed to carry the runoff during the 5 year storm events. Assuming that the existing drainage system is working at 50% capacity the overland flow during various design flood events was calculated by deducting the half of the 5 year flow from the peak discharge value (Table 3).

Table 3, overland flow (m3/s)

ARI 1 in Y (years)	5	20	100
Q overland	1.82	3.85	7.24

The value of 7.24 m3/s for the 100 year flood closely agrees with the overland flow advised by the Council (7.25 m3/s), confirming the accuracy of the assumption.

Hydraulic model

The runoff from a 24.6 ha catchment flows along Moore Lane and then turns Southwards along White Street. The overland flow turns eastwards towards Whites Creek Lane between No. 5 and No. 3 White Street.

HEC-RAS, a steady state one dimensional hydraulic model was used to determine the flood behaviour for the area between White Street and Whites Creek Lane in order to quantify the impact of the proposed development on flooding.

Three cases were investigated: a) existing conditions with both No. 5 and No. 3 Whites Street properties undeveloped; b) semi existing conditions with No. 5 developed and No. 3 existing and c) proposed conditions with both properties developed.

The layouts of the models for cases a), b) and c) are shown on Drawings C-3347-01, C-3347-02 and C-3347-03 respectively. The results for the 1 in 100 year floods are given in Tables 4, 5 and 6, while the differences are given in Tables 7 and 8.

It can be seen from Table 4 that the calculated by Hec-Ras 100 year flood level at cross section 8 of 8.74 m AHD is similar to the flood level provided by the Council of 7.25 m AHD.

Table 4, 1 in 100 year ARI flood, existing conditions, case a)

XS	Q (m3/s)	Inv (m)	WL (m)	Depth (m)	V (m/s)	V x D (m2/s
8	7.25	8.14	8.739	0.599	1.2	0.7188
7.7	7.25	8.05	8.591	0.541	1.96	1.06036
7	7.25	7.59	8.136	0.546	3.2	1.7472
6	7.25	6.3	6.843	0.543	4.4	2.3892
5	7.25	5.86	6.365	0.505	3.59	1.81295
4.7	7.25	5.8	6.174	0.374	3.57	1.33518
4.5	7.25	5.4	6.075	0.675	3.93	2.65275
4	7.25	5.3	6.132	0.832	2.62	2.17984
3	7.25	4.5	6.288	1.788	1.49	2.66412
2	7.25	4.4	6.081	1.681	2.24	3.76544
1	7.25	4.3	5.45	1.15	1.8	2.07

It was assumed for case b) that the new 1500 mm diameter pipe would still carry only 50% of the 1 in 5 year storm because of the limited intake capacity of the existing pits.

It is proposed for case c) to construct a large 900 mm wide and 7.8 m long intake chamber at the upstream site boundary to intercept the difference between the 1 in 20 year flow and the 50% of the 1 in 5 year flow, charging the new pipe to it's full capacity. The size of the intake chamber was determined by assuming 50% blockage of the grates. A 1050 mm diameter pipe would be required to connect the intake chamber to the new 1500 mm diameter pipe.

The depth of water along the proposed driveway would reduce from 130 mm to zero. The proposed basement parking would have to be open to flow, with a minimum freeboard between the car parking spaces and the 100 year flood levels of 300 mm.

Table 5, 1 in 100 year ARI flood, semi-existing conditions, case b)

XS	Q (m3/s)	Inv (m)	WL (m)	Depth (m)	V (m/s)	V x D (m2/s
8	7.25	8.14	8.638	0.498	1.21	0.60258
7.7	7.25	7.98	8.482	0.502	2.09	1.04918
7	7.25	7.7	7.94	0.24	3.75	0.9
6	7.25	6.47	6.795	0.325	3.7	1.2025
5	7.25	5.8	6.177	0.377	3.42	1.28934
4	7.25	5.18	6.04	0.86	2.13	1.8318
3	7.25	4.74	5.932	1.192	1.57	1.87144
2	7.25	4.52	5.41	0.89	2.72	2.4208
1	7.25	4.3	5.45	1.15	1.41	1.6215

Table 6, 1 in 100y Flood, proposed conditions, case c)

XS	Q (m3/s)	Inv (m)	WL (m)	Depth (m)	V (m/s)	V x D (m2/s
8	7.25	8.14	8.638	0.498	1.21	0.60258
7.7	7.25	7.98	8.482	0.502	2.09	1.04918
7	7.25	7.7	7.94	0.24	3.75	0.9
6	7.25	6.47	6.795	0.325	3.7	1.2025
5	7.25	5.8	6.177	0.377	3.42	1.28934
4	7.25	5.18	6.04	0.86	2.13	1.8318
3	7.25	4.74	5.932	1.192	1.57	1.87144
2	7.25	4.52	5.41	0.89	2.72	2.4208
1	7.25	4.3	5.45	1.15	1.41	1.6215

Table 7, Differences (Semi-Proposed – Existing)

XS	Q (m3/s)	Inv (m)	WL (m)	Depth (m)	V (m/s)	V x D (m2/s
8	0	0	-0.101	-0.101	0.01	-0.1162
7.7	0	-0.07	-0.109	-0.039	0.13	-0.0112
7	0	0.11	-0.196	-0.306	0.55	-0.8472
6	0	0.17	-0.048	-0.218	-0.7	-1.1867
5	0	-0.06	-0.188	-0.128	-0.17	-0.5236
4	0	-0.12	-0.092	0.028	-0.49	-0.3480
3	0	0.24	-0.356	-0.596	0.08	-0.7927
2	0	0.12	-0.671	-0.791	0.48	-1.3446
1	0	0	0	0	-0.39	-0.4485

Table 8, Differences (Proposed – Existing)

XS	Q (m3/s)	Inv (m)	WL (m)	Depth (m)	V (m/s)	V x D (m2/s
8	0	0	-0.216	-0.216	0.6	-0.0294
7.7	-3.85	-0.05	-0.249	-0.199	-0.26	-0.479
7	-3.85	0.14	-0.097	-0.237	-1.58	-1.2466
6	-3.85	0.18	-0.083	-0.263	-2.8	-1.9412
5	-3.85	-0.05	-0.179	-0.129	-1.74	-1.1174
4	-3.85	-0.1	-0.432	-0.332	-0.43	-1.0848
3	-3.85	0.25	-0.767	-1.017	0.01	-1.5076
2	-3.85	0.12	-0.624	-0.744	-1.16	-2.7535
1	-3.85	0	0	0	-1.14	-1.311

It can be seen from Table 8 that the proposed works would reduce the flood levels in White Street by more than 200 mm, reduce the flood levels between White Street and Whites Creek Lane and reduce the velocity and the flood hazard along the overland flow path, which is beneficial.

Flood related controls

The following flood related controls apply:

1. Any portion of the development below the 100 year flood level plus 500 mm freeboard must be built from flood compatible materials. Concrete, bricks and hard wood are considered as flood compatible materials;
2. All services associated with the development must be flood proofed to the minimum floor levels or higher;
3. No fences or any other structures are permitted along the floodway.
4. The flood depths of flood waters around and through the site are high during the 100 year flood. A flood depth indicators must be installed at each corner of the building advising the occupants that the site might be inundated during floods showing the depth of water.
5. A flood Emergency Response Plan is included in this report as an appendix.

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Pavel Kozarovski, MIEAust, CPEng, NPER-3

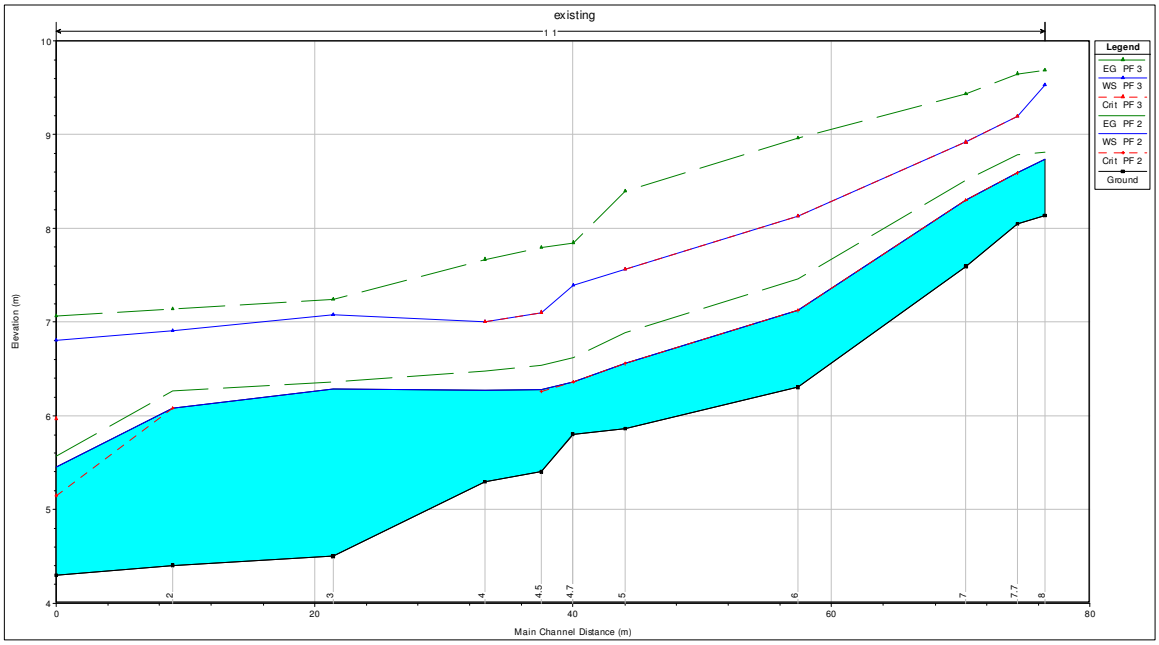
Appendix A
Flood Emergency Response Plan

