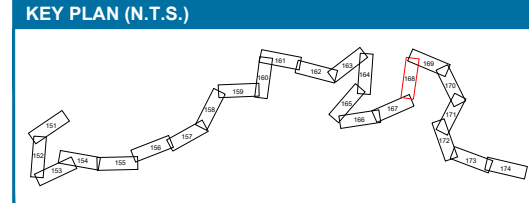


- NOTES**
- ALL DIMENSIONS IN METRES UNLESS NOTED OTHERWISE.
  - REFER DRAWING 1017353.2403-002 FOR GENERAL NOTES AND LEGEND.
  - REFER DRAWING 1017353.2403-311 FOR CULVERT DESIGN DETAILS. RIPRAP EROSION PROTECTION TO BE INSTALLED AT EVERY CULVERT OUTLET AND NOT SHOWN FOR CLARITY, REFER TO DRAWING 1017353.2403-313 FOR DETAILS.

**LEGEND**

**ID** HAZARD LOCATION - REFER TABLE 1

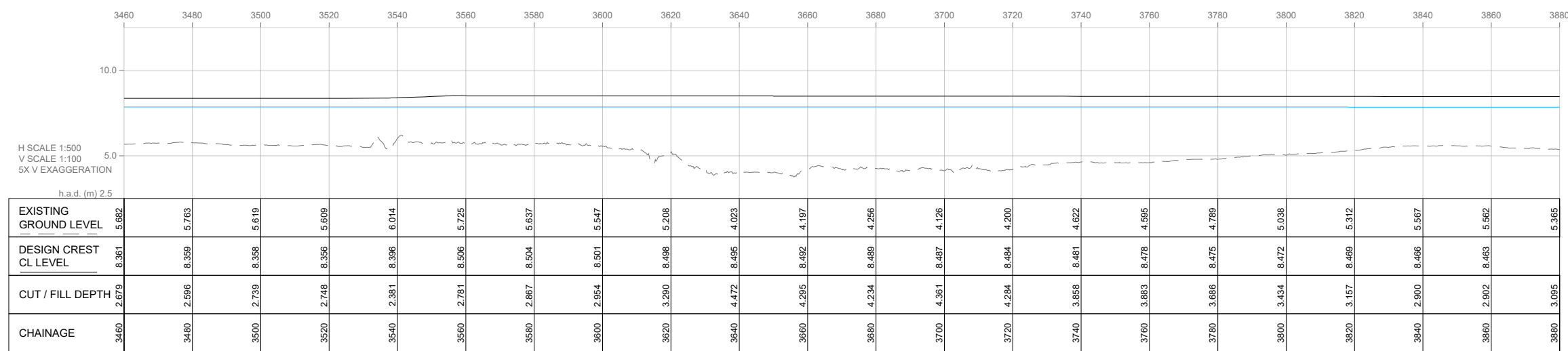
**STOPBANK PLAN**  
SCALE (A1) 1:500  
SCALE (A3) 1:1000



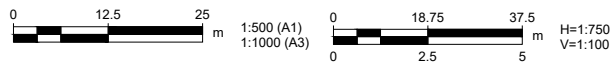
**TABLE 1: SITE HAZARDS TABLE**

| ID | DESCRIPTION                  |
|----|------------------------------|
| 5  | WORKS WITHIN STREAM REQUIRED |

NOTE: THIS TABLE IS NOT AN EXHAUSTIVE LIST OF HAZARDS BUT IS INTENDED TO HIGHLIGHT SITE RISKS IDENTIFIED DURING THE DESIGN TO AID THE CONTRACTOR IN THEIR HAZARD AND RISK ASSESSMENT.



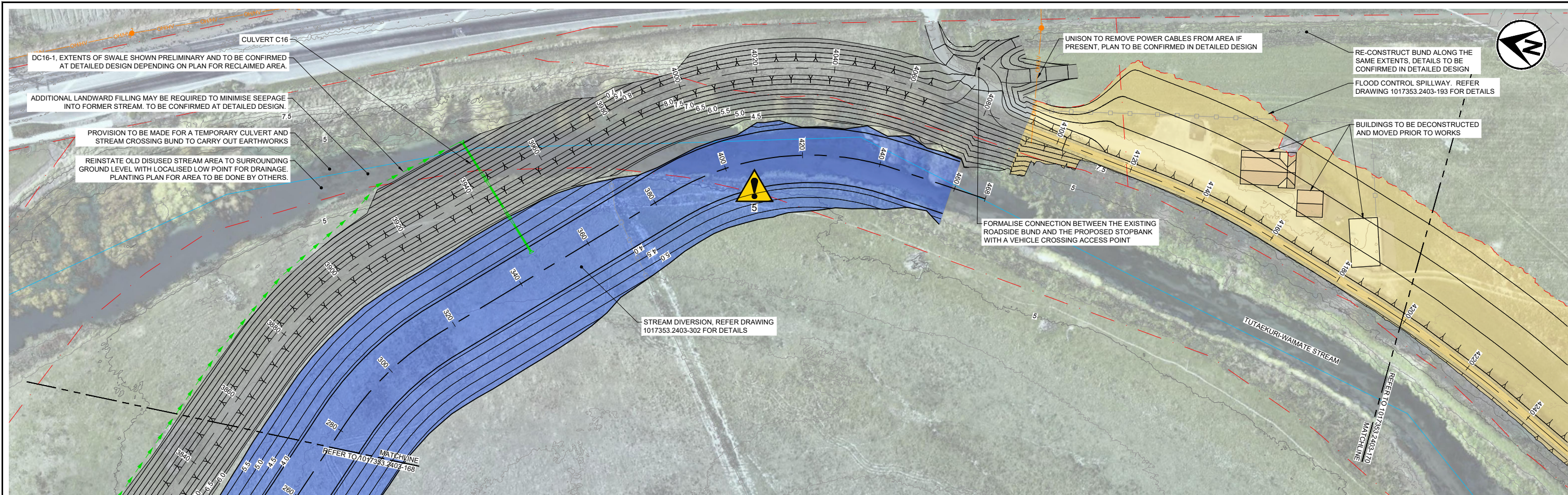
**STOPBANK LONG SECTION**  
SCALE (A1) 1:750 (H) 1:100 (V)  
SCALE (A3) 1:1500 (H) 1:200 (V)



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|                      |                    |      |      |          |  |      |        |                |                    |
|----------------------|--------------------|------|------|----------|--|------|--------|----------------|--------------------|
| 1                    | PRELIMINARY DESIGN | KATU | JEMC | 04.09.25 | DESIGNED   | JEMC | JUN.25 | DRAWING STATUS | PRELIMINARY DRAFT  |
|                      |                    |      |      |          | DRAWN  | KATU | JUN.25 | PROJECT PHASE  | PRELIMINARY DESIGN |
|                      |                    |      |      |          | DESIGN CHECKED   | JWY  | SEP.25 |                |                    |
|                      |                    |      |      |          | DRAWING CHECKED  | HUGO | SEP.25 |                |                    |
| NOT FOR CONSTRUCTION |                    |      |      |          | THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED |      |        |                |                    |
| REV                  | DESCRIPTION        | CAD  | CHK  | DATE     | APPROVED   | DATE |        |                |                    |

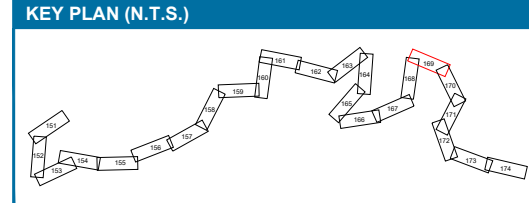
|                   |  |
|-------------------|--|
| <b>CLIENT</b>     | <b>HAWKE'S BAY REGIONAL COUNCIL</b>                                      |
| <b>PROJECT</b>    | <b>PĀKŌWHAI SECONDARY STOPBANK</b>                                       |
| <b>TITLE</b>      | <b>GENERAL ARRANGEMENT<br/>STOPBANK PLAN AND LONG SECTION - SHEET 18</b> |
| <b>SCALE (A1)</b> | <b>AS SHOWN</b>  |
| <b>DWG No.</b>    | <b>1017353.2403-168</b>  |
| <b>REV</b>        | <b>1</b>   |



- NOTES**
- ALL DIMENSIONS IN METRES UNLESS NOTED OTHERWISE.
  - REFER DRAWING 1017353.2403-002 FOR GENERAL NOTES AND LEGEND.
  - REFER DRAWING 1017353.2403-311 FOR CULVERT DESIGN DETAILS. RIPRAP EROSION PROTECTION TO BE INSTALLED AT EVERY CULVERT OUTLET AND NOT SHOWN FOR CLARITY, REFER TO DRAWING 1017353.2403-313 FOR DETAILS.

**LEGEND**

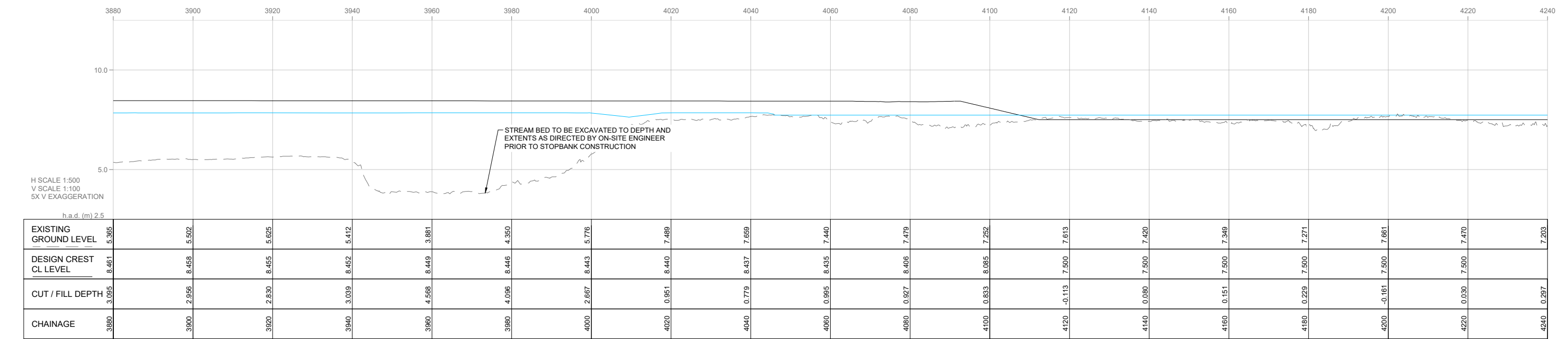
|    |                                 |
|----|---------------------------------|
|    | HAZARD LOCATION - REFER TABLE 1 |
| ID |                                 |



