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ROPER BAR IRON ORE PROJECT

Surface Water Study

Submitted to:

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REPORT



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1.0 INTRODUCTION AND BACKGROUND

Western Desert Resources Ltd (WDR) intends to develop the Roper Bar Iron Ore Project (the Project) in the Northern Territory (NT).

A preliminary surface water study was prepared by Golder Associates Pty Ltd (Golder) in the early part of 2012 (17666004-001-R-Rev0). Golder's preliminary study was appended to a draft Environmental Impact Assessment (EIA) and submitted to the Department of Natural Resources, Environment, the Arts and Sport (NTREAS).

WDR then commissioned Golder to undertake the detailed design of the proposed realignment works (P27646012-001-L-Rev0) based on the mine plan at the time. The agreed scope of services included a significant geotechnical component (to be carried out by Golder personnel from Adelaide).

Subsequent to the acceptance of the above proposal, NTREAS sought clarification of certain matters pertaining to the proposed realignment works outlined in the preliminary study.

As a result, the previous scope of services was revised to include additional work aimed at addressing the issues raised by NTREAS (127646013-001-L-Rev0). At the time, WDR also requested Golder assess the implications of a proposed relief channel located upstream of Wade's Crossing.

However, in response to ongoing hydrological/hydraulic modelling and engagement with certain stakeholders, and also since the additional work was commissioned, the mine plan and layout of certain infrastructure landforms changed. These changes were outlined in a technical memorandum (127646013-003-TM-RevA) submitted to WDR on 11 th June 2012.

At the recent request of WDR we have considered three options for regional surface water management at the Project, these are:

- Option A - Surface water runoff from the upper tributary of the Towns River (UTTR) is to be directed through a designed realignment to the north of the proposed Pit (F-east pit 3).
- Option B - to split the surface water runoff from the UTTR; some discharging north along the designed re-alignment and some south adjacent to the flood protection bund and other infrastructure.
- Option C - to mine F-east pit 3 during the dry season and allow the pit to flood during subsequent wet seasons in the event of a major storm.

The Options A and B require a very different approach to mining F-east pit 3, compared to Option C. Option A and B's approach is to allow mining year round and protect the pit from inundation. Option C allows for mining of F-east Pit 3 during the dry season only. Ultimately, each option is compared to the base case, pre-development condition.



2.0 OBJECTIVES

In order for mining activity to commence, it will be necessary to realign/alter some portion of a local ephemeral watercourse (the watercourse). Pending the outcome of the aforementioned geotechnical investigations, the main purpose of this report is to provide a detailed overview of the potential impacts of the proposed mining strategy and provide designs for any realignment works. More specifically the report addresses the following points with respect to the preferred mining option only:

- Describe and illustrate with maps, plans and cross-sections any proposal to divert creeks or undertake other in-stream works.
- Assess the potential impacts of in-stream works on hydrology and propose measures for avoiding or mitigating the impacts of instream velocities. Designs of any re-alignment works will incorporate rock protection on bank areas that may be subject to erosion. This will be based on hydraulic modelling. In the absence of geotechnical test pitting, designs may be subject to some change.
- Determine pre and post development flood extents (maps) and depths.
- Provide post development detailed hydraulic data for the first 2.5 km downstream of the mine proposal and qualitatively assess the likely impact of the proposed re-alignment works on downstream estuarine and/or marine environments based on hydraulic modelling only.
- Provide plans of the pre-development and development sub-catchment networks.
- Provide estimated flow rates for the pre-development and development scenarios.
- Assess and illustrate the afflux likely to result from the proposed re-alignment works.
- Provide estimated water surface elevations along all affected pit bunds. The need for erosion protection measures will also be addressed.
- A flood map associated with the probable maximum flood (PMP) using the WDR provided final landforms will be provided.



3.0 HYDROLOGIC AND HYDRAULIC MODELLING

3.1 Design Rainfall

Rainfall intensity-frequency-duration (IFD) data appropriate to the study area have been derived using the Bureau of Meteorology's (BoM) online estimation tool, the use of which is compatible with the approach set down in Australian Rainfall & Runoff (ARR) (Institution of Engineers, Australia (IEAust), 1987).

Table 1 provides details of rainfall intensities associated with design rainfall events having durations of between 0.5 and 72 hours and an average recurrence interval (ARI) of 20 years. Figure 1 provides details of the adopted IFD curves for the site.

Table 1: IFD Data

Duration (mins)	Rainfall Intensity (mm/hr)
	ARI = 20 years
5	235
6	221
10	185
20	145
30	122
60	84
120	52
180	38
360	22
720	13
1440	9
2880	7
4320	5

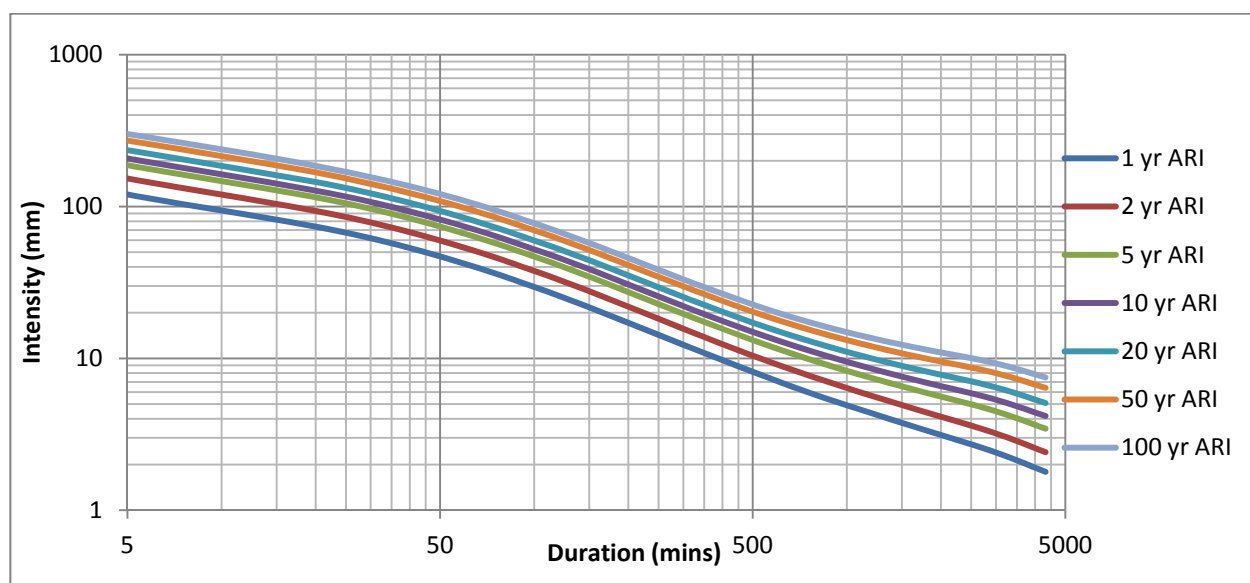


Figure 1: IFD Curves Used for the Roper Bar Project



3.2 Design Standard

The 20 year ARI peak event has been used in this report as the design criteria standard. This ARI has been chosen in the absence of specific guidelines. The 20 year ARI event has been adopted as this provides a reasonable level of risk (e.g. 5% chance of occurring in any one year) and is commensurate with the proposed Life of Mine. See also discussion in Section 3.3.6.

3.3 Hydrologic Analysis

3.3.1 Background

Hydrologic flood modelling was undertaken using RORB Version 6 (Laurenson et al, 2007).

RORB is a catchment runoff and streamflow routing program capable of calculating flood hydrographs from rainfall data and other inputs. The estimated hydrographs can be used to assess the corresponding peak discharge at the outlet of each sub-catchment area.

Volume 2 of ARR provides a range of regional loss parameters appropriate to the study area.

Loss parameters suggested for use in the Northern Territory are:

- Continuing Loss - 1.6 mm/hr
- Initial Loss - a range from 0-80 mm with a median value of 0 mm.

Given the range in suggested initial losses, recourse was made to the initial loss parameters for the Kimberley Region (shallow sand over rock), as a loss values of 0 mm is considered to be overly conservative. The Kimberley region was selected due to its climatic similarities with the project area.

Table 2: Loss Model Parameters

ARI (year)	2	5	20	50
Mean Initial Loss (mm)	30	50	47	47

3.3.2 Catchment Delineation

The pre-development sub-catchment network was delineated using a combination of Shuttle Radar Topography Mission (SRTM) and Light Detection and Ranging (LiDAR) topographic data.

The pre-development sub-catchment network is shown in Figure 2. All references to sub-catchments will use the nomenclature from Figure 2 (A - Z). The combined sub-catchment size at T is approximately 344 km² and at Z is 422 km².

3.3.3 Catchment Coding

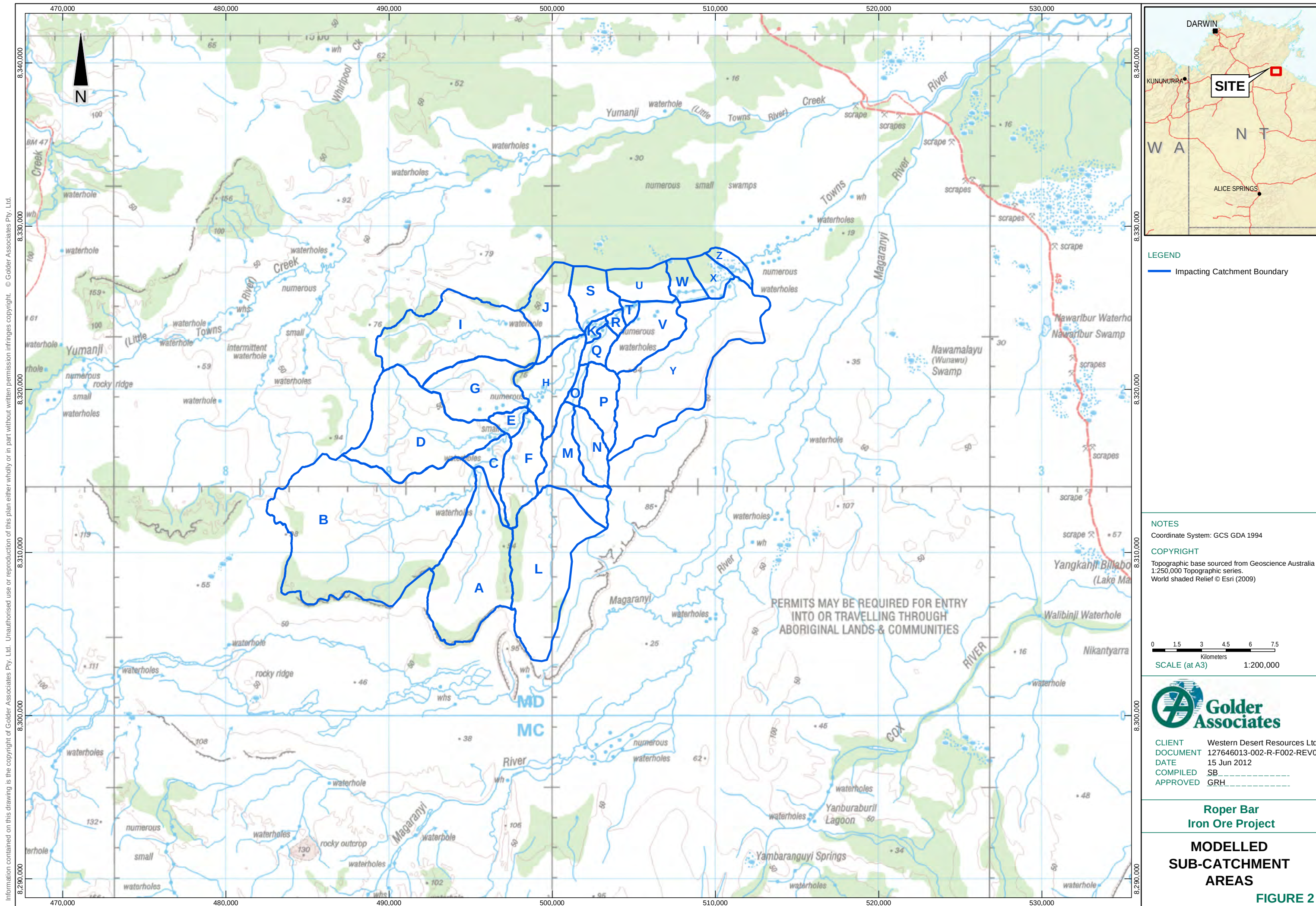
The sub-catchment drainage network shown in Figure 2 was coded in order to derive surface water runoff and streamflow routing using the RORB model.

3.3.4 Rainfall Coding

Using the estimated IFD data, rainfall coding was undertaken in respect of various rainfall events having an ARI of 20 years. This approach was necessary in order to define the rainfall duration that generates the maximum peak discharge.

Rainfall losses were estimated in accordance with Volume 1 of ARR. Similarly, the derivation of temporal rainfall patterns was based on a methodology outlined in Volume 2 of ARR.

The combined catchment and rainfall coding file is included in Appendix A.



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3.3.5 Results

For the range of rainfall event durations under consideration, RORB modelling provided estimates of the peak discharge at the outlet of each sub-catchment. Overall, a 24 hour rainfall event was found to generate the maximum peak discharge. The 24 hour duration rainfall has been adopted for all comparative purposes and other ARI events. Figure 3 illustrates the associated design hydrographs for various ARI events at Catchment T. Catchment T has been used as it is the sub-catchment immediately upstream of the proposed mine area.

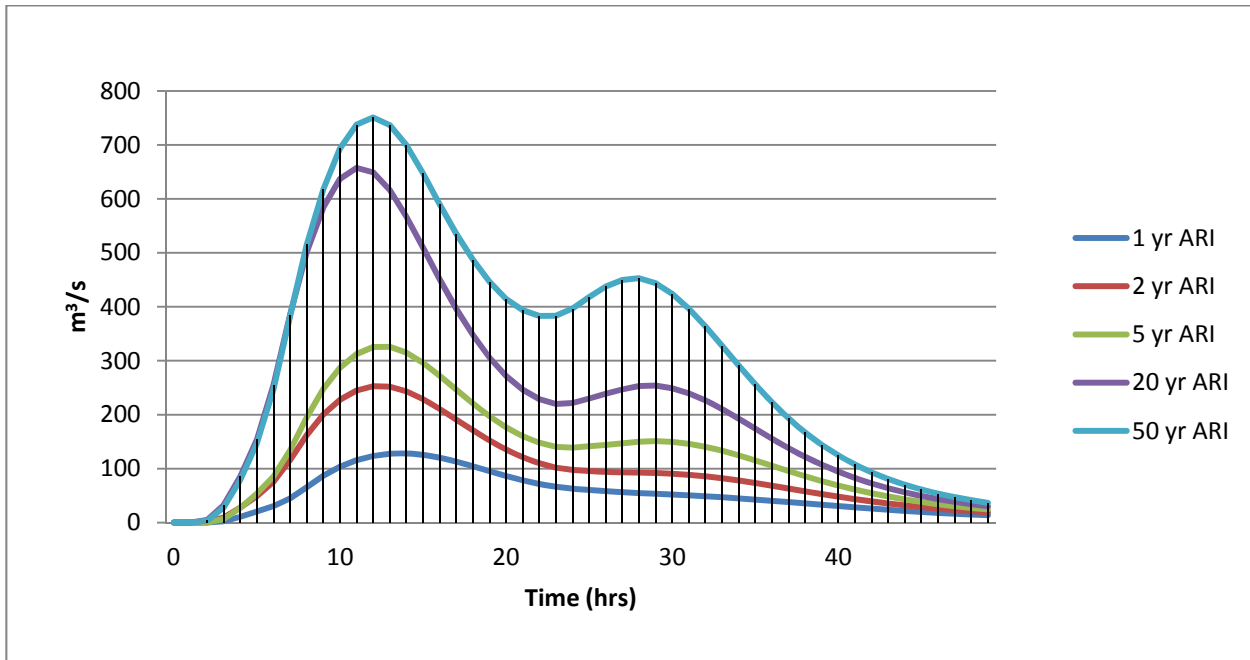


Figure 3: Hydrograph Analysis

3.3.6 Discussion of Hydrologic Results

The hydrographs in Figure 3 highlight a critical hydrological characteristic of the region. The estimated peak flow (at catchment T) of a 24 hour 1:1 year ARI event is 128 m³/s. The natural channel in the general project area is shown in Table 3 below.

Table 3: Typical Watercourse Section in Project Area

Coordinates	Photograph	Approximate Channel Dimensions	Notes
0506268 N 8325326 E			Vertical banks and straight



The flow depth in a channel with these dimensions using a longitudinal slope of 0.002 (typical of local conditions) and Manning's n value of 0.035, would be approximately 3.4 m for the 1 year ARI flood. In other words, it is highly likely the natural channels in this region would only convey the runoff from relatively low magnitude storm events. So, a design event with an ARI of 1 year cannot be fully conveyed through the natural channel capacity and flooding on the overbank regions will occur.

The morphology of the creeks in the region show ox bow lakes and extinct channels that display a highly meandering, sinuous form. Given the estimated flood peaks and lack of in-channel capacity, it would be expected that the area would be highly dynamic with erosion and deposition of sediment common in most flood events. A significant proportion of the design discharge for events exceeding the 1 year ARI are conveyed in the overbank areas.

In cases where estimates of flood discharges can be contained within channel banks, re-alignment designs would require channels that are sized to also convey certain flood discharges within the banks. In this regard where only incidental flows are conveyed within the banks, containing the design flows within a designed channel is impractical.

3.4 Hydraulic Modelling

3.4.1 Overview

In order to gain an understanding of flooding in the vicinity of the proposed mine site, it was considered appropriate that hydraulic modelling and flood mapping should be undertaken. HEC-RAS (version 4) was used as the hydraulic modelling software to simulate flooding of the upper tributary of the Towns River (UTTR) in the vicinity of the proposed development.

Hydraulic models of all the options and pre-development case were developed using HEC-RAS Version 4.1 (US Army Corps of Engineers, 2010). HEC-RAS is a one-dimensional hydraulic modelling package capable of simulating both steady and unsteady flow.

Approximately 85 km of the existing watercourse is represented in the hydraulic model. This includes the 3 km stretch that it is proposed to require channel alteration (only in small sections). All cross-sections in the model were developed using the available LiDAR.

3.4.2 Simulation

The design peak discharge estimates derived using the RORB model were applied to the HEC-RAS model at appropriate locations. For example, the 'first' cross-section in the model (i.e. 8098) is located at the upstream end of model sub-catchment Y. Therefore, the estimated peak 20 year ARI design discharge corresponding to this location ($33 \text{ m}^3/\text{s}$) was applied to the HEC-RAS model at cross-section 8098.

An assumed Manning's n value of 0.035 (main channel and overbank areas) was applied in the model.



4.0 PRE-DEVELOPMENT SURFACE WATER CASE AND OPTIONS STUDY

During the course of this study, three options have been considered. The focus for the surface water study has been to minimise afflux due to the mining proposal as far as practical. This section of the report outlines each option and notes critical points compared to the pre-development case.

4.1 Pre-Development Case

4.1.1 Overview

At present, the main watercourse crosses the study area in a generally west to east direction. Given the flat topography of the area, the watercourse is largely sinuous in nature and there are numerous oxbow lakes located along its route. Similarly, the channel itself is flat and relatively shallow.

The pre-development sub-catchments are shown in Figure 2. For clarity, the footprint of the proposed pit bund is also included. The hydraulic model domain showing the extent of the modelled cross-sections and locations of the proposed mine (not considered in this pre-development case) is presented in Figure 4.

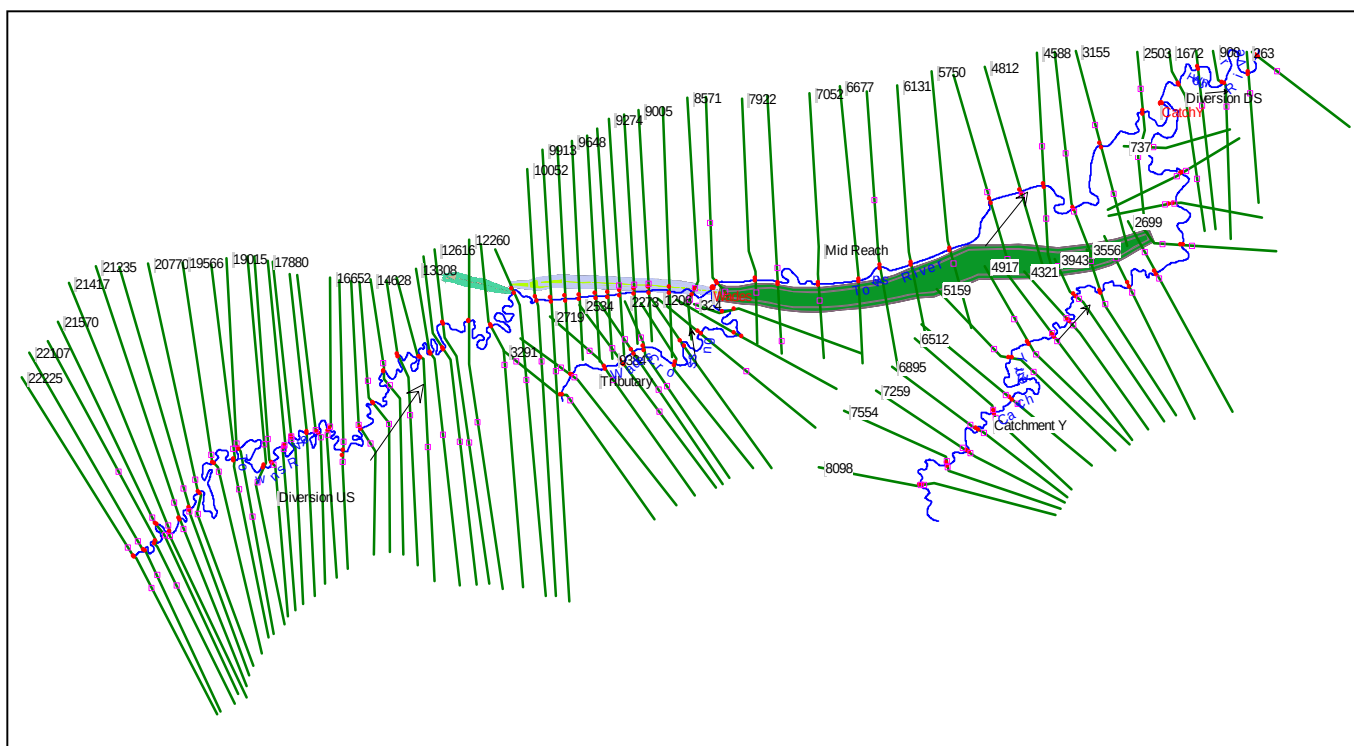
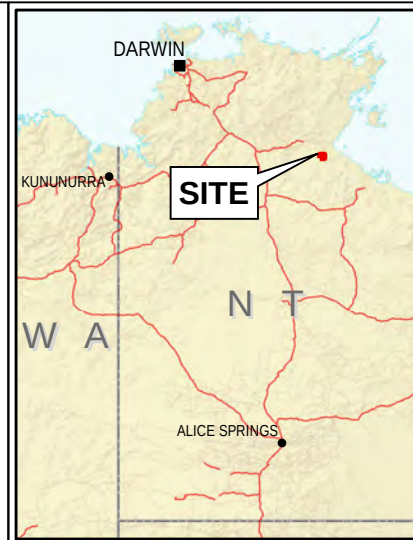
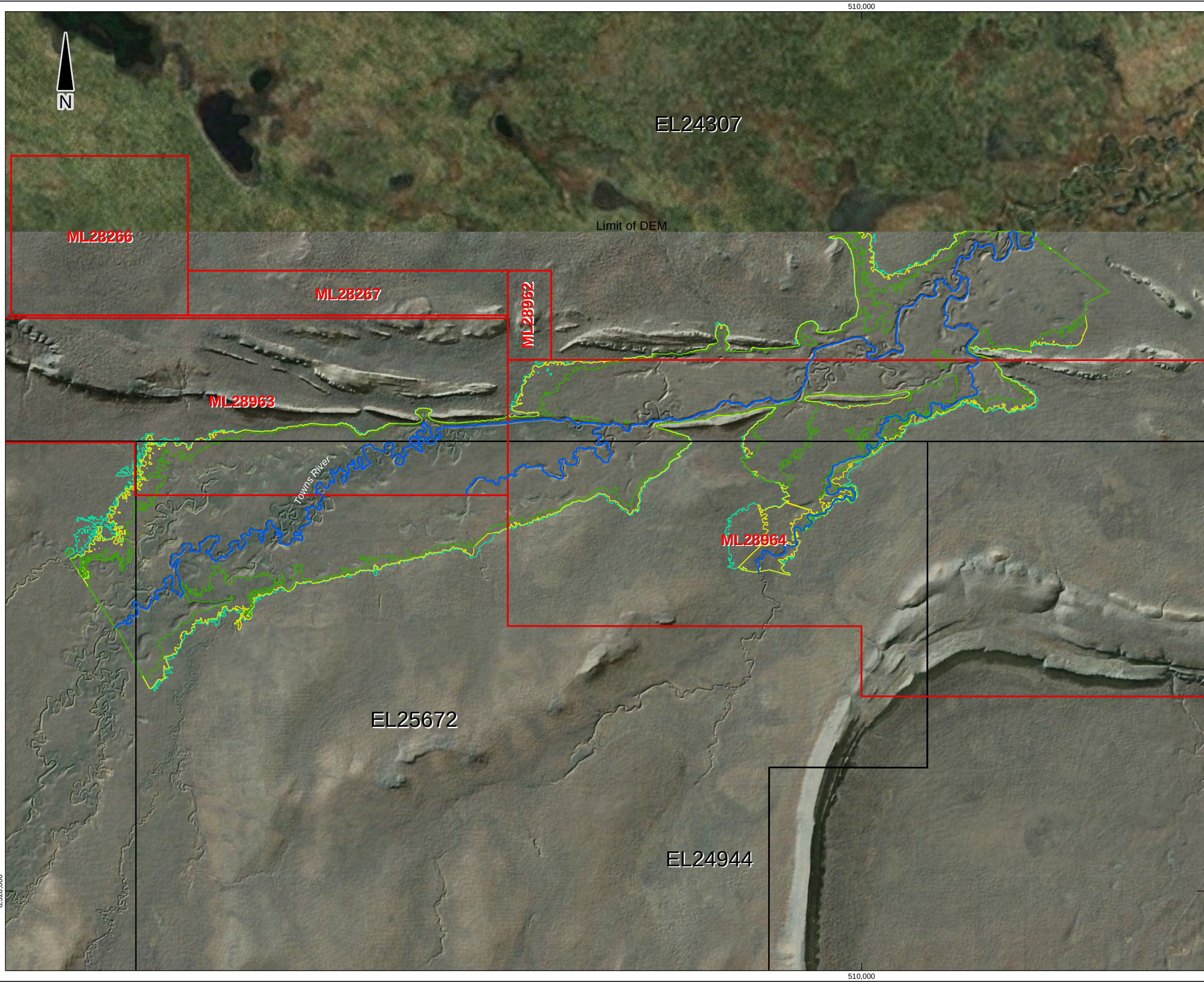


Figure 4: Model Domain - Pre-Development

4.1.2 Extent of Flooding

The results of the hydraulic modelling described above have been used to estimate the areal extent of flooding associated with a 24 hour storm for 5, 20 and 50 ARI design events pre-development. The flood map of these extents is provided in Figure 5 (pit extents have been added for reference only and have not been modelled in this simulation).

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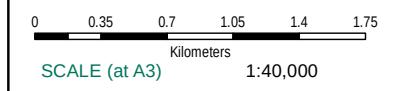
- LEGEND**
- Mining Lease Boundary (approximate)
 - Exploration Lease Boundary
 - Modelled Channel
- Flood Modelling**
- 5 Year ARI Flood Extent
 - 20 Year ARI Flood Extent
 - 50 Year ARI Flood Extent

NOTES

Coordinate System: GDA 1994 MGA Zone 53

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**Roper Bar
Iron Ore Project**

**FLOOD MAP
PRE-DEVELOPMENT
BASELINE**

FIGURE 5

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4.1.3 Pre-Development Results

Appendix B contains detailed hydraulic results for the pre-development case (i.e. water surface elevation, flow velocities, etc). Table 4 provides an overview of the water surface elevation at selected cross-sections while Figure 6 presents the longitudinal water surface profile for the 20 year ARI flood.

Table 4: HEC-RAS Results 20 Year ARI (Pre-Development)

HEC-RAS Cross-Section	Water Surface Elevation (m)	Discharge (m ³ /s)	Average Channel Velocity (m/s)
10366 - upstream	23.9	658	0.6
8282 - mid reach	22.7	668	1.8
55 - downstream	18.5	702	1.9

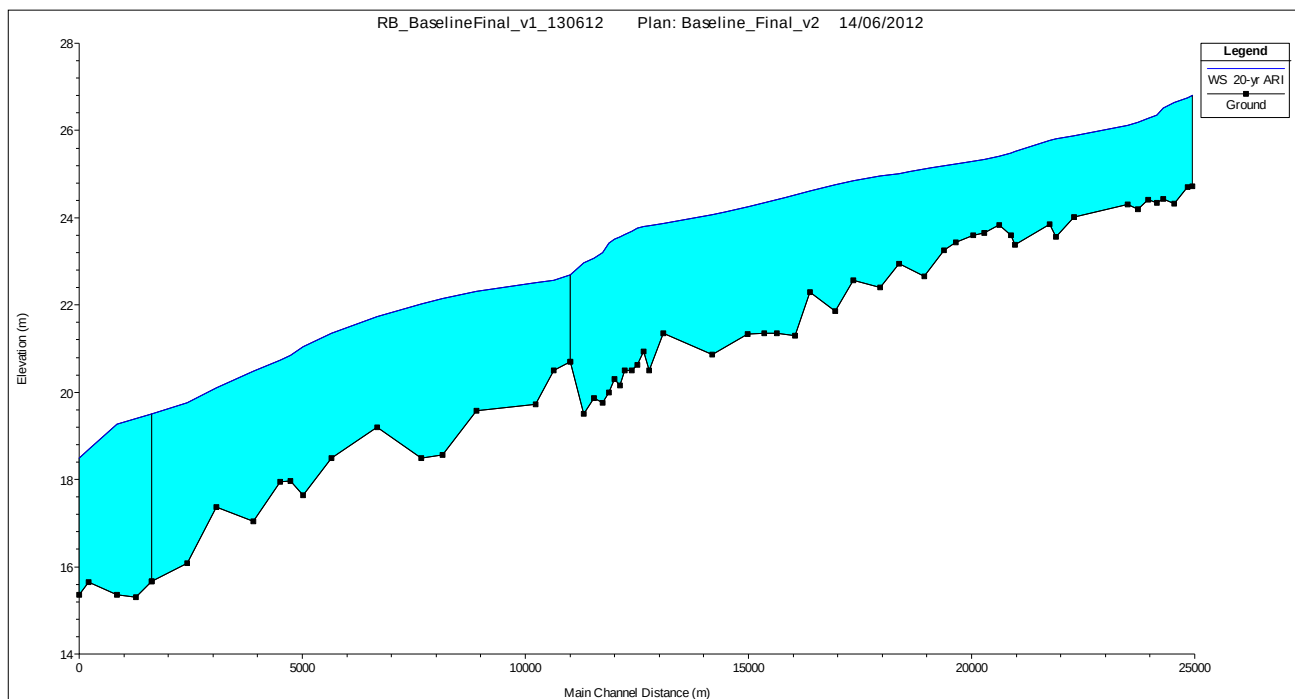


Figure 6: Pre-Development Water Surface Profile along the Length of the Modelled Reach - 20 Year ARI



4.2 Options Study

4.2.1 Overview

At the request of WDR and as noted in Section 1.0, we have considered three options for regional surface water management for the Project. These are:

- Option A - surface water runoff from the upper tributary of the Towns River (UTTR) is to be directed through a designed re-alignment to the north of the proposed F-east pit 3. This is the original option noted as conceptual in Golder's preliminary hydrological report (17666004-001-R-Rev0).
- Option B - to split the surface water runoff from the UTTR, some discharging north along the designed re-alignment and some south adjacent to the flood protection bund and other infrastructure.
- Option C - to mine the F-east pit 3 during the dry season and allow the pit to flood during any major flood events during subsequent wet seasons.

Options A and B require a very different approach to mining F-east pit 3, compared to Option C. Option A and B's approach is to allow mining year round and protect the pit from inundation. Option C allows for mining during the dry season only. Each option is compared to the base case, pre-development condition. From RORB modelled hydrograph analysis, the 20 year ARI peak duration is the 24 hour period. This period has therefore been adopted for all other ARIs, flood mapping and comparative purposes.

4.2.2 Option A

Option A was the original mining plan. Some key results of the analyses are:

- If all runoff is to be directed through the proposed creek re-alignment to the north, a bund is required that should be constructed to approximately 29 m AHD. As the floodplain area is relatively flat, this would require a bund some 2 km in length.
- Velocities within the channel are estimated to be as high as 5 m/s. These velocities would require substantial erosion protection (i.e. gabions) within the channel.
- The afflux currently extends off the southern extent of the model boundary and is approximately 4.5 m above base case levels.
- Areal flooding extents are significantly altered upstream of the proposed alignment.

Considering the required flood control engineering and likely changes in afflux, at the request of WDR this option has not been considered further.

4.2.3 Option B

Some key points of this option are:

- This is a complex modelling exercise. A two-dimensional model is likely required to accurately assess this option. Apart from the complexity, this type of modelling requires significant data input.
- This option is likely to require the most flood protection infrastructure and alteration of the natural environment.
- Issues associated with high flow velocities and afflux are likely to be translated to the eastern end of the proposed pits.

Option B was assessed at a conceptual level only and, at the request of WDR, was not considered further.



4.2.4 Option C

Option C involves mining the F-east pit 3 during the dry season and allowing the pit to flood during subsequent wet seasons in the event of a more significant flood event. Key points of option C are:

- Compared to options A and B, this will have the least afflux and therefore least change to areal flood extents compared to the pre-development case.
- Requires the least alteration of catchments, creek re-alignment and other flood protection infrastructure for the proposed Project.

This is the WDR preferred option and any creek re-alignment works and flooding comparisons to the pre-development case are designed on this basis. Details of Option C are described in the following sections. Figure 7 illustrates the modelled domain, all landforms in this model have been included in the modelling.

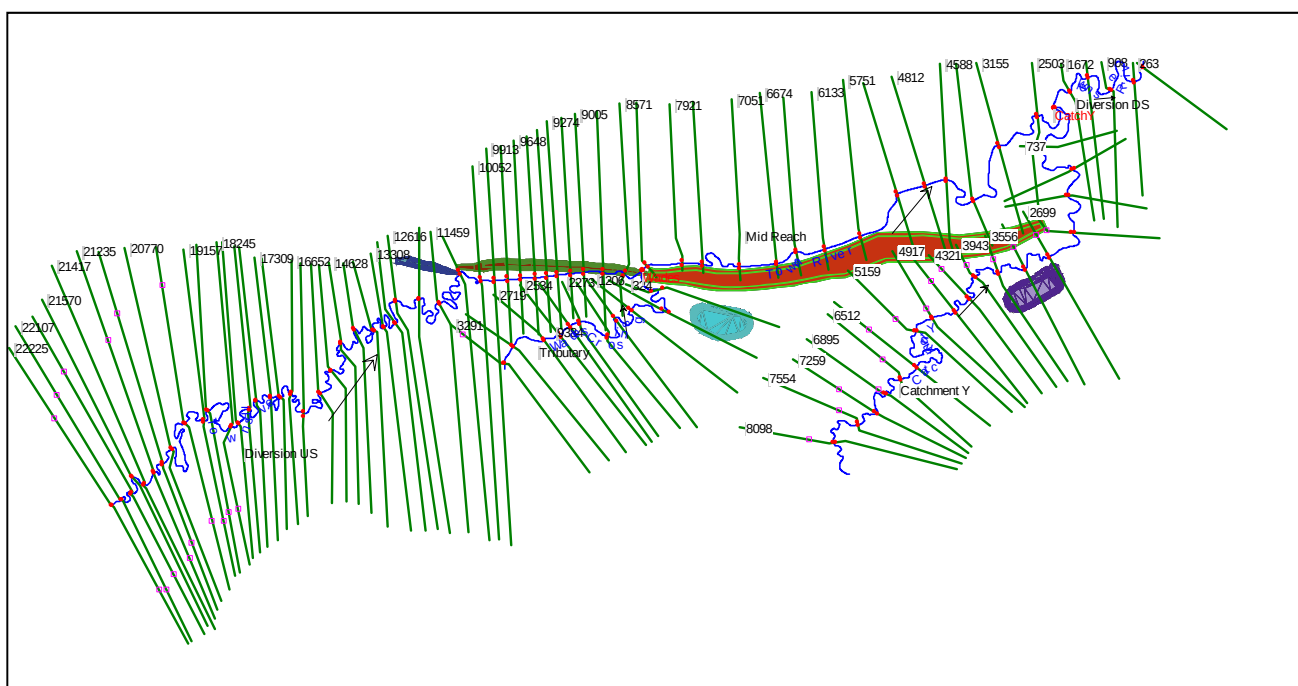


Figure 7: Model Domain - Option C

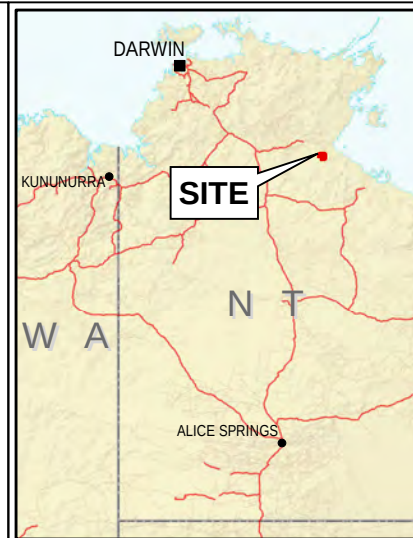
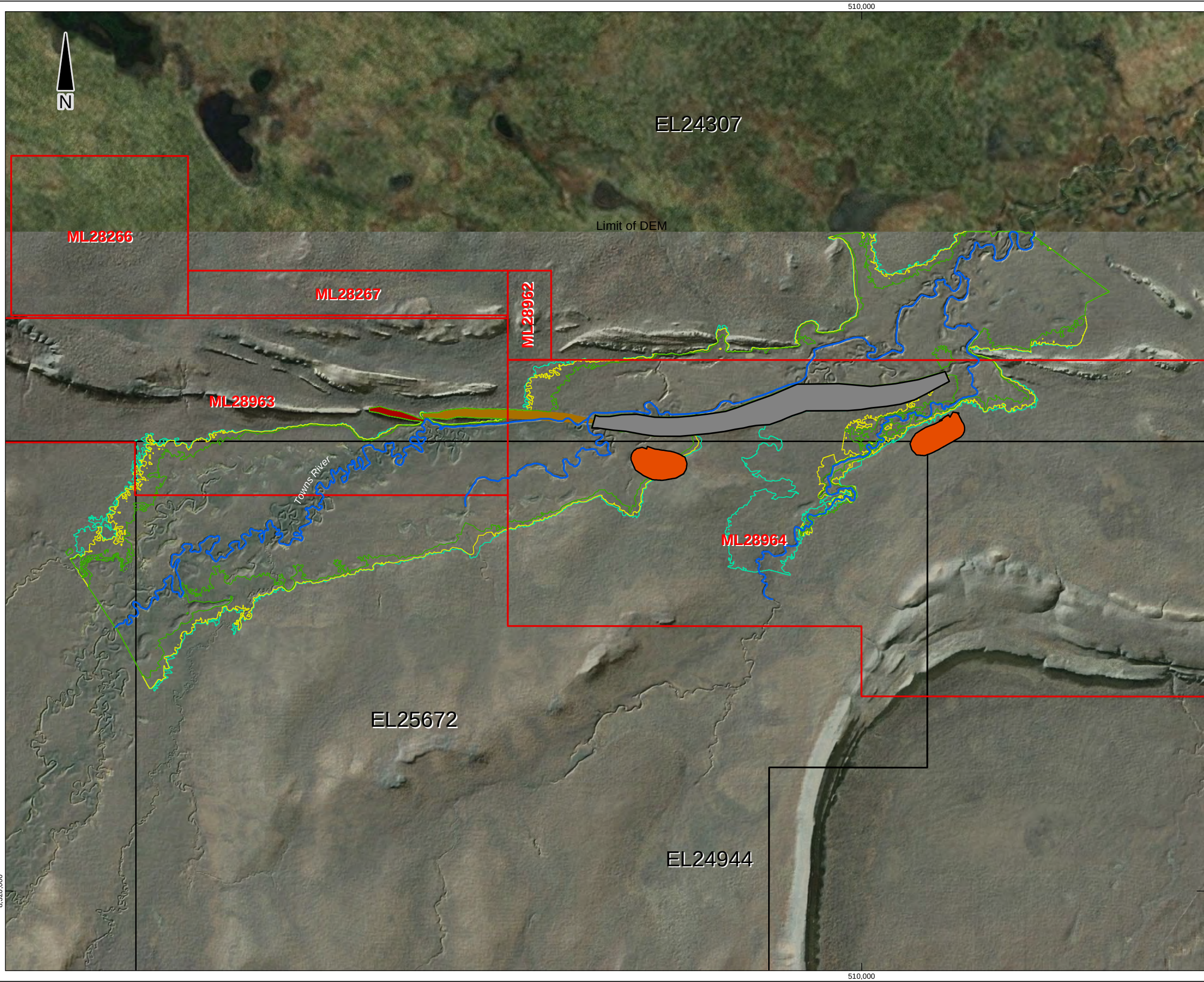
4.2.4.1 Option C - Results

Appendix C contains detailed hydraulic results for the Option C case (i.e. water surface elevation, flow velocities, etc). Table 5 provides an overview of the results at selected cross-sections while Figure 8 presents the areal extent of flooding and Figure 9 the longitudinal water surface profile. The significant reduction in ground elevation to a level of around -20 m around chainage 9000 represents the F-east pit 3.