1. Floods in Leichhardt are considered as "flash floods" and no warning system for this catchment is available. Storms leading to major flooding are typically 2 hours long, however shorter storms as little as a 10 minutes long can produce significant flooding. Once the storm passes floodwaters usually disappear rapidly.
2. During floods many local and major streets and roads will be cut by floodwaters. Travelling through floodwaters on foot, or in a vehicle can be very dangerous as the water may be polluted, obstructions can be hidden under the floodwaters, or you could be wept away. It is recommended to remain within the home as much as practical as this is the safest option. If you need to leave the home do so early in the flood event, before the flood level reaches the road level in front of the dwelling.
3. Develop your own family flood plan and be prepared if flooding should occur while children are coming home from school or when you are returning from work. Talk to the Council to determine the safer travel routes that are less likely to be cut by floodwaters.
4. Do not attempt to save the car if floodwaters start to enter the car park, it is too dangerous as water levels will rise rapidly and you could be trapped.
5. As the flood level approaches the car park floor level (but only if safe to do so) relocate any items that may be damaged by water, or poisons, or wastes to as high a level as possible.
6. As the flood level approaches the habitable floor levels:
    a. Gather medicines, special requirements for babies or the elderly, mobile phones, first aid kit, special papers and any valuables into one location,
    b. Put on strong shoes, raise any items within home that may be damaged by water (e.g. photo albums(to as high a level as possible, with electrical items on top. Turn off and disconnect any large electrical items such as TV that cannot be raised,
    c. Place wet towels across the bottom and lower sides of external doors to slow down the entry of water through the door.
7. In the very rare event that floodwaters may enter the home move to the first floor level. Do not evacuate the home unless instructed to do so by the SES or the Police. Remember floodwaters are much deeper and flow much faster outside.
8. In the case of a medical emergency ring 000 as normal, but explain about the flooding.
9. A laminated copy of this plan should be permanently attached (glued) on an inside cupboard door in the kitchen and laundry and to the inside electrical meter box.
10. This flood management plan should be reviewed every 5 years, particularly with the potential effects of Climate Change with sea level rise and increased rainfall intensities.