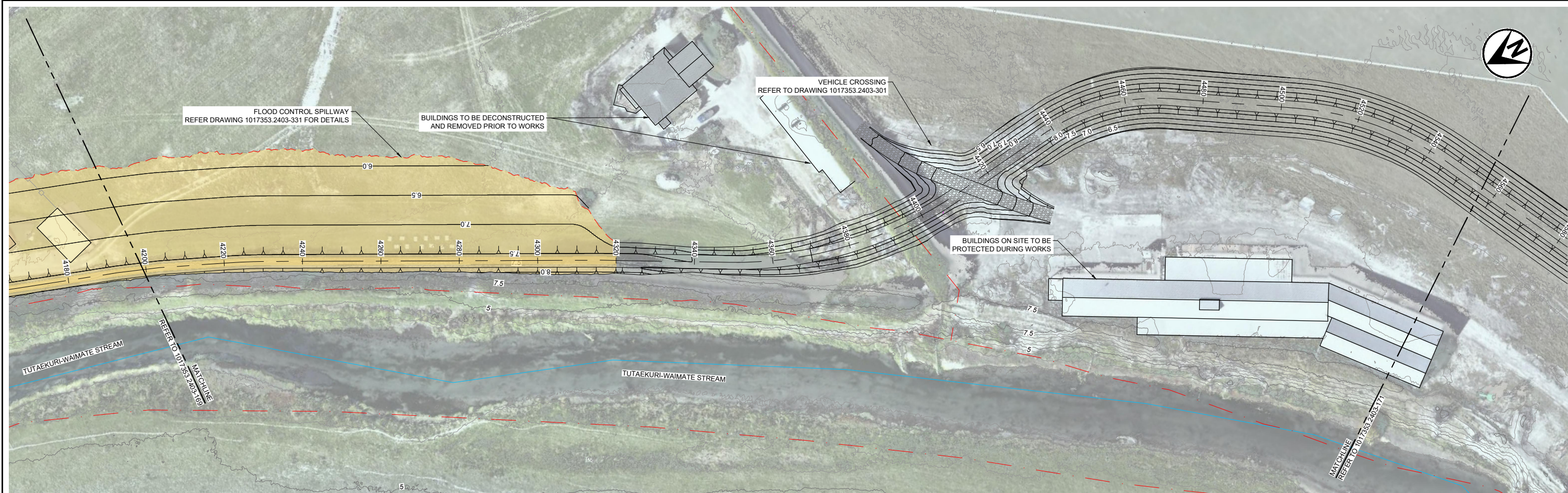
**TABLE 1: SITE HAZARDS TABLE**

| ID | DESCRIPTION                  |
|----|------------------------------|
| 5  | WORKS WITHIN STREAM REQUIRED |

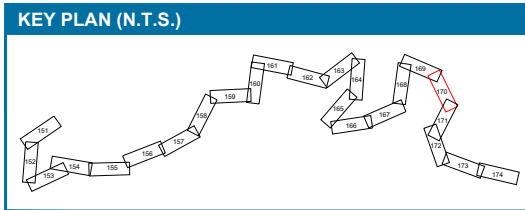
NOTE: THIS TABLE IS NOT AN EXHAUSTIVE LIST OF HAZARDS BUT IS INTENDED TO HIGHLIGHT SITE RISKS IDENTIFIED DURING THE DESIGN TO AID THE CONTRACTOR IN THEIR HAZARD AND RISK ASSESSMENT.



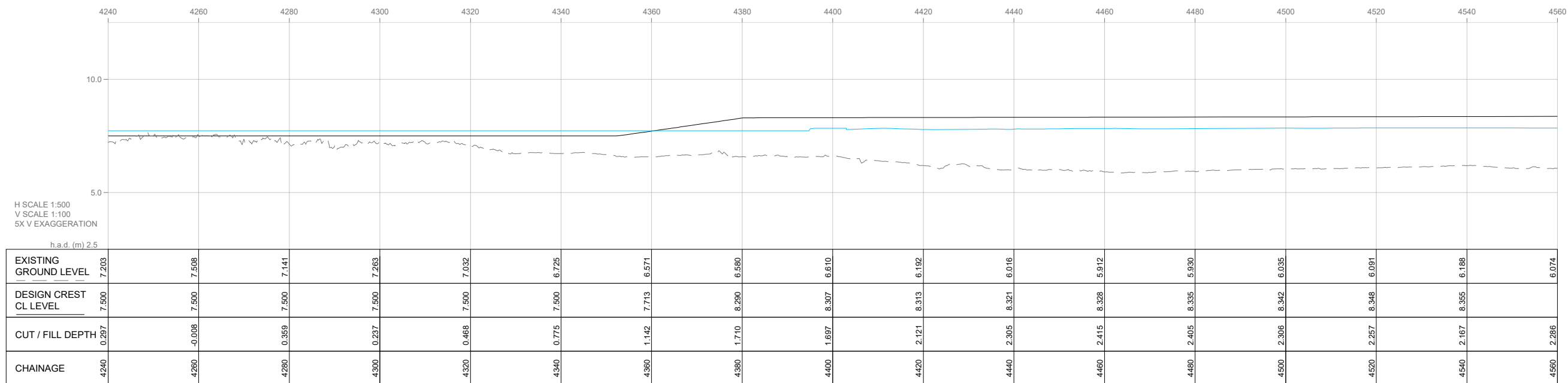
|                            |   |  |   |  |  |
|----------------------------|---|--|---|--|--|
| <br>www.tonkintaylor.co.nz | 1 PRELIMINARY DESIGN<br>REV DESCRIPTION | KATU JEMC<br>CAD CHK DATE  | DESIGNED JEMC JUN.25<br>DRAWN KATU JUN.25<br>DESIGN CHECKED JWY SEP.25<br>DRAWING CHECKED HUGO SEP.25 | DRAWING STATUS<br>PRELIMINARY DRAFT<br>PROJECT PHASE<br>PRELIMINARY DESIGN | CLIENT <b>HAWKE'S BAY REGIONAL COUNCIL</b><br>PROJECT <b>PĀKŌWHAI SECONDARY STOPBANK</b><br>TITLE GENERAL ARRANGEMENT<br>STOPBANK PLAN AND LONG SECTION - SHEET 19 |
|                            | NOT FOR CONSTRUCTION<br>APPROVED DATE   | THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED | SCALE (A1) AS SHOWN<br>DWG No. 1017353.2403-169   | REV 1  |  |



- NOTES**
1. ALL DIMENSIONS IN METRES UNLESS NOTED OTHERWISE.
  2. REFER DRAWING 1017353.2403-002 FOR GENERAL NOTES AND LEGEND.



**STOPBANK PLAN**  
SCALE (A1) 1:500  
SCALE (A3) 1:1000



**STOPBANK LONG SECTION**  
SCALE (A1) 1:500 (H) 1:100 (V)  
SCALE (A3) 1:1000 (H) 1:200 (V)



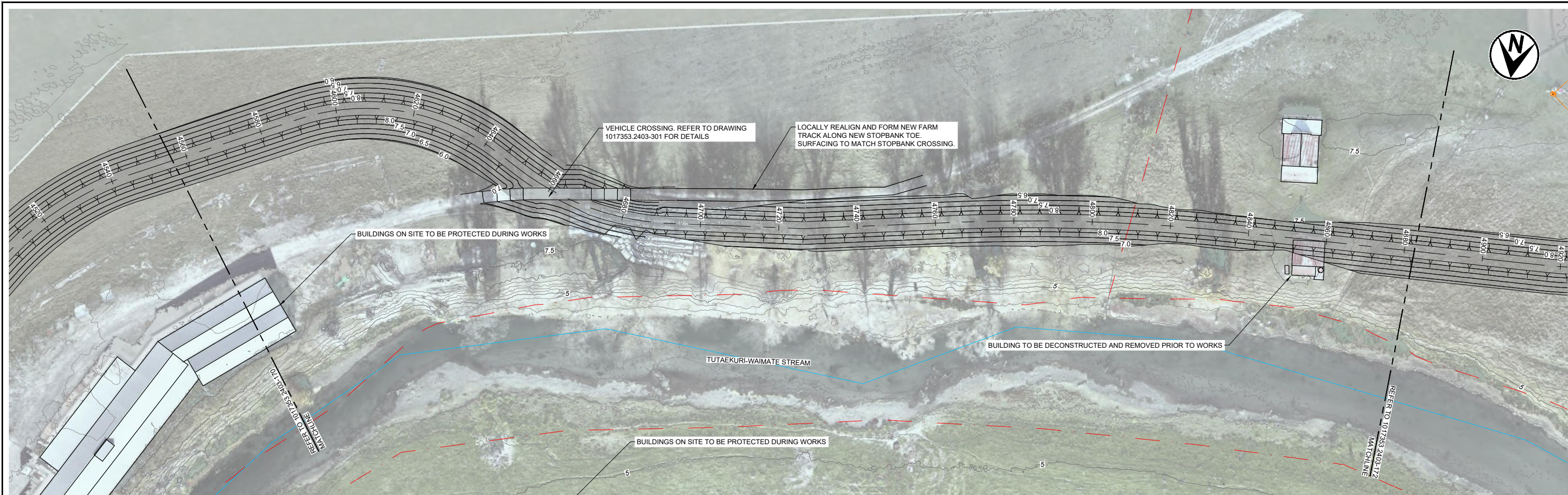
www.tonkintaylor.co.nz

| 1   | PRELIMINARY DESIGN | KATU | JEMC | 04.09.25 |
|-----|--------------------|------|------|----------|
| REV | DESCRIPTION        | CAD  | CHK  | DATE     |

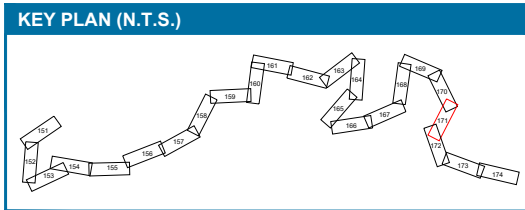
|                             |      |        |                |                    |
|-----------------------------|------|--------|----------------|--------------------|
| DESIGNED                    | JEMC | JUN.25 | DRAWING STATUS | PRELIMINARY DRAFT  |
| DRAWN                       | KATU | JUN.25 | PROJECT PHASE  | PRELIMINARY DESIGN |
| DESIGN CHECKED              | JWY  | SEP.25 |                |                    |
| DRAWING CHECKED             | HUGO | SEP.25 |                |                    |
| <b>NOT FOR CONSTRUCTION</b> |      |        |                |                    |
| APPROVED                    |      | DATE   |                |                    |

THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED

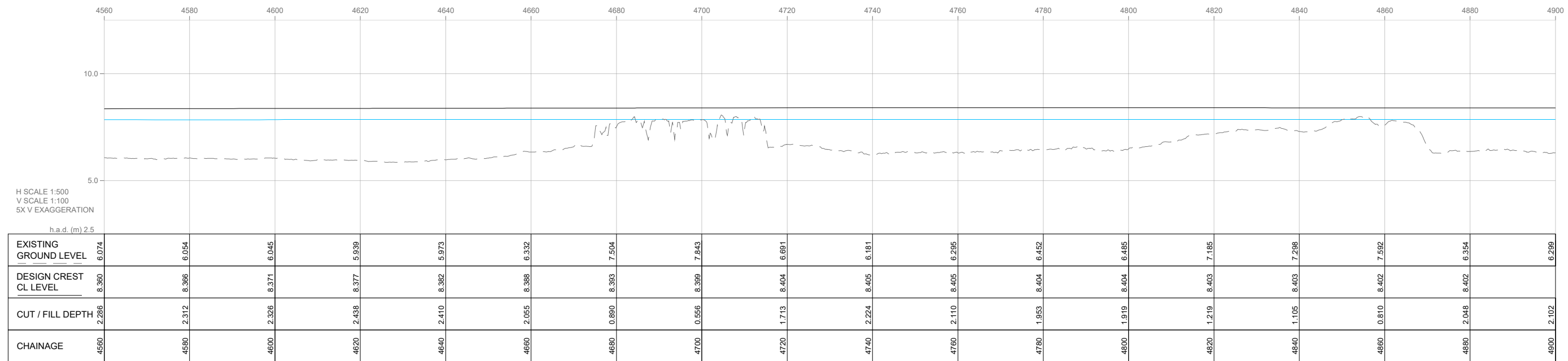
|            |  |
|------------|--|
| CLIENT     | <b>HAWKE'S BAY REGIONAL COUNCIL</b>                              |
| PROJECT    | <b>PĀKŌWHAII SECONDARY STOPBANK</b>                              |
| TITLE      | GENERAL ARRANGEMENT<br>STOPBANK PLAN AND LONG SECTION - SHEET 20 |
| SCALE (A1) | AS SHOWN   |
| DWG No.    | 1017353.2403-170   |
| REV        | 1  |



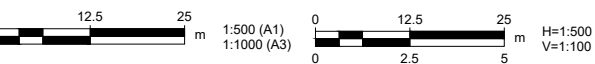
- NOTES**
1. ALL DIMENSIONS IN METRES UNLESS NOTED OTHERWISE.
  2. REFER DRAWING 1017353.2403-002 FOR GENERAL NOTES AND LEGEND.