Table 5: HEC-RAS Results 20 Year ARI (Option C)

HEC-RAS Cross-Section	Water Surface Elevation (m)	Discharge (m ³ /s)	Peak Velocity (m/s)
10366 - upstream	22.9	658	0.8
8282 - mid reach	22.9	668	1.3
55 - downstream	18.5	702	1.9

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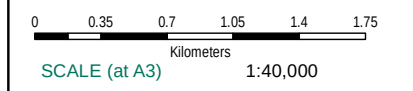
- LEGEND**
- Mining Lease Boundary (approximate)
 - Exploration Lease Boundary
 - Modelled Channel
- Flood Modelling**
- 5 Year ARI Flood Extent
 - 20 Year ARI Flood Extent
 - 50 Year ARI Flood Extent
 - Levee Bank
 - Area F West
 - Area F WW
 - Waste Dumps

NOTES

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**Roper Bar
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**FLOOD MAP
POST-DEVELOPMENT
OPTION C**

FIGURE 8

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ROPER BAR IRON ORE PROJECT

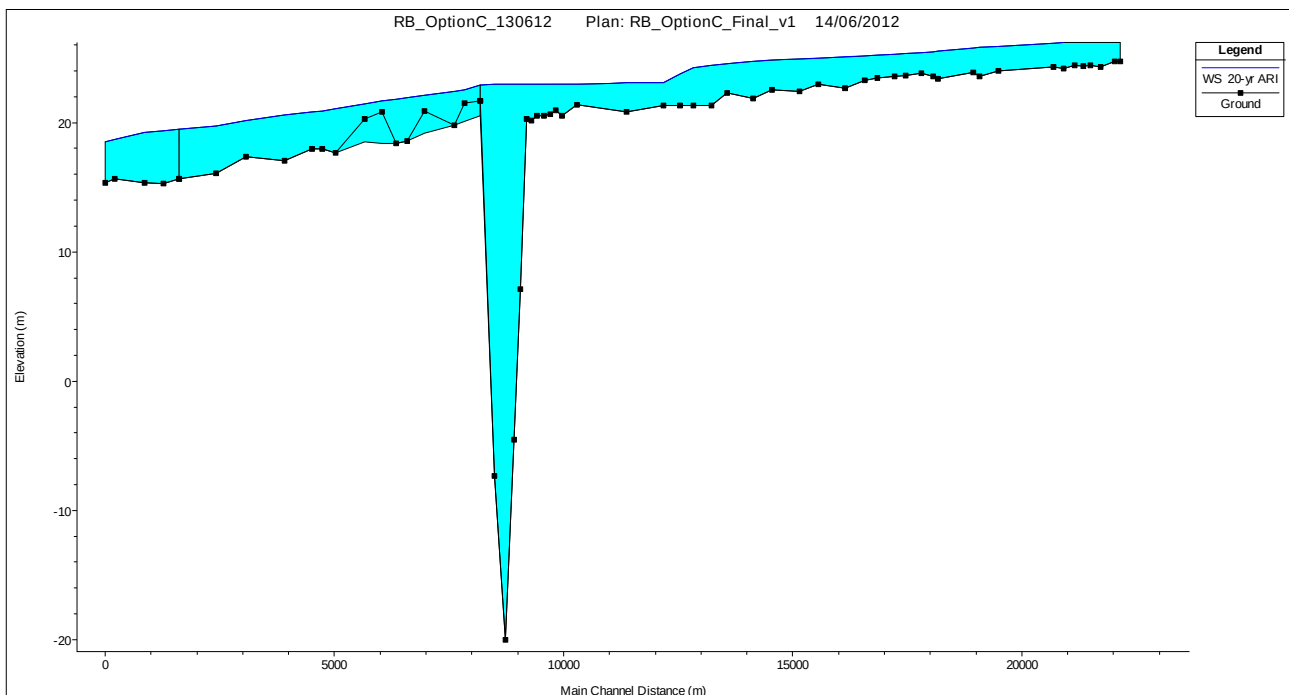


Figure 9: Water Surface Elevation - Option C



5.0 COMPARISON OF PRE-DEVELOPMENT CASE AND OPTION C

This section provides for the suggested creek linkage design and compares the pre-development case to that of Option C.

5.1 Maps, Plans and Cross-Sections of Creek Re-Alignment

Option C plans are presented in Appendix D. This includes a general arrangement, longitudinal profile, and typical cross-sections.

Overall, Option C links sections of the existing creek and allows for the draining of the upstream catchment during flood events. The channel geometry design is broadly based on the existing channel with the design philosophy being to link existing features as much as possible. Bank protection is based on the results of hydraulic modelling and the flow velocities along the creek for a design 24 hour 20 year ARI flood event.

5.1.1 Detailed Design

The diversion channel should be constructed generally from just south of the mine pit, linking with existing channels some 3 km to the east of the F-east pit 3.

Results from HECRAS hydraulic modeling indicate facing class rock protection at least 0.5 m thick should be provided on the outer curves of the largest meanders. This protection should extend from the toe of the channel sideslope to the ground surface on the edge of the channel bank. A filter material is recommended between the embankment and rock to prevent piping of fines from underlying material. Rock size distribution for this class is outlined below.

Rock Class	Rock Size (m)	Rock Mass (kg)	Minimum % of Rock Larger
Facing	0.4	100	0
	0.3	35	50
	0.15	2.5	90

The rock is assumed to have a specific gravity of 2.65 and a spherical shape. No allowance has been made for protection on the overbank flow area adjacent to the banks, which could suffer some damage during larger flood events.

5.2 Potential Impacts of Instream Works on Hydrology (incl. pit void)

5.2.1 Surface Water Elevation and Velocity Changes

Likely changes to surface water elevation (developed case compared to pre-development case) at key areas along the modelled channel of the Project area for the 20 year ARI flood are presented in Table 6.

Appendixes B and C contain all the detailed hydraulic information for all cross-sections along the modelled reach.

Table 6: Estimated Hydraulic Changes along Creek

HEC-RAS Cross-Section	Water Surface Elevation % Change	Peak Flow Velocity % Change
10366 - upstream	-4.2%	33%
8282 - mid reach	0.9%	28%
55 - downstream	0%	0%



5.3 Estimated Downstream Volume Changes - First Fill of Pit Void

Downstream flow volumes will be altered as a result of the pit filling with water. Table 7 outlines the change in downstream flow volume for a single design event for a range of ARIs assuming the pit is empty at the commencement of the flood. These results indicate that as the flood ARI increases the percentage reduction in flow volume discharging downstream of the Project reduces.

Table 7: Downstream Flow Volume Changes Resulting from Pit Filling

ARI (year)	Estimated Volume of Pit Inflow (m ³)	Volume of Pit Void (m ³)	Estimated Percentage Change in Volume
1	1.18E+07	4.40E+06	-37%
2	2.14E+07	4.40E+06	-21%
5	2.90E+07	4.40E+06	-15%
20	5.22E+07	4.40E+06	-8%
50	7.02E+07	4.40E+06	-6%

5.3.1 Qualitative Assessment on Downstream Marine/Estuarine Environments

Assuming the pit has filled with water, the downstream water quantity would remain largely unaltered during ongoing runoff events as compared to the pre-development case. As the total volumes and velocities downstream of the Project remain largely unaltered we would expect that for these two parameters, the impacts to the marine environment, some 45 km away, would be minimal.

Water quality of pit “discharge water” has not been considered in this report.

5.4 Catchment Changes

Option C requires no alteration to the catchment areas. The main characteristics that will be altered as part of this proposal are:

- Mainstream river length and sinuosity
- Hydrograph delay.

The alterations are generally minimal and also significantly smaller than for Options A and B.

5.4.1 Mainstream Length and Sinuosity

5.4.1.1 Length

The entire modelled mainstream length is some 85.8 km. The designs indicate the re-alignment route will add only 200 m to the total length.



5.4.1.2 Sinuosity

The extent to which a creek or stream meanders is referred to as its sinuosity. The sinuosity of the realignment (measured from the western end of the design) is substantially similar to that of the existing watercourse as shown below in Table 8.

Table 8: Impact on Stream Sinuosity Adjacent to Project Site

	Actual Length, A (km)	Shortest Length, B (km)	Sinuosity (A/B)
Existing Watercourse	2.9	2.5	1.16
Design Route (incl. small section south of pit)	3.1	2.5	1.24

5.4.2 Hydrograph Delay

Option C allows for mining during the dry season and for the pit to fill during the subsequent wet seasons during any major inflows. The filling of the pit void will delay the commencement of flow downstream. The results, outlined in Table 9, indicate as the flood ARI increases the delay in flows occurring downstream reduces.

Table 9: Impact on Timing of Downstream Flows

ARI (year)	Estimated Volume of Pit Inflow (m ³)	Volume of Pit Void (m ³)	Time Delay for Hydrograph to Flow Downstream of Pit (hrs)
1	9.77E+06	4.40E+06	18
2	1.77E+07	4.40E+06	12
5	2.39E+07	4.40E+06	11
20	4.30E+07	4.40E+06	8
50	5.77E+07	4.40E+06	8



6.0 OTHER DESIGN CONSIDERATIONS

6.1 Pit Void - Filling Considerations

A number of pit filling considerations are outlined below:

- The upstream end of the pit void should be left higher than the downstream invert level to maintain the drainage pattern in an easterly direction.
- It is recommended to form an entry channel, similar to the natural channel that already exists in the area (refer Table 3). As described in previous sections, the analyses have demonstrated it is likely that in all larger floods overbank flow will occur and flooding into the pit would extend along a wide perimeter.
- The outflow from the pit has been designed and is included in Appendix D.
- Rock protection should be placed along the entire length of the inlet and outlet transitions to and from the pit over a length of at least 10 m upstream and 15 m downstream. Although estimated flow velocities are less than 2 m/s, we recommend facing class rock protection as for the proposed re-alignment channels.

6.2 Bund Heights - Operating Pit

The minimum required heights of the proposed pit and diversion bunds are based on the estimated water surface elevations set out in Table 10 (assuming a minimum freeboard requirement of between 30-50%).

At locations where water is expected to reach the face of either bund, Table 10 provides an overview of the estimated 20 year flood level and corresponding proposed bund elevation.

Table 10: Estimated Surface Water Elevations - Flood Protection Bunds

Location Name	HEC-RAS Cross-Section	Estimated Water Surface Elevation (m)	Notes
Operating pit - south wall - east end	2699	19.6	Unlikely to be affected by 20 year ARI flooding
Operating pit - south wall - nr Wades Crossing	324	23	Freeboard - +50% of the height from ground level to 20 year ARI flood level
Operating pit - north wall - nr Wades Crossing	8282	22.9	Freeboard - +50% of the height from ground level to 20 year ARI flood level
Operating pit - north wall - east end	3994	20.6	Freeboard - +50% of the height from ground level to 20 year ARI flood level
Eastern Waste Dump	2699	19.6	Toe of dump unlikely to be affected by 20 year ARI flooding
Western Waste Dump	324	23	Toe of dump unlikely to be affected by 20 year ARI flooding

6.2.1 Pit Bund and Waste Dump Erosion Protection

The Floodway Design Guide (FDG) (Main Roads Western Australia, 2006) recommends that rock armouring be provided in cases where the adjacent flow velocity exceeds 2 m/s. HECRAS modelling for the developed case indicates velocities adjacent to the pit bund and waste dumps will be well below this level. On this basis we do not consider erosion protection measures are required for the pit bund and waste dump facilities.



7.0 POST-CLOSURE FLOOD ANALYSIS

7.1.1 Overview

The Probable Maximum Precipitation (PMP) appropriate to the study area was estimated using the Generalised Short-Duration Method (GSDM) (BoM, 2003) and the Revised Generalised Tropical Storm Method (GTSMR) (BoM, 2003). The GSDM method is appropriate for storm durations up to 6 hours while the latter is used to define PMP events having durations of 24 hours or more. For intervening periods, interpolation between the results from these two methods is recommended.

The estimated post-closure environment was based on final landform information provided by WDR.

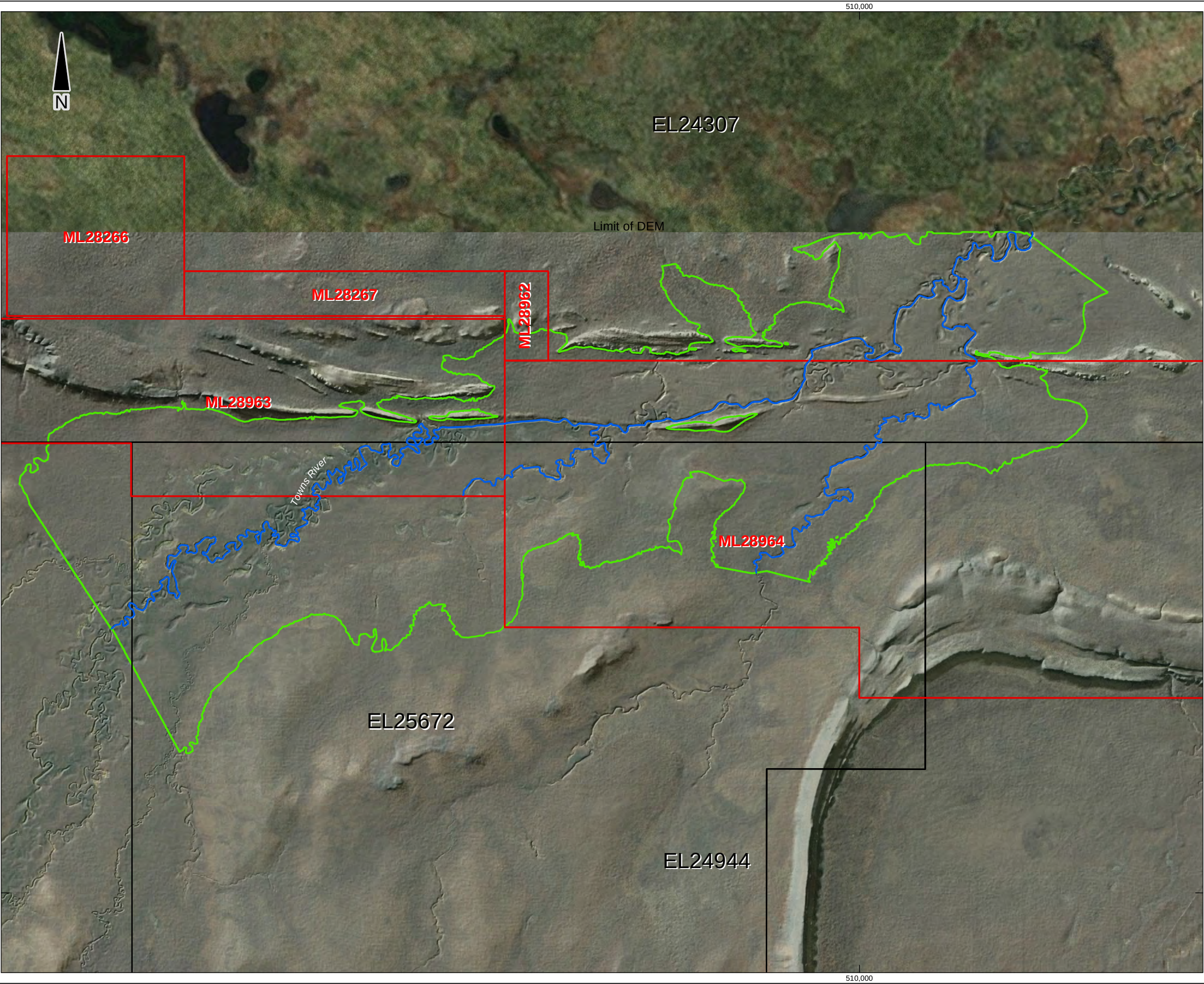
7.1.2 Results

For the range of PMP event durations under consideration, RORB provided estimates of the peak discharge at the outlet of each sub-catchment. A 12 hour PMP event was found to generate the maximum peak discharge of approximately 11 000 m³/s at the catchment outlet (Z). This magnitude of flood would be extremely destructive with widespread damage to all landforms, natural or otherwise, expected.

7.1.3 Probable Maximum Flood (PMF)

The results of the hydraulic modelling described above have been used to estimate the areal extent of flooding associated with the peak PMP event.

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LEGEND

- Mining Lease Boundary (approximate)
- Exploration Lease Boundary
- Modelled Channel

Flood Modelling

- PMF Flood Extent

NOTES

Coordinate System: GDA 1994 MGA Zone 53

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Detailed shaded Relief generated from Digital Elevation Model (DEM) supplied by Client.
World shaded Relief © Esri (2009)
Aerial Photography sourced from Google Earth Pro
Mining Lease boundaries digitized from plans sourced online from the Department of Resources - Northern Territory Government.
Exploration Lease boundaries supplied by Client.

0 0.35 0.7 1.05 1.4 1.75
Kilometers
SCALE (at A3) 1:40,000

**Golder Associates**

CLIENT Western Desert Resources Ltd
DOCUMENT 127646013-002-R-Rev0
DATE 15 Jun 2012
COMPILED SB
APPROVED GRH

**Roper Bar
Iron Ore Project**

**FLOOD MAP
PROBABLE MAXIMUM
FLOOD (PMF)**

FIGURE 10

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8.0 DISCUSSION

In undertaking the studies the following assumptions were made:

- A 20 year rainfall event was the design standard for all hydrologic and hydraulic analyses.
- An average recurrence interval (ARI) of 20 years is the adopted design criteria for all surface water designs
- The designs of the proposed in-stream works are pending the outcome of the geotechnical investigations. However, given the field observations, the results of that investigation are unlikely to change the recommended designs significantly.

If WDR are to mine F-east Pit3, of the options considered, Option C would likely cause the least afflux due to development. From a water quantity perspective, aside from the initial filling of the pit void, there would be minimal impacts downstream of the proposal under this case. The creek re-alignment distance, compared to the total mainstream length under this option, is small and with the philosophy being to link existing features as much as possible, makes this option least likely to result in environmental impacts.

9.0 LIMITATIONS

Your attention is drawn to the document "Limitations", which is included as Appendix F of this report. This document is intended to assist you in ensuring that your expectations of this report are realistic, and that you understand the inherent limitations of a report of this nature. If you are uncertain as to whether this report is appropriate for any particular purpose please discuss this issue with us.

10.0 REFERENCES

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Report Signature Page

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APPENDIX A

Hydrologic Modelling

ROPER BAR VERSION B

0,
1,1,9.68,-99,
9.68km)
3,
1,1,12.4,-99,
10.2)
4,
5,1,2.14,-99,
2.14km)
2,1,4.9,-99,
4.9km)
3,
1,1,10.5,-99,
10.5km)
4,
5,1,1.33,-99,
1.33km)
2,1,3.79,-99,
3.79km)
3,
1,1,5.21,-99,
5.21km)
4,
3,
1,1,3.43,-99,
3.43km)
4,
5,1,6.37,-99,
6.37km)
2,1,10.9,-99,
10.9km)
7
end of H
3,
1,1,7.96,-99,
7.96km)
5,1,2.38,-99,
2.38km)
2,1,2.82,-99,
2.82km)
7
end of J
4,
5,1,2.68,-99,
2.68km)
2,1,1.74,-99,
1.74km)
7
end of K
3,
1,1,7.66,-99,
7.66km)
5,1,1.35,-99,
1.35km)
2,1,7.28,-99,
7.28km)
3,
1,1,4.1,-99,
4.1km)
4,
5,1,3.32,-99,
3.32km)
2,1,1.94,-99,
1.94km)
3,
1,1,4.39,-99,
4.39km)

Untitled

channel type - mixture of channel types
sub area A (natural channel, centroid to d/s
store
sub area B (natural channel, centroid to d/s
add AB
route to C (natural channel, u/s to centroid
sub area C (natural channel, centroid to d/s
store
sub area D (natural channel, centroid to d/s
add ABCD
route to E (natural channel, u/s to centroid
sub area E (natural channel, centroid to d/s
store
sub area F (natural channel, centroid to d/s
add ABCDEF
store
sub area G (natural channel, centroid to d/s
add ABCDEFG
route to H (natural channel, u/s to centroid
sub area H (natural channel, centroid to d/s
store
sub area I (natural channel, centroid to d/s
route to J (natural channel, u/s to centroid
sub area J (natural channel, centroid to d/s
add ABCDEFGHIJ
route to K (natural channel, u/s to centroid
sub area K (natural channel, centroid to d/s
store
sub area L (natural channel, centroid to d/s
route to M (natural channel, u/s to centroid
sub area M (natural channel, centroid to d/s
store
sub area N (natural channel, centroid to d/s
add LMN
route to O (natural channel, u/s to centroid
sub area O (natural channel, centroid to d/s
store
sub area P (natural channel, centroid to d/s

```

                                Untitled
4,                                add LMNOP
5,1,3,-99,                        route to Q (natural channel, u/s to centroid
3.0km)
2,1,2,-99,                        sub area Q (natural channel, centroid to d/s
2.0km)
7
end of Q
4,                                add ABCDEFGHIJKLMOPQ
5,1,1.45,-99,                    route to R (natural channel, u/s to centroid
1.45km)
2,1,2.1,-99,                    sub area R (natural channel, centroid to d/s
2.1km)
7
end of R
3,                                store
1,1,1.93,-99,                    sub area S (natural channel, centroid to d/s
1.93km)
7
end of S
4,                                add ABCDEFGHIJKLMOPQRS
5,1,1.45,-99,                    route to T (natural channel, u/s to centroid
1.45km)
2,1,1.32,-99,                    sub area T (natural channel, centroid to d/s
1.32km)
7
end of T

5,1,0.93,-99,                    route to U (natural, u/s to centroid 0.93km)
2,1,1.75,-99,                    sub area U (natural, centroid to d/s 1.75km)
7
end of U
3,                                store
1,1,5.99,-99,                    sub area V (natural channel, centroid to d/s
5.99km)
7
end of V
4,                                add ABCDEFGHIJKLMNOPQRSTUW
5,1,0.81,-99,                    route to W (natural, u/s to centroid 0.81km)
2,1,1.15,-99,                    sub area W (natural, centroid to d/s 1.15km)
7
end of W
5,1,1.46,-99,                    route to X (natural channel, u/s to centroid
1.46km)
2,1,1.46,-99,                    sub area X (natural channel, centroid to d/s
1.46km)
7
end of X
3,                                store
1,1,11,-99,                      (sub area y natural channel, centroid to d/s
11km)
7
end of y
4,                                add ABCDEFGHIJKLMNOPQRSTUVWXYZ
5,1,1.05,-99,                    route to Z (natural, u/s to centroid 1.05)
2,1,1.05,-99,                    sub area Z (natural, u/s to centroid 1.05)
7
end of Z
0,                                end of vector
C                                sub area data
33.3,83.3,5.64,33.7,2.43,11.9,17.5,13.2,34.2,12.9,1.14,34.5,13.8,7.14,1.62,8.13,
3.18,1.31,8.0,1.25,7.6,12.5,4.5,4.47,41.65,2.7,-99,      areas km2
0,-99,    impervious fractions

DESIGN STORMS FOR ROPER BAR
C                                0.167,24,1,1,0,-99,      (0.5hr duration: 0.167hr/10min storm
incs, perform calcs for 24 incs, 1 burst, 1 pluviograph, uniform RF pattern)
C                                0.167,24,1,1,0,-99,      (1hr duration: 0.167hr/10min storm incs,

```

Untitled

```

perform calcs for 24 incs, 1 burst, 1 pluviograph, uniform RF pattern)
C 0.25,24,1,1,0,-99, (2hr duration: 0.25hr/15min storm incs,
perform calcs for 24 incs, 1 burst, 1 pluviograph, uniform RF pattern)
C 0.25,24,1,1,0,-99, (3hr duration: 0.25hr/15min storm incs,
perform calcs for 24 incs, 1 burst, 1 pluviograph, uniform RF pattern)
C 0.5,48,1,1,0,-99, (6hr duration: 0.5hr/30min storm incs,
perform calcs for 48 incs, 1 burst, 1 pluviograph, uniform RF pattern)
C 1,48,1,1,0,-99, (12hr duration: 1hr/60min storm incs, perform
calcs for 48 incs, 1 burst, 1 pluviograph, uniform RF pattern)
1,48,1,1,0,-99, (24hr duration: 1hr/60min storm incs, perform calcs for
48 incs, 1 burst, 1 pluviograph, uniform RF pattern)
C 2,48,1,1,0,-99, (48hr duration: 2hr/120min storm incs, perform
calcs for 48 incs, 1 burst, 1 pluviograph, uniform RF pattern)
C 2,48,1,1,0,-99, (72hr duration: 2hr/120min storm incs, perform
calcs for 48 incs, 1 burst, 1 pluviograph, uniform RF pattern)
C 3,48,1,1,0,-99, (96hr duration: 3hr/180min storm incs, perform
calcs for 48 incs, 1 burst, 1 pluviograph, uniform RF pattern)
C 3,60,1,1,0,-99, (120hr duration: 3hr/180min storm incs, perform
calcs for 60 incs, 1 burst, 1 pluviograph, uniform RF pattern)
C 0,3, 0.5hr dur, 0.167hr incs, rain for 0-3 incs
C 0,6, 1hr dur, 0.167hr incs, rain for 0-6 incs
C 0,8, 2hr dur, 0.25hr incs, rain for 0-8 incs
C 0,12, 3hr dur, 0.25hr incs, rain for 0-12 incs
C 0,12, 6hr dur, 0.5hr incs, rain for 0-12 incs
C 0,12, 12hr dur, 1hr incs, rain for 0-12 incs
0,24, 24hr dur, 1hr incs, rain for 0-24 incs
C 0,24, 48hr dur, 2hr incs, rain for 0-24 incs
C 0,36, 72hr dur, 2hr incs, rain for 0-36 incs
C 0,32, 96hr dur, 3hr incs, rain for 0-32 incs
C 0,40, 120hr dur, 3hr incs, rain for 0-40 incs
C 20yr storm, 0.5hr dur
C 25.01,25.62,10.37,-99
C 20yr storm, 1hr dur
C 9.1778,24.2496,28.0386,12.2932,6.6518,3.789,-99

C 20yr storm, 2hr dur
C 19.388,36.2608,18.4448,11.7376,8.384,5.3448,3.3536,1.8864,-99

C 20yr storm, 3hr dur
C 5.0556,23.0949,32.0571,15.9711,11.1453,8.6175,6.6642,3.9066,2.9874,2.4129,1.7235
,1.2639,-99
C 20yr storm, 6hr dur
C 16.764,42.636,28.248,10.956,8.844,6.6,5.148,3.96,3.168,2.508,1.848,1.32,-99

C 20yr storm, 12hr dur
C 63.0336,30.0696,12.2208,13.1856,9.9696,7.236,7.0752,5.1456,4.02,3.3768,2.7336,2.
7336,-99

C 20yr storm, 24hr dur
C 66.02928,36.0756,16.398,12.24384,8.08968,6.34056,6.77784,3.93552,2.84232,2.40504
,2.62368,1.96776,1.0932,1.31184,2.1864,3.71688,3.06096,3.2796,4.81008,5.90328,5.
24736,8.08968,9.8388,4.3728,-99
C Matt added more ARI here xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
C 1yr storm, 24hr
C 27.97728,15.2856,6.948,5.18784,3.42768,2.68656,2.87184,1.66752,1.20432,1.01904,1.
11168,0.83376,0.4632,0.55584,0.9264,1.57488,1.29696,1.3896,2.03808,2.50128,2.22
336,3.42768,4.1688,1.8528,-99
C 2 yr storm, 24hr
C 36.6024,19.998,9.09,6.7872,4.4844,3.5148,3.7572,2.1816,1.5756,1.3332,1.4544,1.09

```

Untitled

08,0.606,0.7272,1.212,2.0604,1.6968,1.818,2.6664,3.2724,2.9088,4.4844,5.454,2.424,-99
C 5yr storm, 24hr
C
48.5616,26.532,12.06,9.0048,5.9496,4.663,4.9848,2.8944,2.0904,1.7688,1.9296,1.4472,0.804,0.9648,1.608,2.7336,2.2512,2.412,3.5376,4.3416,3.8592,5.9496,7.236,3.216,-99
C 20yr storm, 24hr dur
C
66.02928,36.0756,16.398,12.24384,8.08968,6.34056,6.77784,3.93552,2.84232,2.40504,2.62368,1.96776,1.0932,1.31184,2.1864,3.71688,3.06096,3.2796,4.810,5.90328,5.24736,8.08968,9.8388,4.3728,-99
C 50yr storm,24hr
C
62.304,37.224,17.688,13.992,10.032,8.976,9.24,6.6,5.544,5.016,5.28,4.224,1.848,0.792,4.488,6.336,5.544,5.808,7.392,8.712,7.656,10.56,11.616,7.128,-99
C 100yr storm,24hr
C
70.8,42.3,20.1,15.9,11.4,10.2,10.5,7.5,6.3,5.7,6,4.8,2.1,0.9,5.1,7.2,6.3,6.6,8.4,9.9,8.7,12,13.2,8.1
C xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
C 20yr storm, 48hr dur
C
95.38368,38.84832,12.00192,5.68512,3.1584,3.1584,2.52672,3.1584,2.52672,5.05344,13.89696,4.7376,16.73952,22.42464,29.68896,8.52768,4.10592,3.79008,2.52672,3.1584,6.3168,9.79104,11.37024,7.26432,-99
C 20yr storm, 72hr dur
C
59.61888,59.61888,18.65376,18.65376,2.19456,2.19456,1.8288,1.8288,1.8288,1.8288,5.85216,5.85216,17.19072,17.19072,12.8016,12.8016,2.56032,2.56032,2.01168,2.01168,3.10896,3.10896,7.68096,7.68096,24.14016,24.14016,9.87552,9.87552,2.19456,2.19456,2.7432,2.7432,4.93776,4.93776,3.6576,3.6576,-99
C PMP 1hr
C 61.48,146.81,168.01,79.5,46.11,28.09,-99
C PMP 2hr
C 115.91,191.62,117.92,88.44,69.01,47.57,28.81,10.72,-99
C
C PMP 3hr
C 41.25,134.25,167.25,101.25,76.5,63,51,33.75,27,23.25,18,13.5,-99
C PMP 6hr
C
116.56,243.46,179.54,83.66,72.38,57.34,47.94,39.48,32.9,28.2,21.62,16.92,-99
C PMP 12hr (6hr)
C
298.92,154.16,73.32,82.72,65.8,53.58,52.64,43.24,35.72,31.96,19.74,28.2,-99
C PMP 12 hr (24hr)
C
391.14,201.72,95.94,108.24,86.1,70.11,68.88,56.58,46.74,41.82,25.83,36.9,-99
C PMP 24hr
C
290.28,173.43,82.41,65.19,46.74,41.82,43.05,30.75,25.83,23.37,24.6,19.68,8.61,3.69,20.91,29.52,25.83,27.06,34.44,40.59,35.67,49.2,54.12,33.21,-99
C PMP 48hr
C
403.56,176.13,71.82,41.04,23.94,25.65,22.23,27.36,10.26,37.62,78.66,37.62,90.63,117.99,145.35,56.43,30.78,29.07,25.65,29.07,44.46,63.27,71.82,49.59,-99
C PMP 72hr
C
C
276.06,276.06,102.72,102.72,18.19,18.19,17.12,17.12,18.19,18.19,41.73,41.73,102.72,102.72,80.25,80.25,22.47,22.47,19.26,19.26,24.61,24.61,52.43,52.43,121.98,121.98,65.27,65.27,20.33,20.33,22.47,22.47,36.38,36.38,27.82,27.82,-99
C
C PMP 96hr
C
33.61854615,90.72067925,149.3770628,22.83460396,71.65630052,52.51649459,137.9111595,163.7789201,186.0484133,113.4066938,10.80866267,48.2933732,57.91528663,83.47739563,66.7467164,43.07644535,24.7520154,98.615273,228.5117032,76.22364454,5.729

Untitled

840731,34.47527702,106.8232168,121.4318052,60.26925451,62.47327427,43.44452351,2
6.33907913,57.02262306,29.66792729,46.4274794,35.6063818,-99

C PMP 120hr

C

11.25854806,7.50982176,13.11330157,52.97425711,33.71318546,35.9621766,42.0821573
8,18.08657777,38.12813197,129.4118832,91.10334139,28.16420393,16.060495,23.78166
386,81.00827658,198.6948921,255.7992646,140.9546535,62.88857291,54.97510864,174.
7483842,155.2749063,20.84531072,22.44449642,26.80761812,106.3010726,44.84448158,
116.9545046,69.6037419,49.10154304,76.46302843,30.14421631,58.16723195,98.745621
91,84.8540322,3.58665804,9.383908212,5.28111108,14.26475434,16.5128801,-99