Appendix B

100 year flood profiles and cross sections for

a) Existing ;
b) Semi Proposed and
c) Proposed Conditions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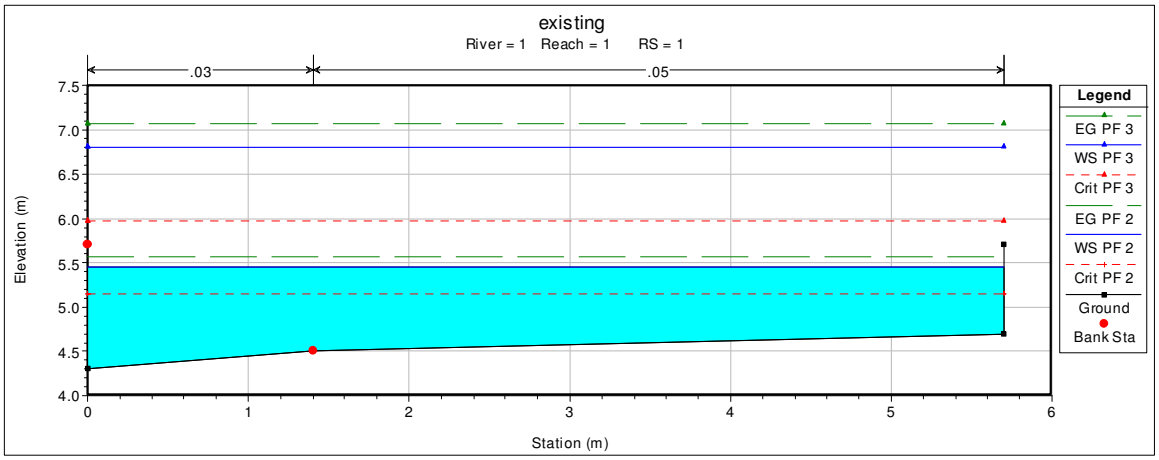
Main Channel Distance (m)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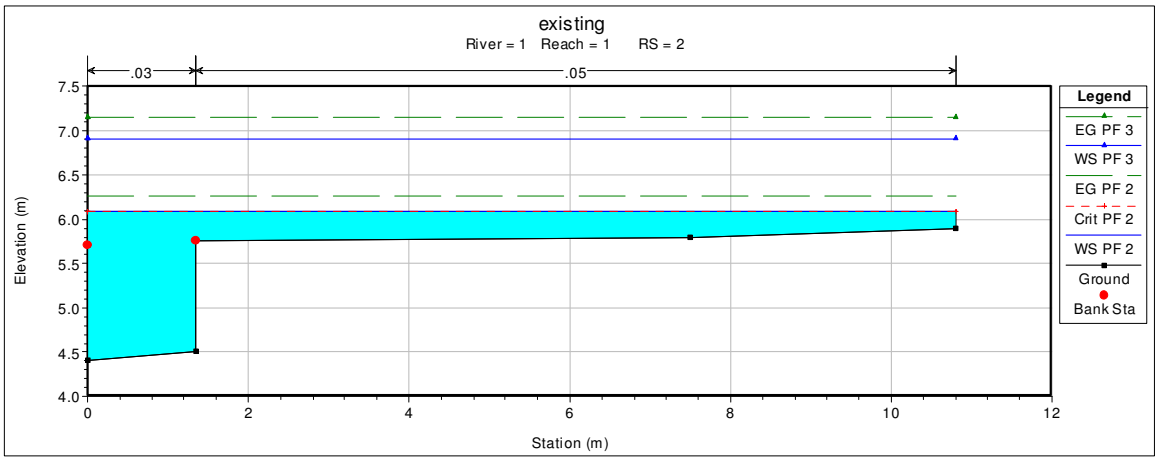
Station (m)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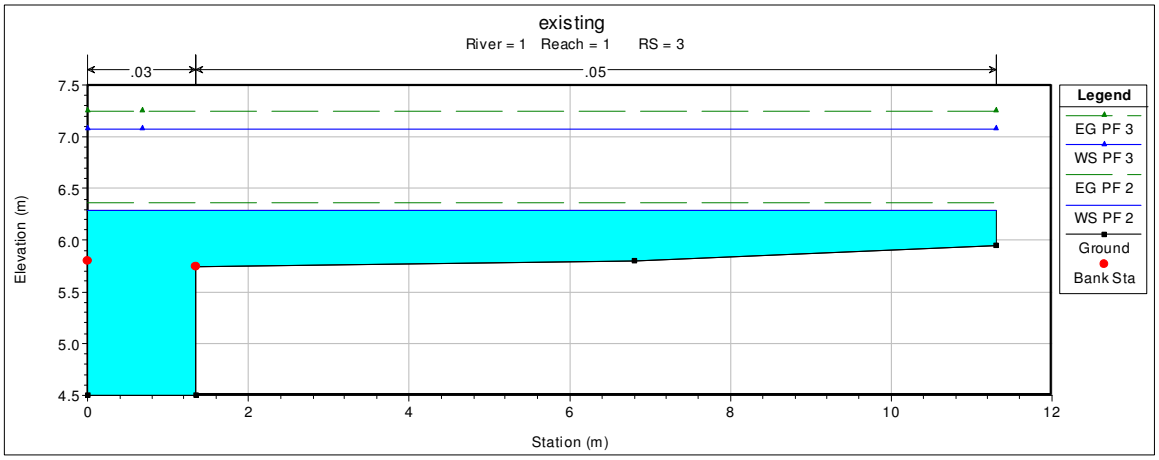
Station (m)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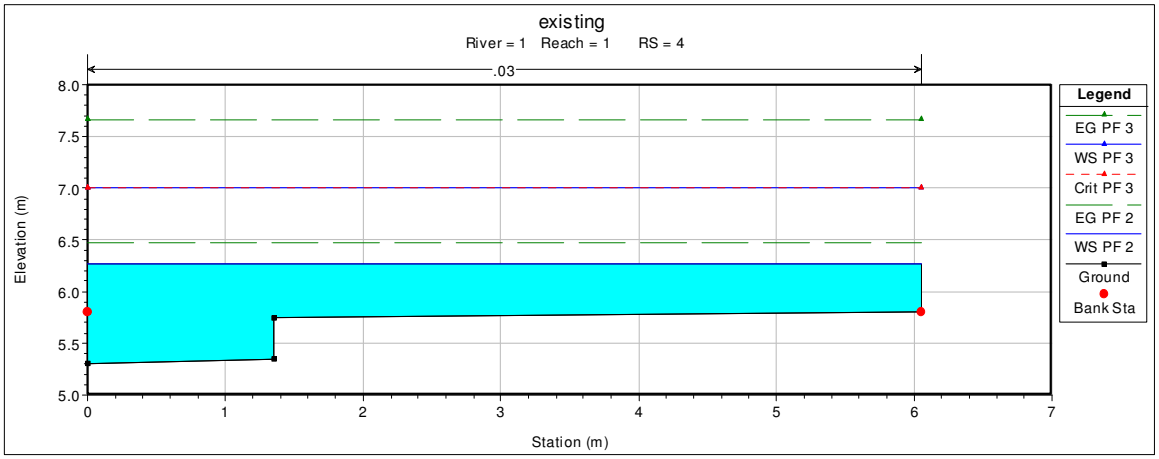
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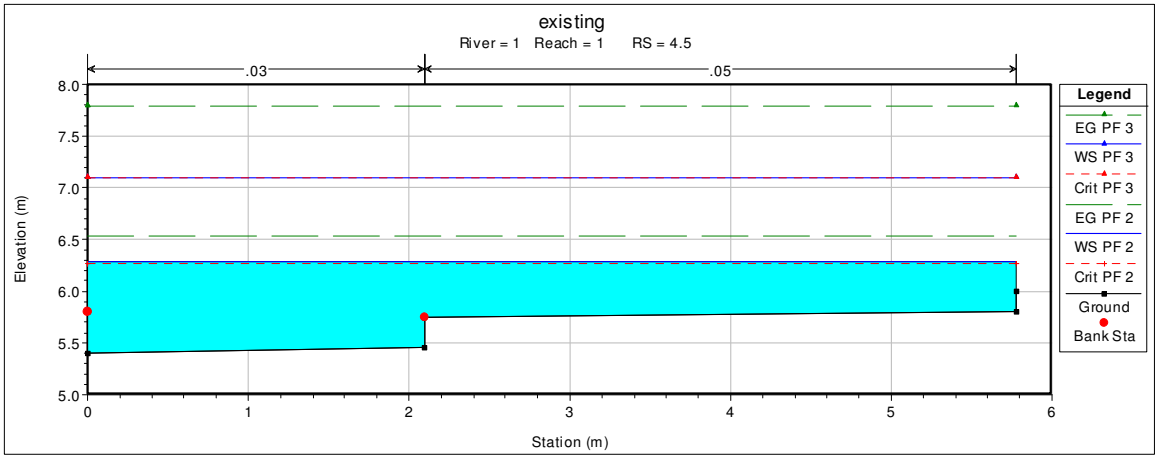
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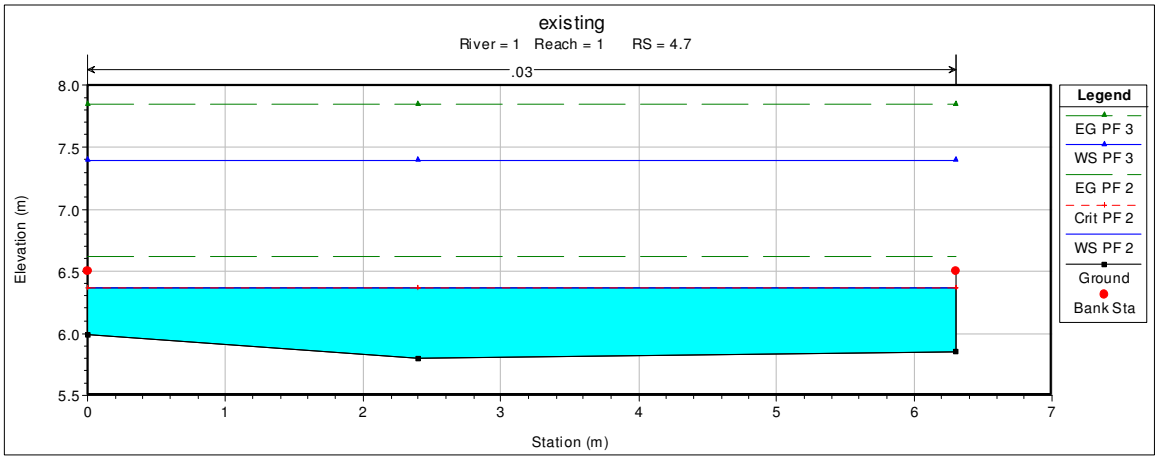
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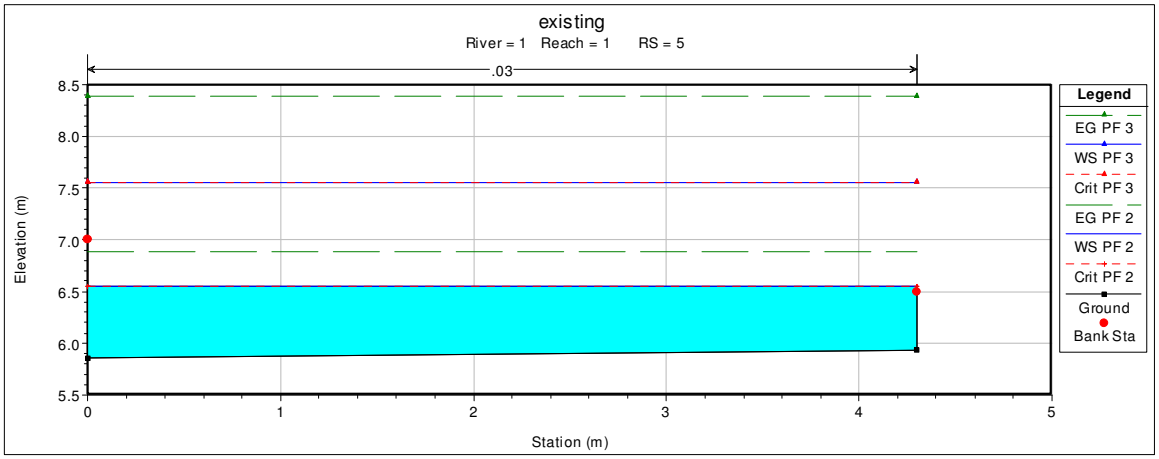