**STOPBANK PLAN**  
SCALE (A1) 1:500  
SCALE (A3) 1:1000



**STOPBANK LONG SECTION**  
SCALE (A1) 1:500 (H) 1:100 (V)  
SCALE (A3) 1:1000 (H) 1:200 (V)



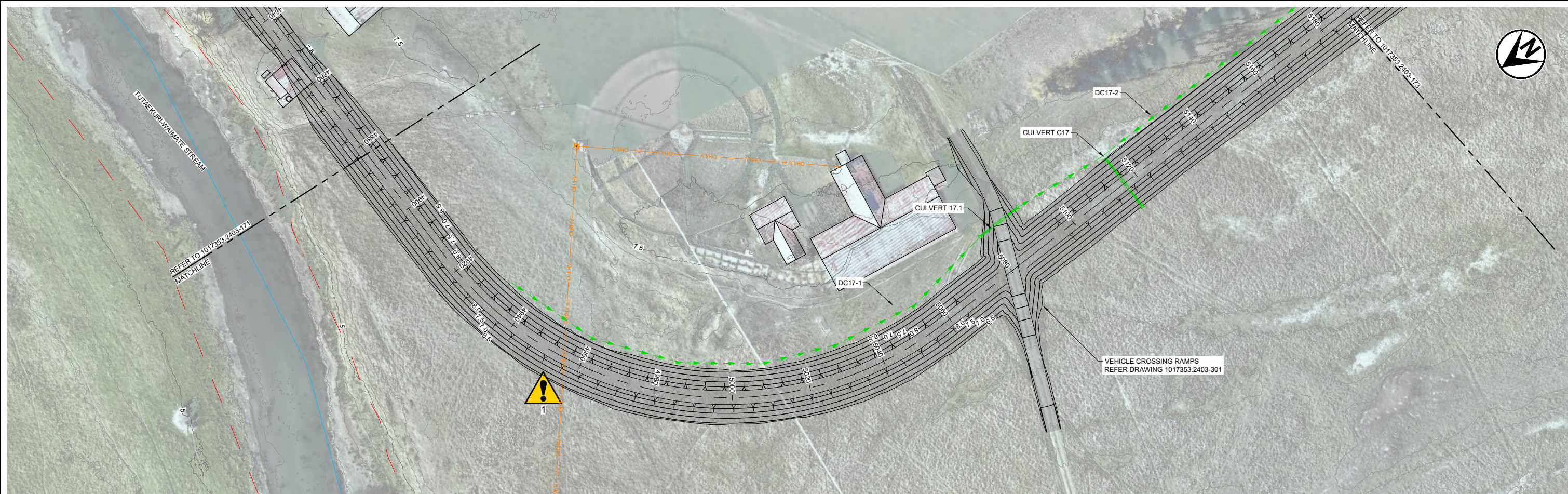
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| 1   | PRELIMINARY DESIGN | KATU | JEMC | 04.09.25 |
|-----|--------------------|------|------|----------|
| REV | DESCRIPTION        | CAD  | CHK  | DATE     |

|                             |      |        |                |                    |
|-----------------------------|------|--------|----------------|--------------------|
| DESIGNED                    | JEMC | JUN.25 | DRAWING STATUS | PRELIMINARY DRAFT  |
| DRAWN                       | KATU | JUN.25 | PROJECT PHASE  | PRELIMINARY DESIGN |
| DESIGN CHECKED              | JWY  | SEP.25 |                |                    |
| DRAWING CHECKED             | HUGO | SEP.25 |                |                    |
| <b>NOT FOR CONSTRUCTION</b> |      |        |                |                    |
| APPROVED DATE               |      |        |                |                    |

THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED

|            |  |
|------------|--|
| CLIENT     | <b>HAWKE'S BAY REGIONAL COUNCIL</b>                              |
| PROJECT    | <b>PĀKŌWHAI SECONDARY STOPBANK</b>                               |
| TITLE      | GENERAL ARRANGEMENT<br>STOPBANK PLAN AND LONG SECTION - SHEET 21 |
| SCALE (A1) | AS SHOWN   |
| DWG No.    | 1017353.2403-171   |
| REV        | 1  |



**NOTES**

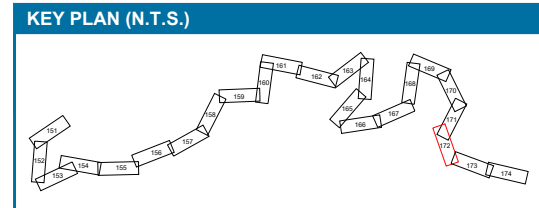
1. ALL DIMENSIONS IN METRES UNLESS NOTED OTHERWISE.
2. REFER DRAWING 1017353.2403-002 FOR GENERAL NOTES AND LEGEND.
3. REFER DRAWING 1017353.2403-311 FOR CULVERT DESIGN DETAILS. RIPRAP EROSION PROTECTION TO BE INSTALLED AT EVERY CULVERT OUTLET AND NOT SHOWN FOR CLARITY, REFER TO DRAWING 1017353.2403-313 FOR DETAILS.

**LEGEND**

HAZARD LOCATION - REFER TABLE 1

ID

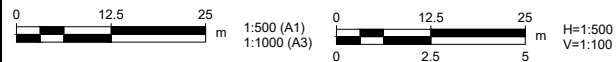
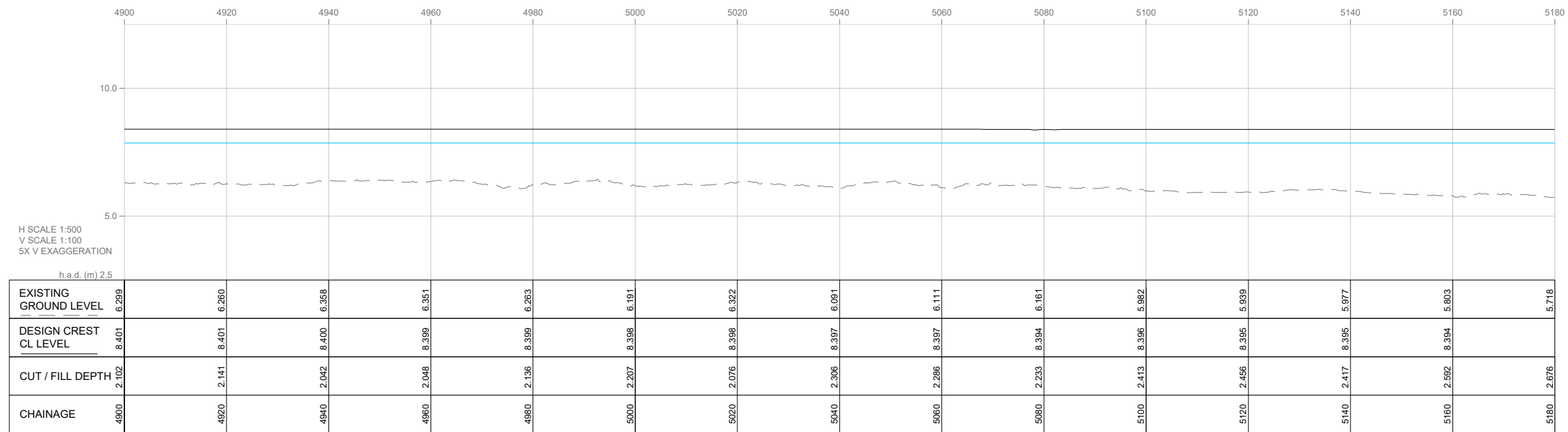
**STOPBANK PLAN**  
SCALE (A1) 1:500  
SCALE (A3) 1:1000



**TABLE 1: SITE HAZARDS TABLE**

| ID | DESCRIPTION                     |
|----|---------------------------------|
| 1  | WORKS UNDER OVERHEAD POWERLINES |

NOTE: THIS TABLE IS NOT AN EXHAUSTIVE LIST OF HAZARDS BUT IS INTENDED TO HIGHLIGHT SITE RISKS IDENTIFIED DURING THE DESIGN TO AID THE CONTRACTOR IN THEIR HAZARD AND RISK ASSESSMENT.



**STOPBANK LONG SECTION**  
SCALE (A1) 1:500 (H) 1:100 (V)  
SCALE (A3) 1:1000 (H) 1:200 (V)



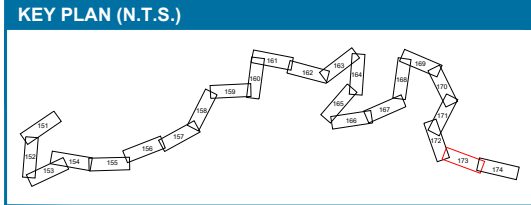
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|                      |                    |      |      |          |  |      |        |                |                    |
|----------------------|--------------------|------|------|----------|--|------|--------|----------------|--------------------|
| 1                    | PRELIMINARY DESIGN | KATU | JEMC | 04.09.25 | DESIGNED   | JEMC | JUN.25 | DRAWING STATUS | PRELIMINARY DRAFT  |
|                      |                    |      |      |          | DRAWN  | KATU | JUN.25 | PROJECT PHASE  | PRELIMINARY DESIGN |
|                      |                    |      |      |          | DESIGN CHECKED   | JWY  | SEP.25 |                |                    |
|                      |                    |      |      |          | DRAWING CHECKED  | HUGO | SEP.25 |                |                    |
| NOT FOR CONSTRUCTION |                    |      |      |          | THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED |      |        |                |                    |
| REV DESCRIPTION      |                    | CAD  | CHK  | DATE     | APPROVED   | DATE |        |                |                    |

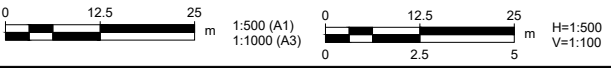
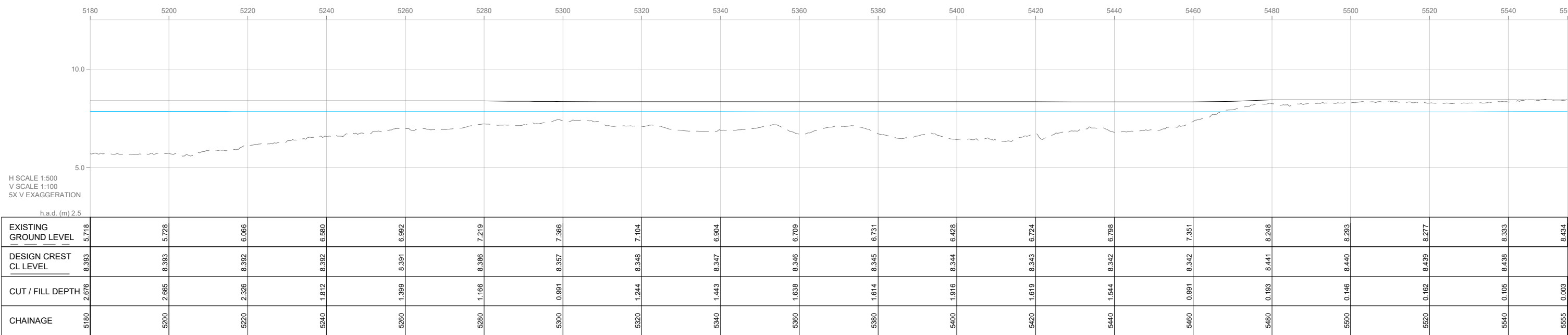
|            |  |
|------------|--|
| CLIENT     | <b>HAWKE'S BAY REGIONAL COUNCIL</b>                              |
| PROJECT    | <b>PĀKŌWHAI SECONDARY STOPBANK</b>                               |
| TITLE      | GENERAL ARRANGEMENT<br>STOPBANK PLAN AND LONG SECTION - SHEET 22 |
| SCALE (A1) | AS SHOWN   |
| DWG No.    | 1017353.2403-172   |
| REV        | 1  |



- NOTES**
1. ALL DIMENSIONS IN METRES UNLESS NOTED OTHERWISE.
  2. REFER DRAWING 1017353.2403-002 FOR GENERAL NOTES AND LEGEND.