APPENDIX B

Hydraulic Modelling Output Tables - Pre-Development Case

HEC-RAS Plan: Baseline_v2

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Wades Crossing	Tributary	3291	1-yr ARI	0.70	21.43	22.18	21.42	22.18	0.000002	0.03	25.86	45.72	0.01
Wades Crossing	Tributary	3291	2-yr ARI	1.70	21.43	22.40	21.46	22.40	0.000004	0.05	37.20	57.16	0.02
Wades Crossing	Tributary	3291	5-yr ARI	3.20	21.43	22.52	21.51	22.52	0.000010	0.09	44.97	79.77	0.03
Wades Crossing	Tributary	3291	20-yr ARI	10.80	21.43	22.79	21.67	22.79	0.000015	0.13	182.62	535.71	0.04
Wades Crossing	Tributary	3291	50-yr ARI	23.40	21.43	22.91	21.85	22.92	0.000029	0.20	258.23	661.09	0.06
Wades Crossing	Tributary	3291	PMP 12hr	420.00	21.43	27.48	22.94	27.48	0.000001	0.10	6794.13	1835.53	0.01
Wades Crossing	Tributary	3091	1-yr ARI	0.70	21.30	22.18	21.49	22.18	0.000006	0.06	12.29	24.82	0.02
Wades Crossing	Tributary	3091	2-yr ARI	1.70	21.30	22.40	21.57	22.40	0.000012	0.10	18.82	35.31	0.04
Wades Crossing	Tributary	3091	5-yr ARI	3.20	21.30	22.52	21.65	22.52	0.000025	0.16	23.46	43.04	0.05
Wades Crossing	Tributary	3091	20-yr ARI	10.80	21.30	22.79	21.88	22.79	0.000003	0.07	356.70	898.04	0.02
Wades Crossing	Tributary	3091	50-yr ARI	23.40	21.30	22.91	22.12	22.91	0.000006	0.10	470.98	960.90	0.03
Wades Crossing	Tributary	3091	PMP 12hr	420.00	21.30	27.48	22.75	27.48	0.000001	0.09	6943.33	1571.62	0.01
Wades Crossing	Tributary	2719	1-yr ARI	0.70	22.23	22.16	22.14	22.17	0.007963		1.94	36.55	0.00
Wades Crossing	Tributary	2719	2-yr ARI	1.70	22.23	22.40	22.17	22.40	0.000001	0.01	162.64	701.55	0.01
Wades Crossing	Tributary	2719	5-yr ARI	3.20	22.23	22.52	22.20	22.52	0.000001	0.01	247.70	738.74	0.01
Wades Crossing	Tributary	2719	20-yr ARI	10.80	22.23	22.79	22.29	22.79	0.000001	0.02	634.36	1282.81	0.01
Wades Crossing	Tributary	2719	50-yr ARI	23.40	22.23	22.91	22.36	22.91	0.000002	0.04	793.31	1292.91	0.01
Wades Crossing	Tributary	2719	PMP 12hr	420.00	22.23	27.48	22.51	27.48	0.000001	0.07	7413.59	1602.49	0.01
Wades Crossing	Tributary	2534	1-yr ARI	0.70	21.45	22.17	21.04	22.17	0.000000	0.01	171.87	587.95	0.00
Wades Crossing	Tributary	2534	2-yr ARI	1.70	21.45	22.40	21.07	22.40	0.000000	0.01	325.17	684.65	0.00
Wades Crossing	Tributary	2534	5-yr ARI	3.20	21.45	22.52	21.10	22.52	0.000000	0.01	470.34	1171.02	0.00
Wades Crossing	Tributary	2534	20-yr ARI	10.80	21.45	22.79	21.21	22.79	0.000000	0.02	799.07	1238.08	0.01
Wades Crossing	Tributary	2534	50-yr ARI	23.40	21.45	22.91	21.34	22.91	0.000001	0.04	952.37	1248.42	0.01
Wades Crossing	Tributary	2534	PMP 12hr	420.00	21.45	27.48	22.28	27.48	0.000001	0.08	7281.42	1634.43	0.01
Wades Crossing	Tributary	2383	1-yr ARI	0.70	20.82	22.17	21.01	22.17	0.000000	0.01	133.89	503.80	0.00
Wades Crossing	Tributary	2383	2-yr ARI	1.70	20.82	22.40	21.10	22.40	0.000000	0.01	383.62	1127.63	0.00
Wades Crossing	Tributary	2383	5-yr ARI	3.20	20.82	22.52	21.18	22.52	0.000000	0.01	518.60	1144.54	0.00
Wades Crossing	Tributary	2383	20-yr ARI	10.80	20.82	22.79	21.41	22.79	0.000000	0.02	828.38	1158.51	0.01
Wades Crossing	Tributary	2383	50-yr ARI	23.40	20.82	22.91	21.67	22.91	0.000001	0.04	973.10	1174.86	0.01
Wades Crossing	Tributary	2383	PMP 12hr	420.00	20.82	27.48	22.35	27.48	0.000001	0.08	6994.93	1714.79	0.01
Wades Crossing	Tributary	2273	1-yr ARI	0.70	20.83	22.17	20.66	22.17	0.000000	0.01	172.83	422.81	0.00
Wades Crossing	Tributary	2273	2-yr ARI	1.70	20.83	22.40	20.72	22.40	0.000000	0.01	457.24	1039.74	0.00
Wades Crossing	Tributary	2273	5-yr ARI	3.20	20.83	22.52	20.77	22.52	0.000000	0.01	580.63	1046.25	0.00
Wades Crossing	Tributary	2273	20-yr ARI	10.80	20.83	22.79	20.95	22.79	0.000000	0.02	864.81	1059.63	0.01
Wades Crossing	Tributary	2273	50-yr ARI	23.40	20.83	22.91	21.13	22.91	0.000001	0.04	995.70	1066.15	0.01
Wades Crossing	Tributary	2273	PMP 12hr	420.00	20.83	27.48	21.88	27.48	0.000001	0.10	6783.03	1844.21	0.01
Wades Crossing	Tributary	1920	1-yr ARI	0.70	19.97	22.17		22.17	0.000000	0.00	322.89	662.95	0.00
Wades Crossing	Tributary	1920	2-yr ARI	1.70	19.97	22.40		22.40	0.000000	0.01	520.43	940.51	0.00
Wades Crossing	Tributary	1920	5-yr ARI	3.20	19.97	22.52		22.52	0.000000	0.01	636.23	983.72	0.00
Wades Crossing	Tributary	1920	20-yr ARI	10.80	19.97	22.79		22.79	0.000000	0.03	903.08	994.64	0.00
Wades Crossing	Tributary	1920	50-yr ARI	23.40	19.97	22.91		22.91	0.000001	0.05	1025.79	1000.91	0.01
Wades Crossing	Tributary	1920	PMP 12hr	420.00	19.97	27.48		27.48	0.000001	0.10	7312.38	1825.63	0.01
Wades Crossing	Tributary	1603	1-yr ARI	0.70	20.74	22.17		22.17	0.000000	0.00	285.00	811.71	0.00
Wades Crossing	Tributary	1603	2-yr ARI	1.70	20.74	22.40		22.40	0.000000	0.01	495.48	969.42	0.00
Wades Crossing	Tributary	1603	5-yr ARI	3.20	20.74	22.52		22.52	0.000000	0.01	610.65	979.03	0.00
Wades Crossing	Tributary	1603	20-yr ARI	10.80	20.74	22.79		22.79	0.000000	0.02	878.44	1003.86	0.01
Wades Crossing	Tributary	1603	50-yr ARI	23.40	20.74	22.91		22.91	0.000001	0.04	1002.24	1010.67	0.01
Wades Crossing	Tributary	1603	PMP 12hr	420.00	20.74	27.48		27.48	0.000000	0.08	7852.84	1831.85	0.01
Wades Crossing	Tributary	1206	1-yr ARI	0.70	20.78	22.17		22.17	0.000000	0.00	541.10	1144.78	0.00
Wades Crossing	Tributary	1206	2-yr ARI	1.70	20.78	22.40		22.40	0.000000	0.00	832.03	1298.12	0.00
Wades Crossing	Tributary	1206	5-yr ARI	3.20	20.78	22.52		22.52	0.000000	0.01	986.46	1312.86	0.00
Wades Crossing	Tributary	1206	20-yr ARI	10.80	20.78	22.79		22.79	0.000000	0.01	1349.49	1381.50	0.00
Wades Crossing	Tributary	1206	50-yr ARI	23.40	20.78	22.91		22.91	0.000000	0.03	1520.25	1399.76	0.01
Wades Crossing	Tributary	1206	PMP 12hr	420.00	20.78	27.48		27.48	0.000000	0.06	9151.56	1852.38	0.01
Wades Crossing	Tributary	780	1-yr ARI	0.70	20.13	22.17		22.17	0.000000	0.00	904.04	1115.66	0.00
Wades Crossing	Tributary	780	2-yr ARI	1.70	20.13	22.40		22.40	0.000000	0.00	1175.35	1177.58	0.00
Wades Crossing	Tributary	780	5-yr ARI	3.20	20.13	22.52		22.52	0.000000	0.00	1315.42	1190.18	0.00
Wades Crossing	Tributary	780	20-yr ARI	10.80	20.13	22.79		22.79	0.000000	0.01	1640.20	1223.13	0.00
Wades Crossing	Tributary	780	50-yr ARI	23.40	20.13	22.91		22.91	0.000000	0.02	1791.00	1232.84	0.00
Wades Crossing	Tributary	780	PMP 12hr	420.00	20.13	27.48		27.48	0.000000	0.07	8317.63	1577.53	0.01
Wades Crossing	Tributary	324	1-yr ARI	0.70	19.88	22.17		22.17	0.000000	0.00	1014.35	1203.12	0.00
Wades Crossing	Tributary	324	2-yr ARI	1.70	19.88	22.40		22.40	0.000000	0.00	1298.11	1227.44	0.00
Wades Crossing	Tributary	324	5-yr ARI	3.20	19.88	22.52		22.52	0.000000	0.00	1444.46	1243.42	0.00
Wades Crossing	Tributary	324	20-yr ARI	10.80	19.88	22.79		22.79	0.000000	0.01	1782.04	1259.25	0.00
Wades Crossing	Tributary	324	50-yr ARI	23.40	19.88	22.91		22.91	0.000000	0.02	1937.05	1266.59	0.00
Wades Crossing	Tributary	324	PMP 12hr	420.00	19.88	27.48		27.48	0.000000	0.06	8677.06	1638.48	0.01
Towns River	Diversion US	22225	1-yr ARI	96.61	24.73	26.39		26.19	0.000398	0.82	286.75	689.12	0.22
Towns River	Diversion US	22225	2-yr ARI	191.60	24.73	26.45		26.30	0.000498	0.95	506.48	1266.18	0.25
Towns River	Diversion US	22225	5-yr ARI	247.70	24.73	26.53		26.30	0.000512	1.00	615.05	1346.33	0.26
Towns River	Diversion US	22225	20-yr ARI	499.90	24.73	26.81		26.38	0.000506	1.11	1049.61	1745.29	0.26
Towns River	Diversion US	22225	50-yr ARI	568.50	24.73	26.87		26.38	0.000495	1.12	1151.20	1777.89	0.26
Towns River	Diversion US	22225	PMP 12hr	7314.00	24.73	29.82		27.31	0.000168	1.23	9632.56	3282.79	0.18
Towns River	Diversion US	22107	1-yr ARI	96.61	24.71	26.34		26.07	0.000407	0.76	286.29	686.03	0.22
Towns River	Diversion US	22107	2-yr ARI	191.60	24.71	26.39		26.20	0.000558	0.92	525.85	1413.01	0.26
Towns River	Diversion US	22107	5-yr ARI	247.70	24.71	26.47		26.26	0.000504	0.91	650.45	1485.15	0.25
Towns River	Diversion US	22107	20-yr ARI	499.90	24.71	26.75		26.37	0.000436	0.96	1100.23	1731.46	0.24
Towns River	Diversion US	22107	50-yr ARI	568.50	24.71	26.81		26.37	0.000433	0.98	1203.89	1819.48	0.24
Towns River	Diversion US	22107	PMP 12hr	7314.00	24.71	29.80		27.37	0.000142	1.10	10567.79	3646.98	0.16
Towns River	Diversion US	21803	1-yr ARI	96.61	24.32	26.31		25.45	0.000056	0.31	642.17	1145.92	0.08
Towns River	Diversion US	21803	2-yr ARI	191.60	24.32	26.27		25.68	0.000276	0.68	598.76	1137.78	0.19
Towns River	Diversion US	21803	5-yr ARI	247.70	24.32	26.35		25.77	0.000309	0.75	721.22	1378.42	0.20
Towns River	Diversion US	21803	20-yr ARI	499.90	24.32	26.63		26.05	0.000342	0.89	1180.17	1767.87	0.21
Towns River	Diversion US	21803	50-yr ARI	568.50	24.32	26.69		26.08	0.000345	0.91	1288.46	1857.11	0.22
Towns River	Diversion US	21803	PMP 12hr	7314.00	24.32	29.76		27.23	0.000129	1.08	10870.69	3648.70	0.16

HEC-RAS Plan: Baseline_v2 (Continued)

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Towns River	Diversion US	21570	1-yr ARI	96.61	24.43	25.93	25.90	26.23	0.008391	3.08	52.65	130.22	0.97
Towns River	Diversion US	21570	2-yr ARI	191.60	24.43	26.16	26.11	26.18	0.000680	1.00	430.82	1136.35	0.29
Towns River	Diversion US	21570	5-yr ARI	247.70	24.43	26.24	26.11	26.25	0.000715	1.07	520.86	1273.46	0.30
Towns River	Diversion US	21570	20-yr ARI	499.90	24.43	26.51	26.11	26.53	0.000779	1.26	916.33	1796.62	0.32
Towns River	Diversion US	21570	50-yr ARI	568.50	24.43	26.57	26.11	26.59	0.000742	1.26	1030.89	1902.34	0.31
Towns River	Diversion US	21570	PMP 12hr	7314.00	24.43	29.73	27.30	29.75	0.000127	1.06	10969.15	3686.23	0.15
Towns River	Diversion US	21417	1-yr ARI	96.61	24.35	26.00	25.93	26.01	0.000300	0.66	290.94	572.55	0.19
Towns River	Diversion US	21417	2-yr ARI	191.60	24.35	26.01	25.93	26.03	0.001140	1.29	294.16	575.04	0.37
Towns River	Diversion US	21417	5-yr ARI	247.70	24.35	26.09	25.93	26.12	0.001066	1.30	393.47	953.68	0.36
Towns River	Diversion US	21417	20-yr ARI	499.90	24.35	26.35	26.00	26.38	0.001168	1.54	731.01	1428.80	0.39
Towns River	Diversion US	21417	50-yr ARI	568.50	24.35	26.41	26.03	26.45	0.001136	1.56	828.78	1576.78	0.39
Towns River	Diversion US	21417	PMP 12hr	7314.00	24.35	29.71	27.21	29.73	0.000117	1.04	11279.29	3738.94	0.15
Towns River	Diversion US	21235	1-yr ARI	96.61	24.42	26.00	25.22	26.00	0.000025	0.18	869.06	1410.34	0.05
Towns River	Diversion US	21235	2-yr ARI	191.60	24.42	25.98	25.45	25.98	0.000105	0.36	848.72	1393.93	0.11
Towns River	Diversion US	21235	5-yr ARI	247.70	24.42	26.05	25.57	26.06	0.000135	0.42	952.95	1480.25	0.13
Towns River	Diversion US	21235	20-yr ARI	499.90	24.42	26.28	25.64	26.29	0.000249	0.65	1330.45	1876.70	0.18
Towns River	Diversion US	21235	50-yr ARI	568.50	24.42	26.35	25.64	26.36	0.000248	0.67	1454.41	1903.31	0.18
Towns River	Diversion US	21235	PMP 12hr	7314.00	24.42	29.70	26.85	29.71	0.000089	0.89	12181.87	3703.10	0.13
Towns River	Diversion US	20990	1-yr ARI	96.61	24.19	25.99	25.86	25.99	0.000051	0.28	736.57	1591.12	0.08
Towns River	Diversion US	20990	2-yr ARI	191.60	24.19	25.94	25.86	25.94	0.000271	0.62	662.50	1564.83	0.18
Towns River	Diversion US	20990	5-yr ARI	247.70	24.19	26.00	25.86	26.01	0.000310	0.69	763.19	1609.75	0.19
Towns River	Diversion US	20990	20-yr ARI	499.90	24.19	26.20	25.86	26.21	0.000475	0.94	1101.77	1879.42	0.25
Towns River	Diversion US	20990	50-yr ARI	568.50	24.19	26.27	25.86	26.28	0.000437	0.93	1234.25	1970.81	0.24
Towns River	Diversion US	20990	PMP 12hr	7314.00	24.19	29.67	26.82	29.69	0.000089	0.91	12006.69	3565.28	0.13
Towns River	Diversion US	20770	1-yr ARI	96.61	24.31	25.68	25.68	25.92	0.007839	2.76	57.15	197.68	0.92
Towns River	Diversion US	20770	2-yr ARI	191.60	24.31	25.82	25.82	25.84	0.000823	0.98	335.23	675.67	0.31
Towns River	Diversion US	20770	5-yr ARI	247.70	24.31	25.86	25.82	25.89	0.001146	1.19	359.47	705.96	0.36
Towns River	Diversion US	20770	20-yr ARI	499.90	24.31	26.12	25.82	26.12	0.000313	0.71	1262.98	1985.88	0.20
Towns River	Diversion US	20770	50-yr ARI	568.50	24.31	26.19	25.82	26.20	0.000324	0.75	1408.21	2142.30	0.20
Towns River	Diversion US	20770	PMP 12hr	7314.00	24.31	29.65	26.62	29.67	0.000081	0.86	12216.89	3476.29	0.12
Towns River	Diversion US	19566	1-yr ARI	96.61	24.01	25.45	25.45	25.45	0.000199	0.45	320.54	565.15	0.15
Towns River	Diversion US	19566	2-yr ARI	191.60	24.01	25.68	25.45	25.68	0.000040	0.23	1316.83	1826.15	0.07
Towns River	Diversion US	19566	5-yr ARI	247.70	24.01	25.65	25.45	25.65	0.000074	0.31	1272.33	1813.38	0.09
Towns River	Diversion US	19566	20-yr ARI	499.90	24.01	25.88	25.45	25.89	0.000129	0.47	1715.92	2057.24	0.13
Towns River	Diversion US	19566	50-yr ARI	568.50	24.01	25.94	25.45	25.95	0.000134	0.49	1844.32	2143.57	0.13
Towns River	Diversion US	19566	PMP 12hr	7314.00	24.01	29.56	26.19	29.58	0.000068	0.81	12588.75	3275.50	0.11
Towns River	Diversion US	19157	1-yr ARI	96.61	23.57	25.40	25.03	25.40	0.000058	0.28	670.65	1444.64	0.08
Towns River	Diversion US	19157	2-yr ARI	191.60	23.57	25.65	25.16	25.66	0.000068	0.34	1089.39	1814.36	0.09
Towns River	Diversion US	19157	5-yr ARI	247.70	23.57	25.61	25.33	25.61	0.000139	0.48	1008.07	1759.64	0.13
Towns River	Diversion US	19157	20-yr ARI	499.90	23.57	25.80	25.33	25.81	0.000250	0.70	1386.75	2050.82	0.18
Towns River	Diversion US	19157	50-yr ARI	568.50	23.57	25.86	25.33	25.87	0.000250	0.72	1511.13	2102.51	0.18
Towns River	Diversion US	19157	PMP 12hr	7314.00	23.57	29.53	26.25	29.55	0.000087	0.94	11521.51	3165.34	0.13
Towns River	Diversion US	19015	1-yr ARI	96.61	23.86	25.39	24.84	25.39	0.000050	0.29	718.53	1394.52	0.08
Towns River	Diversion US	19015	2-yr ARI	191.60	23.86	25.64	25.16	25.65	0.000059	0.35	1117.90	1710.92	0.09
Towns River	Diversion US	19015	5-yr ARI	247.70	23.86	25.59	25.26	25.59	0.000125	0.50	1026.14	1634.68	0.13
Towns River	Diversion US	19015	20-yr ARI	499.90	23.86	25.77	25.37	25.78	0.000227	0.73	1427.00	2074.31	0.18
Towns River	Diversion US	19015	50-yr ARI	568.50	23.86	25.83	25.37	25.84	0.000227	0.74	1552.45	2098.63	0.18
Towns River	Diversion US	19015	PMP 12hr	7314.00	23.86	29.52	26.23	29.54	0.000088	0.97	11433.67	3107.61	0.13
Towns River	Diversion US	18245	1-yr ARI	96.61	23.38	25.21	24.66	25.28	0.001539	1.53	109.13	264.80	0.43
Towns River	Diversion US	18245	2-yr ARI	191.60	23.38	25.20	25.20	25.47	0.006214	3.07	106.91	258.19	0.87
Towns River	Diversion US	18245	5-yr ARI	247.70	23.38	25.49	25.21	25.50	0.000125	0.50	1062.16	1922.22	0.13
Towns River	Diversion US	18245	20-yr ARI	499.90	23.38	25.53	25.21	25.54	0.000433	0.94	1127.62	1960.73	0.24
Towns River	Diversion US	18245	50-yr ARI	568.50	23.38	25.59	25.37	25.61	0.000418	0.95	1262.66	2072.17	0.24
Towns River	Diversion US	18245	PMP 12hr	7314.00	23.38	29.45	26.13	29.47	0.000081	0.93	11545.82	3024.65	0.13
Towns River	Diversion US	18147	1-yr ARI	96.61	23.59	25.23	25.23	25.24	0.000092	0.34	556.41	1295.11	0.10
Towns River	Diversion US	18147	2-yr ARI	191.60	23.59	25.26	25.23	25.27	0.000355	0.68	592.20	1315.15	0.20
Towns River	Diversion US	18147	5-yr ARI	247.70	23.59	25.48	25.23	25.48	0.000117	0.44	1112.20	1987.87	0.12
Towns River	Diversion US	18147	20-yr ARI	499.90	23.59	25.48	25.23	25.49	0.000472	0.88	1115.59	1989.49	0.24
Towns River	Diversion US	18147	50-yr ARI	568.50	23.59	25.55	25.23	25.56	0.000432	0.87	1257.54	2072.38	0.23
Towns River	Diversion US	18147	PMP 12hr	7314.00	23.59	29.44	26.07	29.46	0.000081	0.91	11422.60	2952.55	0.13
Towns River	Diversion US	17880	1-yr ARI	96.61	23.83	25.01	25.01	25.02	0.000267	0.50	271.14	416.27	0.17
Towns River	Diversion US	17880	2-yr ARI	191.60	23.83	25.23	25.01	25.23	0.000055	0.26	1141.00	1670.53	0.08
Towns River	Diversion US	17880	5-yr ARI	247.70	23.83	25.47	25.01	25.47	0.000038	0.25	1565.82	1991.03	0.07
Towns River	Diversion US	17880	20-yr ARI	499.90	23.83	25.41	25.01	25.42	0.000194	0.54	1454.28	1936.85	0.15
Towns River	Diversion US	17880	50-yr ARI	568.50	23.83	25.48	25.01	25.49	0.000192	0.56	1598.05	2012.53	0.15
Towns River	Diversion US	17880	PMP 12hr	7314.00	23.83	29.42	25.62	29.44	0.000074	0.87	11505.40	2802.71	0.12
Towns River	Diversion US	17545	1-yr ARI	96.61	23.65	24.98	24.84	24.99	0.000037	0.21	822.30	1666.71	0.07
Towns River	Diversion US	17545	2-yr ARI	191.60	23.65	25.22	24.84	25.22	0.000049	0.28	1237.35	1895.73	0.08
Towns River	Diversion US	17545	5-yr ARI	247.70	23.65	25.45	24.84	25.46	0.000033	0.26	1723.60	2144.24	0.07
Towns River	Diversion US	17545	20-yr ARI	499.90	23.65	25.34	24.84	25.35	0.000205	0.61	1487.42	2071.23	0.16
Towns River	Diversion US	17545	50-yr ARI	568.50	23.65	25.42	24.84	25.42	0.000201	0.62	1643.54	2139.06	0.16
Towns River	Diversion US	17545	PMP 12hr	7314.00	23.65	29.40	25.73	29.42	0.000075	0.89	11364.27	2722.88	0.12
Towns River	Diversion US	17309	1-yr ARI	96.61	23.59	24.98		24.98	0.000034	0.19	865.68	1664.60	0.06
Towns River	Diversion US	17309	2-yr ARI	191.60	23.59	25.21		25.21	0.000043	0.24	1272.50	1837.44	0.07
Towns River	Diversion US	17309	5-yr ARI	247.70	23.59	25.45		25.45	0.000028	0.22	1729.98	1939.79	0.06
Towns River	Diversion US	17309	20-yr ARI	499.90	23.59	25.30		25.30	0.000199	0.55	1439.76	1881.91	0.16
Towns River	Diversion US	17309	50-yr ARI	568.50	23.59	25.37		25.38	0.000191	0.56	1581.77	1911.24	0.15
Towns River	Diversion US	17309	PMP 12hr	7314.00	23.59	29.38		29.40	0.000082	0.92	10699.58	2533.52	0.13
Towns River	Diversion US	16925	1-yr ARI	96.61	23.44	24.95	24.90	24.95	0.000144	0.42	377.97	610.76	0.13
Towns River	Diversion US	16925	2-yr ARI	191.60	23.44	25.19	24.90	25.19	0.000024	0.20	1533.36	1870.14	0.05
Towns River	Diversion US	16925	5-yr ARI	247.70	23.44	25.44	24.90	25.44	0.000017	0.19	1996.00	1899.64	0.05
Towns River	Diversion US	16925	20-yr ARI	499.90	23.44	25.23	24.90	25.24	0.000143	0.48	1606.00	1875.07	0.13
Towns River	Diversion US	16925	50-yr ARI	568.50	23.44	25.31	24.90	25.32	0.000140	0.50	1751.19	1883.41	0.13
Towns River	Diversion US	16925	PMP 12hr	7314.00	23.44	29.34	25.55						

HEC-RAS Plan: Baseline_v2 (Continued)

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Towns River	Diversion US	16652	1-yr ARI	128.50	23.26	24.94	24.91	24.94	0.000017	0.13	1295.44	1748.03	0.04
Towns River	Diversion US	16652	2-yr ARI	253.70	23.26	25.19	24.91	25.19	0.000027	0.19	1725.52	1805.19	0.06
Towns River	Diversion US	16652	5-yr ARI	327.10	23.26	25.43	24.91	25.43	0.000022	0.19	2178.05	1855.50	0.05
Towns River	Diversion US	16652	20-yr ARI	654.90	23.26	25.19	24.91	25.19	0.000179	0.49	1725.49	1805.18	0.15
Towns River	Diversion US	16652	50-yr ARI	739.80	23.26	25.26	24.92	25.27	0.000179	0.52	1866.48	1826.01	0.15
Towns River	Diversion US	16652	PMP 12hr	9434.00	23.26	29.30	25.67	29.34	0.000135	1.17	10557.05	2439.26	0.16
Towns River	Diversion US	16218	1-yr ARI	128.50	22.66	24.83	24.17	24.91	0.000977	1.38	122.22	149.70	0.36
Towns River	Diversion US	16218	2-yr ARI	253.70	22.66	24.66	24.66	25.10	0.006046	3.17	99.18	127.11	0.87
Towns River	Diversion US	16218	5-yr ARI	327.10	22.66	24.82	24.82	25.35	0.006523	3.54	120.46	147.47	0.92
Towns River	Diversion US	16218	20-yr ARI	654.90	22.66	25.12	24.91	25.12	0.000156	0.62	1789.76	1845.24	0.15
Towns River	Diversion US	16218	50-yr ARI	739.80	22.66	25.19	24.91	25.20	0.000156	0.63	1932.88	1851.30	0.15
Towns River	Diversion US	16218	PMP 12hr	9434.00	22.66	29.24	25.59	29.28	0.000130	1.24	10443.28	2333.36	0.16
Towns River	Diversion US	15646	1-yr ARI	128.50	22.94	24.71	24.71	24.80	0.002961	2.05	168.24	673.74	0.59
Towns River	Diversion US	15646	2-yr ARI	253.70	22.94	24.76	24.76	24.77	0.000075	0.34	1197.63	1787.14	0.10
Towns River	Diversion US	15646	5-yr ARI	327.10	22.94	24.76	24.76	24.77	0.000125	0.43	1197.63	1787.14	0.12
Towns River	Diversion US	15646	20-yr ARI	654.90	22.94	25.02	24.76	25.03	0.000190	0.60	1660.12	1815.72	0.16
Towns River	Diversion US	15646	50-yr ARI	739.80	22.94	25.10	24.76	25.11	0.000189	0.62	1801.29	1824.61	0.16
Towns River	Diversion US	15646	PMP 12hr	9434.00	22.94	29.16	25.56	29.21	0.000138	1.24	10209.90	2279.21	0.17
Towns River	Diversion US	15227	1-yr ARI	128.50	22.41	24.29	23.79	24.30	0.000089	0.42	662.01	1131.96	0.11
Towns River	Diversion US	15227	2-yr ARI	253.70	22.41	24.50	24.01	24.50	0.000134	0.55	968.88	1705.55	0.13
Towns River	Diversion US	15227	5-yr ARI	327.10	22.41	24.60	24.20	24.60	0.000144	0.60	1145.63	1780.17	0.14
Towns River	Diversion US	15227	20-yr ARI	654.90	22.41	24.95	24.29	24.96	0.000155	0.69	1778.52	1824.32	0.15
Towns River	Diversion US	15227	50-yr ARI	739.80	22.41	25.03	24.29	25.04	0.000156	0.71	1920.28	1835.15	0.15
Towns River	Diversion US	15227	PMP 12hr	9434.00	22.41	29.11	25.44	29.15	0.000130	1.29	10415.89	2274.12	0.16
Towns River	Diversion US	14628	1-yr ARI	128.50	22.56	24.21	23.83	24.21	0.000075	0.35	707.72	1177.70	0.10
Towns River	Diversion US	14628	2-yr ARI	253.70	22.56	24.43	24.02	24.43	0.000118	0.49	1006.05	1601.80	0.12
Towns River	Diversion US	14628	5-yr ARI	327.10	22.56	24.52	24.02	24.52	0.000132	0.54	1160.22	1704.97	0.13
Towns River	Diversion US	14628	20-yr ARI	654.90	22.56	24.86	24.02	24.86	0.000162	0.67	1762.28	1808.24	0.15
Towns River	Diversion US	14628	50-yr ARI	739.80	22.56	24.93	24.02	24.94	0.000163	0.69	1901.21	1815.80	0.15
Towns River	Diversion US	14628	PMP 12hr	9434.00	22.56	29.03	25.34	29.07	0.000131	1.28	10458.72	2300.55	0.16
Towns River	Diversion US	14207	1-yr ARI	128.50	21.86	24.15	23.82	24.16	0.000229	0.74	445.22	1022.12	0.18
Towns River	Diversion US	14207	2-yr ARI	253.70	21.86	24.35	23.95	24.36	0.000267	0.86	766.46	1579.49	0.19
Towns River	Diversion US	14207	5-yr ARI	327.10	21.86	24.43	24.00	24.44	0.000277	0.90	908.14	1673.39	0.20
Towns River	Diversion US	14207	20-yr ARI	654.90	21.86	24.76	24.19	24.78	0.000272	0.98	1474.70	1749.10	0.20
Towns River	Diversion US	14207	50-yr ARI	739.80	21.86	24.84	24.24	24.85	0.000265	0.99	1610.94	1758.40	0.20
Towns River	Diversion US	14207	PMP 12hr	9434.00	21.86	28.97	25.44	29.01	0.000150	1.43	10175.01	2387.44	0.18
Towns River	Diversion US	13642	1-yr ARI	128.50	22.30	23.94	23.63	23.95	0.000629	1.01	368.82	1258.75	0.28
Towns River	Diversion US	13642	2-yr ARI	253.70	22.30	24.17	23.83	24.18	0.000375	0.87	745.92	1663.84	0.22
Towns River	Diversion US	13642	5-yr ARI	327.10	22.30	24.26	23.87	24.27	0.000341	0.86	903.74	1675.36	0.21
Towns River	Diversion US	13642	20-yr ARI	654.90	22.30	24.61	24.04	24.62	0.000276	0.88	1493.16	1719.99	0.20
Towns River	Diversion US	13642	50-yr ARI	739.80	22.30	24.69	24.07	24.70	0.000263	0.88	1635.82	1730.50	0.19
Towns River	Diversion US	13642	PMP 12hr	9434.00	22.30	28.89	25.24	28.93	0.000142	1.35	10754.98	2633.28	0.17
Towns River	Diversion US	13308	1-yr ARI	128.50	21.30	23.80	23.27	23.81	0.000345	0.84	410.89	1061.31	0.21
Towns River	Diversion US	13308	2-yr ARI	253.70	21.30	24.05	23.63	24.06	0.000322	0.89	738.22	1443.10	0.21
Towns River	Diversion US	13308	5-yr ARI	327.10	21.30	24.16	23.63	24.16	0.000310	0.91	890.47	1506.71	0.21
Towns River	Diversion US	13308	20-yr ARI	654.90	21.30	24.52	23.86	24.53	0.000273	0.96	1475.93	1668.50	0.20
Towns River	Diversion US	13308	50-yr ARI	739.80	21.30	24.61	23.90	24.62	0.000259	0.95	1622.24	1682.18	0.20
Towns River	Diversion US	13308	PMP 12hr	9434.00	21.30	28.85	25.18	28.88	0.000134	1.34	11047.55	2730.36	0.17
Towns River	Diversion US	12915	1-yr ARI	128.10	21.35	23.70	23.17	23.70	0.000209	0.67	481.12	1112.08	0.17
Towns River	Diversion US	12915	2-yr ARI	252.80	21.35	23.95	23.41	23.96	0.000222	0.76	802.34	1373.46	0.17
Towns River	Diversion US	12915	5-yr ARI	325.90	21.35	24.05	23.48	24.06	0.000232	0.80	945.30	1425.55	0.18
Towns River	Diversion US	12915	20-yr ARI	657.60	21.35	24.42	23.69	24.43	0.000240	0.91	1498.51	1567.74	0.19
Towns River	Diversion US	12915	50-yr ARI	751.00	21.35	24.51	23.69	24.52	0.000240	0.93	1640.22	1601.20	0.19
Towns River	Diversion US	12915	PMP 12hr	9574.00	21.35	28.79	25.09	28.83	0.000144	1.41	10957.02	2787.21	0.17
Towns River	Diversion US	12616	1-yr ARI	128.10	21.35	23.59	23.16	23.61	0.000477	1.11	351.26	1073.94	0.26
Towns River	Diversion US	12616	2-yr ARI	252.80	21.35	23.86	23.54	23.88	0.000357	1.05	684.64	1355.06	0.23
Towns River	Diversion US	12616	5-yr ARI	325.90	21.35	23.97	23.61	23.98	0.000335	1.05	826.88	1394.29	0.22
Towns River	Diversion US	12616	20-yr ARI	657.60	21.35	24.34	23.76	24.35	0.000305	1.11	1367.39	1521.11	0.22
Towns River	Diversion US	12616	50-yr ARI	751.00	21.35	24.43	23.81	24.44	0.000294	1.11	1507.01	1538.80	0.21
Towns River	Diversion US	12616	PMP 12hr	9574.00	21.35	28.74	25.11	28.78	0.000167	1.58	10507.36	2769.32	0.19
Towns River	Diversion US	12260	1-yr ARI	128.10	21.34	23.49	22.61	23.50	0.000212	0.72	425.90	964.63	0.17
Towns River	Diversion US	12260	2-yr ARI	252.80	21.34	23.76	22.97	23.77	0.000246	0.85	794.07	1447.64	0.19
Towns River	Diversion US	12260	5-yr ARI	325.90	21.34	23.87	23.16	23.88	0.000245	0.88	951.11	1502.88	0.19
Towns River	Diversion US	12260	20-yr ARI	657.60	21.34	24.25	23.44	24.26	0.000225	0.93	1529.69	1560.99	0.19
Towns River	Diversion US	12260	50-yr ARI	751.00	21.34	24.34	23.53	24.35	0.000218	0.94	1677.37	1571.23	0.18
Towns River	Diversion US	12260	PMP 12hr	9574.00	21.34	28.68	24.89	28.72	0.000167	1.57	10118.12	2569.64	0.19
Towns River	Diversion US	11459	1-yr ARI	128.10	20.86	23.23	22.85	23.25	0.000518	1.13	252.02	480.57	0.27
Towns River	Diversion US	11459	2-yr ARI	252.80	20.86	23.54	23.08	23.56	0.000309	0.97	691.49	1471.24	0.21
Towns River	Diversion US	11459	5-yr ARI	325.90	20.86	23.65	23.18	23.67	0.000284	0.96	856.24	1479.29	0.20
Towns River	Diversion US	11459	20-yr ARI	657.60	20.86	24.06	23.41	24.07	0.000235	0.98	1466.26	1529.87	0.19
Towns River	Diversion US	11459	50-yr ARI	751.00	20.86	24.16	23.41	24.18	0.000224	0.98	1621.85	1539.51	0.19
Towns River	Diversion US	11459	PMP 12hr	9574.00	20.86	28.54	24.78	28.59	0.000168	1.59	9681.89	2327.58	0.19
Towns River	Diversion US	10366	1-yr ARI	128.10	21.36	23.00	21.86	23.00	0.000129	0.38	469.25	630.21	0.12
Towns River	Diversion US	10366	2-yr ARI	252.80	21.36	23.27	22.20	23.28	0.000202	0.56	656.35	808.08	0.16
Towns River	Diversion US	10366	5-yr ARI	325.90	21.36	23.40	22.32	23.41	0.000199	0.59	1020.91	1553.12	0.16
Towns River	Diversion US	10366	20-yr ARI	657.60	21.36	23.87	22.69	23.87	0.000151	0.62	1759.58	1652.14	0.14
Towns River	Diversion US	10366	50-yr ARI	751.00	21.36	23.98	22.78	23.98	0.000144	0.63	1942.73	1670.99	0.14
Towns River	Diversion US	10366	PMP 12hr	9574.00	21.36	28.39	24.36	28.43	0.000126	1.29	10801.51	2425.81	0.16
Towns River	Diversion US	10052	1-yr ARI	128.10	20.51	22.95	22.15	22.96	0.000195	0.56	353.91	447.90	0.16
Towns River	Diversion US	10052	2-yr ARI	252.80	20.51	23.22	22.31	23.23	0.000187	0.62	839.99	1354.86	0.16
Towns River	Diversion US	10052	5-yr ARI	325.90	20.51	23.35	22.40	23.36	0.000175	0.63	1014.33	1382.80	0.15
Towns River	Diversion US	10052	20-yr ARI	657.60	20.51	23.82	22.69	23.83	0.000143	0.67	1677.96	1415.42	0.14
Towns River	Diversion US	10052	50-yr ARI	751.00	20.51	23.93	22.84	23.94	0.000142	0.69	1835.76	1440.59	0.15
Towns River	Diversion US	10052	PMP										

HEC-RAS Plan: Baseline_v2 (Continued)

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Towns River	Diversion US	9913	1-yr ARI	128.10	20.94	22.93	22.06	22.93	0.000169	0.51	429.48	656.23	0.14
Towns River	Diversion US	9913	2-yr ARI	252.80	20.94	23.20	22.27	23.21	0.000118	0.49	968.48	1331.53	0.12
Towns River	Diversion US	9913	5-yr ARI	325.90	20.94	23.33	22.34	23.34	0.000117	0.51	1141.37	1371.22	0.13
Towns River	Diversion US	9913	20-yr ARI	657.60	20.94	23.81	22.61	23.81	0.000116	0.60	1812.28	1460.79	0.13
Towns River	Diversion US	9913	50-yr ARI	751.00	20.94	23.92	22.67	23.93	0.000115	0.62	1975.06	1468.93	0.13
Towns River	Diversion US	9913	PMP 12hr	9574.00	20.94	28.34	24.26	28.38	0.000132	1.35	11075.48	2851.86	0.17
Towns River	Diversion US	9781	1-yr ARI	128.10	20.63	22.90		22.91	0.000177	0.53	420.68	661.55	0.15
Towns River	Diversion US	9781	2-yr ARI	252.80	20.63	23.17		23.19	0.000223	0.68	601.44	665.26	0.17
Towns River	Diversion US	9781	5-yr ARI	325.90	20.63	23.30		23.31	0.000245	0.74	684.84	667.10	0.18
Towns River	Diversion US	9781	20-yr ARI	657.60	20.63	23.76		23.79	0.000297	0.96	996.45	674.32	0.21
Towns River	Diversion US	9781	50-yr ARI	751.00	20.63	23.87		23.90	0.000307	1.01	1069.62	676.06	0.21
Towns River	Diversion US	9781	PMP 12hr	9574.00	20.63	28.02		28.32	0.000690	3.02	4111.47	1001.40	0.38
Towns River	Diversion US	9648	1-yr ARI	128.10	20.51	22.85		22.87	0.000578	0.90	266.82	577.63	0.26
Towns River	Diversion US	9648	2-yr ARI	252.80	20.51	23.11		23.14	0.000573	1.03	421.36	582.11	0.27
Towns River	Diversion US	9648	5-yr ARI	325.90	20.51	23.24		23.26	0.000588	1.10	491.90	584.03	0.28
Towns River	Diversion US	9648	20-yr ARI	657.60	20.51	23.69		23.73	0.000604	1.32	758.11	589.84	0.29
Towns River	Diversion US	9648	50-yr ARI	751.00	20.51	23.79		23.84	0.000611	1.37	820.41	591.06	0.30
Towns River	Diversion US	9648	PMP 12hr	9574.00	20.51	27.75		28.19	0.001110	3.70	3451.06	956.56	0.48
Towns River	Diversion US	9497	1-yr ARI	128.10	20.50	22.79		22.80	0.000297	0.71	336.04	609.27	0.19
Towns River	Diversion US	9497	2-yr ARI	252.80	20.50	23.05		23.07	0.000362	0.88	493.70	611.96	0.22
Towns River	Diversion US	9497	5-yr ARI	325.90	20.50	23.17		23.19	0.000394	0.96	565.43	613.15	0.23
Towns River	Diversion US	9497	20-yr ARI	657.60	20.50	23.62		23.65	0.000454	1.20	841.19	617.92	0.26
Towns River	Diversion US	9497	50-yr ARI	751.00	20.50	23.72		23.76	0.000466	1.25	905.65	619.05	0.26
Towns River	Diversion US	9497	PMP 12hr	9574.00	20.50	27.69		28.01	0.000831	3.26	4261.00	1284.06	0.42
Towns River	Diversion US	9384	1-yr ARI	128.10	20.16	22.76		22.77	0.000279	0.74	330.94	602.76	0.19
Towns River	Diversion US	9384	2-yr ARI	252.80	20.16	23.01		23.03	0.000368	0.94	481.15	606.18	0.22
Towns River	Diversion US	9384	5-yr ARI	325.90	20.16	23.12		23.14	0.000409	1.03	549.43	607.55	0.24
Towns River	Diversion US	9384	20-yr ARI	657.60	20.16	23.56		23.60	0.000481	1.29	817.93	613.11	0.27
Towns River	Diversion US	9384	50-yr ARI	751.00	20.16	23.66		23.70	0.000496	1.35	880.81	614.63	0.27
Towns River	Diversion US	9384	PMP 12hr	9574.00	20.16	27.70		27.90	0.000580	2.78	5365.05	1507.53	0.35
Towns River	Diversion US	9274	1-yr ARI	128.10	20.31	22.73	22.38	22.74	0.000274	0.66	345.68	583.41	0.18
Towns River	Diversion US	9274	2-yr ARI	252.80	20.31	22.97	22.51	22.99	0.000376	0.86	484.93	588.13	0.22
Towns River	Diversion US	9274	5-yr ARI	325.90	20.31	23.08	22.56	23.10	0.000425	0.95	548.21	590.02	0.24
Towns River	Diversion US	9274	20-yr ARI	657.60	20.31	23.51	22.75	23.54	0.000509	1.22	803.07	595.23	0.27
Towns River	Diversion US	9274	50-yr ARI	751.00	20.31	23.61	22.80	23.65	0.000527	1.28	862.89	596.37	0.28
Towns River	Diversion US	9274	PMP 12hr	9574.00	20.31	27.67	25.21	27.82	0.000452	2.40	5979.77	1531.29	0.31
Towns River	Diversion US	9139	1-yr ARI	128.10	19.99	22.70	22.05	22.70	0.000243	0.60	338.65	485.12	0.17
Towns River	Diversion US	9139	2-yr ARI	252.80	19.99	22.91	22.27	22.93	0.000401	0.85	444.54	489.01	0.23
Towns River	Diversion US	9139	5-yr ARI	325.90	19.99	23.01	22.46	23.04	0.000482	0.98	491.86	490.73	0.25
Towns River	Diversion US	9139	20-yr ARI	657.60	19.99	23.41	22.65	23.46	0.000657	1.33	691.54	497.60	0.30
Towns River	Diversion US	9139	50-yr ARI	751.00	19.99	23.51	22.70	23.57	0.000693	1.41	738.58	499.12	0.31
Towns River	Diversion US	9139	PMP 12hr	9574.00	19.99	27.62	25.07	27.76	0.000419	2.28	6092.55	1464.99	0.29
Towns River	Diversion US	9005	1-yr ARI	128.10	19.76	22.61	21.84	22.65	0.000678	1.09	211.18	478.47	0.29
Towns River	Diversion US	9005	2-yr ARI	252.80	19.76	22.77	22.59	22.84	0.001223	1.57	286.28	480.42	0.40
Towns River	Diversion US	9005	5-yr ARI	325.90	19.76	22.83	22.66	22.92	0.001570	1.83	314.70	481.14	0.46
Towns River	Diversion US	9005	20-yr ARI	657.60	19.76	23.20	22.91	23.32	0.001711	2.19	494.66	485.67	0.49
Towns River	Diversion US	9005	50-yr ARI	751.00	19.76	23.29	22.97	23.42	0.001734	2.26	537.37	486.74	0.50
Towns River	Diversion US	9005	PMP 12hr	9574.00	19.76	27.58	24.84	27.70	0.000358	2.16	6386.80	1425.69	0.27
Towns River	Diversion US	8809	1-yr ARI	128.10	19.87	22.57		22.57	0.000208	0.57	399.62	855.98	0.16
Towns River	Diversion US	8809	2-yr ARI	252.80	19.87	22.66		22.68	0.000511	0.93	478.80	887.56	0.25
Towns River	Diversion US	8809	5-yr ARI	325.90	19.87	22.63		22.67	0.000975	1.27	454.16	885.25	0.35
Towns River	Diversion US	8809	20-yr ARI	657.60	19.87	23.07		23.10	0.000652	1.25	905.87	1195.40	0.30
Towns River	Diversion US	8809	50-yr ARI	751.00	19.87	23.17		23.20	0.000599	1.25	1030.36	1218.81	0.29
Towns River	Diversion US	8809	PMP 12hr	9574.00	19.87	27.55		27.64	0.000242	1.76	7535.47	1603.07	0.22
Towns River	Diversion US	8571	1-yr ARI	128.10	19.51	22.27	21.55	22.45	0.002107	1.91	77.46	86.93	0.51
Towns River	Diversion US	8571	2-yr ARI	252.80	19.51	22.56	22.36	22.58	0.000367	0.81	446.84	456.21	0.22
Towns River	Diversion US	8571	5-yr ARI	325.90	19.51	22.36	22.36	22.41	0.001188	1.45	357.26	449.70	0.39
Towns River	Diversion US	8571	20-yr ARI	657.60	19.51	22.96	22.36	22.98	0.000401	0.96	1070.25	1086.08	0.23
Towns River	Diversion US	8571	50-yr ARI	751.00	19.51	23.07	22.36	23.09	0.000383	0.98	1189.83	1109.94	0.23
Towns River	Diversion US	8571	PMP 12hr	9574.00	19.51	27.46	24.05	27.57	0.000287	1.90	6537.64	1273.66	0.24
Towns River	Mid Reach	8282	1-yr ARI	128.80	20.70	22.12	22.01	22.16	0.001463	1.26	208.39	582.99	0.36
Towns River	Mid Reach	8282	2-yr ARI	254.50	20.70	22.35	22.12	22.39	0.001296	1.33	344.03	614.43	0.35
Towns River	Mid Reach	8282	5-yr ARI	329.10	20.70	22.46	22.17	22.50	0.001255	1.37	414.75	645.41	0.35
Towns River	Mid Reach	8282	20-yr ARI	668.40	20.70	22.69	22.35	22.76	0.001712	1.75	623.18	749.71	0.41
Towns River	Mid Reach	8282	50-yr ARI	774.40	20.70	22.82	22.40	22.88	0.001482	1.70	715.45	756.52	0.39
Towns River	Mid Reach	8282	PMP 12hr	9994.00	20.70	27.18	24.48	27.43	0.000703	2.56	4557.54	929.14	0.33
Towns River	Mid Reach	7922	1-yr ARI	128.80	20.51	21.71	21.13	21.73	0.000912	0.86	241.12	522.04	0.27
Towns River	Mid Reach	7922	2-yr ARI	254.50	20.51	21.93	21.37	21.96	0.001016	1.04	371.93	641.19	0.30
Towns River	Mid Reach	7922	5-yr ARI	329.10	20.51	22.06	21.49	22.09	0.000969	1.08	454.47	675.82	0.30
Towns River	Mid Reach	7922	20-yr ARI	668.40	20.51	22.57	21.84	22.58	0.000196	0.60	1430.83	1142.57	0.14
Towns River	Mid Reach	7922	50-yr ARI	774.40	20.51	22.70	21.90	22.71	0.000190	0.62	1580.74	1147.24	0.14
Towns River	Mid Reach	7922	PMP 12hr	9994.00	20.51	27.14	23.32	27.24	0.000249	1.54	7039.44	1260.26	0.19
Towns River	Mid Reach	7717	1-yr ARI	128.80	19.73	21.54	20.44	21.55	0.000235	0.63	345.91	559.73	0.15
Towns River	Mid Reach	7717	2-yr ARI	254.50	19.73	21.84	20.85	21.84	0.000124	0.51	912.02	1176.12	0.11
Towns River	Mid Reach	7717	5-yr ARI	329.10	19.73	21.99	20.99	22.00	0.000123	0.53	1098.27	1231.74	0.11
Towns River	Mid Reach	7717	20-yr ARI	668.40	19.73	22.51	21.37	22.52	0.000113	0.59	1752.69	1266.80	0.11
Towns River	Mid Reach	7717	50-yr ARI	774.40	19.73	22.64	21.52	22.65	0.000113	0.60	1920.24	1271.26	0.11
Towns River	Mid Reach	7717	PMP 12hr	9994.00	19.73	27.06	23.00	27.15	0.000196	1.49	7701.64	1321.37	0.18
Towns River	Mid Reach	7052	1-yr ARI	128.80	19.57	21.30	20.00	21.31	0.000149	0.44	445.35	750.84	0.12
Towns River	Mid Reach	7052	2-yr ARI	254.50	19.57	21.66	20.31	21.66	0.000157	0.52	718.30	780.12	0.12
Towns River	Mid Reach	7052	5-yr ARI	329.10	19.57	21.81	20.46	21.82	0.000162	0.56	837.71	781.79	0.13
Towns River	Mid Reach	7052	20-yr ARI	668.40	19.57	22.32	20.99	22.34	0.000190	0.70	1237.69	786.20	0.14
Towns River	Mid Reach	7052	50-yr ARI	774.40	19.57	22.45	21.32	22.46	0.000197	0.74	1338.17	787.30	0.15
Towns River	Mid Reach	7052	PMP 12hr	9994.00	19.57	26.51	23.32	26.74	0.000573	2.38	4744.65	1158.05	0.30