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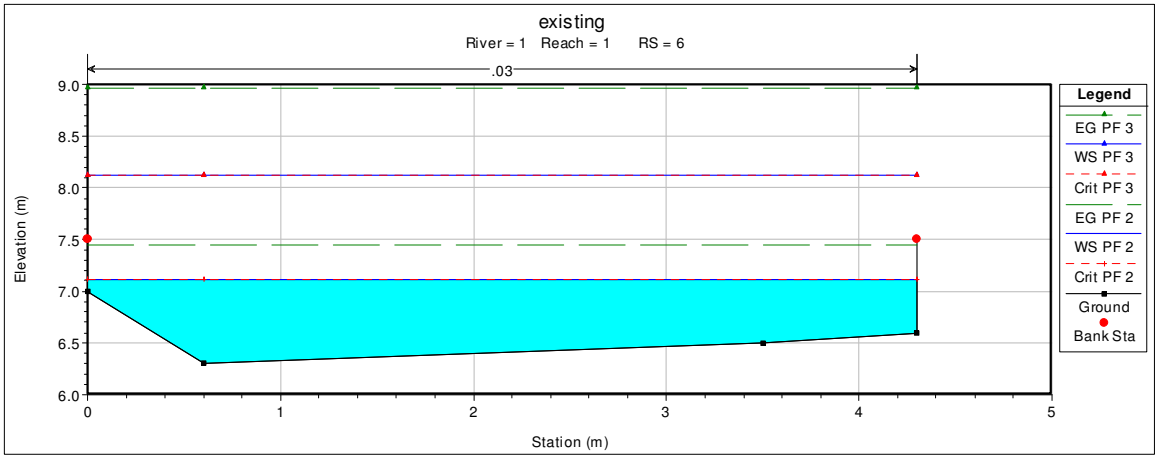
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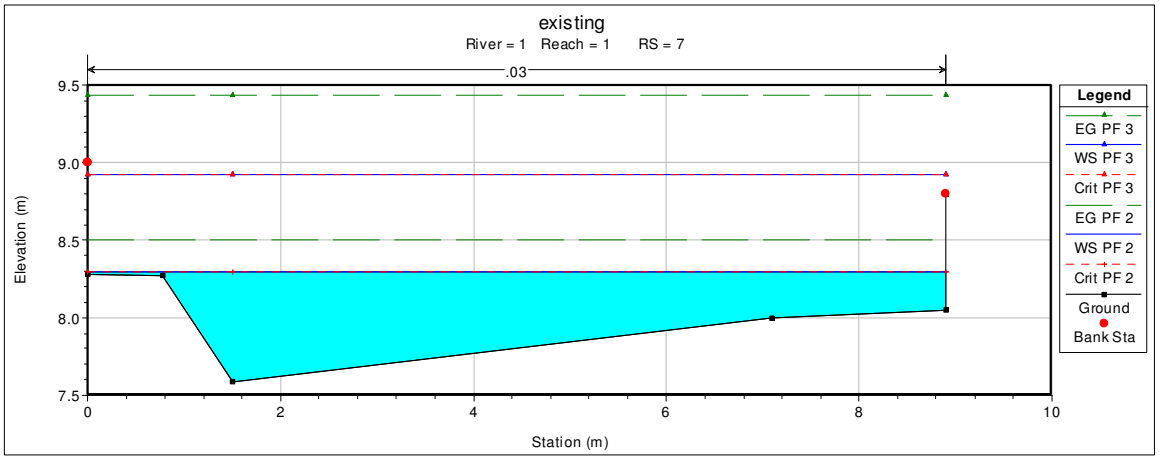
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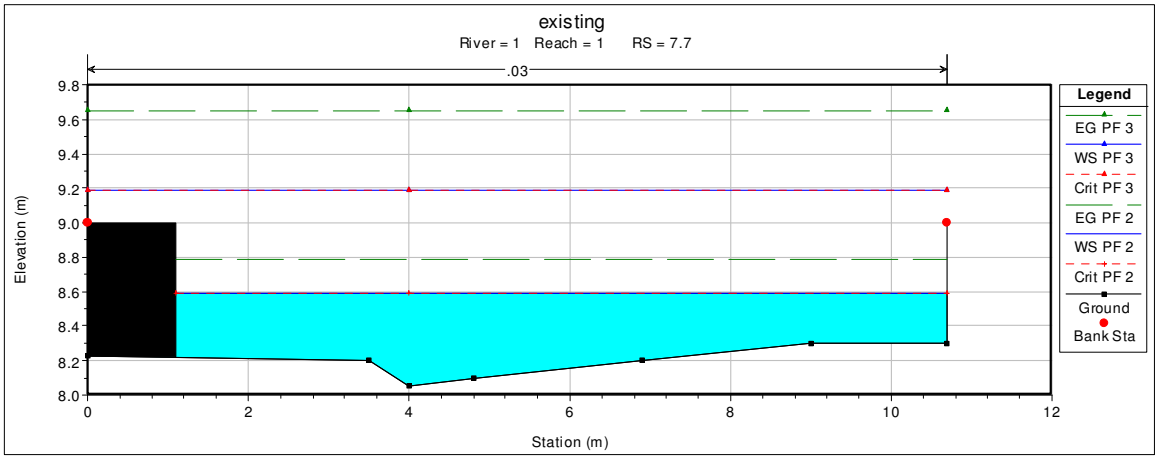
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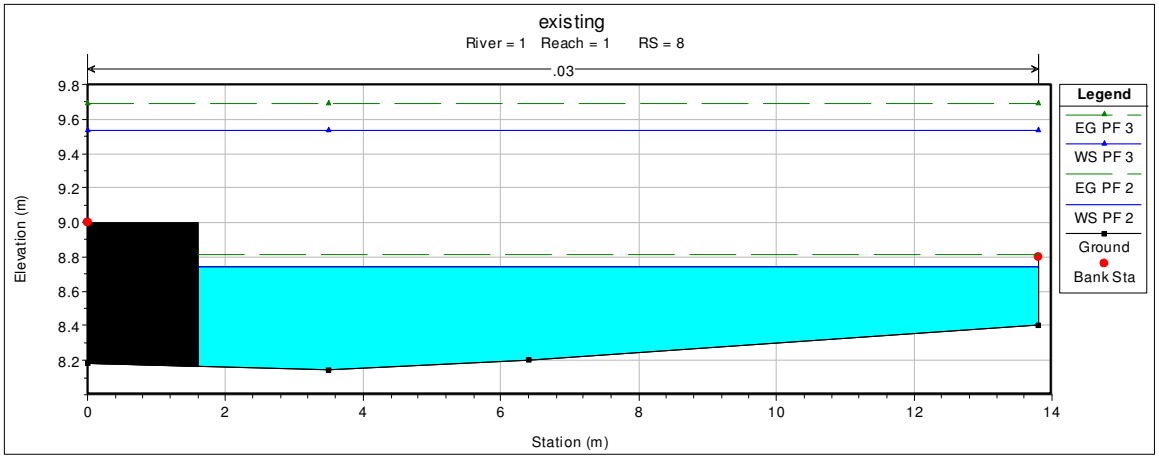
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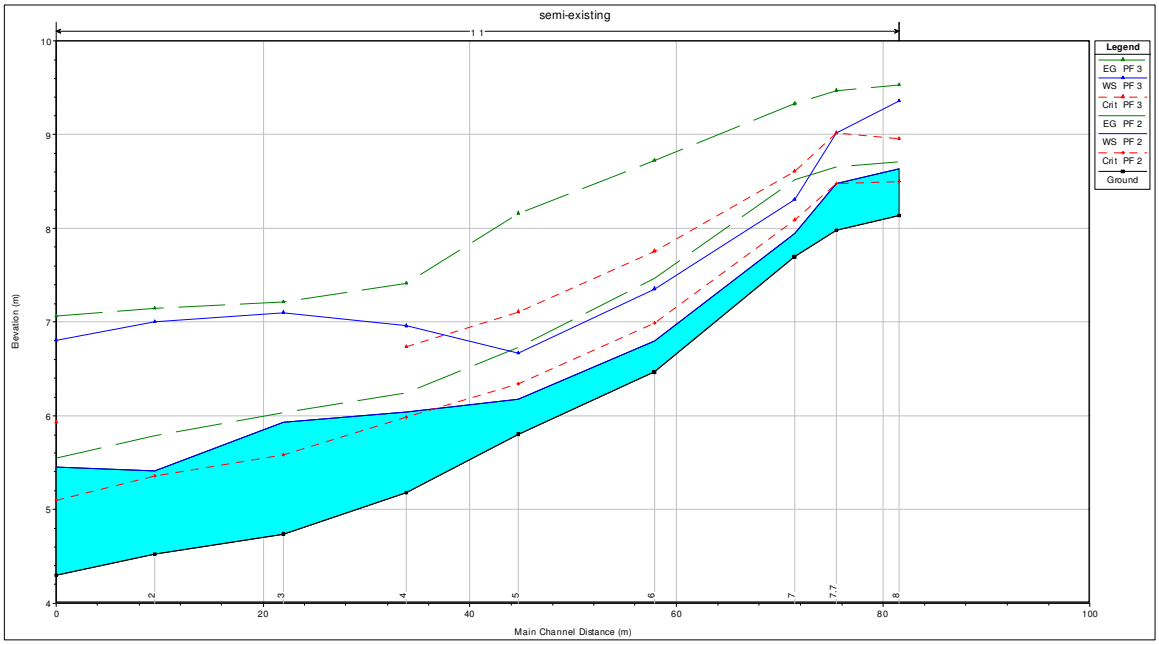
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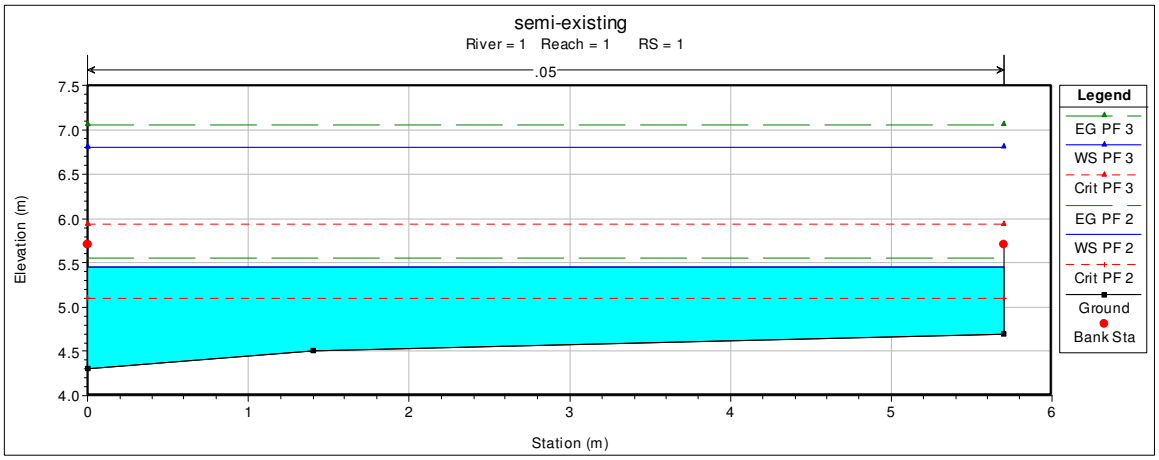
Main Channel Distance (m)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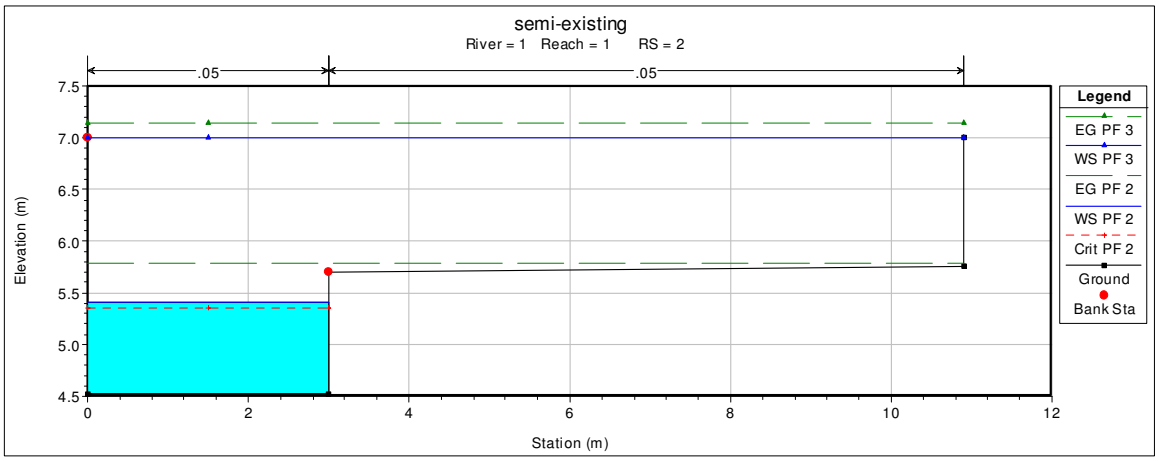
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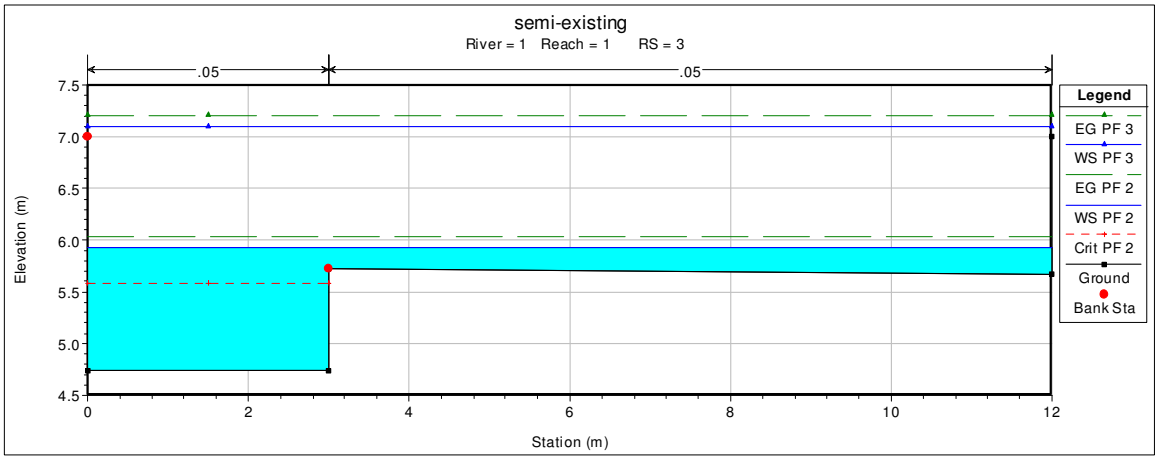