**STOPBANK PLAN**  
SCALE (A1) 1:500  
SCALE (A3) 1:1000



**STOPBANK LONG SECTION**  
SCALE (A1) 1:500 (H) 1:100 (V)  
SCALE (A3) 1:1000 (H) 1:200 (V)



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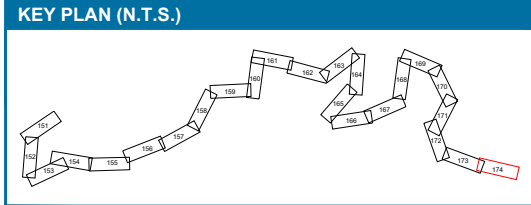
| 1   | PRELIMINARY DESIGN | KATU | JEMC | 04.09.25 |
|-----|--------------------|------|------|----------|
| REV | DESCRIPTION        | CAD  | CHK  | DATE     |

|                             |      |        |  |                    |
|-----------------------------|------|--------|--|--------------------|
| DESIGNED                    | JEMC | JUN.25 | DRAWING STATUS   | PRELIMINARY DRAFT  |
| DRAWN                       | KATU | JUN.25 | PROJECT PHASE  | PRELIMINARY DESIGN |
| DESIGN CHECKED              | JWY  | SEP.25 |  |                    |
| DRAWING CHECKED             | HUGO | SEP.25 |  |                    |
| <b>NOT FOR CONSTRUCTION</b> |      |        |  |                    |
| APPROVED                    |      | DATE   | THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED |                    |

|            |  |
|------------|--|
| CLIENT     | <b>HAWKE'S BAY REGIONAL COUNCIL</b>                              |
| PROJECT    | <b>PĀKŌWHAİ SECONDARY STOPBANK</b>                               |
| TITLE      | GENERAL ARRANGEMENT<br>STOPBANK PLAN AND LONG SECTION - SHEET 23 |
| SCALE (A1) | AS SHOWN   |
| DWG No.    | 1017353.2403-173   |
| REV        | 1  |

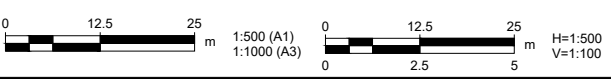


- NOTES**
1. ALL DIMENSIONS IN METRES UNLESS NOTED OTHERWISE.
  2. REFER DRAWING 1017353.2403-002 FOR GENERAL NOTES AND LEGEND.



**STOPBANK PLAN**  
SCALE (A1) 1:500  
SCALE (A3) 1:1000

| Chainage              | 5555  | 5560  | 5580  | 5600  | 5620  | 5640  | 5660  | 5680  | 5700  | 5720  | 5740  | 5760  | 5780  | 5800  | 5820  | 5840  | 5860  | 5880  | 5900  | 5920  | 5923  |
|-----------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| EXISTING GROUND LEVEL | 8.434 | 8.398 | 8.220 | 8.239 | 8.274 | 8.359 | 8.351 | 8.295 | 8.294 | 8.224 | 8.188 | 8.188 | 8.136 | 8.130 | 8.153 | 8.198 | 8.177 | 8.206 | 8.209 | 8.270 | 8.261 |
| DESIGN CREST CL LEVEL | 8.437 | 8.437 | 8.436 | 8.435 | 8.434 | 8.432 | 8.431 | 8.430 | 8.429 | 8.428 | 8.427 | 8.426 | 8.425 | 8.447 | 8.632 | 8.547 | 8.552 | 8.460 | 8.431 | 8.338 | 8.261 |
| CUT / FILL DEPTH      | 0.003 | 0.038 | 0.216 | 0.195 | 0.159 | 0.073 | 0.081 | 0.135 | 0.136 | 0.205 | 0.240 | 0.238 | 0.289 | 0.318 | 0.478 | 0.349 | 0.375 | 0.255 | 0.221 | 0.067 | 0.058 |
| CHAINAGE              | 5555  | 5560  | 5580  | 5600  | 5620  | 5640  | 5660  | 5680  | 5700  | 5720  | 5740  | 5760  | 5780  | 5800  | 5820  | 5840  | 5860  | 5880  | 5900  | 5920  | 5923  |




**STOPBANK LONG SECTION**  
SCALE (A1) 1:500 (H) 1:100 (V)  
SCALE (A3) 1:1000 (H) 1:200 (V)

|                               |                             |                                 |   |                           |  |
|-------------------------------|-----------------------------|---------------------------------|---|---------------------------|--|
| <p>www.tonkintaylor.co.nz</p> | <p>1 PRELIMINARY DESIGN</p> | <p>KATU JEMC 04.09.25</p>       | <p>DESIGNED JEMC JUN.25</p>   | <p>DRAWING STATUS</p>     | <p>CLIENT <b>HAWKE'S BAY REGIONAL COUNCIL</b></p>                              |
|                               |                             |                                 | <p>DRAWN KATU JUN.25</p>  | <p>PRELIMINARY DRAFT</p>  |  |
| <p>REV DESCRIPTION</p>        | <p>CAD CHK DATE</p>         | <p>APPROVED DATE</p>            | <p>DESIGN CHECKED JWY SEP.25</p>  | <p>PROJECT PHASE</p>      | <p>TITLE GENERAL ARRANGEMENT<br/>STOPBANK PLAN AND LONG SECTION - SHEET 24</p> |
|                               |                             |                                 | <p>DRAWING CHECKED HUGO SEP.25</p>  | <p>PRELIMINARY DESIGN</p> |  |
| <p>NOT FOR CONSTRUCTION</p>   |                             |                                 | <p>THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED</p> |                           |  |
| <p>SCALE (A1) AS SHOWN</p>    |                             | <p>DWG No. 1017353.2403-174</p> |   | <p>REV 1</p>              |  |

**NOTES**

1. ALL DIMENSIONS IN METRES UNLESS NOTED OTHERWISE.
2. REFER DRAWING 1017353.2403-002 FOR GENERAL NOTES AND LEGEND.
3. REFER TO DRAWING 1017353.2403-213 FOR SHEETPILE SIZING.

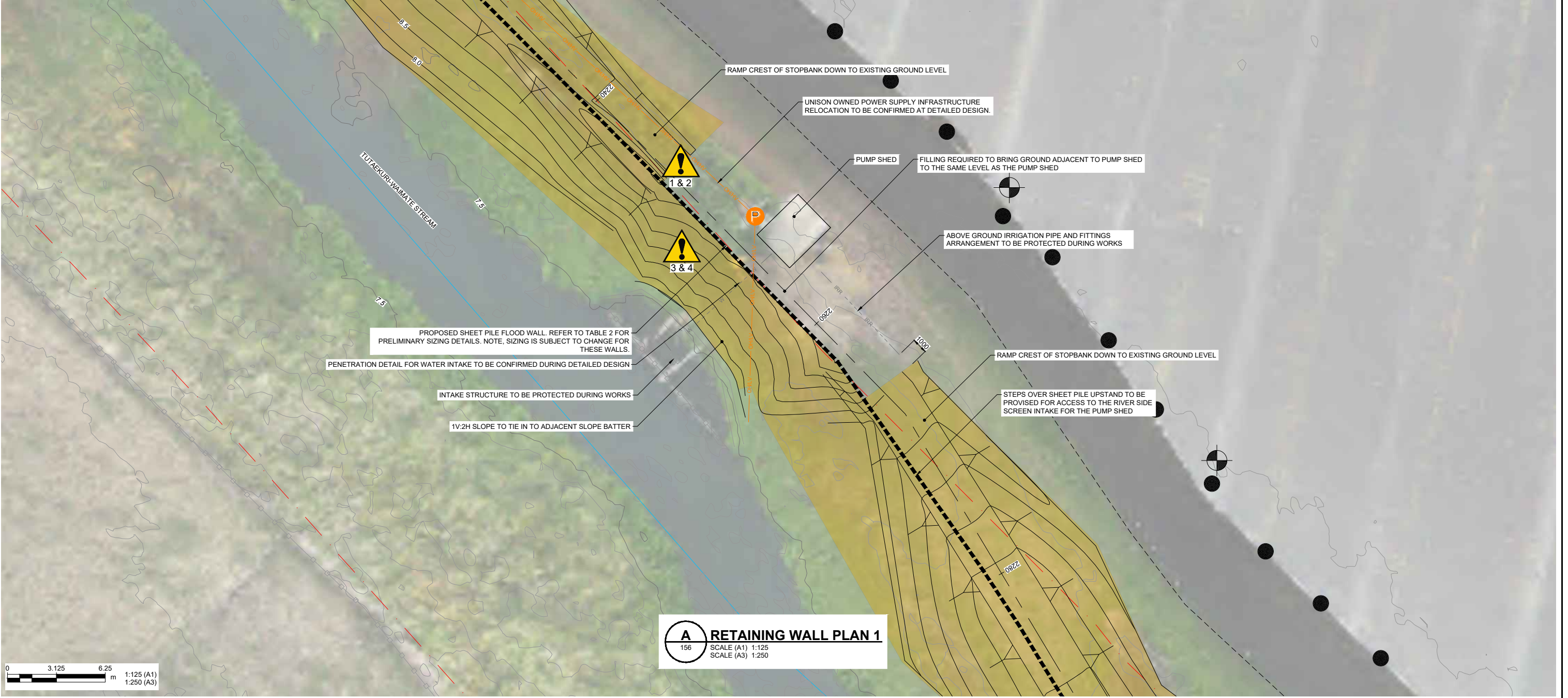
**LEGEND**

 HAZARD LOCATION - REFER TABLE 1  
ID

**TABLE 1: SITE HAZARDS TABLE**

| ID | DESCRIPTION   |
|----|---|
| 1  | WORKS UNDER OVERHEAD POWERLINES                             |
| 2  | WORKS IN CLOSE PROXIMITY TO OVERHEAD POWERLINES             |
| 3  | STOPBANK WORKS IN CLOSE PROXIMITY TO STREAM AND STREAM BANK |
| 4  | UNMAPPED UNDERGROUND UTILITIES EXPECTED WITHIN VICINITY     |

NOTE: THIS TABLE IS NOT AN EXHAUSTIVE LIST OF HAZARDS BUT IS INTENDED TO HIGHLIGHT SITE RISKS IDENTIFIED DURING THE DESIGN TO AID THE CONTRACTOR IN THEIR HAZARD AND RISK ASSESSMENT.



**A RETAINING WALL PLAN 1**  
156 SCALE (A1) 1:125 SCALE (A3) 1:250

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|                 |                    |        |   |                    |          |      |
|-----------------|--------------------|--------|---|--------------------|----------|------|
| DESIGNED        | JEMC               | JUN.25 | DRAWING STATUS  | PRELIMINARY DRAFT  |          |      |
| DRAWN           | KATU               | JUN.25 | PROJECT PHASE   | PRELIMINARY DESIGN |          |      |
| DESIGN CHECKED  | JWY                | SEP.25 | NOT FOR CONSTRUCTION<br><small>THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED</small> |                    |          |      |
| DRAWING CHECKED | HUGO               | SEP.25 |   |                    |          |      |
| 1               | PRELIMINARY DESIGN | KATU   | JEMC  | 04.09.25           |          |      |
| REV             | DESCRIPTION        | CAD    | CHK   | DATE               | APPROVED | DATE |

**CLIENT HAWKE'S BAY REGIONAL COUNCIL**  
**PROJECT PĀKŌWHAI SECONDARY STOPBANK**  
**TITLE GENERAL ARRANGEMENT STOPBANK RETAINING WALL PLAN 1**  
SCALE (A1) 1:125 **DWG No. 1017353.2403-191** **REV 1**

**NOTES**  
 1. ALL DIMENSIONS IN METRES UNLESS NOTED OTHERWISE.  
 2. REFER DRAWING 1017353.2403-002 FOR GENERAL NOTES AND LEGEND.