HEC-RAS Plan: Baseline_v2 (Continued)

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Towns River	Mid Reach	6677	1-yr ARI	128.80	18.56	21.17		21.18	0.000187	0.72	380.80	672.82	0.14
Towns River	Mid Reach	6677	2-yr ARI	254.50	18.56	21.52		21.53	0.000208	0.83	632.37	755.31	0.16
Towns River	Mid Reach	6677	5-yr ARI	329.10	18.56	21.67		21.68	0.000213	0.86	746.22	764.38	0.16
Towns River	Mid Reach	6677	20-yr ARI	668.40	18.56	22.15		22.17	0.000249	1.03	1123.78	784.99	0.18
Towns River	Mid Reach	6677	50-yr ARI	774.40	18.56	22.27		22.30	0.000258	1.07	1218.94	788.33	0.18
Towns River	Mid Reach	6677	PMP 12hr	9994.00	18.56	26.17		26.31	0.000499	2.43	6197.01	1934.42	0.28
Towns River	Mid Reach	6436	1-yr ARI	128.80	18.50	21.06	19.89	21.08	0.000267	0.74	354.04	637.48	0.17
Towns River	Mid Reach	6436	2-yr ARI	254.50	18.50	21.40	20.65	21.42	0.000263	0.80	588.34	729.20	0.17
Towns River	Mid Reach	6436	5-yr ARI	329.10	18.50	21.55	20.92	21.57	0.000261	0.83	697.86	733.97	0.17
Towns River	Mid Reach	6436	20-yr ARI	668.40	18.50	22.02	21.14	22.04	0.000303	1.01	1043.34	743.96	0.19
Towns River	Mid Reach	6436	50-yr ARI	774.40	18.50	22.13	21.19	22.16	0.000316	1.06	1129.07	746.19	0.19
Towns River	Mid Reach	6436	PMP 12hr	9994.00	18.50	26.03	23.14	26.11	0.000294	1.76	8076.67	2075.84	0.21
Towns River	Mid Reach	6131	1-yr ARI	128.80	19.20	20.87		20.88	0.000155	0.43	443.72	624.51	0.12
Towns River	Mid Reach	6131	2-yr ARI	254.50	19.20	21.19		21.20	0.000185	0.53	651.97	716.02	0.13
Towns River	Mid Reach	6131	5-yr ARI	329.10	19.20	21.33		21.34	0.000199	0.58	757.64	779.61	0.14
Towns River	Mid Reach	6131	20-yr ARI	668.40	19.20	21.74		21.76	0.000278	0.79	1144.17	1078.27	0.17
Towns River	Mid Reach	6131	50-yr ARI	774.40	19.20	21.84		21.86	0.000291	0.83	1256.03	1096.96	0.18
Towns River	Mid Reach	6131	PMP 12hr	9994.00	19.20	25.62		25.76	0.000438	1.96	6203.57	1687.49	0.25
Towns River	Mid Reach	5750	1-yr ARI	128.80	18.50	20.55	20.30	20.58	0.000730	1.07	232.13	504.88	0.26
Towns River	Mid Reach	5750	2-yr ARI	254.50	18.50	20.83	20.48	20.86	0.000734	1.19	379.38	561.14	0.27
Towns River	Mid Reach	5750	5-yr ARI	329.10	18.50	20.95	20.55	20.98	0.000781	1.28	443.37	568.36	0.28
Towns River	Mid Reach	5750	20-yr ARI	668.40	18.50	21.35	20.77	21.38	0.000504	1.16	1035.37	1170.08	0.23
Towns River	Mid Reach	5750	50-yr ARI	774.40	18.50	21.46	20.81	21.48	0.000486	1.17	1154.95	1171.44	0.23
Towns River	Mid Reach	5750	PMP 12hr	9994.00	18.50	25.10	22.48	25.27	0.000526	2.18	5608.11	1398.00	0.28
Towns River	Mid Reach	5107	1-yr ARI	128.80	17.64	20.39	19.03	20.39	0.000145	0.56	386.49	480.54	0.14
Towns River	Mid Reach	5107	2-yr ARI	254.50	17.64	20.52	19.32	20.54	0.000365	0.94	451.14	502.35	0.22
Towns River	Mid Reach	5107	5-yr ARI	329.10	17.64	20.66	19.45	20.69	0.000427	1.07	529.24	593.02	0.24
Towns River	Mid Reach	5107	20-yr ARI	668.40	17.64	21.04	19.97	21.08	0.000456	1.25	939.31	858.80	0.26
Towns River	Mid Reach	5107	50-yr ARI	774.40	17.64	21.14	20.03	21.18	0.000471	1.30	1025.69	865.64	0.27
Towns River	Mid Reach	5107	PMP 12hr	9994.00	17.64	24.59	22.45	24.84	0.000865	3.18	4730.42	1233.76	0.42
Towns River	Mid Reach	4812	1-yr ARI	128.80	17.96	20.15	19.80	20.28	0.001674	1.81	97.18	119.11	0.47
Towns River	Mid Reach	4812	2-yr ARI	254.50	17.96	20.35	20.27	20.39	0.000726	1.30	418.44	737.27	0.31
Towns River	Mid Reach	4812	5-yr ARI	329.10	17.96	20.50	20.27	20.53	0.000629	1.27	526.54	750.97	0.30
Towns River	Mid Reach	4812	20-yr ARI	668.40	17.96	20.85	20.38	20.90	0.000739	1.55	795.94	769.69	0.33
Towns River	Mid Reach	4812	50-yr ARI	774.40	17.96	20.95	20.42	21.00	0.000751	1.60	870.32	773.91	0.33
Towns River	Mid Reach	4812	PMP 12hr	9994.00	17.96	24.12	22.53	24.50	0.001432	3.92	3888.80	1237.33	0.53
Towns River	Mid Reach	4588	1-yr ARI	128.80	17.95	20.14	18.89	20.15	0.000182	0.66	427.50	830.72	0.16
Towns River	Mid Reach	4588	2-yr ARI	254.50	17.95	20.24	19.24	20.26	0.000448	1.07	509.38	866.81	0.25
Towns River	Mid Reach	4588	5-yr ARI	329.10	17.95	20.40	19.45	20.42	0.000374	1.03	654.40	914.32	0.23
Towns River	Mid Reach	4588	20-yr ARI	668.40	17.95	20.73	19.84	20.76	0.000502	1.32	963.75	974.79	0.27
Towns River	Mid Reach	4588	50-yr ARI	774.40	17.95	20.82	19.84	20.86	0.000514	1.37	1056.64	991.85	0.28
Towns River	Mid Reach	4588	PMP 12hr	9994.00	17.95	24.19	21.67	24.28	0.000327	1.94	7649.49	1917.05	0.26
Towns River	Mid Reach	3994	1-yr ARI	128.80	17.05	19.95	19.38	19.98	0.000500	1.06	205.24	296.80	0.26
Towns River	Mid Reach	3994	2-yr ARI	254.50	17.05	20.08	19.62	20.09	0.000185	0.68	684.42	827.03	0.16
Towns River	Mid Reach	3994	5-yr ARI	329.10	17.05	20.25	19.72	20.26	0.000187	0.72	838.49	949.92	0.16
Towns River	Mid Reach	3994	20-yr ARI	668.40	17.05	20.49	20.00	20.51	0.000334	1.04	1291.14	1793.04	0.22
Towns River	Mid Reach	3994	50-yr ARI	774.40	17.05	20.58	20.00	20.60	0.000337	1.07	1459.36	1850.36	0.22
Towns River	Mid Reach	3994	PMP 12hr	9994.00	17.05	24.01	21.34	24.09	0.000287	1.79	7898.99	1882.85	0.24
Towns River	Mid Reach	3155	1-yr ARI	128.80	17.36	19.43	18.69	19.47	0.000738	1.10	185.81	285.99	0.30
Towns River	Mid Reach	3155	2-yr ARI	254.50	17.36	19.69	19.11	19.76	0.001256	1.61	282.21	507.12	0.41
Towns River	Mid Reach	3155	5-yr ARI	329.10	17.36	19.83	19.33	19.91	0.001449	1.83	376.18	714.64	0.44
Towns River	Mid Reach	3155	20-yr ARI	668.40	17.36	20.10	19.66	20.13	0.000590	1.29	1031.45	1292.35	0.29
Towns River	Mid Reach	3155	50-yr ARI	774.40	17.36	20.19	19.66	20.23	0.000578	1.31	1150.25	1321.03	0.29
Towns River	Mid Reach	3155	PMP 12hr	9994.00	17.36	23.71	21.31	23.81	0.000364	2.00	7162.47	1784.46	0.27
Towns River	Mid Reach	2503	1-yr ARI	128.80	16.09	18.98	18.42	19.03	0.000631	1.22	200.19	375.61	0.29
Towns River	Mid Reach	2503	2-yr ARI	254.50	16.09	19.27	18.87	19.29	0.000436	1.12	536.73	941.22	0.25
Towns River	Mid Reach	2503	5-yr ARI	329.10	16.09	19.38	18.97	19.41	0.000454	1.19	647.72	1015.58	0.26
Towns River	Mid Reach	2503	20-yr ARI	668.40	16.09	19.76	19.22	19.79	0.000494	1.37	1080.58	1231.08	0.27
Towns River	Mid Reach	2503	50-yr ARI	774.40	16.09	19.87	19.27	19.89	0.000470	1.38	1210.70	1244.91	0.27
Towns River	Mid Reach	2503	PMP 12hr	9994.00	16.09	23.42	20.93	23.55	0.000429	2.31	6351.82	1480.72	0.30
Towns River	Diversion DS	1672	1-yr ARI	133.70	15.66	18.60	17.98	18.63	0.000395	1.10	309.27	690.06	0.24
Towns River	Diversion DS	1672	2-yr ARI	265.00	15.66	19.02	18.49	19.04	0.000245	0.97	709.04	1096.44	0.19
Towns River	Diversion DS	1672	5-yr ARI	344.20	15.66	19.10	18.57	19.12	0.000294	1.09	797.75	1107.53	0.21
Towns River	Diversion DS	1672	20-yr ARI	701.80	15.66	19.50	18.86	19.51	0.000250	1.10	1480.39	1509.43	0.20
Towns River	Diversion DS	1672	50-yr ARI	834.40	15.66	19.60	18.92	19.62	0.000258	1.14	1641.57	1517.85	0.20
Towns River	Diversion DS	1672	PMP 12hr	10992.00	15.66	23.11	20.38	23.23	0.000385	2.29	7193.85	1603.54	0.28
Towns River	Diversion DS	1319	1-yr ARI	133.70	15.30	18.50	16.78	18.52	0.000243	0.85	291.64	330.69	0.19
Towns River	Diversion DS	1319	2-yr ARI	265.00	15.30	18.94	17.37	18.95	0.000226	0.93	720.32	1137.57	0.18
Towns River	Diversion DS	1319	5-yr ARI	344.20	15.30	19.00	17.74	19.01	0.000311	1.10	785.41	1211.54	0.22
Towns River	Diversion DS	1319	20-yr ARI	701.80	15.30	19.40	18.38	19.42	0.000314	1.22	1311.95	1354.31	0.22
Towns River	Diversion DS	1319	50-yr ARI	834.40	15.30	19.50	18.64	19.52	0.000327	1.27	1451.81	1365.22	0.23
Towns River	Diversion DS	1319	PMP 12hr	10992.00	15.30	22.92	20.43	23.08	0.000503	2.58	6410.24	1489.40	0.32
Towns River	Diversion DS	908	1-yr ARI	133.70	15.35	18.44	17.18	18.45	0.000124	0.61	370.45	413.76	0.13
Towns River	Diversion DS	908	2-yr ARI	265.00	15.35	18.87	17.61	18.88	0.000156	0.77	582.95	544.83	0.15
Towns River	Diversion DS	908	5-yr ARI	344.20	15.35	18.88	17.86	18.90	0.000256	0.99	589.35	544.83	0.20
Towns River	Diversion DS	908	20-yr ARI	701.80	15.35	19.28	18.25	19.30	0.000258	1.10	1302.24	1346.70	0.20
Towns River	Diversion DS	908	50-yr ARI	834.40	15.35	19.37	18.34	19.40	0.000284	1.18	1427.85	1351.86	0.21
Towns River	Diversion DS	908	PMP 12hr	10992.00	15.35	22.69	20.39	22.86	0.000546	2.65	6280.77	1563.62	0.33
Towns River	Diversion DS	263	1-yr ARI	133.70	15.64	18.29	17.48	18.32	0.000340	1.03	220.41	259.46	0.22
Towns River	Diversion DS	263	2-yr ARI	265.00	15.64	18.71	17.73	18.74	0.000313	1.11	561.34	1247.09	0.22
Towns River	Diversion DS	263	5-yr ARI	344.20	15.64	18.41	18.10	18.55	0.001617	2.33	256.06	337.36	0.49
Towns River	Diversion DS	263	20-yr ARI	701.80	15.64	18.69	18.65	18.90	0.002407	3.07	534.99	1243.59	0.61
Towns River	Diversion DS	263	50-yr ARI	834.40	15.64	18.79	18.76	18.98	0.002232	3.03	661.17	1275.68	0.59
Towns River	Diversion DS	263	PMP 12hr	10992.00	15.64	22.14	20.38	22.39	0.000912	3.32	5143.10	1339.55	0.43

HEC-RAS Plan: Baseline_v2 (Continued)

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Towns River	Diversion DS	55	1-yr ARI	133.70	15.36	18.09	17.46	18.20	0.001001	1.66	112.04	212.27	0.37
Towns River	Diversion DS	55	2-yr ARI	265.00	15.36	17.97	17.97	18.52	0.005330	3.66	94.59	88.59	0.86
Towns River	Diversion DS	55	5-yr ARI	344.20	15.36	18.31	18.31	18.34	0.000521	1.28	656.43	1126.42	0.28
Towns River	Diversion DS	55	20-yr ARI	701.80	15.36	18.49	18.31	18.54	0.001002	1.87	852.04	1126.42	0.39
Towns River	Diversion DS	55	50-yr ARI	834.40	15.36	18.58	18.31	18.64	0.001000	1.92	954.77	1126.42	0.39
Towns River	Diversion DS	55	PMP 12hr	10992.00	15.36	21.89	19.96	22.18	0.001000	3.37	4683.86	1126.42	0.45
Catchment Y	Catchment Y	8098	1-yr ARI	4.90	23.38	24.42	23.93	24.42	0.000003	0.03	230.88	807.31	0.01
Catchment Y	Catchment Y	8098	2-yr ARI	10.50	23.38	24.13	24.13	24.31	0.012296	1.86	5.66	16.56	0.99
Catchment Y	Catchment Y	8098	5-yr ARI	15.10	23.38	24.17	24.17	24.18	0.000530	0.40	65.83	343.51	0.21
Catchment Y	Catchment Y	8098	20-yr ARI	33.40	23.38	24.29	24.17	24.30	0.000599	0.39	107.92	375.09	0.22
Catchment Y	Catchment Y	8098	50-yr ARI	60.00	23.38	24.32	24.17	24.33	0.001057	0.52	155.69	717.62	0.29
Catchment Y	Catchment Y	8098	PMP 12hr	998.00	23.38	25.26	24.69	25.31	0.001168	1.34	1042.92	1089.41	0.38
Catchment Y	Catchment Y	7554	1-yr ARI	4.90	22.77	23.28	23.12	23.30	0.002139	0.72	7.36	24.51	0.41
Catchment Y	Catchment Y	7554	2-yr ARI	10.50	22.77	23.52	23.24	23.52	0.000829	0.48	37.49	344.83	0.26
Catchment Y	Catchment Y	7554	5-yr ARI	15.10	22.77	23.58	23.32	23.58	0.000647	0.47	63.67	544.96	0.23
Catchment Y	Catchment Y	7554	20-yr ARI	33.40	22.77	23.55	23.53	23.59	0.004833	1.22	50.21	454.06	0.63
Catchment Y	Catchment Y	7554	50-yr ARI	60.00	22.77	23.72	23.57	23.74	0.001123	0.76	160.64	764.00	0.32
Catchment Y	Catchment Y	7554	PMP 12hr	998.00	22.77	24.61	24.09	24.66	0.001190	1.47	1076.27	1294.52	0.39
Catchment Y	Catchment Y	7259	1-yr ARI	4.90	22.33	23.09	22.63	23.10	0.000320	0.38	13.06	26.35	0.17
Catchment Y	Catchment Y	7259	2-yr ARI	10.50	22.33	23.34	22.78	23.35	0.000406	0.52	21.73	63.53	0.20
Catchment Y	Catchment Y	7259	5-yr ARI	15.10	22.33	22.88	22.88	23.06	0.012068	1.89	8.00	21.56	0.99
Catchment Y	Catchment Y	7259	20-yr ARI	33.40	22.33	23.44	23.15	23.44	0.000167	0.37	201.90	799.90	0.13
Catchment Y	Catchment Y	7259	50-yr ARI	60.00	22.33	23.37	23.37	23.39	0.001326	0.97	145.67	769.78	0.37
Catchment Y	Catchment Y	7259	PMP 12hr	998.00	22.33	24.28	23.77	24.33	0.001135	1.55	1058.53	1201.19	0.39
Catchment Y	Catchment Y	6895	1-yr ARI	4.90	22.47	22.91	22.72	22.92	0.000957	0.46	13.51	81.68	0.27
Catchment Y	Catchment Y	6895	2-yr ARI	10.50	22.47	22.83	22.83	22.92	0.011476	1.40	8.63	47.22	0.90
Catchment Y	Catchment Y	6895	5-yr ARI	15.10	22.47	22.89	22.89	22.99	0.011083	1.52	12.12	76.29	0.91
Catchment Y	Catchment Y	6895	20-yr ARI	33.40	22.47	22.95	22.95	23.21	0.023206	2.51	17.83	108.65	1.36
Catchment Y	Catchment Y	6895	50-yr ARI	60.00	22.47	23.02	23.02	23.03	0.000524	0.43	213.42	790.70	0.21
Catchment Y	Catchment Y	6895	PMP 12hr	998.00	22.47	23.82	23.31	23.87	0.001359	1.40	1002.16	1193.48	0.41
Catchment Y	Catchment Y	6512	1-yr ARI	4.90	21.97	22.45	22.26	22.47	0.001478	0.54	9.83	41.06	0.33
Catchment Y	Catchment Y	6512	2-yr ARI	10.50	21.97	22.39	22.39	22.50	0.012490	1.54	7.42	32.99	0.95
Catchment Y	Catchment Y	6512	5-yr ARI	15.10	21.97	22.46	22.46	22.58	0.013352	1.65	9.99	41.26	0.99
Catchment Y	Catchment Y	6512	20-yr ARI	33.40	21.97	22.55	22.55	22.55	0.000031	0.10	395.14	1026.94	0.05
Catchment Y	Catchment Y	6512	50-yr ARI	60.00	21.97	22.55	22.55	22.55	0.000100	0.17	395.14	1026.94	0.09
Catchment Y	Catchment Y	6512	PMP 12hr	998.00	21.97	23.64	22.62	23.66	0.000280	0.72	1699.33	1395.77	0.19
Catchment Y	Catchment Y	6283	1-yr ARI	4.90	21.77	22.32	22.08	22.32	0.000329	0.30	22.41	115.63	0.16
Catchment Y	Catchment Y	6283	2-yr ARI	10.50	21.77	22.18	22.18	22.26	0.012939	1.37	8.71	49.99	0.94
Catchment Y	Catchment Y	6283	5-yr ARI	15.10	21.77	22.20	22.20	22.34	0.020899	1.78	9.71	59.71	1.20
Catchment Y	Catchment Y	6283	20-yr ARI	33.40	21.77	22.36	22.36	22.36	0.000012	0.06	532.65	1116.54	0.03
Catchment Y	Catchment Y	6283	50-yr ARI	60.00	21.77	22.36	22.36	22.36	0.000039	0.11	532.65	1116.54	0.06
Catchment Y	Catchment Y	6283	PMP 12hr	998.00	21.77	23.60	22.36	23.61	0.000144	0.55	2142.11	1456.22	0.14
Catchment Y	Catchment Y	5159	1-yr ARI	4.90	20.85	21.12	21.11	21.20	0.014108	1.25	4.02	25.10	0.95
Catchment Y	Catchment Y	5159	2-yr ARI	10.50	20.85	21.23	21.23	21.35	0.013155	1.53	7.32	34.37	0.97
Catchment Y	Catchment Y	5159	5-yr ARI	15.10	20.85	21.30	21.30	21.43	0.012078	1.64	10.01	40.41	0.96
Catchment Y	Catchment Y	5159	20-yr ARI	33.40	20.85	21.51	21.51	21.66	0.007605	1.84	26.17	194.93	0.83
Catchment Y	Catchment Y	5159	50-yr ARI	60.00	20.85	21.66	21.66	21.74	0.004631	1.69	67.31	339.32	0.67
Catchment Y	Catchment Y	5159	PMP 12hr	998.00	20.85	23.51	21.74	23.51	0.000055	0.45	2976.32	1571.26	0.09
Catchment Y	Catchment Y	4917	1-yr ARI	4.90	19.79	20.44	20.22	20.46	0.001267	0.61	8.46	28.38	0.32
Catchment Y	Catchment Y	4917	2-yr ARI	10.50	19.79	20.74	20.37	20.76	0.000734	0.62	19.26	44.28	0.26
Catchment Y	Catchment Y	4917	5-yr ARI	15.10	19.79	20.89	20.46	20.91	0.000683	0.66	26.69	55.65	0.26
Catchment Y	Catchment Y	4917	20-yr ARI	33.40	19.79	21.16	20.70	21.16	0.000118	0.34	231.44	896.10	0.11
Catchment Y	Catchment Y	4917	50-yr ARI	60.00	19.79	21.10	20.93	21.21	0.003206	1.72	65.20	361.68	0.59
Catchment Y	Catchment Y	4917	PMP 12hr	998.00	19.79	23.49	21.47	23.50	0.000051	0.52	2829.66	1348.95	0.09
Catchment Y	Catchment Y	4659	1-yr ARI	4.90	19.26	20.37	19.63	20.37	0.000140	0.31	15.99	23.98	0.12
Catchment Y	Catchment Y	4659	2-yr ARI	10.50	19.26	20.65	19.80	20.66	0.000239	0.45	23.89	34.93	0.16
Catchment Y	Catchment Y	4659	5-yr ARI	15.10	19.26	20.79	19.92	20.80	0.000285	0.55	29.40	44.66	0.18
Catchment Y	Catchment Y	4659	20-yr ARI	33.40	19.26	20.87	20.25	20.93	0.001038	1.10	33.31	53.11	0.34
Catchment Y	Catchment Y	4659	50-yr ARI	60.00	19.26	20.90	20.61	20.92	0.000498	0.78	186.15	730.92	0.24
Catchment Y	Catchment Y	4659	PMP 12hr	998.00	19.26	23.48	21.32	23.49	0.000048	0.55	2739.90	1212.22	0.09
Catchment Y	Catchment Y	4321	1-yr ARI	4.90	19.64	20.21	20.02	20.24	0.002904	0.84	5.81	17.99	0.47
Catchment Y	Catchment Y	4321	2-yr ARI	10.50	19.64	20.40	20.21	20.46	0.003110	1.02	10.56	40.79	0.51
Catchment Y	Catchment Y	4321	5-yr ARI	15.10	19.64	20.31	20.31	20.49	0.012948	1.88	8.04	23.04	1.01
Catchment Y	Catchment Y	4321	20-yr ARI	33.40	19.64	20.56	20.47	20.58	0.000980	0.72	90.38	412.63	0.30
Catchment Y	Catchment Y	4321	50-yr ARI	60.00	19.64	20.67	20.47	20.68	0.001005	0.81	137.17	477.05	0.32
Catchment Y	Catchment Y	4321	PMP 12hr	998.00	19.64	23.46	21.16	23.47	0.000059	0.58	2453.60	1062.08	0.10
Catchment Y	Catchment Y	3943	1-yr ARI	4.90	19.23	19.72	19.47	19.73	0.000757	0.40	13.99	54.23	0.24
Catchment Y	Catchment Y	3943	2-yr ARI	10.50	19.23	19.89	19.57	19.90	0.000806	0.49	25.25	77.28	0.26
Catchment Y	Catchment Y	3943	5-yr ARI	15.10	19.23	19.98	19.64	19.99	0.000886	0.59	33.31	102.47	0.28
Catchment Y	Catchment Y	3943	20-yr ARI	33.40	19.23	20.21	19.82	20.23	0.000860	0.76	62.71	157.62	0.29
Catchment Y	Catchment Y	3943	50-yr ARI	60.00	19.23	20.38	19.94	20.39	0.000594	0.73	145.17	408.18	0.25
Catchment Y	Catchment Y	3943	PMP 12hr	998.00	19.23	23.44	20.94	23.45	0.000054	0.61	2548.63	1043.14	0.10
Catchment Y	Catchment Y	3556	1-yr ARI	4.90	19.00	19.49	19.22	19.50	0.000484	0.31	17.87	76.07	0.19
Catchment Y	Catchment Y	3556	2-yr ARI	10.50	19.00	19.64	19.32	19.65	0.000543	0.44	30.37	96.42	0.22
Catchment Y	Catchment Y	3556	5-yr ARI	15.10	19.00	19.72	19.40	19.73	0.000587	0.51	39.78	139.55	0.23
Catchment Y	Catchment Y	3556	20-yr ARI	33.40	19.00	19.93	19.54	19.94	0.000643	0.68	74.35	182.61	0.26
Catchment Y	Catchment Y	3556	50-yr ARI	60.00	19.00	20.12	19.71	20.14	0.000756	0.86	119.98	301.09	0.29
Catchment Y	Catchment Y	3556	PMP 12hr	998.00	19.00	23.42	20.77	23.43	0.000037	0.53	2751.70	980.88	0.08
Catchment Y	Catchment Y	3191	1-yr ARI	4.90	18.76	19.19	19.05	19.21	0.001536	0.51	9.69	51.07	0.33
Catchment Y	Catchment Y	3191	2-yr ARI	10.50	18.76	19.31	19.14	19.33	0.001668	0.69	17.93	94.30	0.37
Catchment Y	Catchment Y	3191	5-yr ARI	15.10	18.76	19.41	19.20	19.43	0.001143	0.67	29.12	117.20	0.32
Catchment Y	Catchment Y	3191	20-yr ARI	33.40	18.76	19.73	19.38	19.74	0.000475	0.62	90.26	289.61	0.22
Catchment Y	Catchment Y	3191	50-yr ARI	60.00	18.76	19.77	19.51	19.80	0.001172	1.00	101.65	321.46	0.35
Catchment Y	Catchment Y	3191	PMP 12hr	998.00	18.76	23.42	19.95	23.42	0.000019	0.40	3480.21	1099.62	0.06

HEC-RAS Plan: Baseline_v2 (Continued)

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Catchment Y	Catchment Y	2699	1-yr ARI	4.90	18.18	18.76	18.47	18.77	0.000574	0.41	12.54	46.61	0.22
Catchment Y	Catchment Y	2699	2-yr ARI	10.50	18.18	19.11	18.60	19.11	0.000195	0.37	36.37	92.45	0.14
Catchment Y	Catchment Y	2699	5-yr ARI	15.10	18.18	19.21	18.68	19.21	0.000227	0.44	45.88	101.67	0.15
Catchment Y	Catchment Y	2699	20-yr ARI	33.40	18.18	19.60	18.89	19.61	0.000182	0.51	106.88	248.69	0.15
Catchment Y	Catchment Y	2699	50-yr ARI	60.00	18.18	19.73	19.09	19.73	0.000046	0.27	385.03	576.98	0.08
Catchment Y	Catchment Y	2699	PMP 12hr	998.00	18.18	23.41	19.81	23.41	0.000015	0.37	4036.19	1319.21	0.05
Catchment Y	Catchment Y	2219	1-yr ARI	4.90	17.80	18.72	18.20	18.72	0.000040	0.14	53.53	188.67	0.06
Catchment Y	Catchment Y	2219	2-yr ARI	10.50	17.80	19.11	18.38	19.11	0.000004	0.07	281.57	636.98	0.02
Catchment Y	Catchment Y	2219	5-yr ARI	15.10	17.80	19.20	18.49	19.20	0.000005	0.08	344.92	660.84	0.02
Catchment Y	Catchment Y	2219	20-yr ARI	33.40	17.80	19.60	18.61	19.60	0.000003	0.07	796.72	1037.50	0.02
Catchment Y	Catchment Y	2219	50-yr ARI	60.00	17.80	19.72	18.70	19.72	0.000006	0.11	928.41	1116.59	0.03
Catchment Y	Catchment Y	2219	PMP 12hr	998.00	17.80	23.41	19.28	23.41	0.000005	0.22	5976.93	1413.70	0.03
Catchment Y	Catchment Y	1680	1-yr ARI	4.90	16.95	18.72	17.17	18.72	0.000004	0.09	59.73	56.64	0.02
Catchment Y	Catchment Y	1680	2-yr ARI	10.50	16.95	19.10	17.28	19.10	0.000004	0.10	148.02	200.87	0.02
Catchment Y	Catchment Y	1680	5-yr ARI	15.10	16.95	19.20	17.35	19.20	0.000007	0.13	167.89	208.29	0.03
Catchment Y	Catchment Y	1680	20-yr ARI	33.40	16.95	19.60	17.58	19.60	0.000013	0.21	311.14	570.21	0.04
Catchment Y	Catchment Y	1680	50-yr ARI	60.00	16.95	19.71	17.84	19.72	0.000030	0.33	380.52	642.85	0.07
Catchment Y	Catchment Y	1680	PMP 12hr	998.00	16.95	23.40	19.74	23.40	0.000019	0.49	3127.37	872.28	0.06
Catchment Y	Catchment Y	1338	1-yr ARI	4.90	17.71	18.71	18.09	18.71	0.000104	0.28	22.04	58.88	0.10
Catchment Y	Catchment Y	1338	2-yr ARI	10.50	17.71	19.10	18.25	19.10	0.000002	0.05	310.54	440.47	0.02
Catchment Y	Catchment Y	1338	5-yr ARI	15.10	17.71	19.20	18.34	19.20	0.000001	0.05	599.20	1049.16	0.01
Catchment Y	Catchment Y	1338	20-yr ARI	33.40	17.71	19.60	18.64	19.60	0.000001	0.06	1049.84	1222.94	0.01
Catchment Y	Catchment Y	1338	50-yr ARI	60.00	17.71	19.71	18.84	19.71	0.000003	0.09	1197.64	1328.55	0.02
Catchment Y	Catchment Y	1338	PMP 12hr	998.00	17.71	23.40	19.12	23.40	0.000004	0.21	6252.84	1372.34	0.03
Catchment Y	Catchment Y	737	1-yr ARI	4.90	16.11	18.71	16.36	18.71	0.000001	0.06	102.73	74.02	0.01
Catchment Y	Catchment Y	737	2-yr ARI	10.50	16.11	19.10	16.48	19.10	0.000000	0.04	639.29	833.84	0.01
Catchment Y	Catchment Y	737	5-yr ARI	15.10	16.11	19.20	16.56	19.20	0.000001	0.05	722.80	898.13	0.01
Catchment Y	Catchment Y	737	20-yr ARI	33.40	16.11	19.60	16.81	19.60	0.000001	0.06	1115.20	996.82	0.01
Catchment Y	Catchment Y	737	50-yr ARI	60.00	16.11	19.71	17.07	19.71	0.000002	0.10	1230.01	996.82	0.02
Catchment Y	Catchment Y	737	PMP 12hr	998.00	16.11	23.39	19.09	23.40	0.000006	0.30	4900.72	996.82	0.04