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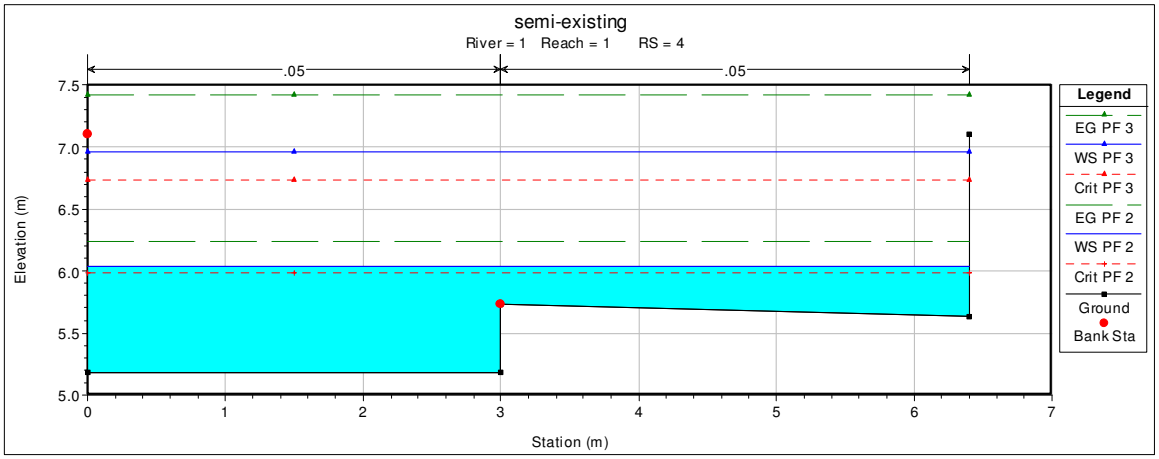
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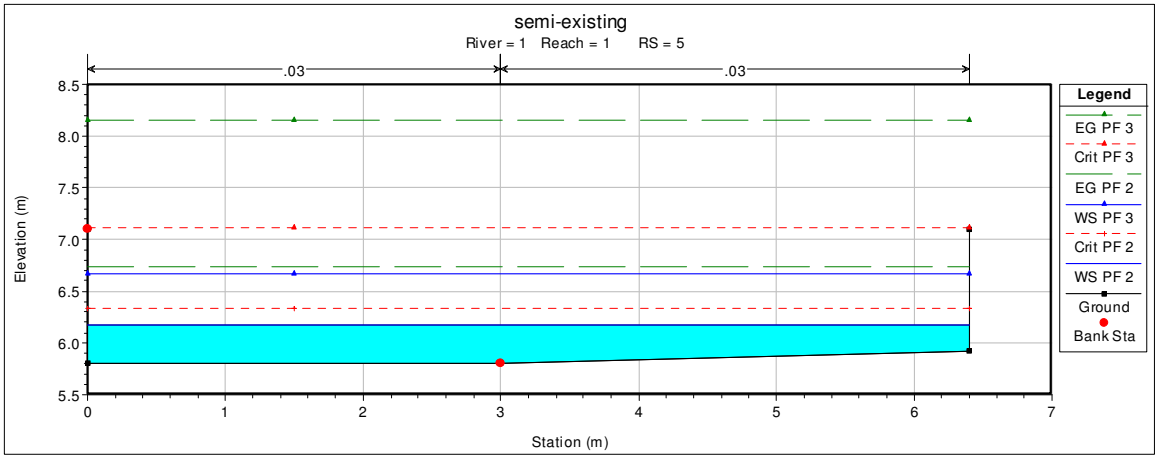
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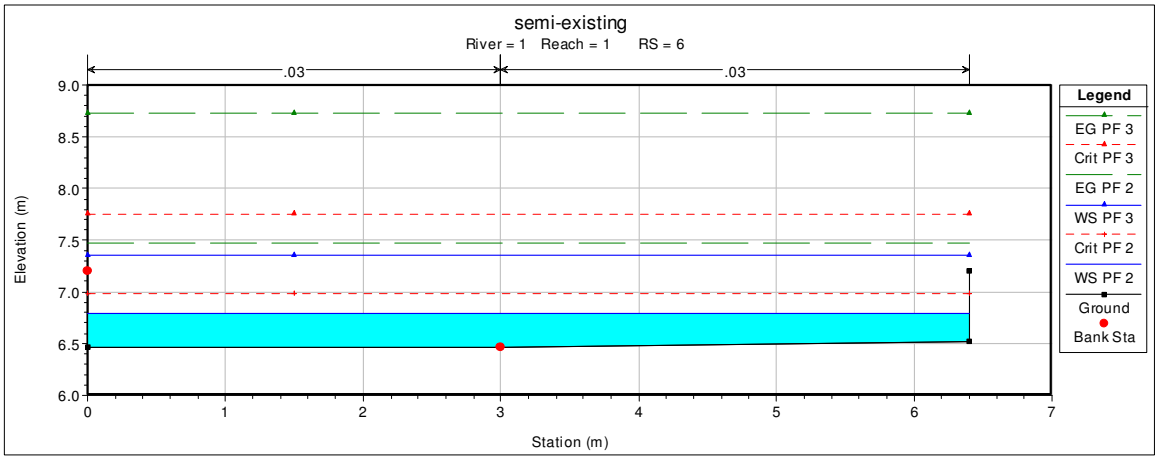
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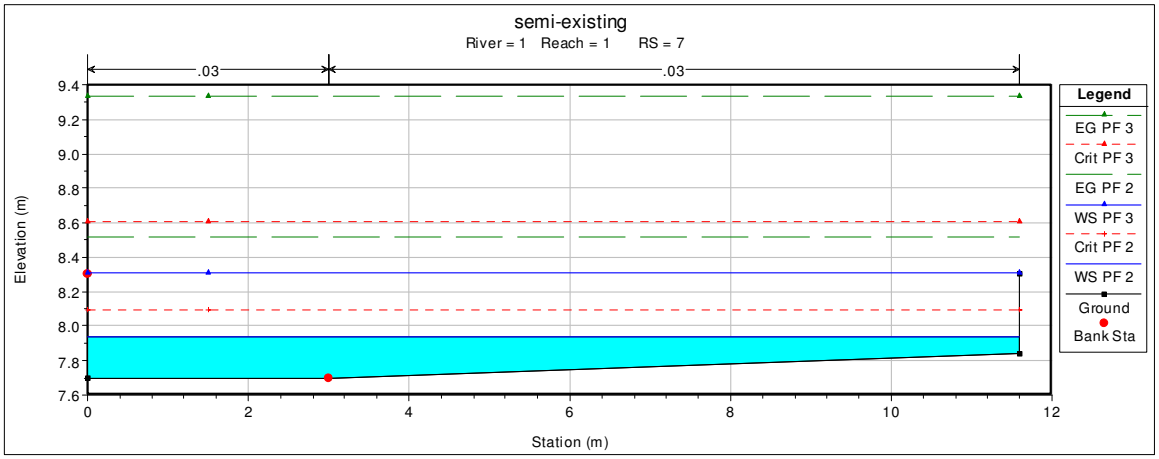
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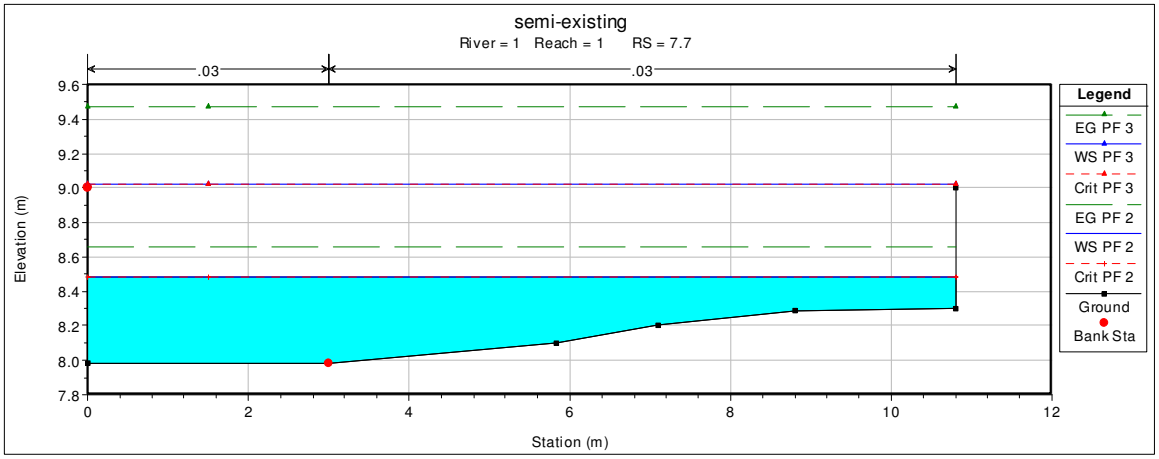
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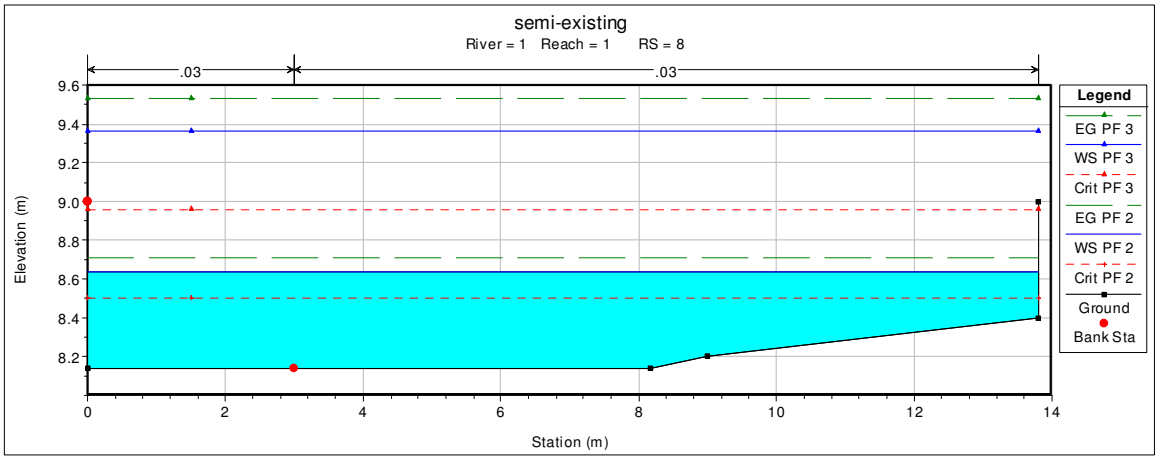
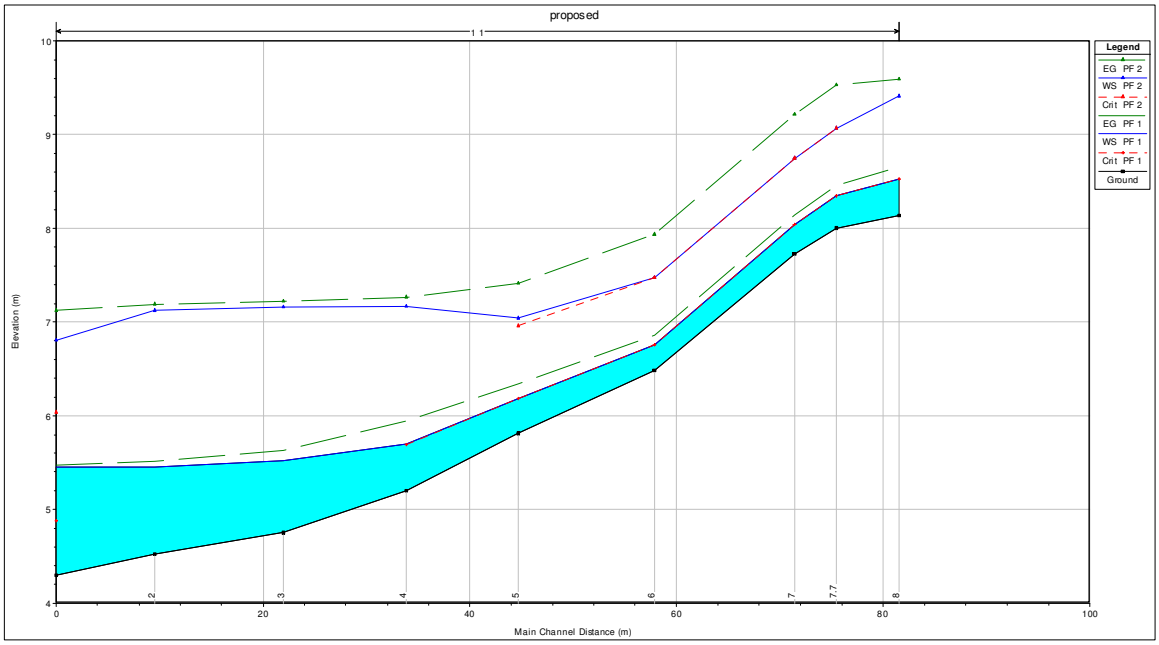
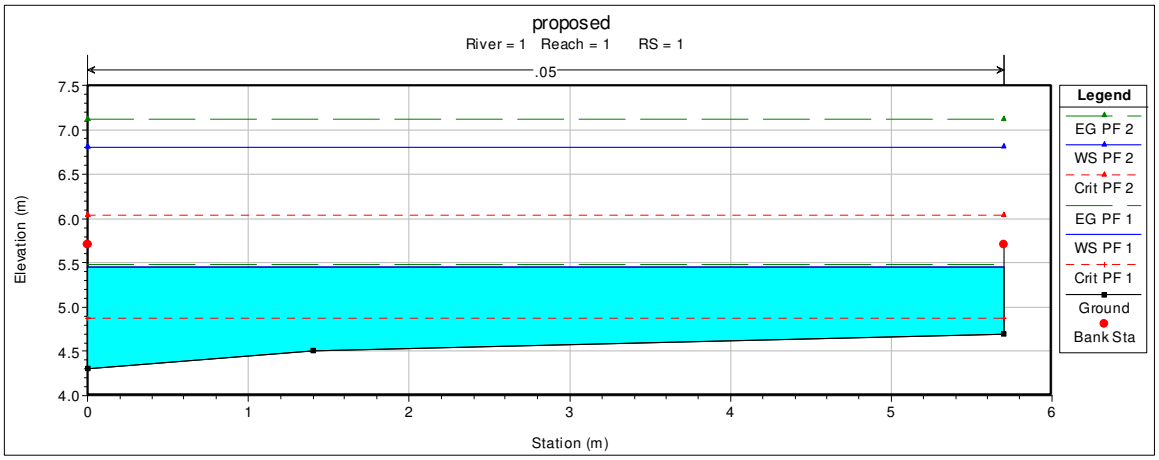
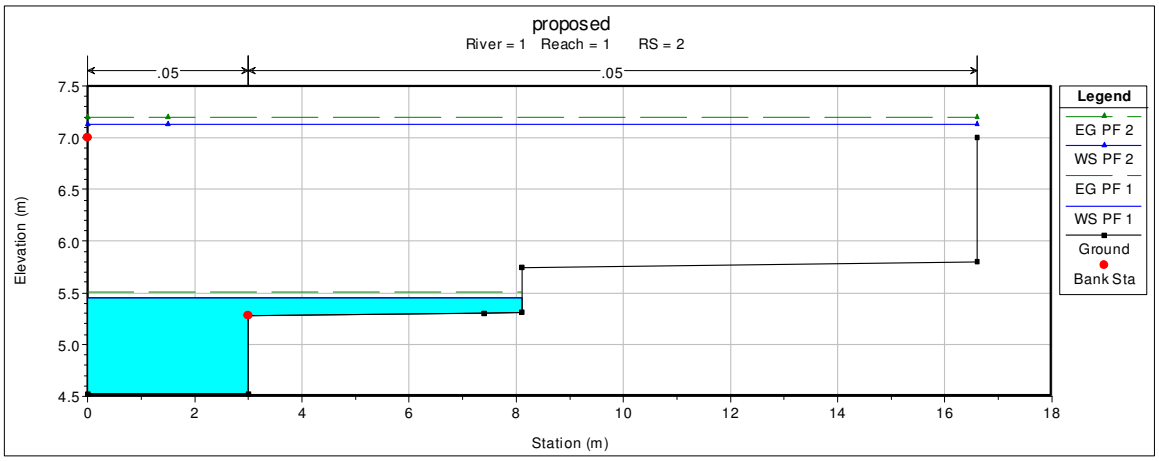
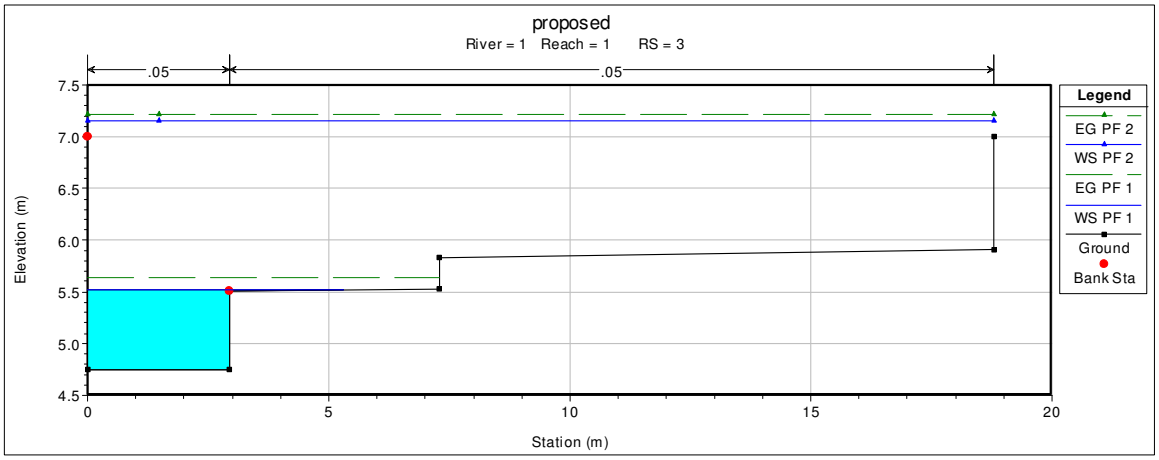
Station (m)
Legend
EG PF 3
WS PF 3
Crit PF 3
EG PF 2
WS PF 2
Crit PF 2
Ground
Bank Sta