HOLD UNDER OPTIONEERING CONSIDERATION TO BE CONFIRMED IN NEXT STAGE OF DESIGN

THERE ARE A NUMBER OF UNKNOWN SERVICES LIKELY TO CONFLICT WITH THE PROPOSED RETAINING WALL. THESE SERVICES WILL REQUIRE REALIGNMENT DURING CONSTRUCTION

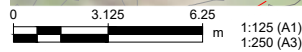
SHED TO BE REMOVED

SHED TO BE REMOVED

75m LONG, MAX. 3.5m HIGH DRIVEN STEEL WITH CONCRETE DEADMAN ANCHOR EMBEDDED

FALL PROTECTION BARRIER TO BE MOUNTED ON TOP OF WALL

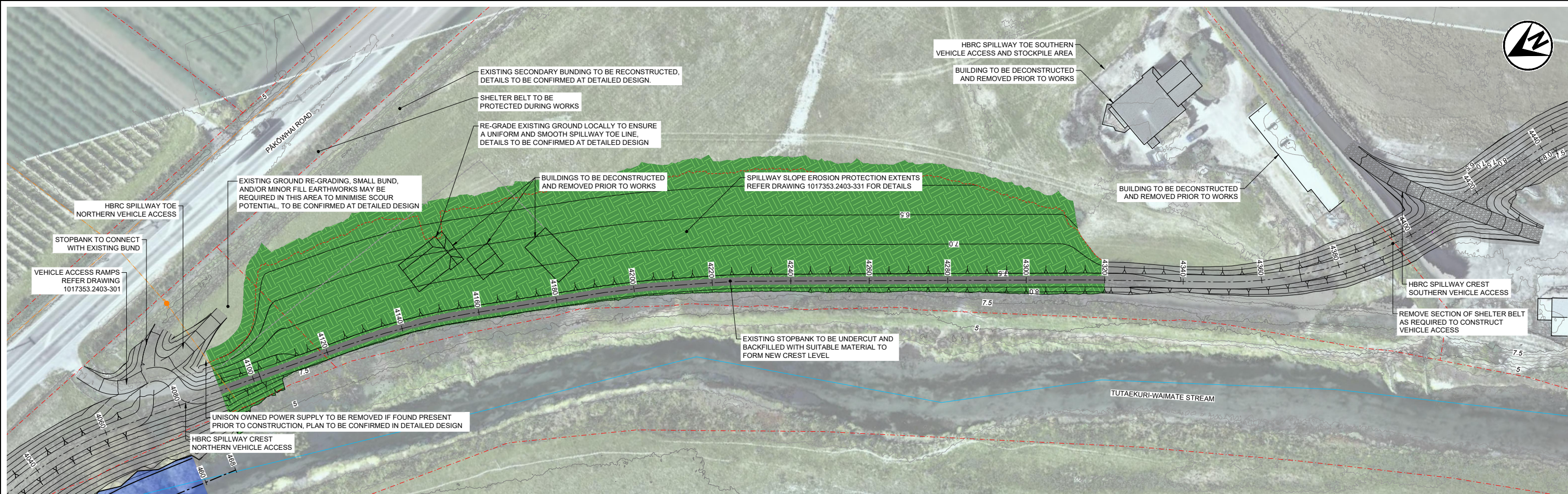
**B RETAINING WALL PLAN 2**  
 164 SCALE (A1) 1:125  
 SCALE (A3) 1:250



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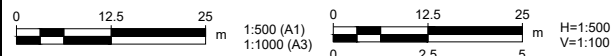
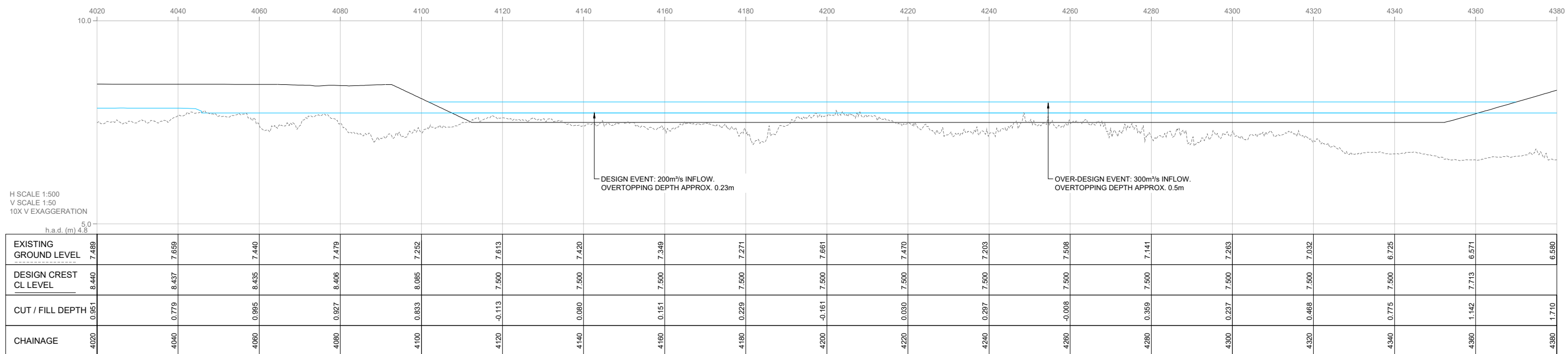
|     |                    |      |      |          |                      |      |  |                |                   |
|-----|--------------------|------|------|----------|----------------------|------|--|----------------|-------------------|
| 1   | PRELIMINARY DESIGN | KATU | JEMC | 04.09.25 | DESIGNED             | JEMC | JUN.25   | DRAWING STATUS | PRELIMINARY DRAFT |
|     |                    |      |      |          | DRAWN                | KATU | JUN.25   | PROJECT PHASE  |                   |
|     |                    |      |      |          | DESIGN CHECKED       | JWY  | SEP.25   |                |                   |
|     |                    |      |      |          | DRAWING CHECKED      | HUGO | SEP.25   |                |                   |
|     |                    |      |      |          | NOT FOR CONSTRUCTION |      | THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED |                |                   |
| REV | DESCRIPTION        | CAD  | CHK  | DATE     | APPROVED             | DATE |  |                |                   |

|            |   |
|------------|---|
| CLIENT     | <b>HAWKE'S BAY REGIONAL COUNCIL</b>                   |
| PROJECT    | <b>PĀKŌWHAI SECONDARY STOPBANK</b>                    |
| TITLE      | GENERAL ARRANGEMENT<br>STOPBANK RETAINING WALL PLAN 2 |
| SCALE (A1) | 1:125   |
| DWG No.    | 1017353.2403-192                                      |
| REV        | 1   |



- NOTES**
1. ALL DIMENSIONS IN METRES UNLESS NOTED OTHERWISE.
  2. REFER DRAWING 1017353.2403-002 FOR GENERAL NOTES AND LEGEND.

**SPILLWAY PLAN**  
SCALE (A1) 1:500  
SCALE (A3) 1:1000



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|     |                    |      |      |          |                      |      |  |                |                    |
|-----|--------------------|------|------|----------|----------------------|------|--|----------------|--------------------|
| 1   | PRELIMINARY DESIGN | KATU | JEMC | 04.09.25 | DESIGNED             | JEMC | JUN.25   | DRAWING STATUS | PRELIMINARY DRAFT  |
| REV | DESCRIPTION        | CAD  | CHK  | DATE     | DESIGN CHECKED       | JWY  | SEP.25   | PROJECT PHASE  | PRELIMINARY DESIGN |
|     |                    |      |      |          | DRAWING CHECKED      | HUGO | SEP.25   |                |                    |
|     |                    |      |      |          | NOT FOR CONSTRUCTION |      | THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED |                |                    |
|     |                    |      |      |          | APPROVED             |      | DATE   |                |                    |

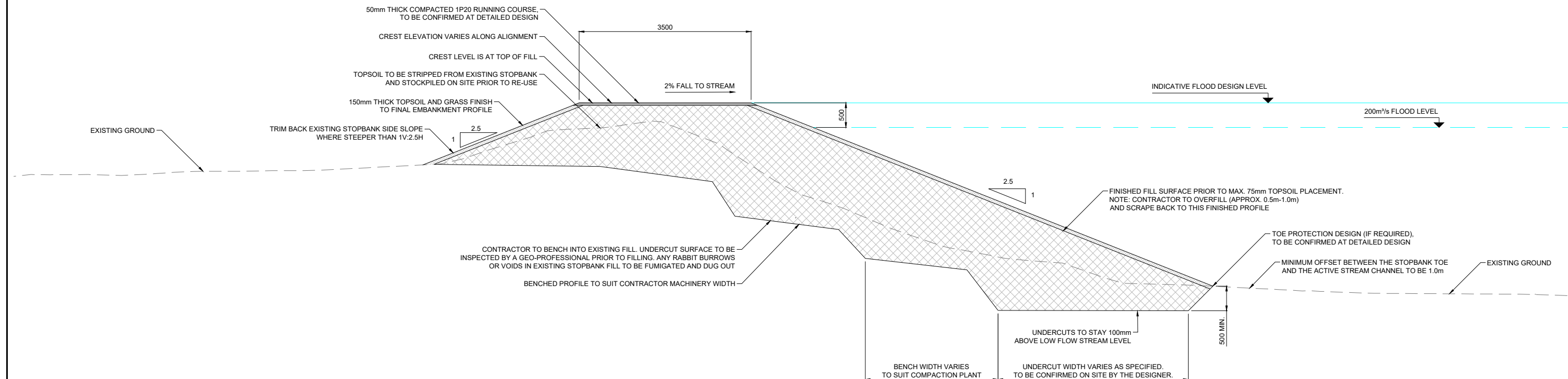
|            |   |
|------------|---|
| CLIENT     | HAWKE'S BAY REGIONAL COUNCIL                          |
| PROJECT    | PĀKŌWHAII SECONDARY STOPBANK                          |
| TITLE      | GENERAL ARRANGEMENT<br>SPILLWAY PLAN AND LONG SECTION |
| SCALE (A1) | 1:500   |
| DWG No.    | 1017353.2403-193                                      |
| REV        | 1   |

**NOTES**

- ALL DIMENSIONS IN METRES UNLESS NOTED OTHERWISE.
- REFER DRAWING 1017353.2403-002 FOR GENERAL NOTES AND LEGEND.

**LEGEND**

- EXISTING GROUND PROFILE
- PROPOSED STOPBANK PROFILE
- DESIGN WATER LEVEL



**TYPICAL STOPBANK REFURBISHMENT SECTION**  
 SCALE (A1) 1:40  
 SCALE (A3) 1:80



|  |  |        |                |                    |          |      |
|--|--|--------|----------------|--------------------|----------|------|
| DESIGNED   | JEMC                                       | JUN.25 | DRAWING STATUS | PRELIMINARY DRAFT  |          |      |
| DRAWN  | KATU                                       | JUN.25 | PROJECT PHASE  | PRELIMINARY DESIGN |          |      |
| DESIGN CHECKED   | JWY  | SEP.25 |                |                    |          |      |
| DRAWING CHECKED  | HUGO                                       | SEP.25 |                |                    |          |      |
| <b>NOT FOR CONSTRUCTION</b>  |  |        |                |                    |          |      |
| THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED |  |        |                |                    |          |      |
| REV  | DESCRIPTION                                | CAD    | CHK            | DATE               | APPROVED | DATE |
| 1  | CONCEPT DESIGN OPTIONS - FOR CLIENT REVIEW | KATU   | JEMC           | 30.05.2025         |          |      |
| 2  | PRELIMINARY DESIGN                         | KATU   | JEMC           | 04.09.25           |          |      |