APPENDIX C

Hydraulic Modelling Output Tables - Option C

HEC-RAS Plan: OptionC_v1

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Wades Crossing	Tributary	3291	1-yr ARI	0.70	21.43	22.16	21.42	22.16	0.000002	0.03	24.94	44.88	0.01
Wades Crossing	Tributary	3291	2-yr ARI	1.70	21.43	22.40	21.46	22.40	0.000004	0.05	39.64	110.33	0.02
Wades Crossing	Tributary	3291	5-yr ARI	3.20	21.43	22.53	21.51	22.53	0.000008	0.08	64.67	282.01	0.03
Wades Crossing	Tributary	3291	20-yr ARI	10.80	21.43	22.97	21.67	22.97	0.000004	0.08	295.17	686.39	0.02
Wades Crossing	Tributary	3291	50-yr ARI	23.40	21.43	23.09	21.85	23.09	0.000010	0.13	384.14	785.98	0.04
Wades Crossing	Tributary	3291	PMP 12hr	420.00	21.43	27.94	22.95	27.94	0.000001	0.08	7643.42	1876.69	0.01
Wades Crossing	Tributary	3091	1-yr ARI	0.70	21.30	22.16		22.16	0.000007	0.06	12.68	52.33	0.03
Wades Crossing	Tributary	3091	2-yr ARI	1.70	21.30	22.40		22.40	0.000004	0.06	77.96	554.24	0.02
Wades Crossing	Tributary	3091	5-yr ARI	3.20	21.30	22.53		22.53	0.000003	0.05	153.14	656.10	0.02
Wades Crossing	Tributary	3091	20-yr ARI	10.80	21.30	22.97		22.97	0.000001	0.04	526.65	1006.24	0.01
Wades Crossing	Tributary	3091	50-yr ARI	23.40	21.30	23.09		23.09	0.000003	0.07	660.38	1207.00	0.02
Wades Crossing	Tributary	3091	PMP 12hr	420.00	21.30	27.94		27.94	0.000000	0.08	7668.09	1610.73	0.01
Wades Crossing	Tributary	2719	1-yr ARI	0.70	22.23	22.16		22.16	0.000002		51.64	420.06	0.00
Wades Crossing	Tributary	2719	2-yr ARI	1.70	22.23	22.40		22.40	0.000000	0.01	205.54	831.58	0.01
Wades Crossing	Tributary	2719	5-yr ARI	3.20	22.23	22.53		22.53	0.000001	0.01	315.96	992.59	0.01
Wades Crossing	Tributary	2719	20-yr ARI	10.80	22.23	22.97		22.97	0.000000	0.02	867.91	1299.65	0.01
Wades Crossing	Tributary	2719	50-yr ARI	23.40	22.23	23.09		23.09	0.000001	0.03	1026.97	1308.77	0.01
Wades Crossing	Tributary	2719	PMP 12hr	420.00	22.23	27.94		27.94	0.000000	0.07	8148.74	1616.85	0.01
Wades Crossing	Tributary	2534	1-yr ARI	0.70	21.45	22.16		22.16	0.000000	0.01	171.67	589.40	0.00
Wades Crossing	Tributary	2534	2-yr ARI	1.70	21.45	22.40		22.40	0.000000	0.01	348.12	896.72	0.00
Wades Crossing	Tributary	2534	5-yr ARI	3.20	21.45	22.53		22.53	0.000000	0.01	479.35	1185.34	0.00
Wades Crossing	Tributary	2534	20-yr ARI	10.80	21.45	22.97		22.97	0.000000	0.02	1024.60	1253.22	0.00
Wades Crossing	Tributary	2534	50-yr ARI	23.40	21.45	23.09		23.09	0.000000	0.03	1177.94	1264.06	0.01
Wades Crossing	Tributary	2534	PMP 12hr	420.00	21.45	27.94		27.94	0.000000	0.07	8089.19	1856.70	0.01
Wades Crossing	Tributary	2383	1-yr ARI	0.70	20.82	22.16		22.16	0.000000	0.01	153.62	633.58	0.00
Wades Crossing	Tributary	2383	2-yr ARI	1.70	20.82	22.40		22.40	0.000000	0.01	386.60	1130.28	0.00
Wades Crossing	Tributary	2383	5-yr ARI	3.20	20.82	22.53		22.53	0.000000	0.01	527.35	1144.96	0.00
Wades Crossing	Tributary	2383	20-yr ARI	10.80	20.82	22.97		22.97	0.000000	0.02	1041.18	1178.29	0.00
Wades Crossing	Tributary	2383	50-yr ARI	23.40	20.82	23.09		23.09	0.000000	0.03	1185.00	1183.27	0.01
Wades Crossing	Tributary	2383	PMP 12hr	420.00	20.82	27.94		27.94	0.000001	0.08	7823.74	1956.55	0.01
Wades Crossing	Tributary	2273	1-yr ARI	0.70	20.83	22.16		22.16	0.000000	0.01	239.37	637.46	0.00
Wades Crossing	Tributary	2273	2-yr ARI	1.70	20.83	22.40		22.40	0.000000	0.01	459.98	1039.88	0.00
Wades Crossing	Tributary	2273	5-yr ARI	3.20	20.83	22.53		22.53	0.000000	0.01	588.63	1046.68	0.00
Wades Crossing	Tributary	2273	20-yr ARI	10.80	20.83	22.97		22.97	0.000000	0.02	1057.60	1072.43	0.00
Wades Crossing	Tributary	2273	50-yr ARI	23.40	20.83	23.09		23.09	0.000000	0.03	1189.19	1085.23	0.01
Wades Crossing	Tributary	2273	PMP 12hr	420.00	20.83	27.94		27.94	0.000001	0.09	7625.34	1844.21	0.01
Wades Crossing	Tributary	1920	1-yr ARI	0.70	19.97	22.16		22.16	0.000000	0.00	316.16	650.00	0.00
Wades Crossing	Tributary	1920	2-yr ARI	1.70	19.97	22.40		22.40	0.000000	0.01	522.95	960.15	0.00
Wades Crossing	Tributary	1920	5-yr ARI	3.20	19.97	22.53		22.53	0.000000	0.01	643.75	984.01	0.00
Wades Crossing	Tributary	1920	20-yr ARI	10.80	19.97	22.97		22.97	0.000000	0.02	1084.05	1004.69	0.00
Wades Crossing	Tributary	1920	50-yr ARI	23.40	19.97	23.09		23.09	0.000000	0.04	1206.89	1014.77	0.01
Wades Crossing	Tributary	1920	PMP 12hr	420.00	19.97	27.94		27.94	0.000000	0.08	8146.31	1825.63	0.01
Wades Crossing	Tributary	1603	1-yr ARI	0.70	20.74	22.16		22.16	0.000000	0.00	276.75	801.21	0.00
Wades Crossing	Tributary	1603	2-yr ARI	1.70	20.74	22.40		22.40	0.000000	0.01	498.04	969.54	0.00
Wades Crossing	Tributary	1603	5-yr ARI	3.20	20.74	22.53		22.53	0.000000	0.01	618.14	979.80	0.00
Wades Crossing	Tributary	1603	20-yr ARI	10.80	20.74	22.97		22.97	0.000000	0.02	1061.19	1013.91	0.00
Wades Crossing	Tributary	1603	50-yr ARI	23.40	20.74	23.09		23.09	0.000000	0.03	1184.88	1020.21	0.01
Wades Crossing	Tributary	1603	PMP 12hr	420.00	20.74	27.94		27.94	0.000000	0.07	8696.83	1850.14	0.01
Wades Crossing	Tributary	1206	1-yr ARI	0.70	20.78	22.16		22.16	0.000000	0.00	529.38	1142.22	0.00
Wades Crossing	Tributary	1206	2-yr ARI	1.70	20.78	22.40		22.40	0.000000	0.00	835.46	1298.44	0.00
Wades Crossing	Tributary	1206	5-yr ARI	3.20	20.78	22.53		22.53	0.000000	0.01	996.50	1313.81	0.00
Wades Crossing	Tributary	1206	20-yr ARI	10.80	20.78	22.97		22.97	0.000000	0.01	1602.17	1407.85	0.00
Wades Crossing	Tributary	1206	50-yr ARI	23.40	20.78	23.09		23.09	0.000000	0.02	1774.25	1424.70	0.00
Wades Crossing	Tributary	1206	PMP 12hr	420.00	20.78	27.94		27.94	0.000000	0.06	9997.84	1852.38	0.01
Wades Crossing	Tributary	780	1-yr ARI	0.70	20.13	22.16		22.16	0.000000	0.00	892.62	1113.94	0.00
Wades Crossing	Tributary	780	2-yr ARI	1.70	20.13	22.40		22.40	0.000000	0.00	1178.45	1177.91	0.00
Wades Crossing	Tributary	780	5-yr ARI	3.20	20.13	22.53		22.53	0.000000	0.00	1324.52	1190.94	0.00
Wades Crossing	Tributary	780	20-yr ARI	10.80	20.13	22.97		22.97	0.000000	0.01	1863.11	1237.26	0.00
Wades Crossing	Tributary	780	50-yr ARI	23.40	20.13	23.09		23.09	0.000000	0.02	2014.60	1258.41	0.00
Wades Crossing	Tributary	780	PMP 12hr	420.00	20.13	27.94		27.94	0.000000	0.06	9044.02	1602.37	0.01
Wades Crossing	Tributary	324	1-yr ARI	0.70	19.88	22.16		22.16	0.000000	0.00	1002.02	1202.27	0.00
Wades Crossing	Tributary	324	2-yr ARI	1.70	19.88	22.40		22.40	0.000000	0.00	1301.35	1228.09	0.00
Wades Crossing	Tributary	324	5-yr ARI	3.20	19.88	22.53		22.53	0.000000	0.00	1453.97	1243.96	0.00
Wades Crossing	Tributary	324	20-yr ARI	10.80	19.88	22.97		22.97	0.000000	0.01	2011.15	1269.83	0.00
Wades Crossing	Tributary	324	50-yr ARI	23.40	19.88	23.09		23.09	0.000000	0.01	2165.88	1277.11	0.00
Wades Crossing	Tributary	324	PMP 12hr	420.00	19.88	27.94		27.94	0.000000	0.06	9425.72	1638.48	0.01
Towns River	Diversion US	22225	1-yr ARI	96.61	24.73	26.23	25.60	26.24	0.000465	0.82	276.88	815.26	0.24
Towns River	Diversion US	22225	2-yr ARI	191.60	24.73	26.44	25.95	26.45	0.000531	0.97	495.02	1257.90	0.26
Towns River	Diversion US	22225	5-yr ARI	247.70	24.73	26.53	26.02	26.54	0.000521	1.01	611.38	1343.38	0.26
Towns River	Diversion US	22225	20-yr ARI	499.90	24.73	26.81	26.27	26.82	0.000507	1.11	1048.63	1738.10	0.26
Towns River	Diversion US	22225	50-yr ARI	568.50	24.73	26.87	26.34	26.88	0.000496	1.12	1149.98	1769.64	0.26
Towns River	Diversion US	22225	PMP 12hr	7314.00	24.73	29.70	27.36	29.73	0.000192	1.29	9241.06	3275.41	0.19
Towns River	Diversion US	22107	1-yr ARI	96.61	24.71	26.17	25.91	26.18	0.000646	0.87	268.23	920.05	0.27
Towns River	Diversion US	22107	2-yr ARI	191.60	24.71	26.37	26.03	26.38	0.000590	0.93	507.50	1378.32	0.27
Towns River	Diversion US	22107	5-yr ARI	247.70	24.71	26.47	26.08	26.48	0.000519	0.92	644.06	1481.93	0.25
Towns River	Diversion US	22107	20-yr ARI	499.90	24.71	26.75	26.25	26.77	0.000437	0.96	1099.98	1731.44	0.24
Towns River	Diversion US	22107	50-yr ARI	568.50	24.71	26.81	26.25	26.83	0.000433	0.98	1203.87	1820.30	0.24
Towns River	Diversion US	22107	PMP 12hr	7314.00	24.71	29.68	27.38	29.71	0.000163	1.16	10123.22	3646.98	0.17
Towns River	Diversion US	21803	1-yr ARI	96.61	24.32	26.04	25.46	26.05	0.000290	0.62	348.21	1007.52	0.18
Towns River	Diversion US	21803	2-yr ARI	191.60	24.32	26.24	25.68	26.25	0.000315	0.72	583.56	1260.29	0.20
Towns River	Diversion US	21803	5-yr ARI	247.70	24.32	26.34	25.77	26.35	0.000326	0.77	713.51	1446.48	0.20
Towns River	Diversion US	21803	20-yr ARI	499.90	24.32	26.63	26.05	26.65	0.000342	0.89	1178.71	1758.31	0.21
Towns River	Diversion US	21803	50-yr ARI	568.50	24.32	26.69	26.08	26.71	0.000345	0.91	1286.60	1845.93	0.22
Towns River	Diversion US	21803	PMP 12hr	7314.00	24.32	29.63	27.23	29.66	0.000149	1.14	10402.76	3648.70	0.17

HEC-RAS Plan: OptionC_v1 (Continued)

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Towns River	Diversion US	21570	1-yr ARI	96.61	24.43	25.90		25.92	0.001168	1.13	200.38	721.01	0.36
Towns River	Diversion US	21570	2-yr ARI	191.60	24.43	26.11	25.71	26.13	0.000911	1.13	376.45	1004.06	0.33
Towns River	Diversion US	21570	5-yr ARI	247.70	24.43	26.21		26.23	0.000844	1.15	491.12	1262.59	0.32
Towns River	Diversion US	21570	20-yr ARI	499.90	24.43	26.51		26.53	0.000779	1.26	916.07	1795.19	0.32
Towns River	Diversion US	21570	50-yr ARI	568.50	24.43	26.57		26.59	0.000742	1.26	1030.81	1901.41	0.31
Towns River	Diversion US	21570	PMP 12hr	7314.00	24.43	29.60		29.62	0.000147	1.12	10478.07	3683.07	0.17
Towns River	Diversion US	21417	1-yr ARI	96.61	24.35	25.51		25.60	0.004839	1.90	79.64	263.95	0.70
Towns River	Diversion US	21417	2-yr ARI	191.60	24.35	25.86		25.91	0.002570	1.78	219.57	578.77	0.54
Towns River	Diversion US	21417	5-yr ARI	247.70	24.35	26.00		26.04	0.001845	1.64	317.04	783.20	0.47
Towns River	Diversion US	21417	20-yr ARI	499.90	24.35	26.35		26.38	0.001169	1.54	730.71	1426.21	0.39
Towns River	Diversion US	21417	50-yr ARI	568.50	24.35	26.41		26.45	0.001138	1.56	828.32	1576.79	0.39
Towns River	Diversion US	21417	PMP 12hr	7314.00	24.35	29.58		29.60	0.000136	1.10	10771.55	3720.53	0.16
Towns River	Diversion US	21235	1-yr ARI	96.61	24.42	25.45	24.73	25.46	0.000255	0.36	325.05	636.38	0.15
Towns River	Diversion US	21235	2-yr ARI	191.60	24.42	25.81	24.97	25.82	0.000178	0.42	637.16	1142.98	0.14
Towns River	Diversion US	21235	5-yr ARI	247.70	24.42	25.94	25.03	25.95	0.000207	0.49	797.92	1349.19	0.15
Towns River	Diversion US	21235	20-yr ARI	499.90	24.42	26.28	25.30	26.29	0.000249	0.65	1330.10	1875.72	0.18
Towns River	Diversion US	21235	50-yr ARI	568.50	24.42	26.35	25.35	26.36	0.000247	0.67	1453.94	1901.38	0.18
Towns River	Diversion US	21235	PMP 12hr	7314.00	24.42	29.56	26.80	29.58	0.000102	0.93	11670.22	3670.27	0.14
Towns River	Diversion US	20990	1-yr ARI	96.61	24.19	25.35	24.81	25.36	0.000684	0.64	179.78	339.95	0.26
Towns River	Diversion US	20990	2-yr ARI	191.60	24.19	25.72	25.02	25.74	0.001000	1.05	367.97	970.43	0.34
Towns River	Diversion US	20990	5-yr ARI	247.70	24.19	25.85	25.12	25.87	0.000667	0.93	531.80	1443.47	0.28
Towns River	Diversion US	20990	20-yr ARI	499.90	24.19	26.20	25.44	26.21	0.000475	0.94	1101.40	1876.34	0.25
Towns River	Diversion US	20990	50-yr ARI	568.50	24.19	26.27	25.51	26.28	0.000438	0.93	1233.57	1969.07	0.24
Towns River	Diversion US	20990	PMP 12hr	7314.00	24.19	29.53	26.82	29.55	0.000102	0.96	11502.94	3542.83	0.14
Towns River	Diversion US	20770	1-yr ARI	96.61	24.31	25.27		25.28	0.000232	0.36	279.38	519.43	0.15
Towns River	Diversion US	20770	2-yr ARI	191.60	24.31	25.62		25.62	0.000299	0.51	509.73	1019.19	0.18
Towns River	Diversion US	20770	5-yr ARI	247.70	24.31	25.76		25.76	0.000335	0.60	674.85	1314.15	0.19
Towns River	Diversion US	20770	20-yr ARI	499.90	24.31	26.12		26.12	0.000313	0.71	1262.77	1985.47	0.20
Towns River	Diversion US	20770	50-yr ARI	568.50	24.31	26.19		26.19	0.000325	0.75	1407.45	2141.39	0.20
Towns River	Diversion US	20770	PMP 12hr	7314.00	24.31	29.51		29.53	0.000092	0.90	11718.41	3439.07	0.13
Towns River	Diversion US	19566	1-yr ARI	96.61	24.01	25.12	24.32	25.13	0.000072	0.20	546.47	980.01	0.08
Towns River	Diversion US	19566	2-yr ARI	191.60	24.01	25.44	24.48	25.44	0.000085	0.29	917.27	1414.27	0.10
Towns River	Diversion US	19566	5-yr ARI	247.70	24.01	25.55	24.54	25.56	0.000098	0.34	1099.02	1719.77	0.11
Towns River	Diversion US	19566	20-yr ARI	499.90	24.01	25.88	24.73	25.89	0.000129	0.47	1713.70	2039.42	0.13
Towns River	Diversion US	19566	50-yr ARI	568.50	24.01	25.94	24.78	25.95	0.000134	0.49	1838.95	2115.90	0.13
Towns River	Diversion US	19566	PMP 12hr	7314.00	24.01	29.41	26.18	29.43	0.000078	0.85	12076.03	3261.56	0.12
Towns River	Diversion US	19157	1-yr ARI	96.61	23.57	25.07	24.22	25.08	0.000214	0.42	328.92	718.04	0.15
Towns River	Diversion US	19157	2-yr ARI	191.60	23.57	25.38	24.60	25.38	0.000246	0.56	645.09	1348.59	0.17
Towns River	Diversion US	19157	5-yr ARI	247.70	23.57	25.49	24.69	25.49	0.000251	0.60	809.05	1563.14	0.17
Towns River	Diversion US	19157	20-yr ARI	499.90	23.57	25.80	24.92	25.81	0.000251	0.70	1385.80	2050.58	0.18
Towns River	Diversion US	19157	50-yr ARI	568.50	23.57	25.86	24.97	25.87	0.000252	0.72	1507.80	2101.40	0.18
Towns River	Diversion US	19157	PMP 12hr	7314.00	23.57	29.37	26.15	29.39	0.000100	0.98	11011.30	3129.61	0.14
Towns River	Diversion US	19015	1-yr ARI	96.61	23.86	25.05	24.26	25.05	0.000151	0.41	375.06	716.69	0.13
Towns River	Diversion US	19015	2-yr ARI	191.60	23.86	25.35	24.59	25.35	0.000204	0.57	699.52	1360.69	0.16
Towns River	Diversion US	19015	5-yr ARI	247.70	23.86	25.46	24.65	25.46	0.000214	0.62	858.69	1586.57	0.17
Towns River	Diversion US	19015	20-yr ARI	499.90	23.86	25.77	24.85	25.78	0.000228	0.73	1425.74	2073.77	0.18
Towns River	Diversion US	19015	50-yr ARI	568.50	23.86	25.83	24.86	25.84	0.000228	0.74	1548.47	2097.84	0.18
Towns River	Diversion US	19015	PMP 12hr	7314.00	23.86	29.35	26.15	29.37	0.000100	1.02	10926.85	3074.38	0.14
Towns River	Diversion US	18245	1-yr ARI	96.61	23.38	24.87	24.22	24.88	0.000393	0.63	270.80	698.56	0.21
Towns River	Diversion US	18245	2-yr ARI	191.60	23.38	25.12	24.45	25.13	0.000438	0.78	494.07	1067.56	0.23
Towns River	Diversion US	18245	5-yr ARI	247.70	23.38	25.21	24.55	25.22	0.000469	0.85	598.67	1304.45	0.24
Towns River	Diversion US	18245	20-yr ARI	499.90	23.38	25.52	24.87	25.54	0.000439	0.95	1122.16	1957.54	0.24
Towns River	Diversion US	18245	50-yr ARI	568.50	23.38	25.59	24.91	25.60	0.000420	0.95	1255.29	2053.17	0.24
Towns River	Diversion US	18245	PMP 12hr	7314.00	23.38	29.28	25.93	29.30	0.000093	0.98	11023.21	2996.69	0.14
Towns River	Diversion US	18147	1-yr ARI	96.61	23.59	24.80		24.81	0.001232	0.93	190.94	698.78	0.35
Towns River	Diversion US	18147	2-yr ARI	191.60	23.59	25.07		25.08	0.000737	0.86	444.03	1195.83	0.28
Towns River	Diversion US	18147	5-yr ARI	247.70	23.59	25.16		25.17	0.000652	0.86	562.17	1422.17	0.27
Towns River	Diversion US	18147	20-yr ARI	499.90	23.59	25.48		25.49	0.000482	0.89	1108.14	1986.04	0.24
Towns River	Diversion US	18147	50-yr ARI	568.50	23.59	25.55		25.56	0.000441	0.88	1248.51	2060.67	0.24
Towns River	Diversion US	18147	PMP 12hr	7314.00	23.59	29.27		29.29	0.000094	0.95	10909.16	2925.06	0.13
Towns River	Diversion US	17880	1-yr ARI	96.61	23.83	24.70		24.70	0.000196	0.32	376.88	915.93	0.13
Towns River	Diversion US	17880	2-yr ARI	191.60	23.83	24.97		24.98	0.000223	0.44	722.97	1543.68	0.15
Towns River	Diversion US	17880	5-yr ARI	247.70	23.83	25.07		25.08	0.000203	0.45	880.34	1577.35	0.15
Towns River	Diversion US	17880	20-yr ARI	499.90	23.83	25.40		25.41	0.000198	0.55	1444.24	1931.81	0.16
Towns River	Diversion US	17880	50-yr ARI	568.50	23.83	25.48		25.48	0.000195	0.57	1586.91	2001.36	0.16
Towns River	Diversion US	17880	PMP 12hr	7314.00	23.83	29.24		29.27	0.000085	0.91	11009.42	2778.00	0.13
Towns River	Diversion US	17545	1-yr ARI	96.61	23.65	24.63		24.64	0.000197	0.38	355.53	971.35	0.14
Towns River	Diversion US	17545	2-yr ARI	191.60	23.65	24.90		24.90	0.000226	0.50	680.87	1527.54	0.16
Towns River	Diversion US	17545	5-yr ARI	247.70	23.65	25.00		25.01	0.000224	0.53	850.24	1708.73	0.16
Towns River	Diversion US	17545	20-yr ARI	499.90	23.65	25.34		25.34	0.000202	0.60	1476.59	2058.54	0.16
Towns River	Diversion US	17545	50-yr ARI	568.50	23.65	25.41		25.42	0.000207	0.63	1628.69	2138.05	0.16
Towns River	Diversion US	17545	PMP 12hr	7314.00	23.65	29.22		29.24	0.000086	0.94	10872.51	2701.33	0.13
Towns River	Diversion US	17309	1-yr ARI	96.61	23.59	24.57		24.58	0.000336	0.41	335.74	885.62	0.18
Towns River	Diversion US	17309	2-yr ARI	191.60	23.59	24.84		24.84	0.000292	0.50	644.54	1425.24	0.18
Towns River	Diversion US	17309	5-yr ARI	247.70	23.59	24.94		24.95	0.000261	0.51	812.24	1644.05	0.17
Towns River	Diversion US	17309	20-yr ARI	499.90	23.59	25.29		25.30	0.000204	0.56	1429.03	1881.00	0.16
Towns River	Diversion US	17309	50-yr ARI	568.50	23.59	25.36		25.37	0.000198	0.57	1565.21	1898.41	0.16
Towns River	Diversion US	17309	PMP 12hr	7314.00	23.59	29.19		29.22	0.000094	0.96	10233.70	2515.38	0.14
Towns River	Diversion US	16925	1-yr ARI	96.61	23.44	24.48		24.48	0.000176	0.34	429.06	993.34	0.13
Towns River	Diversion US	16925	2-yr ARI	191.60	23.44	24.75		24.76	0.000172	0.40	776.53	1509.18	0.14
Towns River	Diversion US	16925	5-yr ARI	247.70	23.44	24.87		24.87	0.000158	0.41	959.79	1622.47	0.13
Towns River	Diversion US	16925	20-yr ARI	499.90	23.44	25.23		25.23	0.000147	0.49	1592.52	1874.19	0.13
Towns River	Diversion US	16925	50-yr ARI	568.50	23.44	25.30		25.30	0.000145	0.50	1730.98	1882.24	0.14
Towns River	Diversion US	16925	PMP 12hr	7314.00	23.44	29.15		29.18	0.000095	0.98	10137.63	2472.35	0.14

HEC-RAS Plan: OptionC_v1 (Continued)

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Towns River	Diversion US	16652	1-yr ARI	128.50	23.26	24.44		24.44	0.000152	0.30	545.22	1125.76	0.12
Towns River	Diversion US	16652	2-yr ARI	253.70	23.26	24.71		24.71	0.000161	0.33	909.37	1506.65	0.13
Towns River	Diversion US	16652	5-yr ARI	327.10	23.26	24.82		24.83	0.000178	0.38	1090.31	1636.84	0.14
Towns River	Diversion US	16652	20-yr ARI	654.90	23.26	25.18		25.19	0.000184	0.50	1710.24	1801.07	0.15
Towns River	Diversion US	16652	50-yr ARI	739.80	23.26	25.25		25.26	0.000186	0.52	1843.63	1824.04	0.15
Towns River	Diversion US	16652	PMP 12hr	9434.00	23.26	29.10		29.15	0.000155	1.22	10083.21	2412.67	0.17
Towns River	Diversion US	16218	1-yr ARI	128.50	22.66	24.38		24.38	0.000127	0.39	593.88	1248.71	0.12
Towns River	Diversion US	16218	2-yr ARI	253.70	22.66	24.65		24.65	0.000133	0.46	961.65	1511.39	0.13
Towns River	Diversion US	16218	5-yr ARI	327.10	22.66	24.76		24.76	0.000144	0.51	1139.20	1708.97	0.14
Towns River	Diversion US	16218	20-yr ARI	654.90	22.66	25.11		25.11	0.000162	0.62	1770.23	1844.39	0.15
Towns River	Diversion US	16218	50-yr ARI	739.80	22.66	25.18		25.19	0.000164	0.65	1904.12	1850.14	0.15
Towns River	Diversion US	16218	PMP 12hr	9434.00	22.66	29.03		29.08	0.000150	1.30	9970.88	2304.03	0.17
Towns River	Diversion US	15646	1-yr ARI	128.50	22.94	24.30		24.31	0.000147	0.35	534.69	1002.61	0.12
Towns River	Diversion US	15646	2-yr ARI	253.70	22.94	24.56		24.56	0.000181	0.46	851.97	1516.66	0.14
Towns River	Diversion US	15646	5-yr ARI	327.10	22.94	24.66		24.67	0.000189	0.50	1021.13	1749.29	0.15
Towns River	Diversion US	15646	20-yr ARI	654.90	22.94	25.00		25.01	0.000199	0.61	1633.00	1813.69	0.16
Towns River	Diversion US	15646	50-yr ARI	739.80	22.94	25.08		25.09	0.000202	0.64	1762.15	1822.31	0.16
Towns River	Diversion US	15646	PMP 12hr	9434.00	22.94	28.95		29.00	0.000158	1.29	9723.15	2227.85	0.18
Towns River	Diversion US	15227	1-yr ARI	128.50	22.41	24.25		24.26	0.000108	0.45	628.67	1168.06	0.12
Towns River	Diversion US	15227	2-yr ARI	253.70	22.41	24.50		24.50	0.000135	0.56	965.67	1703.44	0.13
Towns River	Diversion US	15227	5-yr ARI	327.10	22.41	24.60		24.60	0.000146	0.60	1139.98	1779.45	0.14
Towns River	Diversion US	15227	20-yr ARI	654.90	22.41	24.93		24.94	0.000165	0.71	1743.36	1821.91	0.15
Towns River	Diversion US	15227	50-yr ARI	739.80	22.41	25.00		25.01	0.000169	0.74	1870.66	1830.63	0.16
Towns River	Diversion US	15227	PMP 12hr	9434.00	22.41	28.89		28.93	0.000151	1.35	9910.30	2245.30	0.17
Towns River	Diversion US	14628	1-yr ARI	128.50	22.56	24.20		24.20	0.000077	0.36	700.17	1171.35	0.10
Towns River	Diversion US	14628	2-yr ARI	253.70	22.56	24.42		24.43	0.000119	0.49	1001.91	1598.26	0.12
Towns River	Diversion US	14628	5-yr ARI	327.10	22.56	24.51		24.52	0.000135	0.54	1152.78	1702.00	0.13
Towns River	Diversion US	14628	20-yr ARI	654.90	22.56	24.83		24.84	0.000176	0.70	1714.96	1805.66	0.16
Towns River	Diversion US	14628	50-yr ARI	739.80	22.56	24.90		24.91	0.000182	0.72	1835.29	1812.29	0.16
Towns River	Diversion US	14628	PMP 12hr	9434.00	22.56	28.79		28.84	0.000154	1.35	9915.43	2284.18	0.18
Towns River	Diversion US	14207	1-yr ARI	128.50	21.86	24.14		24.15	0.000234	0.75	458.02	1305.90	0.18
Towns River	Diversion US	14207	2-yr ARI	253.70	21.86	24.34		24.35	0.000274	0.87	759.84	1577.28	0.20
Towns River	Diversion US	14207	5-yr ARI	327.10	21.86	24.43		24.44	0.000288	0.91	895.45	1649.07	0.20
Towns River	Diversion US	14207	20-yr ARI	654.90	21.86	24.73		24.74	0.000313	1.04	1409.08	1745.33	0.22
Towns River	Diversion US	14207	50-yr ARI	739.80	21.86	24.79		24.81	0.000315	1.07	1521.84	1751.82	0.22
Towns River	Diversion US	14207	PMP 12hr	9434.00	21.86	28.72		28.77	0.000180	1.53	9583.23	2355.11	0.19
Towns River	Diversion US	13642	1-yr ARI	128.50	22.30	23.94		23.95	0.000585	0.98	389.08	1414.86	0.27
Towns River	Diversion US	13642	2-yr ARI	253.70	22.30	24.15		24.16	0.000434	0.93	710.50	1655.16	0.24
Towns River	Diversion US	13642	5-yr ARI	327.10	22.30	24.24		24.25	0.000396	0.92	862.03	1672.24	0.23
Towns River	Diversion US	13642	20-yr ARI	654.90	22.30	24.54		24.55	0.000365	0.99	1367.20	1709.08	0.23
Towns River	Diversion US	13642	50-yr ARI	739.80	22.30	24.60		24.61	0.000364	1.01	1476.62	1718.31	0.23
Towns River	Diversion US	13642	PMP 12hr	9434.00	22.30	28.62		28.67	0.000173	1.45	10059.63	2587.49	0.19
Towns River	Diversion US	13308	1-yr ARI	128.50	21.30	23.78		23.79	0.000399	0.90	390.66	1048.68	0.23
Towns River	Diversion US	13308	2-yr ARI	253.70	21.30	24.01		24.02	0.000387	0.97	676.91	1415.00	0.23
Towns River	Diversion US	13308	5-yr ARI	327.10	21.30	24.10		24.11	0.000401	1.02	812.56	1464.51	0.23
Towns River	Diversion US	13308	20-yr ARI	654.90	21.30	24.40		24.42	0.000423	1.15	1286.29	1652.60	0.25
Towns River	Diversion US	13308	50-yr ARI	739.80	21.30	24.47		24.48	0.000420	1.17	1392.93	1662.25	0.25
Towns River	Diversion US	13308	PMP 12hr	9434.00	21.30	28.57		28.61	0.000165	1.45	10295.45	2670.13	0.18
Towns River	Diversion US	12915	1-yr ARI	128.10	21.35	23.65	23.17	23.65	0.000293	0.78	424.92	1035.07	0.20
Towns River	Diversion US	12915	2-yr ARI	252.80	21.35	23.88		23.89	0.000305	0.87	701.23	1324.53	0.20
Towns River	Diversion US	12915	5-yr ARI	325.90	21.35	23.95		23.96	0.000368	0.98	803.16	1373.82	0.22
Towns River	Diversion US	12915	20-yr ARI	657.60	21.35	24.23		24.24	0.000477	1.21	1198.08	1521.85	0.26
Towns River	Diversion US	12915	50-yr ARI	751.00	21.35	24.29		24.31	0.000493	1.26	1291.69	1534.59	0.27
Towns River	Diversion US	12915	PMP 12hr	9574.00	21.35	28.50		28.55	0.000180	1.53	10155.73	2718.52	0.19
Towns River	Diversion US	12616	1-yr ARI	128.10	21.35	23.11	23.11	23.40	0.005373	3.08	76.22	211.81	0.82
Towns River	Diversion US	12616	2-yr ARI	252.80	21.35	23.52		23.66	0.003196	2.81	273.31	946.82	0.66
Towns River	Diversion US	12616	5-yr ARI	325.90	21.35	23.60	23.60	23.72	0.002838	2.73	362.75	1078.03	0.63
Towns River	Diversion US	12616	20-yr ARI	657.60	21.35	23.76	23.76	23.91	0.004253	3.51	542.72	1272.55	0.78
Towns River	Diversion US	12616	50-yr ARI	751.00	21.35	23.78	23.78	23.95	0.004726	3.73	575.22	1302.74	0.82
Towns River	Diversion US	12616	PMP 12hr	9574.00	21.35	28.44		28.49	0.000206	1.70	9677.14	2689.88	0.21
Towns River	Diversion US	12260	1-yr ARI	128.10	21.34	22.16		22.16	0.000000	0.01	1330.42	149.24	0.01
Towns River	Diversion US	12260	2-yr ARI	252.80	21.34	22.42		22.42	0.000001	0.03	1373.17	174.41	0.01
Towns River	Diversion US	12260	5-yr ARI	325.90	21.34	22.56		22.56	0.000002	0.05	1398.14	186.24	0.02
Towns River	Diversion US	12260	20-yr ARI	657.60	21.34	23.07		23.08	0.000008	0.12	1544.58	500.36	0.03
Towns River	Diversion US	12260	50-yr ARI	751.00	21.34	23.20		23.22	0.000011	0.14	1619.25	611.70	0.04
Towns River	Diversion US	12260	PMP 12hr	9574.00	21.34	28.39		28.43	0.000114	1.26	11209.24	2535.91	0.16
Towns River	Diversion US	11459	1-yr ARI	128.10	20.86	22.16		22.16	0.000000	0.02	1193.15	110.31	0.01
Towns River	Diversion US	11459	2-yr ARI	252.80	20.86	22.42		22.42	0.000002	0.05	1226.94	184.21	0.01
Towns River	Diversion US	11459	5-yr ARI	325.90	20.86	22.56		22.56	0.000003	0.06	1254.47	218.22	0.02
Towns River	Diversion US	11459	20-yr ARI	657.60	20.86	23.06		23.08	0.000011	0.15	1425.70	513.80	0.04
Towns River	Diversion US	11459	50-yr ARI	751.00	20.86	23.19		23.21	0.000014	0.18	1509.19	762.34	0.04
Towns River	Diversion US	11459	PMP 12hr	9574.00	20.86	28.30		28.34	0.000121	1.32	10762.30	2339.61	0.16
Towns River	Diversion US	10366	1-yr ARI	128.10	21.36	22.14		22.16	0.000056	0.15	310.87	191.63	0.07
Towns River	Diversion US	10366	2-yr ARI	252.80	21.36	22.38		22.41	0.000187	0.35	370.01	307.52	0.14
Towns River	Diversion US	10366	5-yr ARI	325.90	21.36	22.50		22.55	0.000283	0.46	409.57	373.72	0.17
Towns River	Diversion US	10366	20-yr ARI	657.60	21.36	22.94		23.03	0.000657	0.82	666.51	815.01	0.27
Towns River	Diversion US	10366	50-yr ARI	751.00	21.36	23.07		23.15	0.000673	0.91	786.55	970.95	0.28
Towns River	Diversion US	10366	PMP 12hr	9574.00	21.36	28.16		28.20	0.000140	1.32	10440.35	2352.81	0.17
Towns River	Diversion US	10052	1-yr ARI	128.10	20.51	22.15		22.15	0.000005	0.06	703.64	417.91	0.02
Towns River	Diversion US	10052	2-yr ARI	252.80	20.51	22.39		22.40	0.000016	0.12	812.46	487.85	0.04
Towns River	Diversion US	10052	5-yr ARI	325.90	20.51	22.51		22.52	0.000025	0.16	872.77	521.48	0.05
Towns River	Diversion US	10052	20-yr ARI	657.60	20.51	22.94		22.97	0.000071	0.34	1160.93	903.32	0.09
Towns River	Diversion US	10052	50-yr ARI	751.00	20.51	23.06		23.09	0.000084	0.39	1285.51	1213.34	0.10
Towns River	Diversion US	10052	PMP 12hr	9574.00	20.51	28.12		28.16	0.000129	1.32	11016.44	2567.52	0.16

HEC-RAS Plan: OptionC_v1 (Continued)