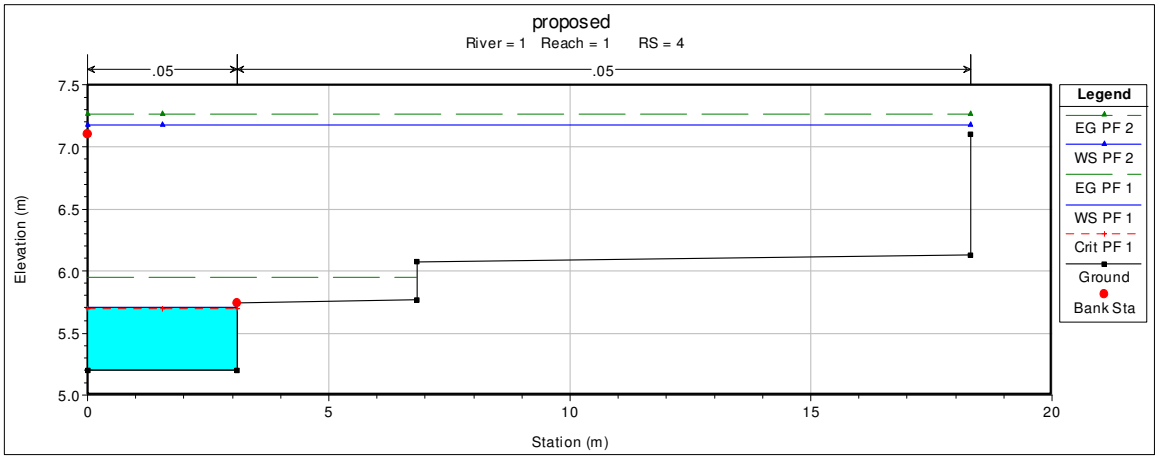

semi-existing
River = 1 Reach = 1 RS = 8
.03
.03
Elevation (m)
9.6
9.4
9.2
9.0
8.8
8.6
8.4
8.2
0
2
4
6
8
10
12
14
Station (m)
Legend
EG PF 3
WS PF 3
Crit PF 3
EG PF 2
WS PF 2
Crit PF 2
Ground
Bank Sta