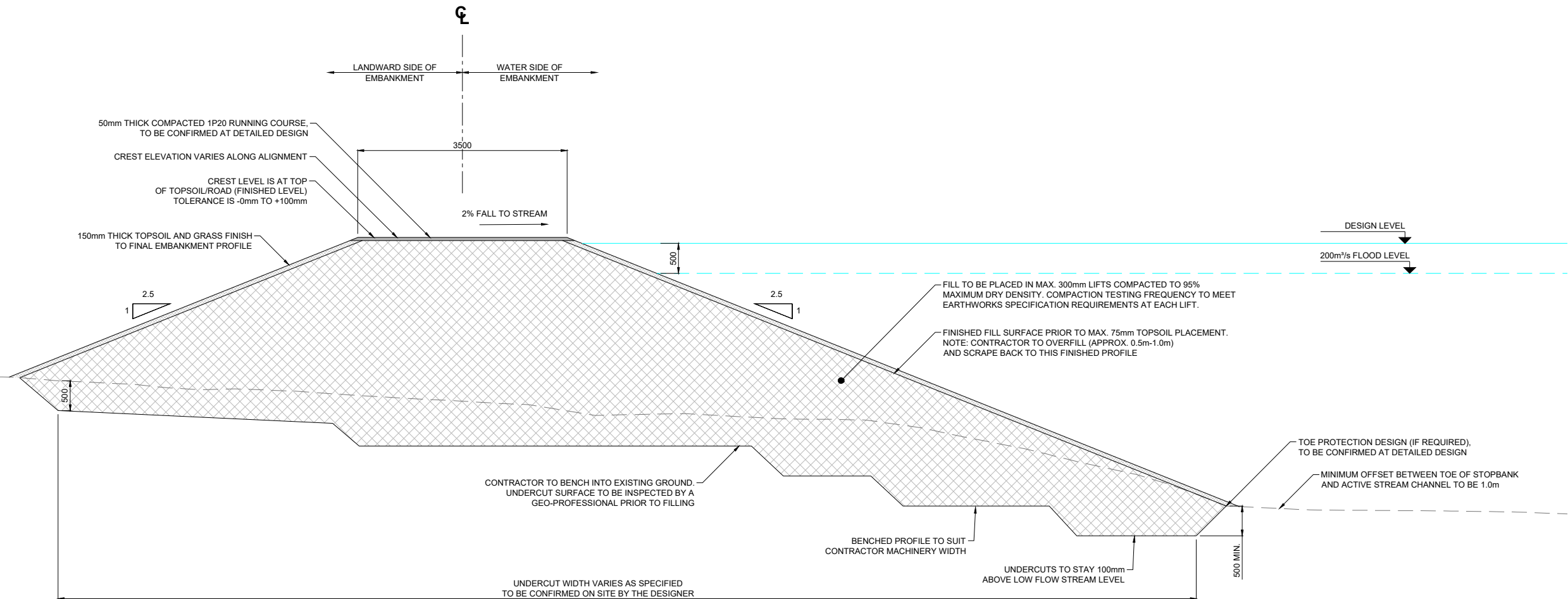
|            |   |
|------------|---|
| CLIENT     | <b>HAWKE'S BAY REGIONAL COUNCIL</b>                   |
| PROJECT    | <b>PĀKŌWHAI SECONDARY STOPBANK</b>                    |
| TITLE      | SECTIONS<br>TYPICAL STOPBANK (REFURBISHMENT) - TYPE A |
| SCALE (A1) | 1:40  |
| DWG No.    | 1017353.2403-210                                      |
| REV        | 2   |

**NOTES**

- ALL DIMENSIONS IN METRES UNLESS NOTED OTHERWISE.
- REFER DRAWING 1017353.2403-002 FOR GENERAL NOTES AND LEGEND.

**LEGEND**

- EXISTING GROUND PROFILE
- PROPOSED STOPBANK PROFILE
- DESIGN WATER LEVEL



**TYPICAL NEW STOPBANK SECTION - TYPE A**  
 SCALE (A1) 1:40  
 SCALE (A3) 1:80



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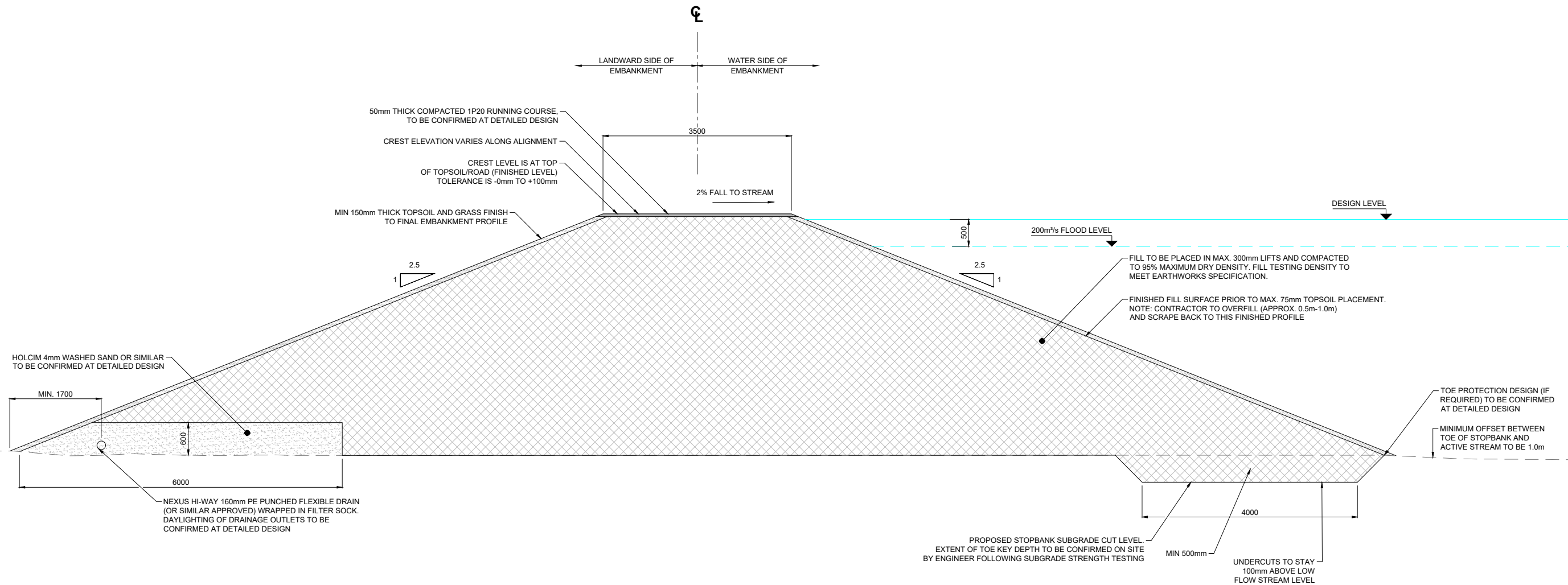
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|-----------------|--------------------|------|------|----------|-----------------|------|--------|----------------------|--------------------|--|---------------------------------------|
| 1               | PRELIMINARY DESIGN | KATU | JEMC | 04.09.25 | DESIGNED        | JEMC | JUN.25 | DRAWING STATUS       | PRELIMINARY DRAFT  | CLIENT   | HAWKE'S BAY REGIONAL COUNCIL          |
|                 |                    |      |      |          | DRAWN           | KATU | JUN.25 | PROJECT PHASE        | PRELIMINARY DESIGN | PROJECT  | PĀKŌWHAI SECONDARY STOPBANK           |
|                 |                    |      |      |          | DESIGN CHECKED  | JWY  | SEP.25 |                      |                    | TITLE  | SECTIONS                              |
|                 |                    |      |      |          | DRAWING CHECKED | HUGO | SEP.25 |                      |                    |  | TYPICAL NEW STOPBANK SECTION - TYPE A |
| REV DESCRIPTION |                    |      |      |          | CAD             |      | CHK    | DATE                 | APPROVED           |  | DATE                                  |
|                 |                    |      |      |          |                 |      |        | NOT FOR CONSTRUCTION |                    | THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED |                                       |
|                 |                    |      |      |          |                 |      |        | SCALE (A1) 1:40      |                    | DWG No. 1017353.2403-211   |                                       |
|                 |                    |      |      |          |                 |      |        |                      |                    | REV 1  |                                       |

**NOTES**

- ALL DIMENSIONS IN METRES UNLESS NOTED OTHERWISE.
- REFER DRAWING 1017353.2403-002 FOR GENERAL NOTES AND LEGEND.

**LEGEND**

- EXISTING GROUND PROFILE
- PROPOSED STOPBANK PROFILE
- DESIGN WATER LEVEL



**TYPICAL NEW STOPBANK SECTION - TYPE B**

SCALE (A1) 1:40  
SCALE (A3) 1:80



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|                 |                    |      |      |          |                 |      |        |                    |  |  |
|-----------------|--------------------|------|------|----------|-----------------|------|--------|--------------------|--|--|
| 1               | PRELIMINARY DESIGN | KATU | JEMC | 04.09.25 | DESIGNED        | JEMC | JUN.25 | DRAWING STATUS     | CLIENT <b>HAWKE'S BAY REGIONAL COUNCIL</b> |  |
|                 |                    |      |      |          | DRAWN           | KATU | JUN.25 | PRELIMINARY DRAFT  | PROJECT <b>PĀKŌWHAİ SECONDARY STOPBANK</b> |  |
|                 |                    |      |      |          | DESIGN CHECKED  | JWY  | SEP.25 | PROJECT PHASE      | TITLE SECTIONS                             |  |
|                 |                    |      |      |          | DRAWING CHECKED | HUGO | SEP.25 | PRELIMINARY DESIGN | TYPICAL NEW STOPBANK SECTION - TYPE B      |  |
| REV DESCRIPTION |                    |      |      |          | APPROVED        |      | DATE   |                    | SCALE (A1) 1:40                            |  |
|                 |                    |      |      |          |                 |      |        |                    | DWG No. 1017353.2403-212                   |  |
|                 |                    |      |      |          |                 |      |        |                    | REV 1                                      |  |

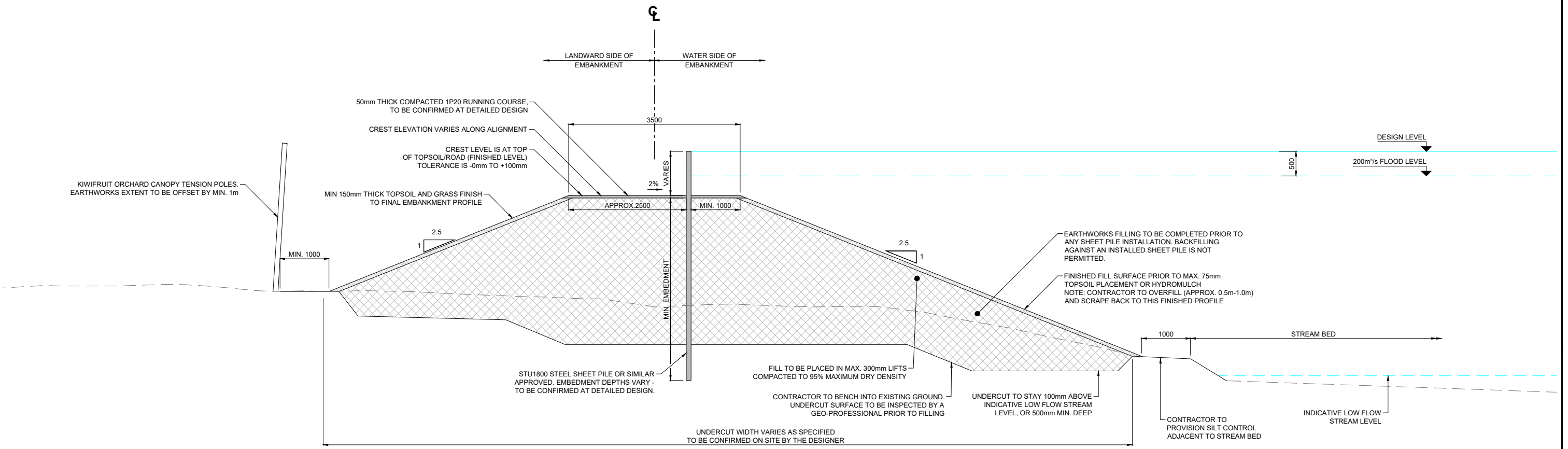
NOT FOR CONSTRUCTION  
THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED

**NOTES**

- ALL DIMENSIONS IN METRES UNLESS NOTED OTHERWISE.
- REFER DRAWING 1017353.2403-002 FOR GENERAL NOTES AND LEGEND.