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Towns River	Diversion US	9913	1-yr ARI	128.10	20.94	22.15		22.15	0.000000	0.01	1783.65	439.87	0.00
Towns River	Diversion US	9913	2-yr ARI	252.80	20.94	22.39		22.39	0.000001	0.03	1907.30	551.00	0.01
Towns River	Diversion US	9913	5-yr ARI	325.90	20.94	22.51		22.52	0.000001	0.03	1978.11	623.00	0.01
Towns River	Diversion US	9913	20-yr ARI	657.60	20.94	22.95		22.96	0.000005	0.09	2367.78	1292.75	0.02
Towns River	Diversion US	9913	50-yr ARI	751.00	20.94	23.08		23.08	0.000006	0.10	2525.37	1309.58	0.03
Towns River	Diversion US	9913	PMP 12hr	9574.00	20.94	28.11		28.15	0.000082	1.04	12636.56	2861.64	0.13
Towns River	Diversion US	9781	1-yr ARI	128.10	20.63	22.15		22.15	0.000000	0.01	2348.68	262.19	0.00
Towns River	Diversion US	9781	2-yr ARI	252.80	20.63	22.39		22.39	0.000000	0.02	2416.59	318.45	0.01
Towns River	Diversion US	9781	5-yr ARI	325.90	20.63	22.51		22.52	0.000001	0.02	2462.95	476.10	0.01
Towns River	Diversion US	9781	20-yr ARI	657.60	20.63	22.96		22.96	0.000002	0.06	2778.01	765.68	0.02
Towns River	Diversion US	9781	50-yr ARI	751.00	20.63	23.08		23.08	0.000003	0.07	2871.20	767.51	0.02
Towns River	Diversion US	9781	PMP 12hr	9574.00	20.63	28.01		28.12	0.000138	1.35	6964.74	1086.72	0.17
Towns River	Diversion US	9648	1-yr ARI	128.10	20.51	22.15		22.15	0.000000	0.01	2285.73	183.58	0.00
Towns River	Diversion US	9648	2-yr ARI	252.80	20.51	22.39		22.39	0.000000	0.02	2338.07	287.03	0.01
Towns River	Diversion US	9648	5-yr ARI	325.90	20.51	22.51		22.52	0.000001	0.02	2378.83	382.88	0.01
Towns River	Diversion US	9648	20-yr ARI	657.60	20.51	22.96		22.96	0.000002	0.06	2659.91	682.79	0.02
Towns River	Diversion US	9648	50-yr ARI	751.00	20.51	23.08		23.08	0.000003	0.07	2742.96	685.00	0.02
Towns River	Diversion US	9648	PMP 12hr	9574.00	20.51	27.98		28.10	0.000174	1.50	6545.49	1088.71	0.19
Towns River	Diversion US	9497	1-yr ARI	128.10	20.50	22.15		22.15	0.000000	0.01	2589.38	243.89	0.00
Towns River	Diversion US	9497	2-yr ARI	252.80	20.50	22.39		22.39	0.000000	0.02	2660.12	406.43	0.01
Towns River	Diversion US	9497	5-yr ARI	325.90	20.50	22.51		22.52	0.000000	0.02	2725.76	647.24	0.01
Towns River	Diversion US	9497	20-yr ARI	657.60	20.50	22.96		22.96	0.000002	0.06	3041.19	718.90	0.01
Towns River	Diversion US	9497	50-yr ARI	751.00	20.50	23.08		23.08	0.000002	0.07	3128.65	720.49	0.02
Towns River	Diversion US	9497	PMP 12hr	9574.00	20.50	27.99		28.07	0.000134	1.35	7710.94	1354.43	0.17
Towns River	Diversion US	9384	1-yr ARI	128.10	20.16	22.15		22.15	0.000000	0.01	2575.26	179.47	0.00
Towns River	Diversion US	9384	2-yr ARI	252.80	20.16	22.39		22.39	0.000000	0.02	2671.01	624.63	0.01
Towns River	Diversion US	9384	5-yr ARI	325.90	20.16	22.51		22.52	0.000000	0.03	2754.93	706.70	0.01
Towns River	Diversion US	9384	20-yr ARI	657.60	20.16	22.96		22.96	0.000002	0.06	3069.03	715.71	0.01
Towns River	Diversion US	9384	50-yr ARI	751.00	20.16	23.08		23.08	0.000002	0.07	3156.10	717.67	0.02
Towns River	Diversion US	9384	PMP 12hr	9574.00	20.16	27.98		28.05	0.000150	1.46	8660.63	1518.61	0.18
Towns River	Diversion US	9274	1-yr ARI	128.10	20.31	22.15		22.15	0.000000	0.01	2579.44	271.94	0.00
Towns River	Diversion US	9274	2-yr ARI	252.80	20.31	22.39		22.39	0.000000	0.02	2714.13	678.49	0.01
Towns River	Diversion US	9274	5-yr ARI	325.90	20.31	22.51		22.52	0.000000	0.02	2797.11	678.63	0.01
Towns River	Diversion US	9274	20-yr ARI	657.60	20.31	22.96		22.96	0.000002	0.06	3096.71	679.14	0.01
Towns River	Diversion US	9274	50-yr ARI	751.00	20.31	23.08		23.08	0.000002	0.07	3179.20	679.28	0.02
Towns River	Diversion US	9274	PMP 12hr	9574.00	20.31	27.97		28.03	0.000129	1.32	9140.25	1546.12	0.16
Towns River	Diversion US	9139	1-yr ARI	128.10	7.13	22.15		22.15	0.000000	0.02	2651.37	309.64	0.00
Towns River	Diversion US	9139	2-yr ARI	252.80	7.13	22.39		22.39	0.000000	0.04	2762.02	541.47	0.01
Towns River	Diversion US	9139	5-yr ARI	325.90	7.13	22.51		22.52	0.000000	0.04	2830.36	566.45	0.01
Towns River	Diversion US	9139	20-yr ARI	657.60	7.13	22.96		22.96	0.000001	0.09	3081.61	571.07	0.01
Towns River	Diversion US	9139	50-yr ARI	751.00	7.13	23.08		23.08	0.000002	0.11	3151.91	596.67	0.02
Towns River	Diversion US	9139	PMP 12hr	9574.00	7.13	27.96		28.01	0.000115	1.42	9273.84	1476.42	0.15
Towns River	Diversion US	9005	1-yr ARI	128.10	-4.53	22.15		22.15	0.000000	0.03	2550.59	160.47	0.00
Towns River	Diversion US	9005	2-yr ARI	252.80	-4.53	22.39		22.39	0.000000	0.06	2625.81	528.51	0.01
Towns River	Diversion US	9005	5-yr ARI	325.90	-4.53	22.51		22.52	0.000000	0.08	2691.11	540.14	0.01
Towns River	Diversion US	9005	20-yr ARI	657.60	-4.53	22.96		22.96	0.000003	0.21	2956.27	838.51	0.02
Towns River	Diversion US	9005	50-yr ARI	751.00	-4.53	23.08		23.08	0.000008	0.37	3064.81	925.58	0.04
Towns River	Diversion US	9005	PMP 12hr	9574.00	-4.53	27.94		28.00	0.000097	1.68	9487.35	1427.36	0.14
Towns River	Diversion US	8809	1-yr ARI	128.10	-20.00	22.15		22.15	0.000000	0.05	2612.40	586.16	0.00
Towns River	Diversion US	8809	2-yr ARI	252.80	-20.00	22.39		22.39	0.000000	0.11	2767.15	673.25	0.01
Towns River	Diversion US	8809	5-yr ARI	325.90	-20.00	22.51		22.52	0.000000	0.15	2852.59	748.94	0.01
Towns River	Diversion US	8809	20-yr ARI	657.60	-20.00	22.95		22.96	0.000003	0.38	3267.17	1112.19	0.03
Towns River	Diversion US	8809	50-yr ARI	751.00	-20.00	23.07		23.08	0.000004	0.42	3407.80	1196.36	0.03
Towns River	Diversion US	8809	PMP 12hr	9574.00	-20.00	27.90		27.98	0.000062	2.00	10589.86	1608.92	0.12
Towns River	Diversion US	8571	1-yr ARI	128.10	-7.33	22.15		22.15	0.000000	0.08	1921.77	758.06	0.01
Towns River	Diversion US	8571	2-yr ARI	252.80	-7.33	22.39		22.39	0.000001	0.17	2128.97	946.59	0.01
Towns River	Diversion US	8571	5-yr ARI	325.90	-7.33	22.51		22.51	0.000001	0.26	2246.63	996.74	0.02
Towns River	Diversion US	8571	20-yr ARI	657.60	-7.33	22.95		22.96	0.000005	0.47	2705.42	1085.33	0.03
Towns River	Diversion US	8571	50-yr ARI	751.00	-7.33	23.07		23.08	0.000006	0.53	2835.72	1110.36	0.04
Towns River	Diversion US	8571	PMP 12hr	9574.00	-7.33	27.84		27.96	0.000086	2.35	8685.42	1343.99	0.15
Towns River	Mid Reach	8282	1-yr ARI	128.80	20.50	22.12		22.15	0.001651	1.03	199.06	540.74	0.37
Towns River	Mid Reach	8282	2-yr ARI	254.50	20.50	22.35		22.39	0.001384	1.11	329.31	563.41	0.35
Towns River	Mid Reach	8282	5-yr ARI	329.10	20.50	22.47		22.51	0.001315	1.16	396.09	578.56	0.35
Towns River	Mid Reach	8282	20-yr ARI	668.40	20.50	22.89		22.95	0.001181	1.33	658.74	646.56	0.35
Towns River	Mid Reach	8282	50-yr ARI	774.40	20.50	23.01		23.07	0.001162	1.38	736.08	675.48	0.35
Towns River	Mid Reach	8282	PMP 12hr	9994.00	20.50	27.61		27.89	0.000718	2.53	4304.21	819.89	0.33
Towns River	Mid Reach	7921	1-yr ARI	128.80	20.10	21.66		21.69	0.000946	1.02	227.16	515.27	0.29
Towns River	Mid Reach	7921	2-yr ARI	254.50	20.10	21.97		21.99	0.000839	0.82	393.41	580.55	0.27
Towns River	Mid Reach	7921	5-yr ARI	329.10	20.10	22.10		22.12	0.000822	0.88	467.96	598.33	0.27
Towns River	Mid Reach	7921	20-yr ARI	668.40	20.10	22.55		22.59	0.000764	1.07	740.61	612.75	0.28
Towns River	Mid Reach	7921	50-yr ARI	774.40	20.10	22.67		22.71	0.000755	1.11	814.46	616.98	0.28
Towns River	Mid Reach	7921	PMP 12hr	9994.00	20.10	27.30		27.60	0.000759	2.43	4066.51	737.35	0.33
Towns River	Mid Reach	7714	1-yr ARI	128.80	19.77	21.52		21.53	0.000595	0.47	263.79	507.82	0.23
Towns River	Mid Reach	7714	2-yr ARI	254.50	19.77	21.83		21.84	0.000599	0.68	447.64	623.00	0.25
Towns River	Mid Reach	7714	5-yr ARI	329.10	19.77	21.95		21.97	0.000594	0.75	526.52	630.78	0.25
Towns River	Mid Reach	7714	20-yr ARI	668.40	19.77	22.41		22.45	0.000585	0.98	821.77	653.77	0.27
Towns River	Mid Reach	7714	50-yr ARI	774.40	19.77	22.53		22.57	0.000582	1.04	901.76	658.13	0.27
Towns River	Mid Reach	7714	PMP 12hr	9994.00	19.77	27.15		27.45	0.000680	2.89	4126.51	712.02	0.37
Towns River	Mid Reach	7051	1-yr ARI	128.80	19.20	21.14		21.16	0.000585	0.91	255.92	651.81	0.23
Towns River	Mid Reach	7051	2-yr ARI	254.50	19.20	21.52		21.53	0.000438	0.74	515.55	712.71	0.20
Towns River	Mid Reach	7051	5-yr ARI	329.10	19.20	21.65		21.66	0.000432	0.75	608.28	715.58	0.20
Towns River	Mid Reach	7051	20-yr ARI	668.40	19.20	22.11		22.14	0.000421	0.89	943.48	718.00	0.21
Towns River	Mid Reach	7051	50-yr ARI	774.40	19.20	22.24		22.27	0.000420	0.93	1032.43	718.54	0.21
Towns River	Mid Reach	7051	PMP 12hr	9994.00	19.20	26.81		27.04	0.000594	2.06	4617.58	1122.43	0.29

HEC-RAS Plan: OptionC_v1 (Continued)

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Towns River	Mid Reach	6674	1-yr ARI	128.80	18.56	20.99		21.01	0.000291	0.85	266.93	355.59	0.20
Towns River	Mid Reach	6674	2-yr ARI	254.50	18.56	21.32		21.35	0.000474	1.21	460.57	695.95	0.26
Towns River	Mid Reach	6674	5-yr ARI	329.10	18.56	21.46		21.49	0.000468	1.25	554.64	706.10	0.26
Towns River	Mid Reach	6674	20-yr ARI	668.40	18.56	21.94		21.97	0.000453	1.40	897.17	723.32	0.27
Towns River	Mid Reach	6674	50-yr ARI	774.40	18.56	22.06		22.10	0.000448	1.43	988.31	724.67	0.27
Towns River	Mid Reach	6674	PMP 12hr	9994.00	18.56	26.66		26.82	0.000467	2.75	5693.38	1445.91	0.32
Towns River	Mid Reach	6435	1-yr ARI	128.80	18.37	20.85		20.89	0.001103	1.33	206.01	565.64	0.37
Towns River	Mid Reach	6435	2-yr ARI	254.50	18.37	21.19		21.22	0.000693	1.11	442.90	763.67	0.29
Towns River	Mid Reach	6435	5-yr ARI	329.10	18.37	21.34		21.36	0.000616	1.11	555.01	806.19	0.28
Towns River	Mid Reach	6435	20-yr ARI	668.40	18.37	21.84		21.86	0.000448	1.14	984.44	902.71	0.25
Towns River	Mid Reach	6435	50-yr ARI	774.40	18.37	21.97		21.99	0.000430	1.16	1103.89	948.56	0.25
Towns River	Mid Reach	6435	PMP 12hr	9994.00	18.37	26.61		26.72	0.000302	2.07	7046.33	1474.65	0.25
Towns River	Mid Reach	6133	1-yr ARI	128.80	18.40	20.71		20.72	0.000304	0.71	320.67	501.14	0.17
Towns River	Mid Reach	6133	2-yr ARI	254.50	18.40	21.06		21.07	0.000352	0.62	508.14	572.66	0.18
Towns River	Mid Reach	6133	5-yr ARI	329.10	18.40	21.20		21.22	0.000356	0.67	591.98	573.01	0.18
Towns River	Mid Reach	6133	20-yr ARI	668.40	18.40	21.71		21.74	0.000395	0.87	881.40	574.20	0.20
Towns River	Mid Reach	6133	50-yr ARI	774.40	18.40	21.83		21.87	0.000408	0.92	953.97	574.49	0.21
Towns River	Mid Reach	6133	PMP 12hr	9994.00	18.40	26.30		26.56	0.000768	2.47	4349.56	1207.51	0.32
Towns River	Mid Reach	5751	1-yr ARI	128.80	18.50	20.49		20.52	0.001162	1.11	200.54	450.80	0.33
Towns River	Mid Reach	5751	2-yr ARI	254.50	18.50	20.85		20.88	0.000745	1.06	366.27	466.11	0.27
Towns River	Mid Reach	5751	5-yr ARI	329.10	18.50	21.00		21.03	0.000729	1.11	434.22	469.20	0.27
Towns River	Mid Reach	5751	20-yr ARI	668.40	18.50	21.47		21.53	0.000790	1.35	656.36	476.57	0.29
Towns River	Mid Reach	5751	50-yr ARI	774.40	18.50	21.59		21.65	0.000817	1.42	714.72	478.14	0.30
Towns River	Mid Reach	5751	PMP 12hr	9994.00	18.50	25.48		26.09	0.001887	3.54	2867.45	860.33	0.51
Towns River	Mid Reach	5107	1-yr ARI	128.80	17.64	20.20		20.21	0.000263	0.70	286.24	453.79	0.18
Towns River	Mid Reach	5107	2-yr ARI	254.50	17.64	20.54		20.56	0.000363	0.95	474.77	617.98	0.22
Towns River	Mid Reach	5107	5-yr ARI	329.10	17.64	20.68		20.70	0.000374	1.01	567.25	670.46	0.23
Towns River	Mid Reach	5107	20-yr ARI	668.40	17.64	21.10		21.14	0.000475	1.29	863.91	729.87	0.27
Towns River	Mid Reach	5107	50-yr ARI	774.40	17.64	21.20		21.24	0.000499	1.36	938.23	735.06	0.28
Towns River	Mid Reach	5107	PMP 12hr	9994.00	17.64	24.75		25.11	0.001111	3.67	3958.12	976.45	0.48
Towns River	Mid Reach	4812	1-yr ARI	128.80	17.96	20.02		20.07	0.000969	1.33	187.08	458.13	0.35
Towns River	Mid Reach	4812	2-yr ARI	254.50	17.96	20.36		20.40	0.000768	1.34	384.43	615.80	0.32
Towns River	Mid Reach	4812	5-yr ARI	329.10	17.96	20.52		20.55	0.000676	1.33	479.91	625.96	0.31
Towns River	Mid Reach	4812	20-yr ARI	668.40	17.96	20.90		20.95	0.000800	1.63	720.96	637.56	0.34
Towns River	Mid Reach	4812	50-yr ARI	774.40	17.96	20.99		21.05	0.000847	1.72	777.80	639.79	0.36
Towns River	Mid Reach	4812	PMP 12hr	9994.00	17.96	24.11		24.65	0.002008	4.63	3256.81	1054.07	0.63
Towns River	Mid Reach	4588	1-yr ARI	128.80	17.95	19.91		19.93	0.000424	0.91	268.15	492.10	0.23
Towns River	Mid Reach	4588	2-yr ARI	254.50	17.95	20.26		20.28	0.000388	1.00	516.43	892.62	0.23
Towns River	Mid Reach	4588	5-yr ARI	329.10	17.95	20.43		20.45	0.000326	0.97	684.97	1084.31	0.22
Towns River	Mid Reach	4588	20-yr ARI	668.40	17.95	20.81		20.83	0.000348	1.12	1230.07	1619.94	0.23
Towns River	Mid Reach	4588	50-yr ARI	774.40	17.95	20.90		20.92	0.000348	1.15	1378.60	1666.68	0.23
Towns River	Mid Reach	4588	PMP 12hr	9994.00	17.95	24.26		24.36	0.000351	2.03	7148.38	1716.80	0.27
Towns River	Mid Reach	3994	1-yr ARI	128.80	17.05	19.68		19.69	0.000349	0.79	305.89	481.64	0.21
Towns River	Mid Reach	3994	2-yr ARI	254.50	17.05	20.04		20.05	0.000356	0.92	513.88	774.49	0.22
Towns River	Mid Reach	3994	5-yr ARI	329.10	17.05	20.23		20.24	0.000345	0.97	705.97	1280.80	0.22
Towns River	Mid Reach	3994	20-yr ARI	668.40	17.05	20.59		20.61	0.000381	1.14	1261.74	1728.57	0.24
Towns River	Mid Reach	3994	50-yr ARI	774.40	17.05	20.68		20.70	0.000380	1.16	1419.12	1733.18	0.24
Towns River	Mid Reach	3994	PMP 12hr	9994.00	17.05	24.06		24.15	0.000340	1.96	7268.53	1733.80	0.26
Towns River	Mid Reach	3155	1-yr ARI	128.80	17.36	19.27		19.30	0.000618	0.92	231.38	405.27	0.27
Towns River	Mid Reach	3155	2-yr ARI	254.50	17.36	19.60		19.63	0.000697	1.16	391.91	632.65	0.30
Towns River	Mid Reach	3155	5-yr ARI	329.10	17.36	19.77		19.81	0.000842	1.36	530.62	1042.26	0.34
Towns River	Mid Reach	3155	20-yr ARI	668.40	17.36	20.13		20.17	0.000719	1.43	946.49	1221.06	0.32
Towns River	Mid Reach	3155	50-yr ARI	774.40	17.36	20.22		20.26	0.000697	1.45	1055.04	1233.81	0.32
Towns River	Mid Reach	3155	PMP 12hr	9994.00	17.36	23.71		23.83	0.000419	2.15	6726.12	1694.88	0.29
Towns River	Mid Reach	2503	1-yr ARI	128.80	16.09	18.91		18.94	0.000505	1.06	263.03	595.58	0.26
Towns River	Mid Reach	2503	2-yr ARI	254.50	16.09	19.20		19.23	0.000564	1.25	475.15	878.26	0.28
Towns River	Mid Reach	2503	5-yr ARI	329.10	16.09	19.33		19.36	0.000567	1.30	597.82	991.27	0.28
Towns River	Mid Reach	2503	20-yr ARI	668.40	16.09	19.76		19.79	0.000494	1.37	1080.57	1231.08	0.27
Towns River	Mid Reach	2503	50-yr ARI	774.40	16.09	19.87		19.89	0.000470	1.38	1210.69	1244.91	0.27
Towns River	Mid Reach	2503	PMP 12hr	9994.00	16.09	23.42		23.55	0.000429	2.31	6351.78	1480.72	0.30
Towns River	Diversion DS	1672	1-yr ARI	133.70	15.66	18.49		18.52	0.000524	1.22	288.68	698.57	0.27
Towns River	Diversion DS	1672	2-yr ARI	265.00	15.66	18.92		18.93	0.000267	0.99	714.68	1233.99	0.20
Towns River	Diversion DS	1672	5-yr ARI	344.20	15.66	19.07		19.08	0.000235	0.96	903.59	1265.31	0.19
Towns River	Diversion DS	1672	20-yr ARI	701.80	15.66	19.50		19.51	0.000250	1.10	1480.36	1509.42	0.20
Towns River	Diversion DS	1672	50-yr ARI	834.40	15.66	19.60		19.62	0.000257	1.14	1641.57	1517.85	0.20
Towns River	Diversion DS	1672	PMP 12hr	10992.00	15.66	23.11		23.23	0.000385	2.28	7193.84	1603.54	0.28
Towns River	Diversion DS	1319	1-yr ARI	133.70	15.30	18.38		18.40	0.000231	0.80	306.08	394.63	0.18
Towns River	Diversion DS	1319	2-yr ARI	265.00	15.30	18.80		18.82	0.000375	1.15	572.83	962.14	0.24
Towns River	Diversion DS	1319	5-yr ARI	344.20	15.30	18.96		18.98	0.000346	1.15	747.10	1178.52	0.23
Towns River	Diversion DS	1319	20-yr ARI	701.80	15.30	19.40		19.42	0.000314	1.22	1311.93	1354.31	0.22
Towns River	Diversion DS	1319	50-yr ARI	834.40	15.30	19.50	18.65	19.52	0.000327	1.27	1451.82	1365.22	0.23
Towns River	Diversion DS	1319	PMP 12hr	10992.00	15.30	22.92		23.08	0.000503	2.58	6410.23	1489.40	0.32
Towns River	Diversion DS	908	1-yr ARI	133.70	15.35	18.30		18.31	0.000183	0.71	331.69	378.83	0.16
Towns River	Diversion DS	908	2-yr ARI	265.00	15.35	18.69		18.71	0.000230	0.90	538.12	955.76	0.18
Towns River	Diversion DS	908	5-yr ARI	344.20	15.35	18.85		18.87	0.000235	0.95	734.67	1300.08	0.19
Towns River	Diversion DS	908	20-yr ARI	701.80	15.35	19.28		19.30	0.000258	1.10	1302.21	1346.69	0.20
Towns River	Diversion DS	908	50-yr ARI	834.40	15.35	19.37		19.40	0.000284	1.18	1427.87	1351.86	0.21
Towns River	Diversion DS	908	PMP 12hr	10992.00	15.35	22.69		22.86	0.000546	2.65	6280.77	1563.62	0.33
Towns River	Diversion DS	263	1-yr ARI	133.70	15.64	18.03		18.09	0.000791	1.44	160.14	212.52	0.33
Towns River	Diversion DS	263	2-yr ARI	265.00	15.64	18.27		18.39	0.001424	2.10	216.77	286.67	0.45
Towns River	Diversion DS	263	5-yr ARI	344.20	15.64	18.37		18.53	0.001789	2.42	252.02	425.27	0.51
Towns River	Diversion DS	263	20-yr ARI	701.80	15.64	18.69		18.90	0.002407	3.07	536.06	1243.64	0.61
Towns River	Diversion DS	263	50-yr ARI	834.40	15.64	18.79		18.98	0.002232	3.03	661.09	1275.67	0.59
Towns River	Diversion DS	263	PMP 12hr	10992.00	15.64	22.14		22.39	0.000912	3.32	5143.11	1339.55	0.43

HEC-RAS Plan: OptionC_v1 (Continued)

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Towns River	Diversion DS	55	1-yr ARI	133.70	15.36	17.84	17.66	17.91	0.001000	1.51	202.44	679.36	0.37
Towns River	Diversion DS	55	2-yr ARI	265.00	15.36	18.07	17.92	18.13	0.000999	1.64	393.64	957.61	0.37
Towns River	Diversion DS	55	5-yr ARI	344.20	15.36	18.17	18.00	18.22	0.001001	1.70	497.17	1076.78	0.38
Towns River	Diversion DS	55	20-yr ARI	701.80	15.36	18.49	18.21	18.54	0.001000	1.87	852.50	1126.42	0.39
Towns River	Diversion DS	55	50-yr ARI	834.40	15.36	18.58	18.26	18.64	0.001001	1.92	954.49	1126.42	0.39
Towns River	Diversion DS	55	PMP 12hr	10992.00	15.36	21.89	19.96	22.18	0.001000	3.37	4683.88	1126.42	0.45
Catchment Y	Catchment Y	8098	1-yr ARI	4.90	23.38	24.00	23.91	24.01	0.000771	0.42	20.62	172.16	0.24
Catchment Y	Catchment Y	8098	2-yr ARI	10.50	23.38	24.10	23.96	24.11	0.000679	0.42	45.34	317.30	0.23
Catchment Y	Catchment Y	8098	5-yr ARI	15.10	23.38	24.16	23.99	24.16	0.000634	0.41	65.30	435.77	0.22
Catchment Y	Catchment Y	8098	20-yr ARI	33.40	23.38	24.24	24.08	24.24	0.000921	0.54	102.23	492.54	0.28
Catchment Y	Catchment Y	8098	50-yr ARI	60.00	23.38	24.29	24.13	24.30	0.001559	0.75	128.20	549.85	0.36
Catchment Y	Catchment Y	8098	PMP 12hr	998.00	23.38	25.26	24.70	25.31	0.001171	1.43	1042.34	1089.28	0.38
Catchment Y	Catchment Y	7554	1-yr ARI	4.90	22.77	23.23	23.11	23.26	0.003064	0.77	6.35	23.41	0.47
Catchment Y	Catchment Y	7554	2-yr ARI	10.50	22.77	23.40	23.24	23.44	0.002877	0.88	14.17	70.67	0.48
Catchment Y	Catchment Y	7554	5-yr ARI	15.10	22.77	23.47	23.36	23.51	0.003101	0.97	19.10	86.33	0.50
Catchment Y	Catchment Y	7554	20-yr ARI	33.40	22.77	23.75	23.54	23.77	0.000809	0.72	84.21	366.69	0.28
Catchment Y	Catchment Y	7554	50-yr ARI	60.00	22.77	23.76	23.66	23.77	0.000668	0.66	188.76	807.33	0.26
Catchment Y	Catchment Y	7554	PMP 12hr	998.00	22.77	24.61	24.11	24.66	0.001186	1.52	1074.56	1293.73	0.39
Catchment Y	Catchment Y	7259	1-yr ARI	4.90	22.33	23.08	22.84	23.08	0.000248	0.32	20.60	99.44	0.15
Catchment Y	Catchment Y	7259	2-yr ARI	10.50	22.33	23.23	22.78	23.23	0.000294	0.39	47.37	267.57	0.17
Catchment Y	Catchment Y	7259	5-yr ARI	15.10	22.33	23.30	22.89	23.31	0.000279	0.38	69.74	361.77	0.16
Catchment Y	Catchment Y	7259	20-yr ARI	33.40	22.33	23.16	23.16	23.26	0.005525	1.63	31.68	188.35	0.71
Catchment Y	Catchment Y	7259	50-yr ARI	60.00	22.33	23.34	23.28	23.39	0.003319	1.34	84.97	429.42	0.56
Catchment Y	Catchment Y	7259	PMP 12hr	998.00	22.33	24.28	23.77	24.33	0.001120	1.48	1062.89	1201.58	0.38
Catchment Y	Catchment Y	6895	1-yr ARI	4.90	22.47	22.72	22.72	22.80	0.014155	1.25	4.12	33.42	0.95
Catchment Y	Catchment Y	6895	2-yr ARI	10.50	22.47	22.86	22.83	22.93	0.008300	1.22	10.06	62.26	0.77
Catchment Y	Catchment Y	6895	5-yr ARI	15.10	22.47	22.89	22.89	22.99	0.011198	1.52	12.07	75.95	0.91
Catchment Y	Catchment Y	6895	20-yr ARI	33.40	22.47	23.04	23.04	23.04	0.000130	0.22	229.39	796.73	0.11
Catchment Y	Catchment Y	6895	50-yr ARI	60.00	22.47	23.04	23.04	23.05	0.000418	0.39	229.39	796.73	0.19
Catchment Y	Catchment Y	6895	PMP 12hr	998.00	22.47	23.85	23.31	23.90	0.001238	1.36	1039.78	1208.50	0.39
Catchment Y	Catchment Y	6512	1-yr ARI	4.90	21.97	22.10	21.83	22.10	0.000515	0.15	18.64	77.83	0.16
Catchment Y	Catchment Y	6512	2-yr ARI	10.50	21.97	22.23	21.92	22.24	0.000737	0.29	31.55	118.44	0.22
Catchment Y	Catchment Y	6512	5-yr ARI	15.10	21.97	22.40	21.98	22.40	0.000500	0.31	59.77	249.02	0.19
Catchment Y	Catchment Y	6512	20-yr ARI	33.40	21.97	22.14	22.14	22.26	0.016672	1.01	21.62	85.65	0.96
Catchment Y	Catchment Y	6512	50-yr ARI	60.00	21.97	22.28	22.28	22.41	0.015991	1.48	37.72	144.03	1.04
Catchment Y	Catchment Y	6512	PMP 12hr	998.00	21.97	23.69	22.62	23.71	0.000248	0.69	1771.86	1404.91	0.18
Catchment Y	Catchment Y	6283	1-yr ARI	4.90	21.77	22.03	21.54	22.03	0.000246	0.15	30.32	269.96	0.12
Catchment Y	Catchment Y	6283	2-yr ARI	10.50	21.77	22.15	21.70	22.16	0.000229	0.18	82.85	554.32	0.12
Catchment Y	Catchment Y	6283	5-yr ARI	15.10	21.77	22.40	21.80	22.40	0.000002	0.03	569.48	1124.87	0.01
Catchment Y	Catchment Y	6283	20-yr ARI	33.40	21.77	22.03	22.03	22.09	0.010073	0.95	32.82	288.03	0.78
Catchment Y	Catchment Y	6283	50-yr ARI	60.00	21.77	22.20	22.09	22.20	0.000144	0.15	351.43	1022.24	0.10
Catchment Y	Catchment Y	6283	PMP 12hr	998.00	21.77	23.65	22.32	23.66	0.000128	0.53	2224.10	1462.14	0.13
Catchment Y	Catchment Y	5159	1-yr ARI	4.90	20.85	21.14	21.11	21.20	0.009622	1.09	4.63	26.95	0.79
Catchment Y	Catchment Y	5159	2-yr ARI	10.50	20.85	21.23	21.23	21.35	0.013155	1.53	7.32	34.37	0.97
Catchment Y	Catchment Y	5159	5-yr ARI	15.10	20.85	21.33	21.30	21.44	0.008681	1.47	11.29	43.02	0.82
Catchment Y	Catchment Y	5159	20-yr ARI	33.40	20.85	21.60	21.51	21.65	0.002995	1.28	47.98	332.66	0.53
Catchment Y	Catchment Y	5159	50-yr ARI	60.00	20.85	21.67	21.67	21.74	0.003985	1.59	76.25	435.88	0.63
Catchment Y	Catchment Y	5159	PMP 12hr	998.00	20.85	23.56	21.79	23.57	0.000058	0.48	2878.27	1508.23	0.09
Catchment Y	Catchment Y	4917	1-yr ARI	4.90	19.79	20.42	20.22	20.44	0.001527	0.65	7.89	27.39	0.35
Catchment Y	Catchment Y	4917	2-yr ARI	10.50	19.79	20.68	20.37	20.70	0.001032	0.71	16.70	40.64	0.31
Catchment Y	Catchment Y	4917	5-yr ARI	15.10	19.79	20.80	20.45	20.82	0.001139	0.80	21.72	47.49	0.33
Catchment Y	Catchment Y	4917	20-yr ARI	33.40	19.79	20.99	20.70	21.06	0.002101	1.27	33.15	91.27	0.47
Catchment Y	Catchment Y	4917	50-yr ARI	60.00	19.79	21.14	20.92	21.25	0.002958	1.70	58.06	229.44	0.57
Catchment Y	Catchment Y	4917	PMP 12hr	998.00	19.79	23.55	21.57	23.55	0.000066	0.60	2517.02	1219.75	0.11
Catchment Y	Catchment Y	4659	1-yr ARI	4.90	19.26	20.34	19.63	20.34	0.000159	0.32	15.27	23.25	0.13
Catchment Y	Catchment Y	4659	2-yr ARI	10.50	19.26	20.55	19.81	20.56	0.000323	0.50	23.35	109.14	0.18
Catchment Y	Catchment Y	4659	5-yr ARI	15.10	19.26	20.64	19.91	20.65	0.000409	0.58	38.68	253.08	0.21
Catchment Y	Catchment Y	4659	20-yr ARI	33.40	19.26	20.79	20.25	20.81	0.000525	0.74	91.55	393.32	0.24
Catchment Y	Catchment Y	4659	50-yr ARI	60.00	19.26	20.92	20.74	20.94	0.000567	0.84	145.61	428.16	0.26
Catchment Y	Catchment Y	4659	PMP 12hr	998.00	19.26	23.53	21.34	23.54	0.000060	0.62	2410.57	1057.38	0.10
Catchment Y	Catchment Y	4321	1-yr ARI	4.90	19.64	20.18	20.02	20.21	0.002301	0.75	8.62	53.34	0.42
Catchment Y	Catchment Y	4321	2-yr ARI	10.50	19.64	20.33	20.21	20.35	0.001787	0.71	24.62	176.12	0.38
Catchment Y	Catchment Y	4321	5-yr ARI	15.10	19.64	20.40	20.27	20.41	0.001490	0.64	37.17	214.53	0.34
Catchment Y	Catchment Y	4321	20-yr ARI	33.40	19.64	20.54	20.39	20.55	0.001240	0.61	80.82	394.33	0.32
Catchment Y	Catchment Y	4321	50-yr ARI	60.00	19.64	20.67	20.47	20.68	0.001016	0.68	138.24	462.58	0.30
Catchment Y	Catchment Y	4321	PMP 12hr	998.00	19.64	23.51	21.15	23.52	0.000068	0.61	2248.05	975.29	0.11
Catchment Y	Catchment Y	3943	1-yr ARI	4.90	19.23	19.72	19.47	19.72	0.000770	0.40	13.90	54.02	0.24
Catchment Y	Catchment Y	3943	2-yr ARI	10.50	19.23	19.89	19.58	19.90	0.000815	0.49	25.51	93.82	0.26
Catchment Y	Catchment Y	3943	5-yr ARI	15.10	19.23	19.98	19.64	19.99	0.000833	0.57	36.85	160.47	0.27
Catchment Y	Catchment Y	3943	20-yr ARI	33.40	19.23	20.19	19.82	20.20	0.000711	0.67	78.62	266.46	0.26
Catchment Y	Catchment Y	3943	50-yr ARI	60.00	19.23	20.38	20.02	20.39	0.000607	0.74	143.51	387.57	0.25
Catchment Y	Catchment Y	3943	PMP 12hr	998.00	19.23	23.48	20.94	23.49	0.000070	0.70	2192.86	883.21	0.11
Catchment Y	Catchment Y	3556	1-yr ARI	4.90	19.00	19.50	19.22	19.50	0.000455	0.31	18.24	76.37	0.18
Catchment Y	Catchment Y	3556	2-yr ARI	10.50	19.00	19.66	19.32	19.67	0.000463	0.42	32.37	108.41	0.20
Catchment Y	Catchment Y	3556	5-yr ARI	15.10	19.00	19.73	19.40	19.74	0.000525	0.50	41.73	145.55	0.22
Catchment Y	Catchment Y	3556	20-yr ARI	33.40	19.00	19.94	19.54	19.96	0.000587	0.66	76.90	187.32	0.24
Catchment Y	Catchment Y	3556	50-yr ARI	60.00	19.00	20.13	19.70	20.14	0.000704	0.83	120.63	278.80	0.28
Catchment Y	Catchment Y	3556	PMP 12hr	998.00	19.00	23.45	20.82	23.46	0.000076	0.76	2014.78	773.82	0.12
Catchment Y	Catchment Y	3191	1-yr ARI	4.90	18.86	19.23	19.05	19.24	0.001234	0.44	11.80	64.91	0.29
Catchment Y	Catchment Y	3191	2-yr ARI	10.50	18.86	19.35	19.14	19.36	0.001905	0.69	21.86	108.23	0.38
Catchment Y	Catchment Y	3191	5-yr ARI	15.10	18.86	19.43	19.22	19.44	0.001449	0.67	31.19	119.01	0.35
Catchment Y	Catchment Y	3191	20-yr ARI	33.40	18.86	19.74	19.38	19.75	0.000553	0.55	91.97	265.96	0.23
Catchment Y	Catchment Y	3191	50-yr ARI	60.00	18.86	19.91	19.49	19.92	0.000497	0.62	140.68	293.75	0.23
Catchment Y	Catchment Y	3191	PMP 12hr	998.00	18.86	23.43	20.51	23.44	0.000052	0.63	2329.14	836.38	0.10

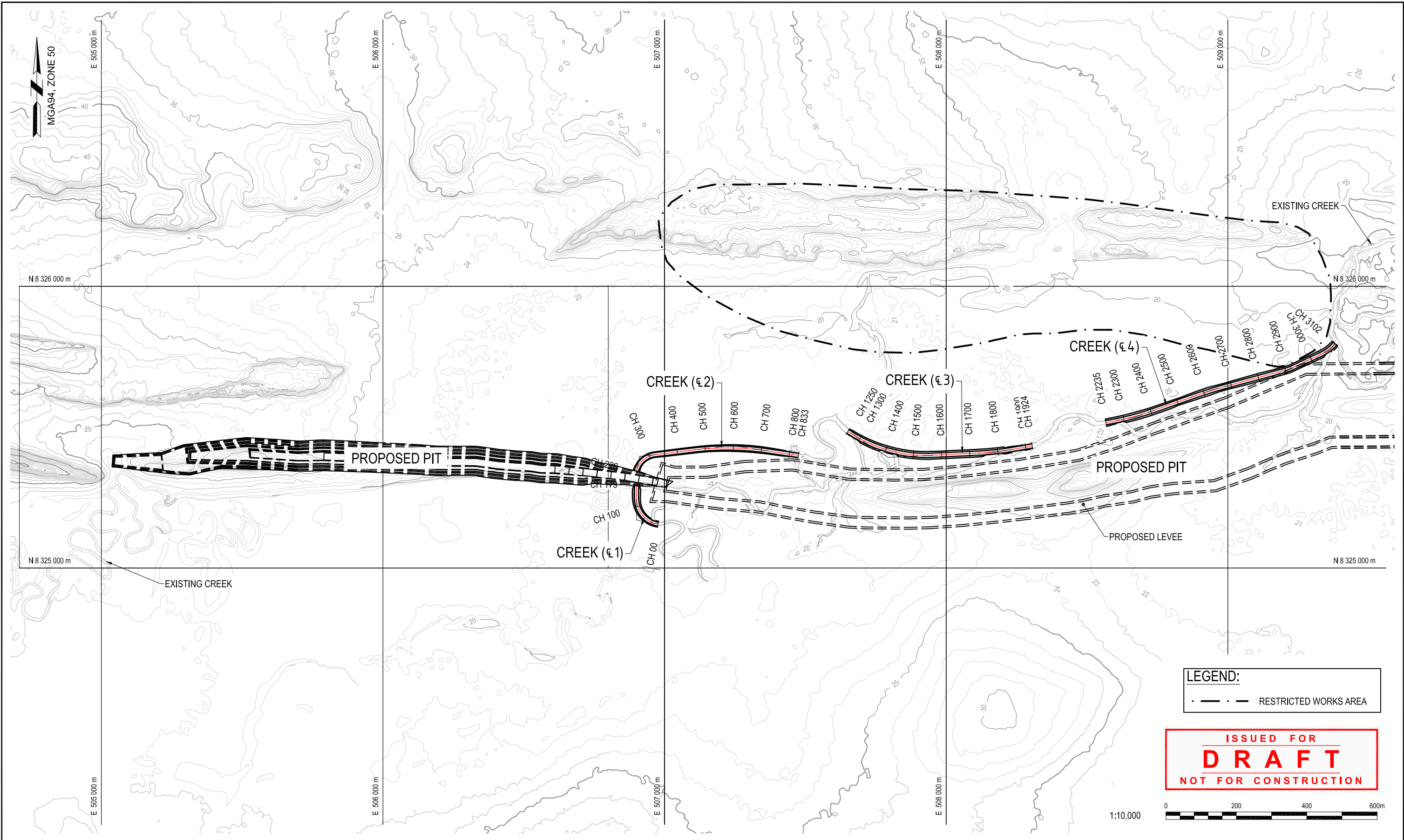
HEC-RAS Plan: OptionC_v1 (Continued)

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Catchment Y	Catchment Y	2699	1-yr ARI	4.90	18.18	18.72	18.47	18.73	0.000881	0.47	10.69	40.74	0.26
Catchment Y	Catchment Y	2699	2-yr ARI	10.50	18.18	19.03	18.60	19.03	0.000332	0.44	29.13	83.52	0.18
Catchment Y	Catchment Y	2699	5-yr ARI	15.10	18.18	19.17	18.68	19.18	0.000281	0.47	42.13	100.14	0.17
Catchment Y	Catchment Y	2699	20-yr ARI	33.40	18.18	19.60	18.89	19.61	0.000175	0.50	115.38	280.96	0.15
Catchment Y	Catchment Y	2699	50-yr ARI	60.00	18.18	19.73	19.10	19.74	0.000293	0.69	152.32	297.20	0.19
Catchment Y	Catchment Y	2699	PMP 12hr	998.00	18.18	23.41	20.42	23.42	0.000037	0.60	2775.60	1040.08	0.09
Catchment Y	Catchment Y	2219	1-yr ARI	4.90	17.80	18.64	18.20	18.64	0.000075	0.18	47.58	262.68	0.08
Catchment Y	Catchment Y	2219	2-yr ARI	10.50	17.80	19.02	18.38	19.02	0.000008	0.09	227.82	616.47	0.03
Catchment Y	Catchment Y	2219	5-yr ARI	15.10	17.80	19.16	18.50	19.16	0.000006	0.08	319.84	646.37	0.03
Catchment Y	Catchment Y	2219	20-yr ARI	33.40	17.80	19.60	18.60	19.60	0.000004	0.09	643.17	820.82	0.02
Catchment Y	Catchment Y	2219	50-yr ARI	60.00	17.80	19.73	18.68	19.73	0.000009	0.14	748.91	880.73	0.03
Catchment Y	Catchment Y	2219	PMP 12hr	998.00	17.80	23.41	19.37	23.41	0.000008	0.28	4779.43	1138.13	0.04
Catchment Y	Catchment Y	1680	1-yr ARI	4.90	18.82	18.63		18.64	0.000006		77.15	98.38	0.00
Catchment Y	Catchment Y	1680	2-yr ARI	10.50	18.82	19.01		19.01	0.000010	0.03	131.13	183.66	0.02
Catchment Y	Catchment Y	1680	5-yr ARI	15.10	18.82	19.16		19.16	0.000013	0.05	159.63	205.11	0.03
Catchment Y	Catchment Y	1680	20-yr ARI	33.40	18.82	19.60		19.60	0.000021	0.12	311.48	570.73	0.05
Catchment Y	Catchment Y	1680	50-yr ARI	60.00	18.82	19.71		19.72	0.000053	0.21	381.52	644.66	0.08
Catchment Y	Catchment Y	1680	PMP 12hr	998.00	18.82	23.40		23.40	0.000020	0.40	3127.51	872.29	0.06
Catchment Y	Catchment Y	1338	1-yr ARI	4.90	17.71	18.63		18.63	0.000005	0.05	137.09	415.02	0.02
Catchment Y	Catchment Y	1338	2-yr ARI	10.50	17.71	19.01		19.01	0.000002	0.04	413.98	950.40	0.01
Catchment Y	Catchment Y	1338	5-yr ARI	15.10	17.71	19.16		19.16	0.000002	0.05	556.86	1040.11	0.01
Catchment Y	Catchment Y	1338	20-yr ARI	33.40	17.71	19.60		19.60	0.000001	0.05	1049.82	1222.94	0.01
Catchment Y	Catchment Y	1338	50-yr ARI	60.00	17.71	19.71		19.71	0.000003	0.08	1197.64	1328.54	0.02
Catchment Y	Catchment Y	1338	PMP 12hr	998.00	17.71	23.40		23.40	0.000004	0.21	6252.80	1372.34	0.03
Catchment Y	Catchment Y	737	1-yr ARI	4.90	16.11	18.63		18.63	0.000000	0.04	278.10	564.41	0.01
Catchment Y	Catchment Y	737	2-yr ARI	10.50	16.11	19.01		19.01	0.000000	0.04	566.98	817.39	0.01
Catchment Y	Catchment Y	737	5-yr ARI	15.10	16.11	19.16		19.16	0.000001	0.05	687.24	852.84	0.01
Catchment Y	Catchment Y	737	20-yr ARI	33.40	16.11	19.60		19.60	0.000001	0.06	1115.19	996.82	0.01
Catchment Y	Catchment Y	737	50-yr ARI	60.00	16.11	19.71		19.71	0.000002	0.10	1230.01	996.82	0.02
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APPENDIX D