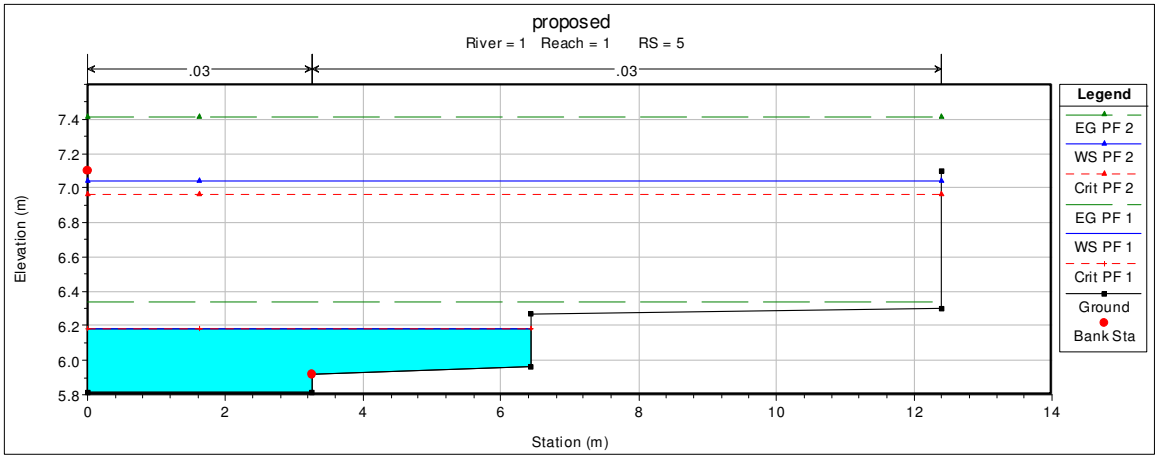

proposed
Legend
EG PF 2
WS PF 2
Crit PF 2
EG PF 1
WS PF 1
Crit PF 1
Ground
Elevation (m)
Main Channel Distance (m)

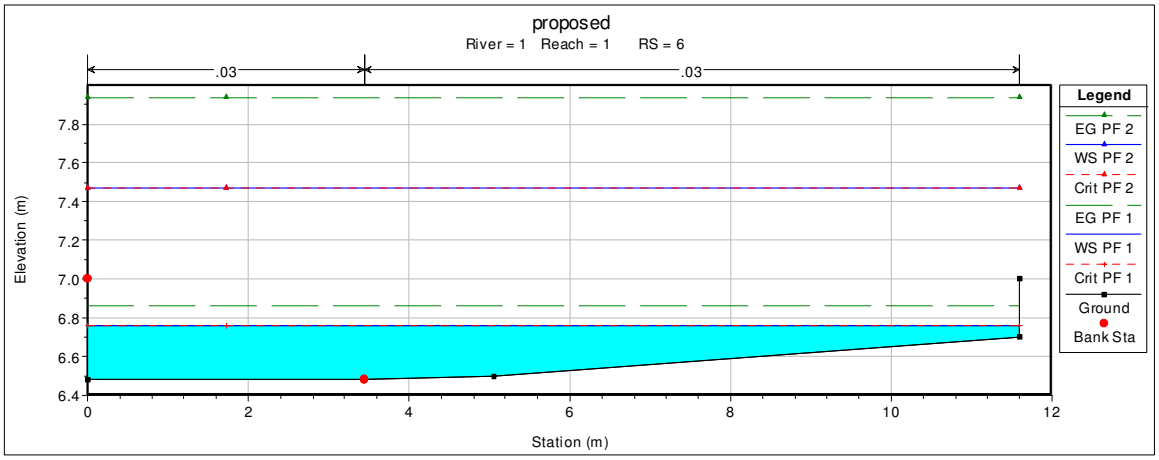

proposed
River = 1 Reach = 1 RS = 1
.05
Legend
EG PF 2
WS PF 2
Crit PF 2
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (m)
Station (m)

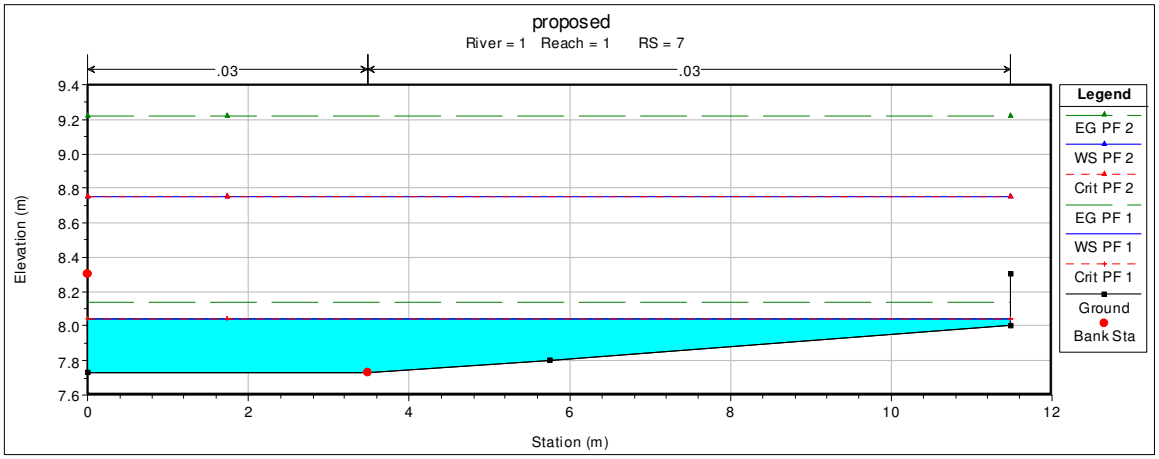

proposed
River = 1 Reach = 1 RS = 2
.05
.05
Legend
EG PF 2
WS PF 2
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (m)
Station (m)

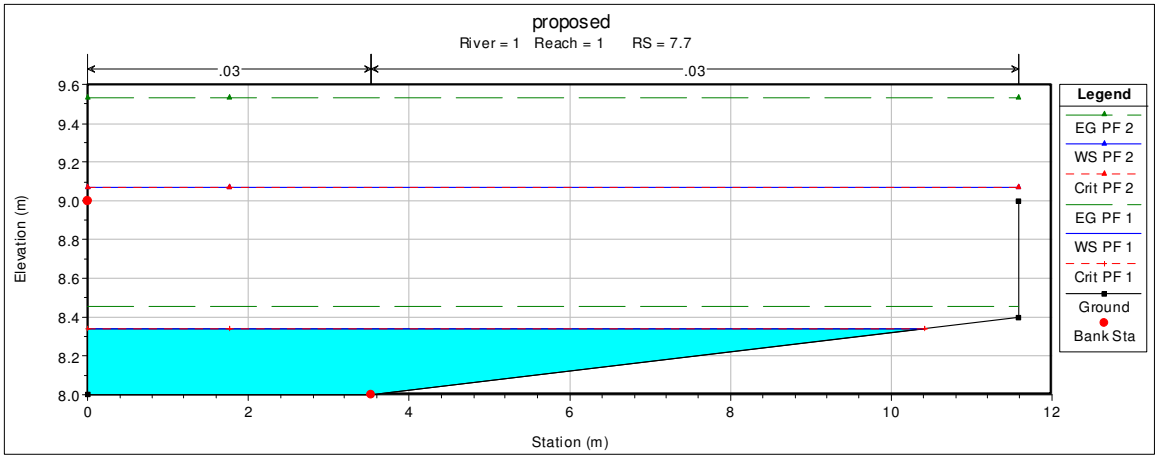

proposed
River = 1 Reach = 1 RS = 3
.05
.05
Elevation (m)
Station (m)
Legend
EG PF 2
WS PF 2
EG PF 1
WS PF 1
Ground
Bank Sta

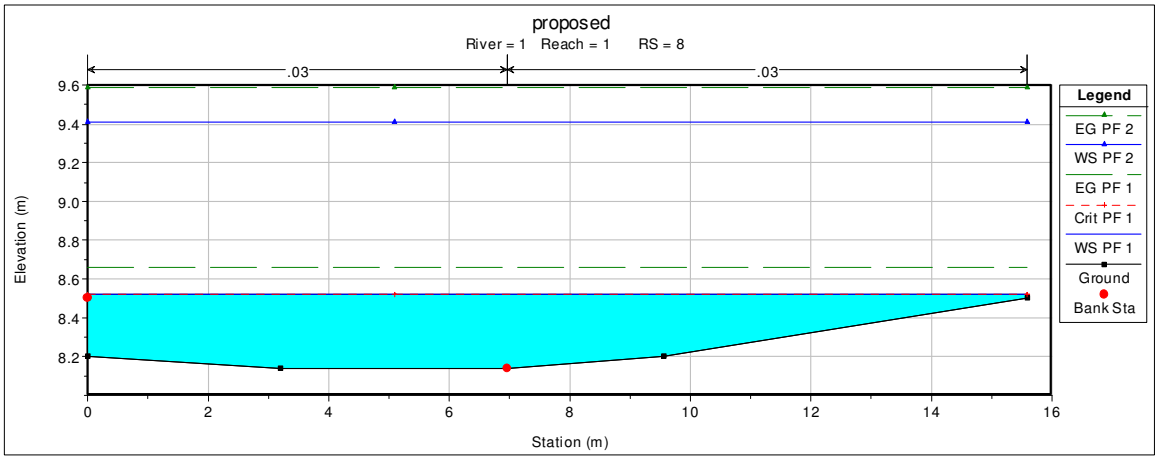

proposed
River = 1 Reach = 1 RS = 4
.05
.05
Elevation (m)
Station (m)
Legend
EG PF 2
WS PF 2
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta

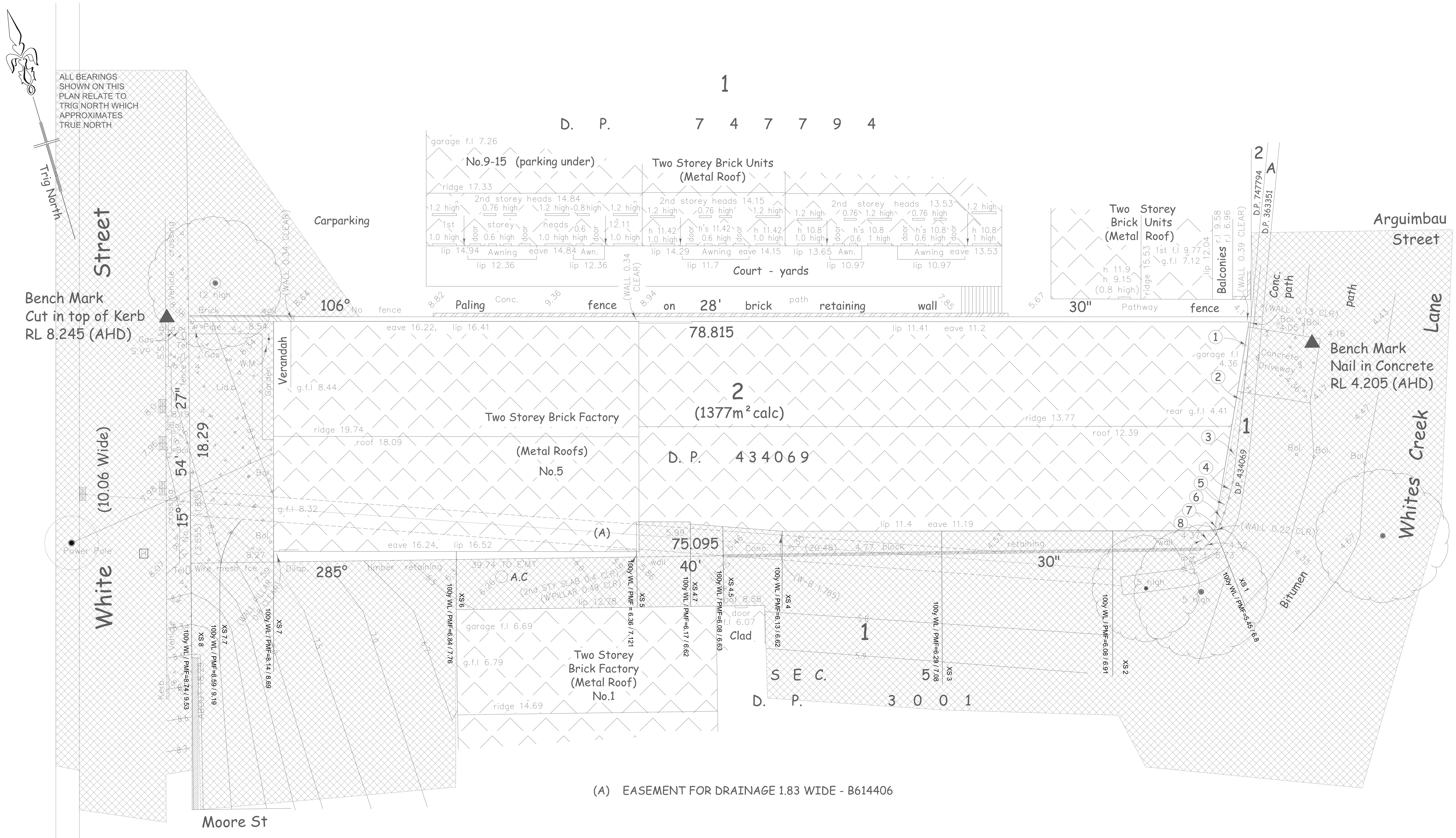

proposed
River = 1 Reach = 1 RS = 5
.03
.03
Elevation (m)
Station (m)
Legend
EG PF 2
WS PF 2
Crit PF 2
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta


proposed
River = 1 Reach = 1 RS = 6
.03
.03
Elevation (m)
Station (m)
Legend
EG PF 2
WS PF 2
Crit PF 2
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta


proposed
River = 1 Reach = 1 RS = 7
.03
.03
Elevation (m)
Station (m)
Legend
EG PF 2
WS PF 2
Crit PF 2
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta


proposed
River = 1 Reach = 1 RS = 7.7
.03
.03
Elevation (m)
Station (m)
Legend
EG PF 2
WS PF 2
Crit PF 2
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta


proposed
River = 1 Reach = 1 RS = 8
.03
.03
Elevation (m)
9.6
9.4
9.2
9.0
8.8
8.6
8.4
8.2
0
2
4
6
8
10
12
14
16
Station (m)
Legend
EG PF 2
WS PF 2
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta



LEGEND	
● SDP ● DP	SEALED PVC DOWNPIPE 100 Ø DOWNPIPE
—— 23 — — 22	EXISTING CONTOUR (m) PROPOSED CONTOUR (m)
Fp ● FW	SUB_SOIL DRAIANGE FLUSH POINT FLOOR WASTE 250x250 min
L=9 Ø100	STORMWATER DRAINAGE PIPE DIAMETER = 100 mm, 9 m LONG
	SUBSOIL DRAINAGE PIPE (default Ø100mm, min. slope 1%)
23.00 22.50	FINISHED GROUND LEVEL=23.0(m) PIPE INVERT LEVEL=22.5 (m)
+23.17	EXISTING GROUND LEVEL (m)
23.20	PROPOSED GROUND LEVEL (m)
23.20	TOP OF WALL (m)

Amendments

Issue	Date	Comments
1	29/07/18	for information
2	4/08/18	for information 2
3	6/10/18	for submission
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-

FLOOD STUDY FOR PROPOSED DEVELOPMENT AT No. 1-3 WHITE STREET, LILYFIELD EXISTING CONDITIONS, CASE A	DRAWN BY: P.K. DRAWING No.C-3347-01 SCALE: 1:100 on A0, 1:200 on A2
DESIGNED BY: PAVEL KOZAROVSKI, MIEAus, CPEng, NPER-3	Kozarovski & Partners 14/52-54 KINGSWAY, CRONULLA NSW 2230 (02) 8544 8720 Mobile: 0412 997 767 pavelk@optusnet.com.au

LEGEND

Symbol	Description
SDP / DP	SEALED PVC DOWNPIPE 100 Ø / DOWNPIPE
23 / 22	EXISTING CONTOUR (m) / PROPOSED CONTOUR (m)
Fp / FW	SUB_SOIL DRAIANGE FLUSH POINT / FLOOR WASTE 250x250 min
L=9 Ø100	STORMWATER DRAINAGE PIPE DIAMETER = 100 mm, 9 m LONG
	SUBSOIL DRAINAGE PIPE (default Ø100mm, min. slope 1%)
23.00 / 22.50	FINISHED GROUND LEVEL=23.0(m) PIPE INVERT LEVEL=22.5 (m)
+23.17	EXISTING GROUND LEVEL (m)
23.20	PROPOSED GROUND LEVEL (m)
23.20	TOP OF WALL (m)

Amendments

Issue	Date	Comments
1	29/07/18	for information
2	4/08/18	for information 2
3	6/10/18	for submission
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-

FLOOD STUDY FOR PROPOSED DEVELOPMENT AT No. 1-3 WHITE STREET, LILYFIELD	DRAWN BY: P.K.
	DRAWING No.C-3347-02
EXIST. COND. WITH APPROVED No. 5, CASE B	SCALE: 1:100 on A0, 1:200 on A2
DESIGNED BY: PAVEL KOZAROVSKI, MIEAus, CPEng, NPER-3	Kozarovski & Partners 14/52-54 KINGSWAY, CRONULLA NSW 2230 (02) 8544 8720 Mobile: 0412 997 767 pavelk@optusnet.com.au

LEGEND

Symbol	Description
SDP / DP	SEALED PVC DOWNPIPE 100 Ø / DOWNPIPE
23 / 22	EXISTING CONTOUR (m) / PROPOSED CONTOUR (m)
Fp / FW	SUB_SOIL DRAIANGE FLUSH POINT / FLOOR WASTE 250x250 min
L=9 Ø100	STORMWATER DRAINAGE PIPE DIAMETER = 100 mm, 9 m LONG
	SUBSOIL DRAINAGE PIPE (default Ø100mm, min. slope 1%)
23.00 / 22.50	FINISHED GROUND LEVEL=23.0(m) PIPE INVERT LEVEL=22.5 (m)
+23.17	EXISTING GROUND LEVEL (m)
△23.20	PROPOSED GROUND LEVEL (m)
23.20	TOP OF WALL (m)

Amendments

Issue	Date	Comments
1	29/07/18	for information
2	4/08/18	for information 2
3	6/10/18	for submission
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-

FLOOD STUDY FOR PROPOSED DEVELOPMENT AT No. 1-3 WHITE STREET, LILYFIELD

PROPOSED CONDITIONS, CASE C

DRAWN BY: P.K.

DRAWING No.C-3347-03

SCALE: 1:100 on A0, 1:200 on A2

DESIGNED BY: PAVEL KOZAROVSKI, MIEAus, CPEng, NPER-3

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(02) 8544 8720
Mobile: 0412 997 767 pavelk@optusnet.com.au

LEGEND

Symbol	Description
● SDP / ● DP	SEALED PVC DOWNPIPE 100 Ø / DOWNPIPE
—— 23 / — — 22	EXISTING CONTOUR (m) / PROPOSED CONTOUR (m)
Fp ● / FW	SUB_SOIL DRAIANGE FLUSH POINT / FLOOR WASTE 250x250 min
L=9 Ø100	STORMWATER DRAINAGE PIPE DIAMETER = 100 mm, 9 m LONG
—— ... ——	SUBSOIL DRAINAGE PIPE (default Ø100mm, min. slope 1%)
23.00 / 22.50	FINISHED GROUND LEVEL=23.0(m) PIPE INVERT LEVEL=22.5 (m)
+23.17	EXISTING GROUND LEVEL (m)
△23.20	PROPOSED GROUND LEVEL (m)
23.20	TOP OF WALL (m)

1 2 3 4 5 10

Amendments

Issue	Date	Comments
1	29/07/18	for information
2	4/08/18	for information 2
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-

FLOOD STUDY FOR
PROPOSED DEVELOPMENT AT
No. 1-3 WHITE STREET, LILYFIELD

PROPOSED CONDITIONS

DESIGNED BY: PAVEL KOZAROVSKI, MIEAus, CPEng, NPER-3

DRAWN BY: P.K.

DRAWING No.C-3347-01

SCALE: 1:100 on A0, 1:200 on A2

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