**LEGEND**

- EXISTING GROUND PROFILE
- PROPOSED STOPBANK PROFILE
- DESIGN WATER LEVEL



**FEL BLOCK HYBRID STOPBANK/ FLOOD WALL SECTION**

SCALE (A1) 1:40  
SCALE (A3) 1:80

**TABLE 1: SHEET PILE SIZING**

| MAX. HEIGHT (HEIGHT ABOVE STOPBANK/GROUND LEVEL) (m) | SHEET PILE TYPE | MIN. EMBEDMENT (m) | MIN. STOPBANK FILL THICKNESS (m) |
|--|-----------------|--------------------|----------------------------------|
| 0.5  | SP3W/STU 1800   | 2.5                | 2.5                              |
| 1.0  |                 | 5.0                | 2.0                              |
| 2.5  |                 | 6.5                | 0.5                              |

**NOTES:**

- WE HAVE ASSUMED THE SHEET PILE WALL WILL NOT WITHSTAND THE LOADING/EFFECTS OF LATERAL SPREADING AND WILL REQUIRE SPECIFIC ASSESSMENT AFTER A LIQUEFACTION-TRIGGERING EARTHQUAKE EVENT.
- WE HAVE ASSUMED THE EXPECTED DISPLACEMENT AS A RESULT OF ULS EARTHQUAKE LOADING (UP TO 200mm) IS DEEMED ACCEPTABLE.
- IT IS ASSUMED DISPLACEMENT IN THE HIGHEST RETAINED HEIGHT (IN THE ORDER OF 100mm) ARE ACCEPTABLE AND SOME SEEPAGE AT JOINS BETWEEN PILE LENGTHS MAY OCCUR.
- OUR PILE CAPACITY ASSUMES NO SLIPPAGE BETWEEN THE SHEET PILES DURING HYDROSTATIC LOADING.
- WE HAVE ASSUMED LOADING FROM A HYDROSTATIC LOAD AND HAVE NOT TAKEN INTO CONSIDERATION IMPACT LOADING (E.G. FROM WAVE ACTION OR A TREE).
- WE HAVE ASSUMED A 50-YEAR DESIGN LIFE AND CLASSIFIED THE SITE AS "MODERATELY" CORROSIVE AS DEFINED BY NZS 3404:2018 TO DETERMINE THE CORRODED PILE CAPACITY.
- 390MPa GRADED STEEL HAS BEEN ASSUMED FOR OUR CALCULATIONS.
- WE HAVE NOT PERFORMED A SCOUR CALCULATION AT THE TOE OF THE EXISTING STOPBANK AND HAVE NOT ASSESSED IF THIS WILL BE ERODED BASED ON THE MODELLED FLOODING.
- WE HAVE ASSUMED ALL EARTHWORKS WILL BE COMPLETED, THEN THE SHEET PILES WILL BE DRIVEN THROUGH THE COMPETENT FILL MATERIAL.
- ANY PROPOSED SHEET PILES THAT HAVE BEEN PREVIOUSLY INSTALLED ARE SUBJECT TO ENGINEER'S APPROVAL.
- SHEET PILES SHALL BE INSTALLED WITHIN THE FOLLOWING TOLERANCES: IN PLAN, ±50mm OF THE GIVEN SHEET PILE LINE AT COMMENCING SURFACE, VERTICAL 1 IN 75, AND LEVEL -0 and +20mm OF REQUIRED TOP LEVEL.
- CAULKING BETWEEN SHEET PILE JOINTS TO BE CONSIDERED AT DETAILED DESIGN.



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|                 |                    |      |      |          |                      |      |        |  |                          |         |                              |
|-----------------|--------------------|------|------|----------|----------------------|------|--------|--|--------------------------|---------|------------------------------|
| 1               | PRELIMINARY DESIGN | KATU | JEMC | 04.09.25 | DESIGNED             | JEMC | JUN.25 | DRAWING STATUS   | PRELIMINARY DRAFT        | CLIENT  | HAWKE'S BAY REGIONAL COUNCIL |
|                 |                    |      |      |          | DRAWN                | KATU | JUN.25 | PROJECT PHASE  | PRELIMINARY DESIGN       | PROJECT | PĀKŌWHAİ SECONDARY STOPBANK  |
|                 |                    |      |      |          | DESIGN CHECKED       | JWY  | SEP.25 |  |                          |         |                              |
|                 |                    |      |      |          | DRAWING CHECKED      | HUGO | SEP.25 |  |                          |         |                              |
|                 |                    |      |      |          | NOT FOR CONSTRUCTION |      |        | THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED |                          |         |                              |
|                 |                    |      |      |          | APPROVED             | DATE |        |  |                          |         |                              |
| REV DESCRIPTION |                    | CAD  | CHK  | DATE     | APPROVED             |      | DATE   |  |                          |         |                              |
|                 |                    |      |      |          |                      |      |        | SCALE (A1) 1:40  | DWG No. 1017353.2403-213 | REV 1   |                              |

**CLIENT HAWKE'S BAY REGIONAL COUNCIL**

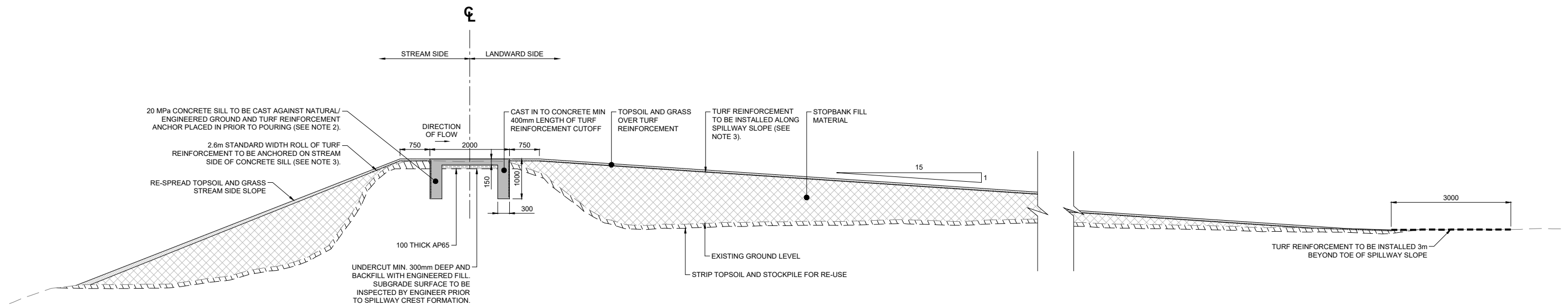
**PROJECT PĀKŌWHAİ SECONDARY STOPBANK**

**TITLE SECTIONS**

**FEL BLOCK HYBRID STOPBANK/FLOOD WALL SECTION**

SCALE (A1) 1:40      DWG No. 1017353.2403-213      REV 1

- NOTES**
1. ALL MEASUREMENTS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
  2. REINFORCEMENT ARRANGEMENT NOT SHOWN FOR CLARITY AND TO BE CONFIRMED AT DETAILED DESIGN.
  3. TURF REINFORCEMENT TO BE INSTALLED IN ACCORDANCE WITH MANUFACTURERS SPECIFICATIONS, AND TYPE TO BE CONFIRMED IN DETAILED DESIGN.
  4. ALL LEVELS ARE IN NEW ZEALAND VERTICAL DATUM 2016 (NZVD2016) UNLESS NOTED OTHERWISE.
- LEGEND**
- - - - - EXISTING GROUND PROFILE
  - PROPOSED STOPBANK PROFILE



**TYPICAL SECTION: SPILLWAY DETAIL**

SCALE (A1) 1:50  
SCALE (A3) 1:100

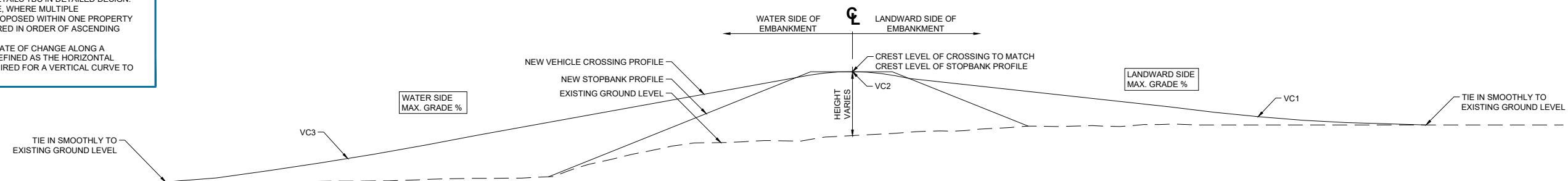


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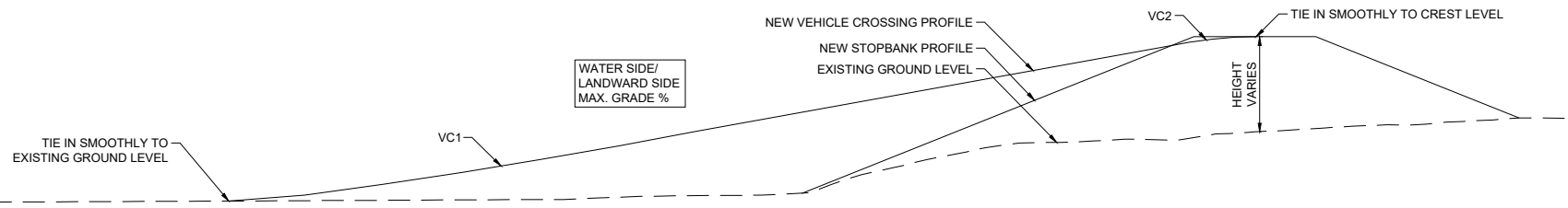
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| 1               | PRELIMINARY DESIGN | KATU | JEMC | 04.09.25 | DESIGNED        | JEMC | JUN.25 | DRAWING STATUS   | PRELIMINARY DRAFT  | CLIENT     | <b>HAWKE'S BAY REGIONAL COUNCIL</b> |
|                 |                    |      |      |          | DRAWN           | KATU | JUN.25 | PROJECT PHASE  | PRELIMINARY DESIGN | PROJECT    | <b>PĀKŌWHAI SECONDARY STOPBANK</b>  |
|                 |                    |      |      |          | DESIGN CHECKED  | JWY  | SEP.25 |  |                    | TITLE      | SECTIONS                            |
|                 |                    |      |      |          | DRAWING CHECKED | HUGO | SEP.25 |  |                    |            | TYPICAL SECTION SPILLWAY DETAIL     |
| REV DESCRIPTION |                    |      |      |          | CAD             | CHK  | DATE   | APPROVED   | DATE               | SCALE (A1) | 1:50                                |
|                 |                    |      |      |          |                 |      |        | NOT FOR CONSTRUCTION   |                    | DWG No.    | 1017353.2403-214                    |
|                 |                    |      |      |          |                 |      |        | THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED |                    | REV        | 1                                   |

**NOTES**

1. ALL DIMENSIONS IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. ALL VEHICLE CROSSINGS AND ACCESS RAMPS TO BE SURFACED WITH AP20 RUNNING COURSE UNLESS NOTED OTHERWISE. DEPTH AND DETAILS TBC IN DETAILED DESIGN.
3. UNLESS NOTED OTHERWISE, WHERE MULTIPLE CROSSINGS/RAMPS ARE PROPOSED WITHIN ONE PROPERTY PARCEL, THEY ARE NUMBERED IN ORDER OF ASCENDING STOPBANK CHAINAGE.
4. K-VALUE QUANTIFIES THE RATE OF CHANGE ALONG A VERTICAL CURVE, AND IS DEFINED AS THE HORIZONTAL DISTANCE IN METRES REQUIRED FOR A VERTICAL CURVE TO CHANGE IN GRADE BY 1%.