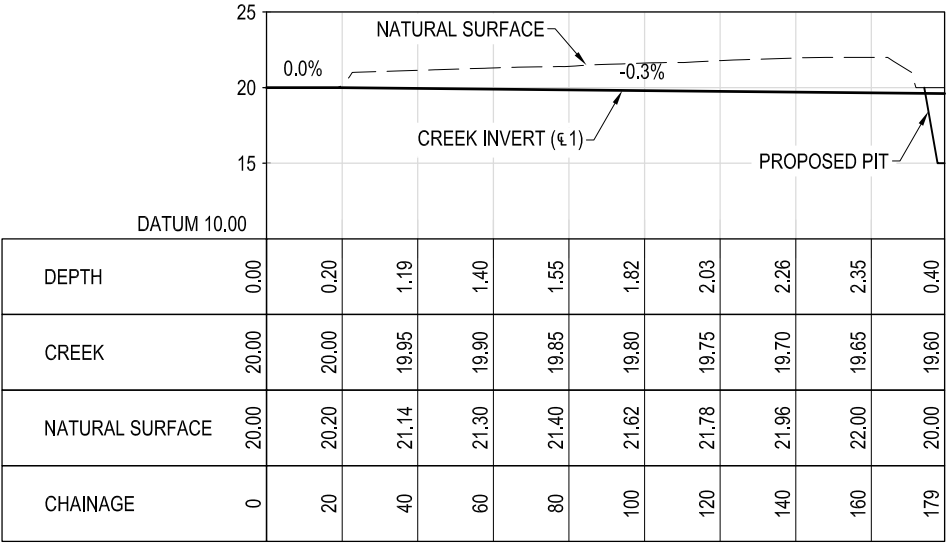
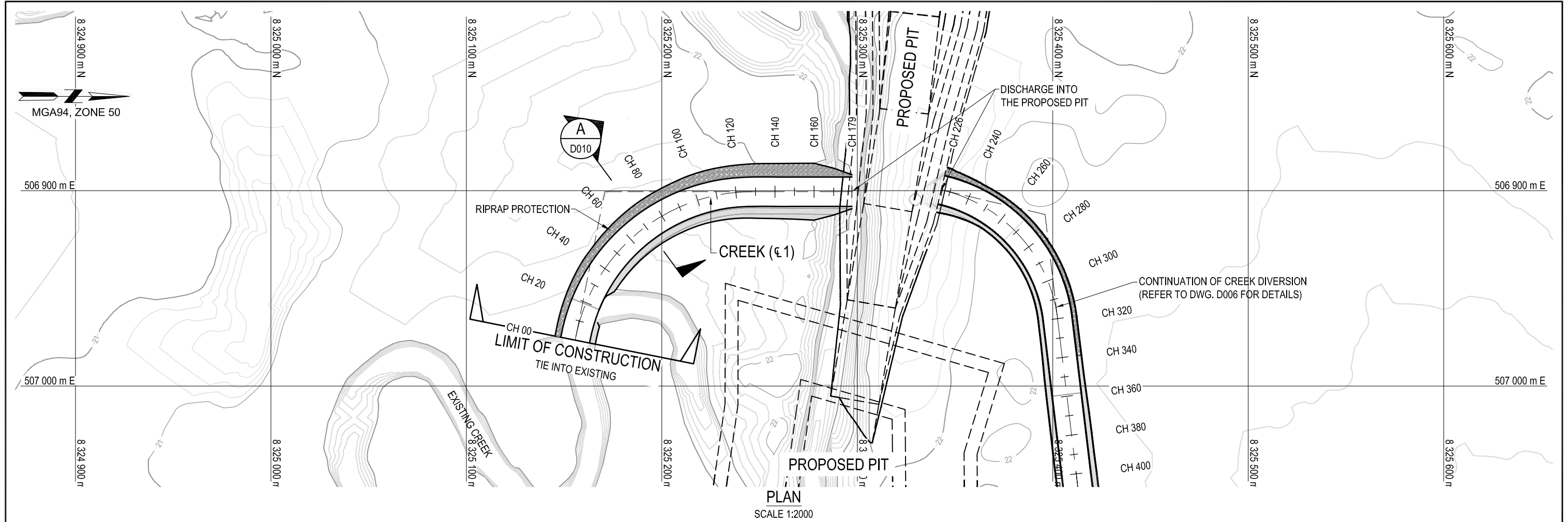
Designs for Option C - Preliminary



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										DRAWING TITLE GENERAL ARRANGEMENT			
										PROJECT No 127646013			
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LONGITUDINAL SECTION CH0 - CH179

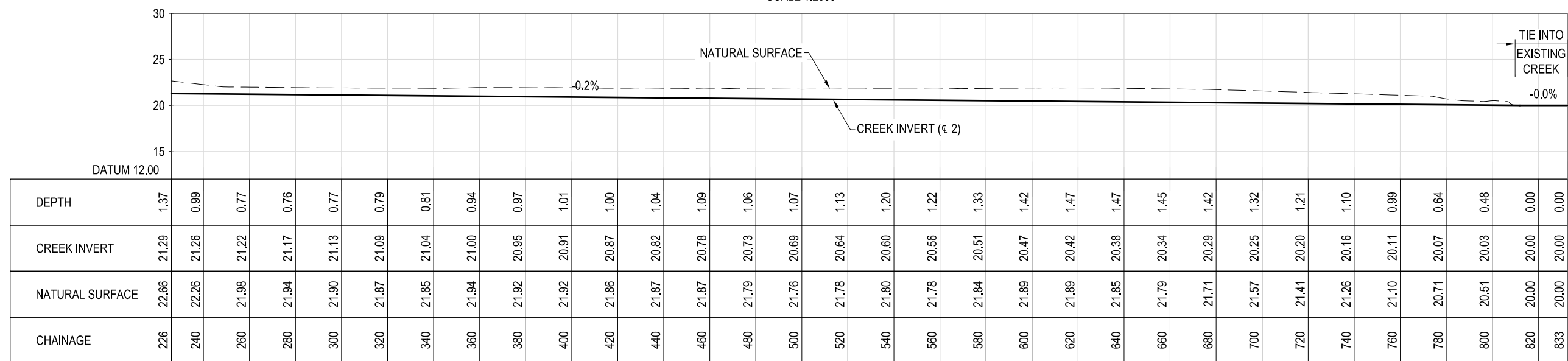
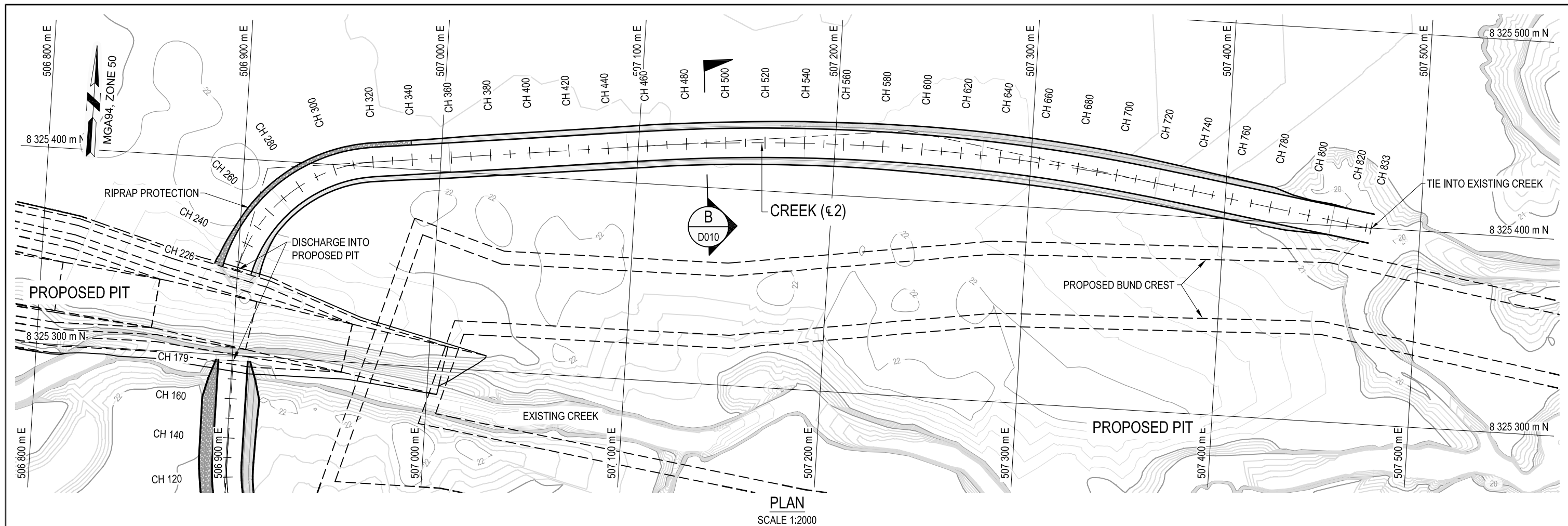
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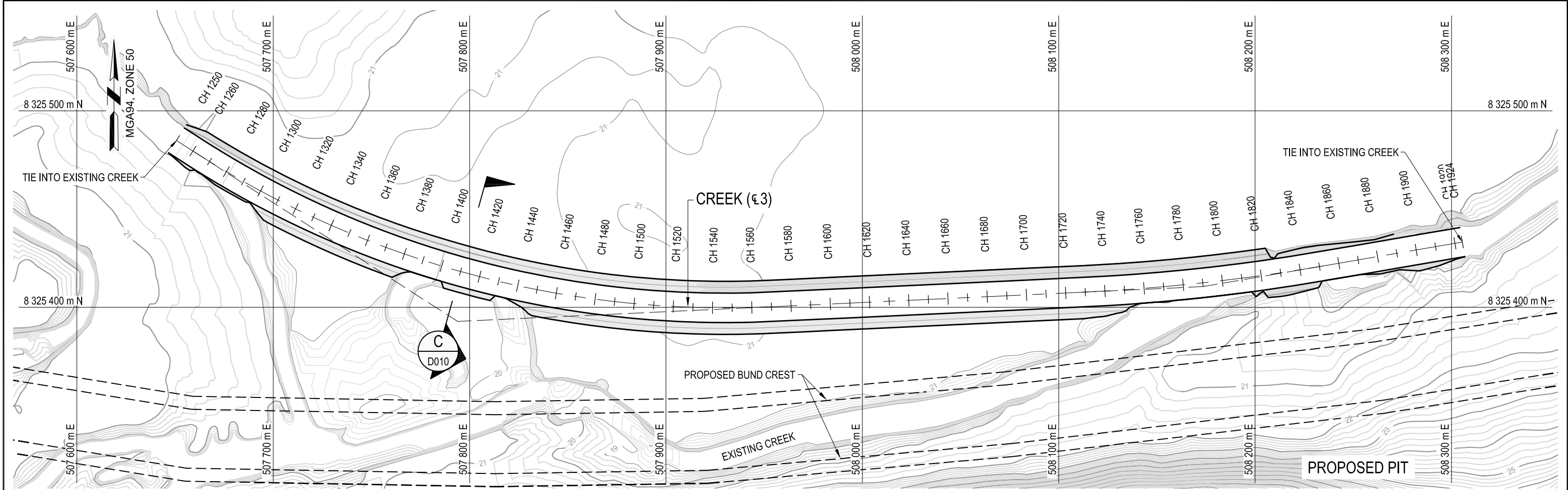
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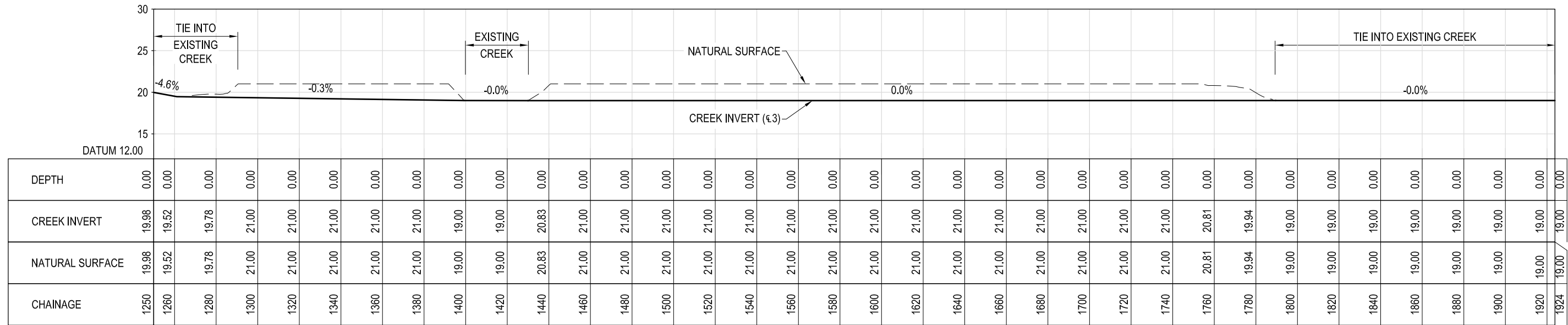
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PLAN

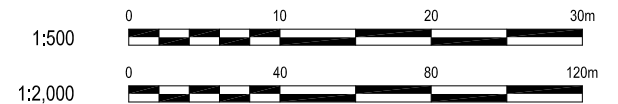
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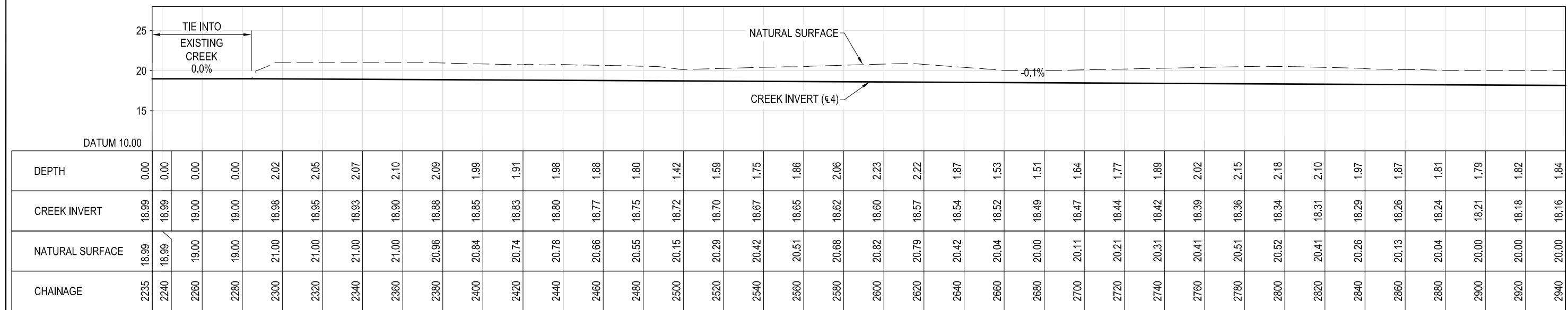
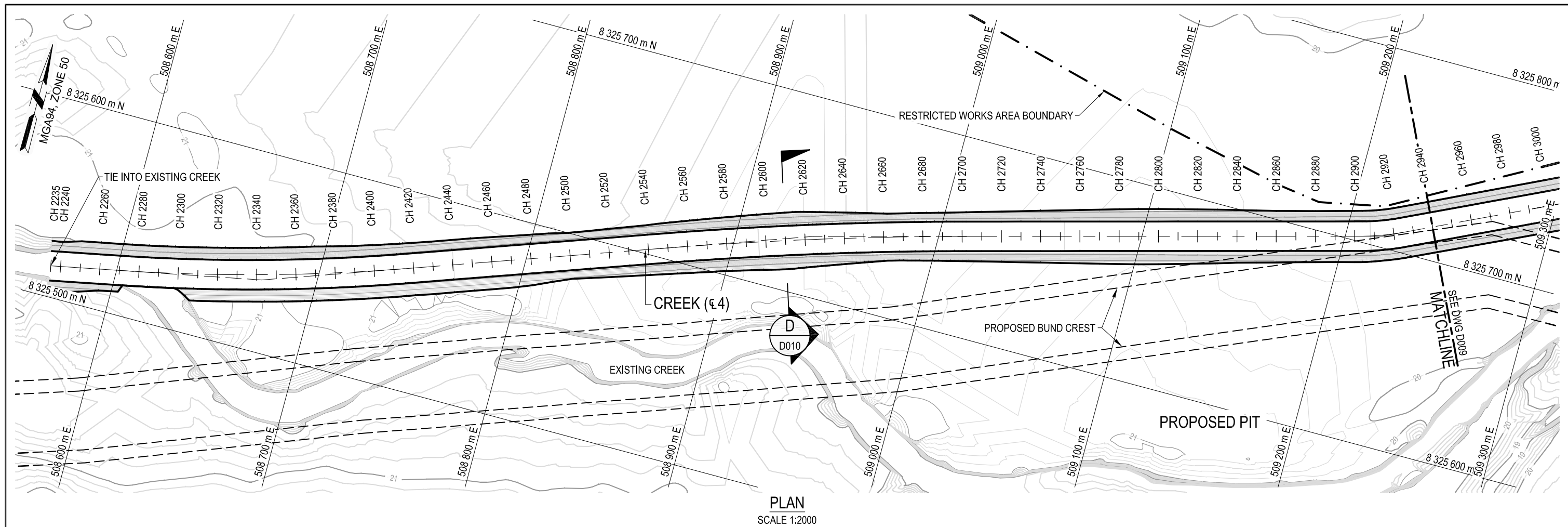
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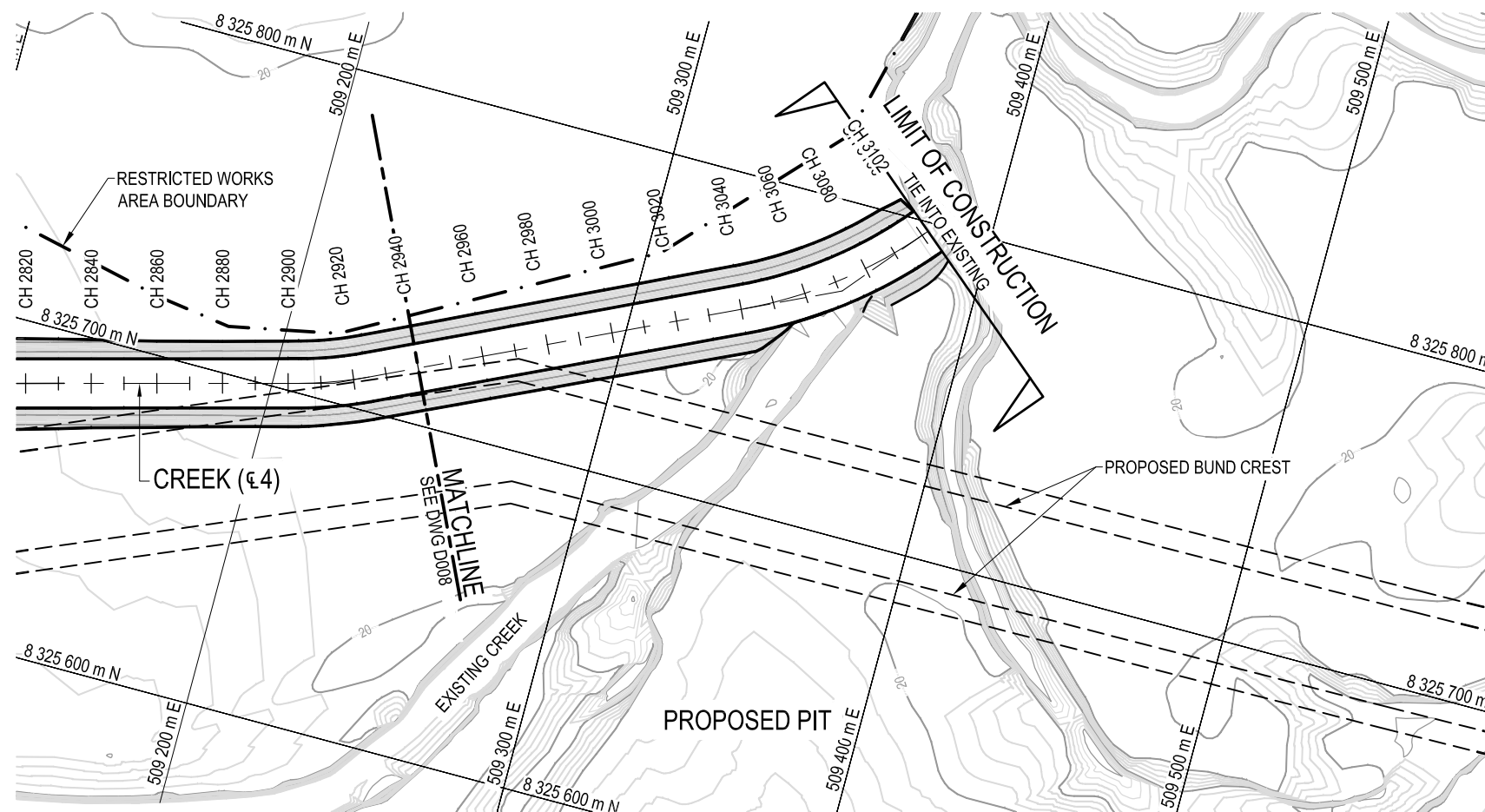
PROJECT
Roper Bar Project - Ephemeral Creek Re-Alignment

DRAWING TITLE
PLAN AND LONGITUDINAL SECTION
SHEET 4 OF 5

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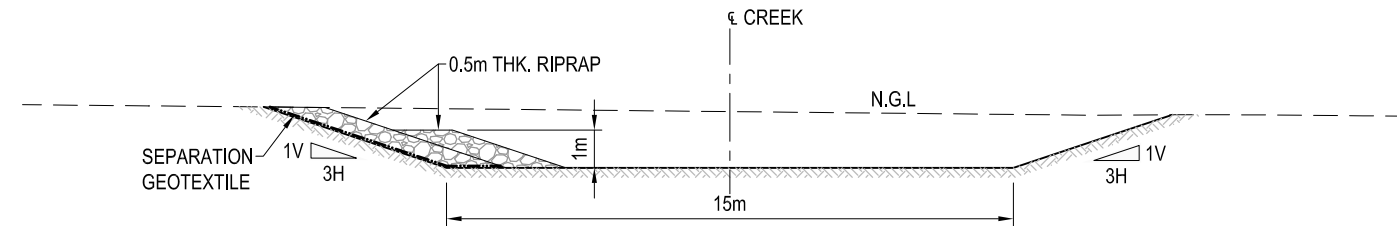


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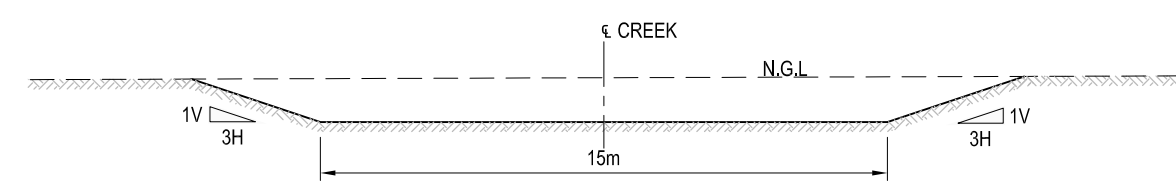


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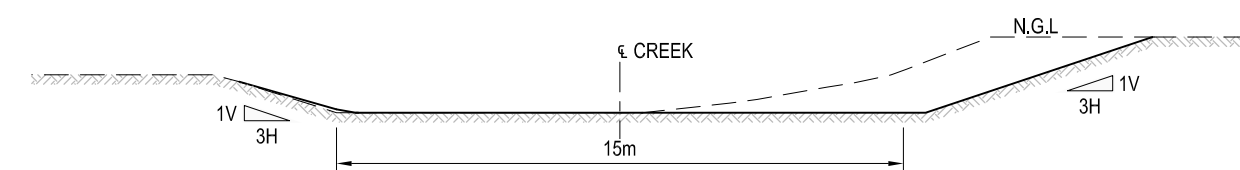
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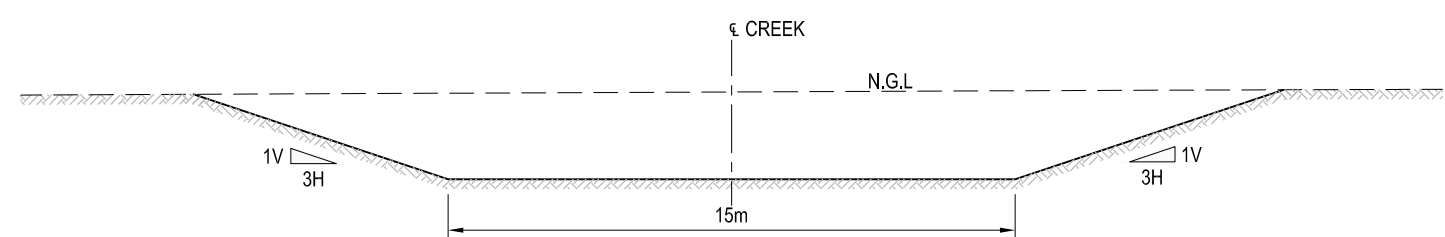
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VER SCALE 1:200



SECTION **B** TYPICAL SECTION AT CH530
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SECTION **C** TYPICAL SECTION AT CH1430
HOR SCALE 1:200
VER SCALE 1:200



SECTION **D** TYPICAL SECTION AT CH2610
HOR SCALE 1:200
VER SCALE 1:200

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APPENDIX E

Geotechnical Report - Preliminary



15 June 2012

GEOTECHNICAL INVESTIGATION - WESTERN DESERT TOWNS RIVER REALIGNMENT

Roper Bar Iron Ore Project - Interim Factual Report

Submitted to:
Western Desert Resources
Level 1 / 26 Greenhill Road
WAYVILLE SA 5034

REPORT



Report Number. 127646013-002-R-Rev0

Distribution:

1 Copy - Golder Associates
1 Copy - Western Desert Resources





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Report of Test Pits

Explanation of Notes, Abbreviations & Terms Used on Borehole and Test Pit Reports

Method of Soil Description Used on Borehole and Test Pit Reports

Terms for Rock Material Strength & Weathering and Abbreviations for Defect Descriptions

APPENDIX C

Limitations (LEG04 RL1)



1.0 INTRODUCTION

This report presents the results of a geotechnical study carried out by Golder Associates Pty Ltd (Golder Associates) for the proposed realignment of a section of the Towns River as part of the Roper Bar Iron Ore Project, Northern Territory. The study was commissioned by Western Desert Resources (WDR) on 30 March 2012 (email Younge/Goode) and was undertaken in general accordance with our proposal (reference P27646012-001-L-Rev2) dated 23 March 2012. At the time of required submission of this document laboratory testing was incomplete and as such this is an interim report.

The extent of the study area is shown on Figure 1. The proposed realignment is approximately 4.5 km long predominantly striking east west, bypassing the iron ore deposit on the northern side. The alignment details were sourced from Golder Associates Draft General Arrangement drawing D002 Revision A, dated 30 May 2012. The creek invert details referred to in this report were from the Golder Associates preliminary design documentation at the time of the investigation. We have since been informed (email Young/Thomas) on 13 June 2012 that the length of the realignment has been reduced to the portion adjacent to the eastern section of the ore body (east of Wade's Crossing). This report provides information for the realignment originally considered.

The aim of the investigation was to make an assessment of the geotechnical conditions along the proposed realignment and identify potential geotechnical constraints that might affect or limit the proposed development.



2.0 METHODOLOGY

A desktop study was undertaken by consulting publicly available geological information including geological maps and publications from the Northern Territory Geological Survey and journal articles. We sourced GIS data from Geosciences Australia and consulted data published by that organisation.

Fieldwork for the geotechnical investigation was carried out between 1 June and 5 June 2012. The fieldwork consisted of a walkover of the proposed realignment on the first day followed by three days of targeted intrusive investigations. This involved excavating 15 test pits at locations along the proposed realignment, to a target depth of 0.5 m below the proposed invert level. Materials recovered during the investigation were logged and a number of samples from the test pits were taken for geotechnical laboratory testing.

The fieldwork was undertaken by an Engineering Geologist from Golder Associates who made general observations of the following to assist in the location of intrusive investigations:

- geomorphological and topographic setting;
- location and extent of soil and rock exposures along the alignment and adjacent features, where observed;
- materials exposed at the ground surface;
- form and condition of the Towns River channel; and
- distribution of vegetation.

Rock and soil samples were collected from the test pits for potential laboratory testing.



3.0 DESKTOP STUDY

The explanatory notes for the Mount Young 1:250,000 map sheet indicate that the terrain along the proposed realignment may be generalised as falling within the Gulf Fall zone. However we note that the site is located very close to the boundary with the Coastal Plain zone.

The distinct topographical and geological features associated with each zone are outlined in the subsequent section. The zones are not continuous. Their geographical distribution is presented on Figure 2.

3.1 Topography and Geology

3.1.1 Gulf Fall

The Gulf Fall zone is located predominantly west of the Limmen River. A rock outcrop associated with the Gulf Fall zone is also present south of the Yiyintyi Range. Based on the available information the topography of the Gulf fall zone has been shaped by differential erosion creating steep sided ridges of sandstone with valleys of less resistant rock in between. The ridges generally have an elevation 30 m to 60 m above the intervening valleys.

The Mount Young mapsheet provides the following nomenclature for the geological materials which may be present in Gulf Fall zones of the proposed creek realignment:

- *"JALBOI MEMBER: Quartzarenite and sublitharenite, very fine to medium grained with thinly interbedded, commonly micaceous siltstone and mudstone; common mudstone intraclasts and cross-beds."*
- *"Qa: Gravel, sand, silt: alluvium."*
- *"MOROAK SANDSTONE MEMBER: Mainly fine-grained sandstone, in places ferruginous; thin bedded to flaggy with some interbedded coarse-grained sandstone and minor conglomerate."*

3.1.2 Coastal Plain

The Coastal Plain zone is characterised as a wide, flat, low lying plain with elevations ranging from sea level up to about 30 m AHD. Northwest trending sand dunes with very low relief occur in places. Drainage in the Coastal Plain zone occurs through sub-parallel streams generally trending southwest to northeast.

The Mount Young geological mapsheet and its explanatory notes indicate that the majority of the Coastal Plain contains a soil profile consisting of sand overlying a laterite profile. In places the sands are cemented together to form lateritic rock outcrops. Alluvial soils comprising sands, gravels silts and clays may be expected near major streams and drainage channels. Calcrete outcrops are present between the Yiyintyi Ranges and the Nathan River.



4.0 GEOTECHNICAL INVESTIGATION

4.1 Method of Investigation

Fieldwork for the investigation was carried out from the 1 June to 5 June 2012 and included a site walkover of the proposed realignment followed by excavating 15 test pits (GTP01 to GTP15) to a least 0.5 m below the proposed invert level at each location or refusal at shallower depth.

Initially, test pits locations were positioned along the proposed realignment at approximately even spacing progressing west to east (GTP01 to GTP10). A further five test pits were located between these pits in particular areas of interest (GTP11 to GTP15). The approximate test pit locations are shown on Figure 1.

The test pit excavations were undertaken using a CAT 325 DL Excavator and CAT 432E Backhoe fitted with a 1.5 m toothed bucket and 0.45 m toothed bucket respectively. The test pits were backfilled with excavated spoil and tamped down with the back of the bucket.

The fieldwork was carried out in the presence of an Engineering Geologist from Golder Associates who located the test pits, logged and took samples of the materials encountered and performed field testing.

4.2 Subsurface Conditions

Descriptions of the materials encountered in the test pits are presented in the Reports of Test Pits in Appendix A. Our explanatory sheets of Terms and Abbreviations and Methods of Soil Classification used in preparing the Reports of Test Pits are also included. Where consistencies or densities are stated in test pit logs, they have been estimated from pocket penetrometers testing, visual observation and from our assessment of excavation resistance. Photographs of test pit excavations are presented with the test pit logs.

The test pits at the site all encountered clays, generally overlying a mixture of soil and rock strength materials.

Pale brown, orange brown and red brown clays of a medium to high plasticity with varying levels of sand and increasing gravel content with depth were observed in all test pits. Within the western portion of the site test pits GTP01-GTP06, GTP11, GTP14, and GTP15 exhibited silty and clayey sands at the ground surface overlying the clayey materials.

The mixture of soil and rock strength materials comprised low plasticity sandy clay and a laterised sandstone/siltstone. Backhoe and excavator refusal was reached in the hard lateritic rock layer in test pits GTP04, GTP05, GTP06, GTP08, GTP09, GTP10, GTP12, GTP13 and GTP14.

Table 1 gives a generalised description of materials found in the test pits.

Table 1: Generalised Stratigraphy

Unit	Top Depth (mbgs*)	Description
1	0	Silty SAND and Clayey SAND, fine to medium grained, grey brown, low liquid limit fines
2	0 - 2.2	CLAY, high plasticity, mottled grey, red brown, orange brown with fine to coarse grained sand
3	0.5 - 1.6	Gravelly CLAY, high plasticity, mottled grey, orange brown and red brown, fine to medium gravel, with fine to coarse grained sand.
4	1.7 - 3.3	Mixture of SOIL (80%) and ROCK (20%) SOIL generally comprised Gravelly CLAY, low plasticity, mottled pale brown and orange brown, fine to medium gravel, with fine to coarse



GEOTECHNICAL INVESTIGATION - TOWNS RIVER REALIGNMENT

Unit	Top Depth (mbgs*)	Description
		grained sand. ROCK is LATERISED SANDSTONE/SILTSTONE, fine to medium grained, granular, mottled grey, brown, orange brown, red, black, low strength, highly weathered.

*** mbgs – metres below ground surface**

The composition of the materials observed in the test pits was reasonably consistent with the exception of moisture content. Groundwater inflow was encountered in GTP06 and GTP10 at depths of 1.2 m and 1.5 m respectively. Correspondingly, the moisture contents of the materials encountered in these test pits were significantly higher than those observed in other pits. It must be noted that both these test pits were positioned in relatively close proximity to the existing creek.

Pocket penetrometer testing of the cohesive soils from the test pits suggests that the clay layers generally ranged from a stiff to a very stiff consistency. Clays close to the ground surface were generally of a friable consistency while clays at greater depth generally had a consistency of stiff to hard.



5.0 GEOTECHNICAL LABORATORY TESTING

At the time of producing this report, laboratory testing of selected samples recovered from the test pits was being undertaken by Cardno Ullman & Nolan Darwin laboratory. We understand that this laboratory is Association of Testing Authorities (NATA) accredited in accordance with the various test methods set out in Australian Standard AS 1289 'Methods of Testing Soils for Engineering Purposes'.

Samples and testing were selected on varying material type, depth below ground surface and moisture content.

The proposed geotechnical laboratory testing underway is as follows:

- Atterberg Limit including Linear shrinkage and moisture content – 8 tests;
- Particle size distribution (PSD) including hydrometer – 8 tests;
- Emerson Class Number – 8 tests;
- Pinhole Dispersion – 8 tests; and
- Standard Compaction – 8 tests.



6.0 LIMITATIONS

Your attention is drawn to the document – “Limitations” (LEG04 RL1), which is provided in Appendix C of this report. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be. The document is not intended to reduce the level of responsibility accepted by Golder Associates, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.



Report Signature Page

GOLDER ASSOCIATES PTY LTD

Andy Thomas
Engineering Geologist

AT/THH/rr

A.B.N. 64 006 107 857

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APPENDIX A

Figures 1 & 2

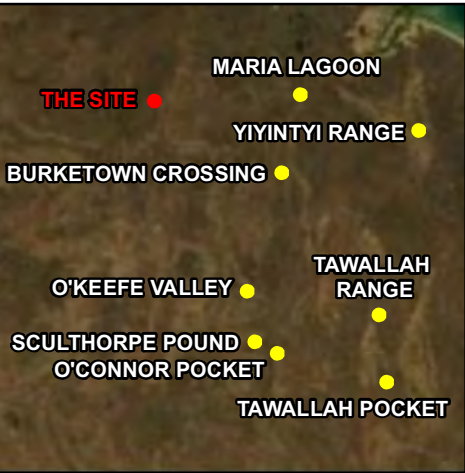
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ROPER BAR PROJECT -
EPHEMERAL CREEK RE-ALIGNMENT

WESTERN DESERT RESOURCES LTD

TEST PIT PLAN



LEGEND

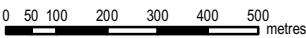
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Aerial image sourced from Bing Maps, date sourced 07.06.2011.



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DATUM GDA 94, PROJECTION MGA Zone 53

PROJECT: 127646013
DATE: 07 JUN 2012
DRAWN: KB
CHECKED: AT

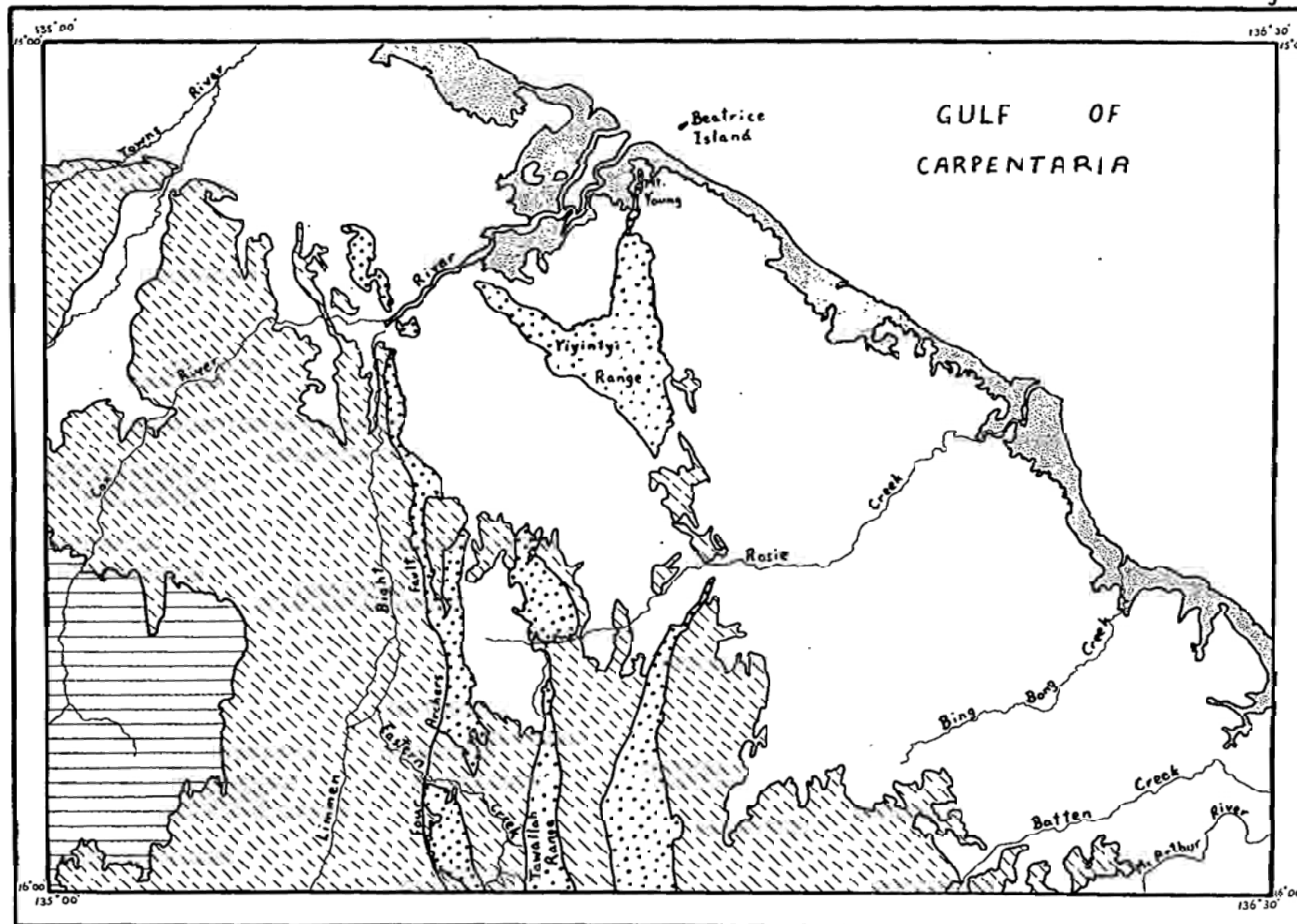
FIGURE 1



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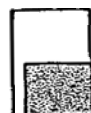
PHYSIOGRAPHIC SKETCH MAP – MT YOUNG SHEET AREA

Fig. 1



REFERENCE

COASTAL PLAIN



Tidal Flats

GULF FALL



Cox River Plateau

Main Ranges

GEOTECHNICAL DESKTOP
STUDY FOR PROPOSED CREEK
REALIGNMENT

WESTERN DESERT RESOURCES LTD

GEOLOGICAL ZONES

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Image sourced from Geoscience Australia, Commonwealth of Australia, date sourced 01.12.2011

SCALE (at A4) N.T.S

PROJECT: 127646013
DATE: 15 JUN 2012
DRAWN: KB
CHECKED: AT

FIGURE 2





APPENDIX B

Report of Test Pits

Explanation of Notes, Abbreviations & Terms Used on Borehole and Test Pit Reports

Method of Soil Description Used on Borehole and Test Pit Reports

Terms for Rock Material Strength & Weathering and Abbreviations for Defect Descriptions



REPORT OF TEST PIT: GTP01

CLIENT: Western Desert Resources
 PROJECT: Roper Bar Creek Realignment
 LOCATION: Roper Bar
 JOB NO: 127646013

POSITION:
 COORDS: 505130.0 m E 8325487.0 m N MGA94 53
 SURFACE RL: 24.59 m DATUM: AHD
 PIT DEPTH: 3.30 m
 BUCKET TYPE: 1500 mm Toothed

SHEET: 1 OF 1
 MACHINE: CAT 325 D L Excavator
 CONTRACTOR: WDR
 LOGGED: AT DATE: 2/6/12
 CHECKED: TH DATE: 15/6/12

Excavation					Sampling		Field Material Description							
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS		
EX	L		0.0	24.59	GTP01-01 0.00-0.40 m Rec = /400 mm PP U 0.00-3.30 m Rec = /3300 mm			SM	Silty SAND, fine to medium grain, red grey brown, low liquid limit fines		L	0.00 m - Grass on surface		
			0.40	24.19				SC			Clayey SAND, fine to medium grained, pale brown with orange red staining, low plasticity fines	D - VD	0.0-0.4 m - fine roots and organic material, inferred topsoil	
	M		0.5	24.19	GTP01-02 1.00 m				CH	CLAY, high plasticity, mottled grey, orange and red brown, with fine sand		H - Fb	Excavator resistance very high - rocking back on tracks to dig 2.2 m - inferred weathered laterite material No structure observed	
	1.0													
	H-R		2.0	2.20	GTP01-03 2.50 m 2.60 m PP >500 kPa									
			2.5	22.39										
			3.0	3.30	3.30 m PP >500 kPa				Test pit terminated @ 3.3 m Practical refusal on lateritic clay - penetration rate very slow No groundwater encountered TEST PIT DISCONTINUED @ 3.30 m					
			3.5	21.29										
			4.0											
			4.5											
			5.0											

Sketch & Other Observations



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GAP gINT FN. F03e
 RL3



REPORT OF TEST PIT: GTP02

CLIENT: Western Desert Resources
PROJECT: Roper Bar Creek Realignment
LOCATION: Roper Bar
JOB NO: 127646013

POSITION:
COORDS: 505604.0 m E 8325543.0 m N MGA94 53
SURFACE RL: 27.92 m DATUM: AHD
PIT DEPTH: 7.80 m
BUCKET TYPE: 1500 mm Toothed

SHEET: 1 OF 2
MACHINE: CAT 325 D L Excavator
CONTRACTOR: WDR
LOGGED: AT DATE: 2/6/12
CHECKED: TH DATE: 15/6/12

Excavation					Sampling		Field Material Description						
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY	DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L		0.0	27.92	PP U 0.00-5.00 m Rec = /5000 mm			SM	Silty SAND, fine to medium grain, grey brown, low liquid limit fines		L		Grass on surface
			0.50	27.42				CI-CH	Sandy CLAY, medium to high plasticity, mottled pale brown, orange and red brown, fine to coarse grained sand Becoming mottled red grey yellow and orange brown with depth				0-0.4 m - fine roots and organic material, inferred topsoil
			1.0	26.62				CH	CLAY, high plasticity, mottled red, grey, yellow and orange brown, with fine sand				0.5 m - Inferred weathered laterite material
	M-H		1.30	26.62	1.00 m PP >500 kPa GTP02-01 1.00 m					D	H - Fb		Inferred laterised clays, iron indurated
			1.5										1.3-3.0m - very slow penetration rate
			2.0										
	H		2.5		2.10 m PP >500 kPa								
			3.0	3.00									
			3.5	24.92					as above, increasing grey colour				
			4.0										
			4.5	4.30									
			5.00	23.62	GTP02-02 3.00 m				as above, increasing red colour	D - M	H	D	

Sketch & Other Observations



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GAP gINT FN. F03e
RL3



REPORT OF TEST PIT: GTP02

CLIENT: Western Desert Resources
PROJECT: Roper Bar Creek Realignment
LOCATION: Roper Bar
JOB NO: 127646013

POSITION:
COORDS: 505604.0 m E 8325543.0 m N MGA94 53
SURFACE RL: 27.92 m DATUM: AHD
PIT DEPTH: 7.80 m
BUCKET TYPE: 1500 mm Toothed

SHEET: 2 OF 2
MACHINE: CAT 325 D L Excavator
CONTRACTOR: WDR
LOGGED: AT DATE: 2/6/12
CHECKED: TH DATE: 15/6/12

Excavation				Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	H		5.0	22.92	5.00 m PP >500 kPa				as above, mottled pale grey, orange brown, red brown and red		Boundaries indistinct and inferred from samples only 5.5-6.5 m - material is laterised siltstone/claystone - evidence of laminated structure
			5.5								
			5.75								
			22.17						as above, mottled pale grey and red brown		
			6.0		GTP02-03 6.00 m						
			6.25								
			21.67						as above, mottled brown, orange brown and white	D - M H	
			6.5								
			7.0		PP U 7.00-7.80 m Rec = /800 mm 7.00 m PP >500 kPa						
			7.5								
			7.80								
			20.12		GTP02-04 7.80 m				Groundwater not encountered TEST PIT DISCONTINUED @ 7.80 m		
			8.0								
			8.5								
			9.0								
			9.5								
			10.0								

Sketch & Other Observations



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GAP gINT FN. F03e
RL3



REPORT OF TEST PIT: GTP03

CLIENT: Western Desert Resources
PROJECT: Roper Bar Creek Realignment
LOCATION: Roper Bar
JOB NO: 127646013

POSITION:
COORDS: 506200.0 m E 8325577.0 m N MGA94 53
SURFACE RL: 23.02 m DATUM: AHD
PIT DEPTH: 3.10 m
BUCKET TYPE: 1500 mm Toothed

SHEET: 1 OF 1
MACHINE: CAT 325 D L Excavator
CONTRACTOR: WDR
LOGGED: AT DATE: 3/6/12
CHECKED: TH DATE: 15/6/12

Excavation					Sampling		Field Material Description				
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L		0.0	22.92	PP U 0.00-3.10 m Rec = /3100 mm		SC	Clayey SAND, fine grain, brown, low plasticity fines	D	L	Grass on surface 0.1-3.1 m - Material recovered in clods in part - gravel to cobble size
			0.5	22.32			CH	Sandy CLAY, high plasticity, mottled yellow brown and orange brown, fine to coarse grained sand, dry, sand size particles are clay nodules and laterite pisolites	M		
	M-H		1.0		1.00 m PP >500 kPa		CH	CLAY, high plasticity, mottled grey, orange brown, red brown, fine to coarse grained sand, sand sized particles are hard clay nodules and laterite pisolites	D - M	H	
	1.5										
	H-R		2.0	21.02	1.50 m PP >500 kPa GTP03-01 1.50 m		CH	Sandy CLAY, high plasticity, mottled yellow brown and orange brown, fine to coarse grained sand, with fine to medium gravel. Gravel and sand sized particles are laterite pisolites	D		
			2.5								
			3.0	19.92	3.00 m PP >500 kPa GTP03-02 3.00 m			Refusal on rock strength material @ 3.1 m			
			3.5				Groundwater not encountered TEST PIT DISCONTINUED @ 3.10 m				
			4.0								
			4.5								
		5.0									

Sketch & Other Observations



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GAP gINT FN. F03e
RL3



REPORT OF TEST PIT: GTP04

CLIENT: Western Desert Resources
PROJECT: Roper Bar Creek Realignment
LOCATION: Roper Bar
JOB NO: 127646013

POSITION:
COORDS: 506795.0 m E 8325527.0 m N MGA94 53
SURFACE RL: 21.81 m DATUM: AHD
PIT DEPTH: 2.80 m
BUCKET TYPE: 1500 mm Toothed

SHEET: 1 OF 1
MACHINE: CAT 325 D L Excavator
CONTRACTOR: WDR
LOGGED: AT DATE: 2/6/12
CHECKED: TH DATE: 15/6/12

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L-M		0.0	21.71	PP U 0.00-2.80 m Rec = /2800 mm			CL	Sandy CLAY, low plasticity, brown, fine grained sand, inferred topsoil	D	Fb	Grass on surface
			CL	Sandy CLAY, low plasticity, pale brown, fine grained sand						0.0-0.4 m fine roots and organic matter		
	0.5		21.31	CH				CLAY, high plasticity, mottled brown, orange brown, grey and red brown, trace fine grained sand	M (<PL)	F - St		
	1.0		1.00 m PP <50=100 kPa									
	M		2.0	2.00 m PP =100=400 kPa				St - VSt				
H-R	2.5	19.51	CL	Recovered as a mixture of SOIL (80%) and ROCK (20%)	D		2.3-2.8 m - Recovered as granular material					
		2.80 19.01		SOIL is: Sandy CLAY, low plasticity, grey brown, fine to coarse grained sand, with fine to coarse gravel, angular								
			3.0		GTP04-01 2.60-2.80 m Rec = /200 mm			ROCK is: LATERITIC SANDSTONE/SILTSTONE, fine to medium grained, granular, low strength, highly weathered, recovered as angular 'sheet-like' rock				
			3.5					Refusal @ 2.8 m				
			4.0					Groundwater not encountered				
			4.5					TEST PIT DISCONTINUED @ 2.80 m				
			5.0									

Sketch & Other Observations



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GAP gINT FN. F03e
RL3



REPORT OF TEST PIT: GTP05

CLIENT: Western Desert Resources
PROJECT: Roper Bar Creek Realignment
LOCATION: Roper Bar
JOB NO: 127646013

POSITION:
COORDS: 507232.0 m E 8325571.0 m N MGA94 53
SURFACE RL: 21.47 m DATUM: AHD
PIT DEPTH: 2.10 m
BUCKET TYPE: 1500 mm Toothed

SHEET: 1 OF 1
MACHINE: CAT 325 D L Excavator
CONTRACTOR: WDR
LOGGED: AT DATE: 2/6/12
CHECKED: TH DATE: 15/6/12

Excavation				Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L-M		0.0	21.47	PP U 0.00-2.10 m Rec = /2100 mm			CH	CLAY, high plasticity, orange brown with red brown staining with fine grained sand, trace fine gravel laterite nodules	St	Grass on surface
			0.50	20.97				CH	CLAY, high plasticity, mottled grey, orange brown, with fine sand		0-0.4 m - fine roots
	M		1.0		1.00 m PP =200-300 kPa				Increasing sand and gravel content with depth, with fine to coarse sand, with fine to medium gravel	M (<PL)	Sand and gravel sized particles are laterite pisolites
	H-R		1.90	19.57	1.80 m PP =400-500 kPa GTP05-01 1.80 m			CI	Recovered as a mixture of SOIL(80%) and ROCK (20%)	D	1.9-2.1 m - Recovered as granular material
			2.10	19.37					SOIL is Sandy CLAY, medium to high plasticity, orange pale brown, fine to coarse grained sand, trace fine to medium gravel laterite nodules ROCK is LATERISED SANDSTONE/SILTSTONE, fine to medium grained, granular, massive, pale grey, brown and red brown, low strength, highly weathered, pisolite nodules within rock material Refusal @ 2.1 m Groundwater not encountered Additional excavation adjacent with backhoe which refused @ 2.1 m also TEST PIT DISCONTINUED @ 2.10 m		
			2.5								
			3.0								
			3.5								
			4.0								
			4.5								
			5.0								

Sketch & Other Observations



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GAP gINT FN. F03e
RL3



REPORT OF TEST PIT: GTP06

CLIENT: Western Desert Resources
PROJECT: Roper Bar Creek Realignment
LOCATION: Roper Bar
JOB NO: 127646013

POSITION:
COORDS: 507808.0 m E 8325607.0 m N MGA94 53
SURFACE RL: 21.00 m DATUM: AHD
PIT DEPTH: 1.80 m
BUCKET TYPE: 450 mm Toothed

SHEET: 1 OF 1
MACHINE: CAT 432E Backhoe
CONTRACTOR: WDR
LOGGED: AT DATE: 2/6/12
CHECKED: TH DATE: 15/6/12

Excavation					Sampling		Field Material Description						
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION		MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L		0.0	21.00	PP U 0.00-1.80 m Rec = /1800 mm GTP06-01 0.20 m 0.60 m PP <50 kPa 1.20-1.70 m PP <50 kPa GTP06-02 BDS 1.30-1.50 m Rec = /200 mm			SM	Silty SAND, fine grained, grey brown, low liquid limit fines	D	L	Grass on surface 0.0-0.3 - Roots and organic matter 	

Sketch & Other Observations



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GAP gINT FN. F03e
RL3



REPORT OF TEST PIT: GTP07

CLIENT: Western Desert Resources
 PROJECT: Roper Bar Creek Realignment
 LOCATION: Roper Bar
 JOB NO: 127646013

POSITION:
 COORDS: 508274.0 m E 8325645.0 m N MGA94 53
 SURFACE RL: 21.00 m DATUM: AHD
 PIT DEPTH: 2.80 m
 BUCKET TYPE: 450 mm Toothed

SHEET: 1 OF 1
 MACHINE: CAT 432E Backhoe
 CONTRACTOR: WDR
 LOGGED: AT DATE: 2/6/12
 CHECKED: TH DATE: 15/6/12

Excavation				Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L-M		0.0	21.00	PP U 0.00-2.80 m Rec = /2800 mm			CL	CLAY, low plasticity, yellow brown, with fine grained sand	M	Grass on surface
			0.30	20.70				CH	CLAY, high plasticity, mottled yellow brown, orange and red brown, with fine and coarse sand, coarse sand sized particles are laterite pisolites	Vst-H	
			0.5								
	M-H		1.0		1.00-1.50 m PP =100-250 kPa					St-Vst	
			1.5								
			2.0		2.00 m PP =150-250 kPa GTP07-01 2.00 m						
			2.40	18.60				CL	Mixture of SOIL (80%) and ROCK (20%)	D	2.4 m - Rock recovered as fine to coarse grained, gravel to cobble sized
			2.80	18.20	GTP07-02 2.80 m				SOIL is Sandy CLAY, low plasticity, orange brown grey and red brown, fine grained sand		Soil and laterite nodules can be broken down with strong hand pressure
			3.0						ROCK is LATERITE, fine grained, grey, orange brown, red brown, granular, massive, very low strength, highly weathered		
			3.5						Ground water not encountered TEST PIT DISCONTINUED @ 2.80 m		

Sketch & Other Observations



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GAP gINT FN. F03e
 RL3



REPORT OF TEST PIT: GTP08

CLIENT: Western Desert Resources
PROJECT: Roper Bar Creek Realignment
LOCATION: Roper Bar
JOB NO: 127646013

POSITION:
COORDS: 508576.0 m E 8325727.0 m N MGA94 53
SURFACE RL: 20.70 m DATUM: AHD
PIT DEPTH: 2.30 m
BUCKET TYPE: 450 mm Toothed

SHEET: 1 OF 1
MACHINE: CAT 432E Backhoe
CONTRACTOR: WDR
LOGGED: AT DATE: 2/6/12
CHECKED: TH DATE: 15/6/12

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L-M		0.0	20.70	PP U 0.00-2.30 m Rec = /2300 mm 0.20 m PP =400=500 kPa 1.30 m PP =50=75 kPa 2.00 m PP =50=300 kPa GTP08-01 2.10 m 2.50 m PP =100=400 kPa							

Sketch & Other Observations



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GAP gINT FN. F03e
RL3



REPORT OF TEST PIT: GTP09

CLIENT: Western Desert Resources
PROJECT: Roper Bar Creek Realignment
LOCATION: Roper Bar
JOB NO: 127646013

POSITION:
COORDS: 509131.0 m E 8325694.0 m N MGA94 53
SURFACE RL: 20.29 m DATUM: AHD
PIT DEPTH: 2.20 m
BUCKET TYPE: 450 mm Toothed

SHEET: 1 OF 1
MACHINE: CAT 432E Backhoe
CONTRACTOR: WDR
LOGGED: AT DATE: 3/6/12
CHECKED: TH DATE: 15/6/12

Excavation				Sampling		Field Material Description						
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L		0.0	20.29	PP			CH	CLAY, high plasticity, pale brown, with fine grained sand	D	H	Grass on surface
			0.30	19.99	U 0.00-2.20 m Rec = /2200 mm 0.20 m PP =400 kPa			CH	CLAY, high plasticity, mottled brown, red brown, grey and orange brown, with fine grained sand			0.0-0.2 m - fine roots
	M		0.5									
			1.0		1.00-1.50 m PP =150-400 kPa					M (<PL)	St - VSt	
			1.5		GTP09-01 1.50 m							
	H-R		2.0	2.00				CI	Recovered as a mixture of SOIL (80%) and ROCK (20%)	D - M	Fb	2.0-2.2 m - laterite rock in tabular form - cobble sized
			2.0	18.29	GTP09-02 2.00-2.20 m Rec = /200 mm							
			2.0	18.09								
			2.5						SOIL is a Sandy CLAY, medium to high plasticity, orange pale brown, fine to coarse sand, trace fine to medium gravel laterite nodules			
			3.0						ROCK is LATERISED SANDSTONE/SILTSTONE, fine to medium grained, granular massive, pale grey, brown and red brown, low strength, highly weathered, pisolite nodules within rock material			
			3.5						Refusal @ 2.2 m			
			4.0						Groundwater not encountered			
			4.5						TEST PIT DISCONTINUED @ 2.20 m			
			5.0									

Sketch & Other Observations



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GAP gINT FN. F03e
RL3



REPORT OF TEST PIT: GTP10

CLIENT: Western Desert Resources
PROJECT: Roper Bar Creek Realignment
LOCATION: Roper Bar
JOB NO: 127646013

POSITION:
COORDS: 509219.0 m E 8325692.0 m N MGA94 53
SURFACE RL: 20.05 m DATUM: AHD
PIT DEPTH: 2.50 m
BUCKET TYPE: 450 mm Toothed

SHEET: 1 OF 1
MACHINE: CAT 432E Backhoe
CONTRACTOR: WDR
LOGGED: AT DATE: 3/6/12
CHECKED: TH DATE: 15/6/12

Excavation				Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L	▽	0.0	20.05	PP	X	X	ML	Sandy SILT, low liquid limit, brown, fine grained sand	D - M	Thick grasses on surface
			0.30	19.75	U 0.00-2.50 m Rec = /2500 mm 0.10 m PP <50 kPa			CH	Sandy CLAY, high plasticity, grey, orange and red brown, fine grained sand	F - St	0.0-0.2 m - Roots and organic material
H-R	X	03/06/12	0.5		0.50 m PP =50-100 kPa						Pit walls collapsing below 1.0 m
			1.0		1.00-2.00 m PP <50 kPa					M (>PL)	
			1.5							S - F	
			2.0								
			2.30	17.75	GTP10-01 2.00 m			CL	Recovered as a mixture of SOIL and ROCK	D - M	Recovered as granular material
			2.50	17.55					SOIL is Sandy CLAY, low plasticity, grey brown, fine to coarse grained sand, with fine to medium gravel		Gravel is laterite pisolites
			3.0						ROCK is LATERISED SANDSTONE/SILTSTONE, fine to medium grained, granular, massive, low to medium strength, highly weathered, recovered as gravel and cobbles		
			3.5						Terminated @ 2.5 m		
			4.0						Groundwater inflow encountered @ 1.5 m. Groundwater pooling in base of test pit		
			4.5						TEST PIT DISCONTINUED @ 2.50 m		
			5.0								

Sketch & Other Observations



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GAP gINT FN. F03e
RL3



REPORT OF TEST PIT: GTP11

CLIENT: Western Desert Resources
PROJECT: Roper Bar Creek Realignment
LOCATION: Roper Bar
JOB NO: 127646013

POSITION:
COORDS: 505422.0 m E 8325514.0 m N MGA94 53
SURFACE RL: 26.83 m DATUM: AHD
PIT DEPTH: 6.00 m
BUCKET TYPE: 1500 mm Toothed

SHEET: 1 OF 2
MACHINE: CAT 325 D L Excavator
CONTRACTOR: WDR
LOGGED: AT DATE: 3/6/12
CHECKED: TH DATE: 15/6/12

Excavation				Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L		0.0	26.83	PP U 0.00-3.00 m Rec = /3000 mm		x x x	SM	Silty SAND, fine grained, dark grey brown, low liquid limit fines, topsoil	L	Grass on surface
			0.30	26.53			x x x	SM	Silty SAND, fine to medium grained, pale brown, with orange brown staining, low liquid limit fines		0.0-0.5 - Fine to medium sized roots
	M-H		0.5				x x x				
			1.0				x x x				
			1.5	1.50			x x x				
EX			1.5	25.33			o o o	CH	Gravelly CLAY, high plasticity, mottled grey, orange brown and red brown, fine to medium gravel, with fine to coarse grained sand, gravel is sub-rounded		1.5-6.0 m - Gravel and sand nodules are lateritic pisolites and hard clay nodules. Clay nodules can be broken down when worked with water
			2.0		2.00 m PP >500 kPa		o o o				2.0-6.0 m - Material excavated in clods - gravel to cobble sized
	H-R		2.5				o o o				
			3.0				o o o				
			3.5		3.00 m PP >500 kPa GTP11-02 3.00 m		o o o				
EX			4.0	4.00			o o o	CH	Gravelly CLAY, high plasticity, mottled grey, purple, black and orange brown, fine to medium gravel with fine to coarse sand, gravel is sub-rounded	H	2.5 m - Minor side wall slumping
	H		4.5	22.83			o o o				
			5.0				o o o				

Sketch & Other Observations



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GAP gINT FN. F03e
RL3



REPORT OF TEST PIT: GTP11

CLIENT: Western Desert Resources
PROJECT: Roper Bar Creek Realignment
LOCATION: Roper Bar
JOB NO: 127646013

POSITION:
COORDS: 505422.0 m E 8325514.0 m N MGA94 53
SURFACE RL: 26.83 m DATUM: AHD
PIT DEPTH: 6.00 m
BUCKET TYPE: 1500 mm Toothed

SHEET: 2 OF 2
MACHINE: CAT 325 D L Excavator
CONTRACTOR: WDR
LOGGED: AT DATE: 3/6/12
CHECKED: TH DATE: 15/6/12

Excavation				Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	H		5.0		GTP11-03 5.00 m			CH	Gravelly CLAY, high plasticity, mottled grey, purple, black and orange brown, fine to medium gravel with fine to coarse sand, gravel is sub-rounded	D	H
			6.0	6.00 20.83					Test pit terminated @ 6.0 m due to burst excavator hydraulic hose Groundwater not encountered Excavation walls remaining vertical TEST PIT DISCONTINUED @ 6.00 m		
			6.5								
			7.0								
			7.5								
			8.0								
			8.5								
			9.0								
			9.5								
			10.0								

Sketch & Other Observations



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GAP gINT FN. F03e
RL3



REPORT OF TEST PIT: GTP12

CLIENT: Western Desert Resources
PROJECT: Roper Bar Creek Realignment
LOCATION: Roper Bar
JOB NO: 127646013

POSITION:
COORDS: 507501.0 m E 8325627.0 m N MGA94 53
SURFACE RL: 21.00 m DATUM: AHD
PIT DEPTH: 2.30 m
BUCKET TYPE: 450 mm Toothed

SHEET: 1 OF 1
MACHINE: CAT 432E Backhoe
CONTRACTOR: WDR
LOGGED: AT DATE: 3/6/12
CHECKED: TH DATE: 15/6/12

Excavation				Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L		0.0	20.90	PP U 0.00-2.30 m Rec = /2300 mm 0.10 m PP >500 kPa 0.30 m PP >500 kPa			CL CH	Sandy CLAY, low plasticity, dark grey brown, fine grained sand, topsoil	D Fb	Grass on surface
			0.5						CLAY, medium to high plasticity, mottled pale brown, orange brown and red brown, with fine to coarse grained sand		0.0-0.2 m - fine roots
	M-H		1.0							D - M Fb - H	
			1.5	1.60 19.40	GTP12-01 1.50 m			CL	Gravelly CLAY, low plasticity, mottled pale brown and orange brown, fine to medium gravel, with fine to coarse grained sand	D Fb	
	H-R		2.0	2.20				CL	Mixture of SOIL (80%) and ROCK (20%)		
			2.5	18.70					SOIL is Gravelly CLAY, low plasticity, mottled pale brown and orange brown, fine to medium gravel, with fine to coarse grained sand		
			3.0						ROCK is LATERISED SANDSTONE/SILTSTONE, fine to medium grained, granular, mottled grey, brown, orange brown, red, black, low strength, highly weathered		
			3.5						Refusal @ 2.3 m		
			4.0						Groundwater not encountered		
			4.5						TEST PIT DISCONTINUED @ 2.30 m		
			5.0								

Sketch & Other Observations



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GAP gINT FN. F03e
RL3



REPORT OF TEST PIT: GTP13

CLIENT: Western Desert Resources
PROJECT: Roper Bar Creek Realignment
LOCATION: Roper Bar
JOB NO: 127646013

POSITION:
COORDS: 508749.0 m E 8325727.0 m N MGA94 53
SURFACE RL: 20.45 m DATUM: AHD
PIT DEPTH: 2.30 m
BUCKET TYPE: 450 mm Toothed

SHEET: 1 OF 1
MACHINE: CAT 432E Backhoe
CONTRACTOR: WDR
LOGGED: AT DATE: 3/6/12
CHECKED: TH DATE: 15/6/12

Excavation				Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L		0.0	20.35	PP U 0.00-2.30 m Rec = /2300 mm 0.10 m PP =150-200 kPa			CL CH	Sandy CLAY, low plasticity, dark grey brown, fine grained sand CLAY, high plasticity, mottled pale brown, red brown and orange brown, with fine to medium grained sand	D F	Grass on surface 0.0-0.2 m fine roots
	M		0.5								
			1.0		1.00 m PP =300-500 kPa					M (<PL)	VSt-H
	H-R		2.0	18.45	1.50 m PP =350-500 kPa			CL	Mixture of SOIL (80%) and ROCK (20%)	D	Recovered as granular material - gravel to cobble sized
			2.30	18.15					SOIL is Gravelly CLAY, low plasticity, mottled pale brown and orange brown, fine to medium gravel, with fine to coarse grained sand ROCK is LATERISED SANDSTONE/SILTSTONE, fine to medium grained, granular, mottled grey, brown, orange brown, red, black, low strength, highly weathered Refusal @ 2.3 m Groundwater not encountered TEST PIT DISCONTINUED @ 2.30 m		
			2.5								
			3.0								
			3.5								
			4.0								
			4.5								
			5.0								

Sketch & Other Observations



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GAP gINT FN. F03e
RL3



REPORT OF TEST PIT: GTP14

CLIENT: Western Desert Resources
 PROJECT: Roper Bar Creek Realignment
 LOCATION: Roper Bar
 JOB NO: 127646013

POSITION:
 COORDS: 505945.0 m E 8325553.0 m N MGA94 53
 SURFACE RL: 24.39 m DATUM: AHD
 PIT DEPTH: 3.40 m
 BUCKET TYPE: 450 mm Toothed

SHEET: 1 OF 1
 MACHINE: CAT 432E Backhoe
 CONTRACTOR: WDR
 LOGGED: AT DATE: 4/6/12
 CHECKED: TH DATE: 15/6/12

Excavation					Sampling		Field Material Description						
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY	DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L		0.0	0.10 24.29				SM	Silty SAND, fine to medium grained, dark grey brown, low liquid limit fines, topsoil	D	L	Grass on surface 0.0-0.3 m - Fine to medium roots <	

Sketch & Other Observations



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GAP gINT FN. F03e
 RL3



REPORT OF TEST PIT: GTP15

CLIENT: Western Desert Resources
PROJECT: Roper Bar Creek Realignment
LOCATION: Roper Bar
JOB NO: 127646013

POSITION:
COORDS: 505851.0 m E 8325548.0 m N MGA94 53
SURFACE RL: 26.19 m DATUM: AHD
PIT DEPTH: 4.10 m
BUCKET TYPE: 450 mm Toothed

SHEET: 1 OF 1
MACHINE: CAT 432E Backhoe
CONTRACTOR: WDR
LOGGED: AT DATE: 4/6/12
CHECKED: TH DATE: 15/6/12

Excavation					Sampling		Field Material Description				
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L		0.0	26.19	GTP15-01 1.00-1.10 m Rec = /100 mm			SC	Clayey SAND, fine to medium grain, grey brown, low plasticity fines	D	Grass on surface
			0.50	25.69				GC	Clayey GRAVEL, fine to coarse, pale brown, orange brown and red brown, low plasticity fines, rounded gravel	D	0.0-0.3 m - Small to medium roots
	M-H		1.0	25.09				CH	CLAY, high plasticity, mottled grey, red brown and orange brown, with fine grained sand	D - M	
			1.5	24.59				CH	Mixture of SOIL (80%) and ROCK (20%)		
			2.0						SOIL is CLAY, high plasticity, mottled grey, red brown and orange brown, with fine grain sand		
			2.5						ROCK is LATERISED SILTSTONE, fine grained, granular, layered, red brown with orange brown and black staining, highly weathered, low strength	H	
	M		3.0							D	
			3.5								
			4.0	4.10							
			4.5	22.09					Test pit terminated @ 4.1 m at limit of backhoe		
									Groundwater not encountered TEST PIT DISCONTINUED @ 4.10 m		

Sketch & Other Observations



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GAP gINT FN. F03e
RL3

EXPLANATION OF NOTES, ABBREVIATIONS & TERMS USED ON BOREHOLE AND TEST PIT REPORTS

DRILLING/EXCAVATION METHOD

AS*	Auger Screwing	RD	Rotary blade or drag bit	NQ	Diamond Core - 47 mm
AD*	Auger Drilling	RT	Rotary Tricone bit	NMLC	Diamond Core - 52 mm
*V	V-Bit	RAB	Rotary Air Blast	HQ	Diamond Core - 63 mm
*T	TC-Bit, e.g. ADT	RC	Reverse Circulation	HMLC	Diamond Core - 63mm
HA	Hand Auger	PT	Push Tube	BH	Tractor Mounted Backhoe
ADH	Hollow Auger	CT	Cable Tool Rig	EX	Tracked Hydraulic Excavator
DTC	Diatube Coring	JET	Jetting	EE	Existing Excavation
WB	Washbore or Bailer	NDD	Non-destructive digging	HAND	Excavated by Hand Methods

PENETRATION/EXCAVATION RESISTANCE

- L Low resistance.** Rapid penetration possible with little effort from the equipment used.
- M Medium resistance.** Excavation/possible at an acceptable rate with moderate effort from the equipment used.
- H High resistance** to penetration/excavation. Further penetration is possible at a slow rate and requires significant effort from the equipment.
- R Refusal or Practical Refusal.** No further progress possible without the risk of damage or unacceptable wear to the digging implement or machine.

These assessments are subjective and are dependent on many factors including the equipment power, weight, condition of excavation or drilling tools, and the experience of the operator.

WATER



Water level at date shown



Partial water loss



Water inflow



Complete water loss

GROUNDWATER NOT OBSERVED The observation of groundwater, whether present or not, was not possible due to drilling water, surface seepage or cave in of the borehole/test pit.

GROUNDWATER NOT ENCOUNTERED The borehole/test pit was dry soon after excavation. However, groundwater could be present in less permeable strata. Inflow may have been observed had the borehole/test pit been left open for a longer period.

SAMPLING AND TESTING

SPT	Standard Penetration Test to AS1289.6.3.1-2004
4,7,11 N=18	4,7,11 = Blows per 150mm. N = Blows per 300mm penetration following 150mm seating
30/80mm	Where practical refusal occurs, the blows and penetration for that interval are reported
RW	Penetration occurred under the rod weight only
HW	Penetration occurred under the hammer and rod weight only
HB	Hammer double bouncing on anvil
DS	Disturbed sample
BDS	Bulk disturbed sample
G	Gas Sample
W	Water Sample
FP	Field permeability test over section noted
FV	Field vane shear test expressed as uncorrected shear strength (s_v = peak value, s_r = residual value)
PID	Photoionisation Detector reading in ppm
PM	Pressuremeter test over section noted
PP	Pocket penetrometer test expressed as instrument reading in kPa
U63	Thin walled tube sample - number indicates nominal sample diameter in millimetres
WPT	Water pressure tests
DCP	Dynamic cone penetration test
CPT	Static cone penetration test
CPTu	Static cone penetration test with pore pressure (u) measurement

Ranking of Visually Observable Contamination and Odour (for specific soil contamination assessment projects)

R = 0	No visible evidence of contamination	R = A	No non-natural odours identified
R = 1	Slight evidence of visible contamination	R = B	Slight non-natural odours identified
R = 2	Visible contamination	R = C	Moderate non-natural odours identified
R = 3	Significant visible contamination	R = D	Strong non-natural odours identified

ROCK CORE RECOVERY

TCR = Total Core Recovery (%)

SCR = Solid Core Recovery (%)

RQD = Rock Quality Designation (%)

$$= \frac{\text{Length of core recovered}}{\text{Length of core run}} \times 100$$

$$= \frac{\sum \text{Length of cylindrical core recovered}}{\text{Length of core run}} \times 100$$

$$= \frac{\sum \text{Axial lengths of core} > 100 \text{ mm}}{\text{Length of core run}} \times 100$$



METHOD OF SOIL DESCRIPTION USED ON BOREHOLE AND TEST PIT REPORTS



FILL



GRAVEL (GP or GW)



SAND (SP or SW)



SILT (ML or MH)



CLAY (CL, CI or CH)



ORGANIC SOILS (OL or OH or Pt)



COBBLES or BOULDERS

Combinations of these basic symbols may be used to indicate mixed materials such as sandy clay.

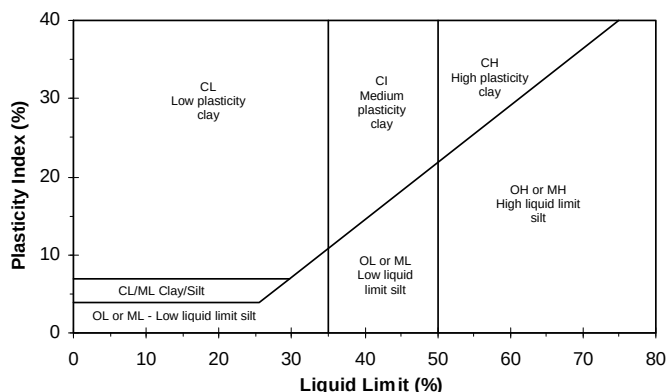
CLASSIFICATION AND INFERRED STRATIGRAPHY

Soil and Rock is classified and described in Reports of Boreholes and Test Pits using the preferred method given in AS1726 – 1993, (Amdt1 – 1994 and Amdt2 – 1994), Appendix A. The material properties are assessed in the field by visual/tactile methods.

Particle Size

Major Division	Sub Division	Particle Size
BOULDERS		> 200 mm
COBBLES		63 to 200 mm
GRAVEL	Coarse	20 to 63 mm
	Medium	6.0 to 20 mm
	Fine	2.0 to 6.0 mm
SAND	Coarse	0.6 to 2.0 mm
	Medium	0.2 to 0.6 mm
	Fine	0.075 to 0.2 mm
SILT		0.002 to 0.075 mm
CLAY		< 0.002 mm

Plasticity Properties



MOISTURE CONDITION

AS1726 - 1993

Symbol	Term	Description
D	Dry	Sands and gravels are free flowing. Clays & Silts may be brittle or friable and powdery.
M	Moist	Soils are darker than in the dry condition & may feel cool. Sands and gravels tend to cohere.
W	Wet	Soils exude free water. Sands and gravels tend to cohere.

CONSISTENCY AND DENSITY

AS1726 - 1993

Symbol	Term	Undrained Shear Strength
VS	Very Soft	0 to 12 kPa
S	Soft	12 to 25 kPa
F	Firm	25 to 50 kPa
St	Stiff	50 to 100 kPa
VSt	Very Stiff	100 to 200 kPa
H	Hard	Above 200 kPa

Symbol	Term	Density Index %	SPT "N" #
VL	Very Loose	Less than 15	0 to 4
L	Loose	15 to 35	4 to 10
MD	Medium Dense	35 to 65	10 to 30
D	Dense	65 to 85	30 to 50
VD	Very Dense	Above 85	Above 50

In the absence of test results, consistency and density may be assessed from correlations with the observed behaviour of the material.

SPT correlations are not stated in AS1726 – 1993, and may be subject to corrections for overburden pressure and equipment type.



TERMS FOR ROCK MATERIAL STRENGTH & WEATHERING AND ABBREVIATIONS FOR DEFECT DESCRIPTIONS

STRENGTH

Symbol	Term	Point Load Index, $I_s(50)$ (MPa)	Field Guide
EL	Extremely Low	< 0.03	Easily remoulded by hand to a material with soil properties.
VL	Very Low	0.03 to 0.1	Material crumbles under firm blows with sharp end of pick; can be peeled with knife; too hard to cut a triaxial sample by hand. Pieces up to 30 mm can be broken by finger pressure.
L	Low	0.1 to 0.3	Easily scored with a knife; indentations 1 mm to 3 mm show in the specimen with firm blows of pick point; has dull sound under hammer. A piece of core 150 mm long by 50 mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.
M	Medium	0.3 to 1	Readily scored with a knife; a piece of core 150 mm long by 50 mm diameter can be broken by hand with difficulty.
H	High	1 to 3	A piece of core 150 mm long by 50 mm diameter cannot be broken by hand but can be broken with pick with a single firm blow; rock rings under hammer.
VH	Very High	3 to 10	Hand specimen breaks with pick after more than one blow; rock rings under hammer.
EH	Extremely High	>10	Specimen requires many blows with geological pick to break through intact material; rock rings under hammer.

ROCK STRENGTH TEST RESULTS

▼	Point Load Strength Index, $I_s(50)$, Axial test (MPa)
◀	Point Load Strength Index, $I_s(50)$, Diametral test (MPa)
Relationship between $I_s(50)$ and UCS (unconfined compressive strength) will vary with rock type and strength, and should be determined on a site-specific basis. UCS is typically 10 to 30 x $I_s(50)$, but can be as low as 5.	

ROCK MATERIAL WEATHERING

Symbol	Term	Field Guide
RS	Residual Soil	Soil developed on extremely weathered rock; the mass structure and substance fabric are no longer evident; there is a large change in volume but the soil has not been significantly transported.
EW	Extremely Weathered	Rock is weathered to such an extent that it has soil properties - i.e. it either disintegrates or can be remoulded, in water.
DW	HW	Rock strength usually changed by weathering. The rock may be highly discoloured, usually by iron staining. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores. In some environments it is convenient to subdivide into Highly Weathered and Moderately Weathered, with the degree of alteration typically less for MW.
	MW	
SW	Slightly Weathered	Rock is slightly discoloured but shows little or no change of strength relative to fresh rock.
FR	Fresh	Rock shows no sign of decomposition or staining.

ABBREVIATIONS FOR DEFECT TYPES AND DESCRIPTIONS

Defect Type	Coating or Infilling	Roughness
B Bedding parting	Cn Clean	Sl Slickensided
X Foliation	Sn Stain	Sm Smooth
C Contact	Vr Veneer	Ro Rough
L Cleavage	Ct Coating or Infill	
J Joint	Planarity	
SS/SZ Sheared seam/zone (Fault)	Pl Planar	Vertical Boreholes – The dip (inclination from horizontal) of the defect is given. Inclined Boreholes – The inclination is measured as the acute angle to the core axis.
CS/CZ Crushed seam/zone (Fault)	Un Undulating	
DS/DZ Decomposed seam/zone	St Stepped	
IS/IZ Infilled seam/zone		
S Schistosity		
V Vein		



APPENDIX C

Limitations (LEG04 RL1)

LIMITATIONS

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APPENDIX F

Limitations



LIMITATIONS

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