**A TYPICAL VEHICLE CROSSING DETAIL**  
SCALE (A1) 1:100  
SCALE (A3) 1:200



**B TYPICAL VEHICLE ACCESS RAMP DETAIL**  
SCALE (A1) 1:100  
SCALE (A3) 1:200

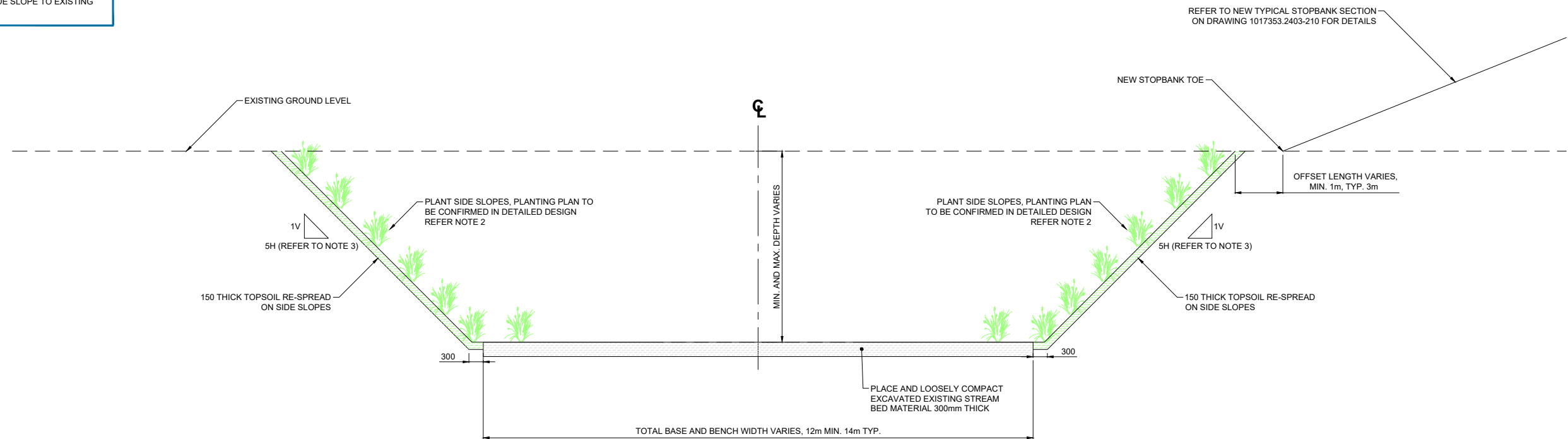
| CROSSING/ RAMP ID               | LAND WARD SIDE GRADE % | RIVERSIDE GRADE % | TOTAL ROAD/ RAMP LENGTH (m) | TYPICAL ROAD WIDTH (m) | MIN. K VALUE (SEE NOTE 4) | TRAFFICABILITY  | SURFACING                    |
|---------------------------------|------------------------|-------------------|-----------------------------|------------------------|---------------------------|---|------------------------------|
| 1135 LINKS ROAD ACCESSWAY       | 3.0                    | -                 | 55                          | 3.5                    | -                         | PRIVATE AND/ OR HBRC ACCESS ONLY. ONE-WAY TRAFFIC. LARGE RIGID TRUCK DESIGN VEHICLE.          | SEALED - TO MATCH EXISTING   |
| 1153 LINKS ROAD ACCESS RAMPS    | 8.7                    | -                 | 85.5                        | 3.5                    | -                         | PRIVATE AND/ OR HBRC ACCESS ONLY. ONE-WAY TRAFFIC. LARGE RIGID TRUCK DESIGN VEHICLE.          | UNSEALED - TO MATCH EXISTING |
| 70 FRANKLIN ROAD ACCESS RAMPS   | 12.3                   | 13.4              | 102                         | 3.5                    | 1                         | PRIVATE AND/ OR HBRC ACCESS ONLY. ONE-WAY TRAFFIC. 22M HPMV TRUCK AND TRAILER DESIGN VEHICLE. | UNSEALED - TO MATCH EXISTING |
| FRANKLIN ROAD CROSSING          | 11                     | 11.9              | 50                          | 7                      | 1                         | PUBLIC ACCESS. TWO-WAY TRAFFIC. 22M HPMV TRUCK AND TRAILER DESIGN VEHICLE.                    | SEALED - TO MATCH EXISTING   |
| CHESTERHOPE ROAD CROSSING       | 12.5                   | 11.5              | 31                          | 7                      | 1                         | PUBLIC ACCESS. TWO-WAY TRAFFIC. 22M HPMV TRUCK AND TRAILER DESIGN VEHICLE.                    | SEALED - TO MATCH EXISTING   |
| 1882 PAKOWHAI ROAD ACCESS RAMPS | 15.0                   | 15.0              | 21                          | 3.5                    | 0.8                       | HBRC ACCESS ONLY. ONE-WAY TRAFFIC. LARGE RIGID TRUCK DESIGN VEHICLE.                          | UNSEALED                     |
| 1854 PAKOWHAI ROAD CROSSING 1   | 12.1                   | 12.1              | 110                         | 3.5                    | 1.4                       | PRIVATE AND/ OR HBRC ACCESS ONLY. ONE-WAY TRAFFIC. 22M HPMV TRUCK AND TRAILER DESIGN VEHICLE. | UNSEALED - TO MATCH EXISTING |
| 1854 PAKOWHAI ROAD CROSSING 2   | 15.0                   | 15.0              | 143                         | 3.5                    | 0.3                       | PRIVATE AND/ OR HBRC ACCESS ONLY. ONE-WAY TRAFFIC. STOCK & LIGHT DUTY VEHICLES ONLY.          | UNSEALED - TO MATCH EXISTING |
| 1854 PAKOWHAI ROAD CROSSING 3   | 15.0                   | 12.5              | 89.5                        | 3.5                    | 0.8                       | PRIVATE AND/ OR HBRC ACCESS ONLY. ONE-WAY TRAFFIC. STOCK & LIGHT DUTY VEHICLES ONLY.          | UNSEALED - TO MATCH EXISTING |
| HODGSON ROAD CROSSING           | 11.0                   | 11.2              | 55                          | 3.5                    | 2                         | PRIVATE AND/ OR HBRC ACCESS ONLY. ONE-WAY TRAFFIC. STOCK & LIGHT DUTY VEHICLES ONLY.          | UNSEALED - TO MATCH EXISTING |



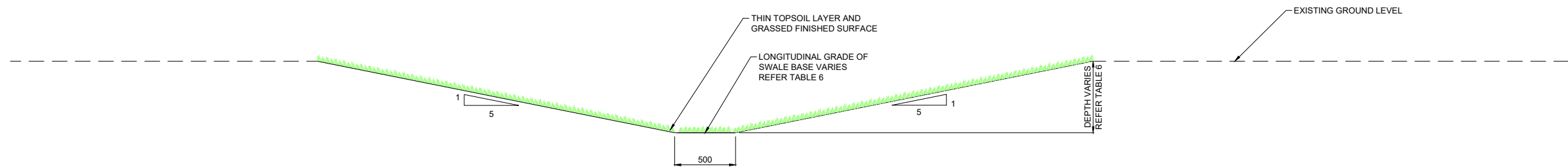
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|                 |                    |      |      |          |                      |      |                          |  |                   |        |                                |
|-----------------|--------------------|------|------|----------|----------------------|------|--------------------------|--|-------------------|--------|--------------------------------|
| 1               | PRELIMINARY DESIGN | KATU | JEMC | 04.09.25 | DESIGNED             | JEMC | JUN.25                   | DRAWING STATUS   | PRELIMINARY DRAFT | CLIENT | HAWKE'S BAY REGIONAL COUNCIL   |
|                 |                    |      |      |          | DRAWN                | KATU | JUN.25                   |  |                   |        |                                |
|                 |                    |      |      |          | DESIGN CHECKED       | JWY  | SEP.25                   |  |                   | TITLE  | DETAILS                        |
|                 |                    |      |      |          | DRAWING CHECKED      | HUGO | SEP.25                   |  |                   |        | TYPICAL VEHICLE ACCESS DETAILS |
|                 |                    |      |      |          | NOT FOR CONSTRUCTION |      |                          | THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED |                   |        |                                |
|                 |                    |      |      |          | APPROVED             | DATE |                          |  |                   |        |                                |
| REV DESCRIPTION |                    | CAD  | CHK  | DATE     | SCALE (A1) 1:100     |      | DWG No. 1017353.2403-301 |  | REV 1             |        |                                |

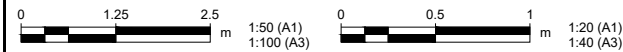
- NOTES**
1. ALL DIMENSIONS IN MILLIMETRES UNLESS NOTED OTHERWISE.
  2. PLANTING REQUIREMENTS AND CHANNEL BASE REQUIREMENTS TO BE CONFIRMED IN DETAILED DESIGN.
  3. TRANSITION LENGTH FROM DESIGN SIDE SLOPE TO EXISTING CHANNEL SIDE SLOPE VARIES.



**TYPICAL STREAM DIVERSION DETAIL**  
 SCALE (A1) 1:50  
 SCALE (A3) 1:100



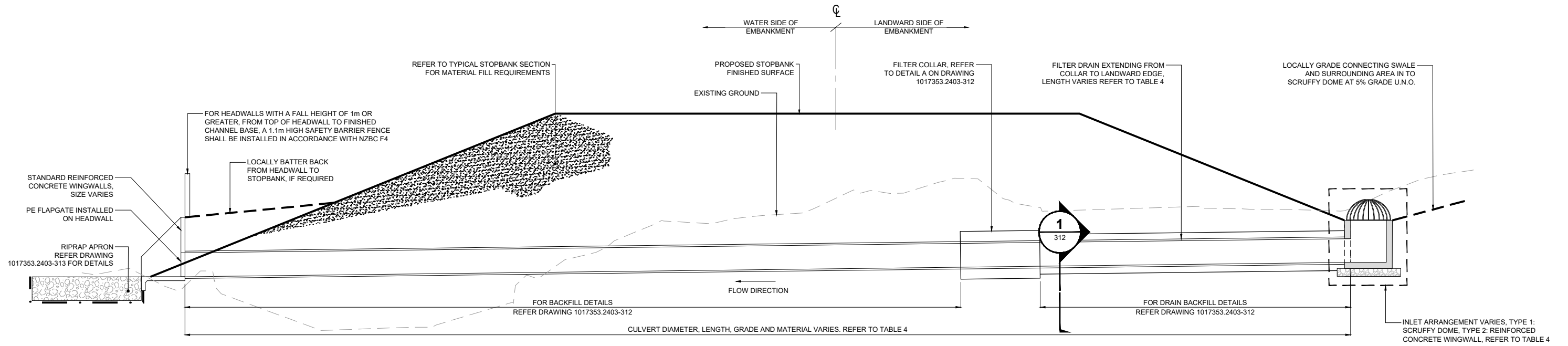
**TYPICAL NEW WAIOHKI DRAIN DETAIL**  
 SCALE (A1) 1:20  
 SCALE (A3) 1:40



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|                 |                    |      |      |          |                      |      |  |                     |                    |         |                                     |
|-----------------|--------------------|------|------|----------|----------------------|------|--|---------------------|--------------------|---------|-------------------------------------|
| 1               | PRELIMINARY DESIGN | KATU | JEMC | 04.09.25 | DESIGNED             | JEMC | JUN.25   | DRAWING STATUS      | PRELIMINARY DRAFT  | CLIENT  | <b>HAWKE'S BAY REGIONAL COUNCIL</b> |
|                 |                    |      |      |          | DRAWN                | KATU | JUN.25   | PROJECT PHASE       | PRELIMINARY DESIGN | PROJECT | <b>PĀKŌWHAI SECONDARY STOPBANK</b>  |
|                 |                    |      |      |          | DESIGN CHECKED       | JWY  | SEP.25   |                     |                    | TITLE   | DETAILS                             |
|                 |                    |      |      |          | DRAWING CHECKED      | HUGO | SEP.25   |                     |                    |         | TYPICAL STREAM DIVERSION DETAILS    |
|                 |                    |      |      |          | NOT FOR CONSTRUCTION |      | THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED |                     |                    |         |                                     |
| REV DESCRIPTION |                    | CAD  | CHK  | DATE     | APPROVED             | DATE |  | SCALE (A1) AS SHOWN |                    | DWG No. | 1017353.2403-302                    |
|                 |                    |      |      |          |                      |      |  |                     |                    |         | REV 1                               |

- NOTES**
1. ALL DIMENSIONS IN MILLIMETRES UNLESS NOTED OTHERWISE.
  2. FILTER CLOTH TO BE INSTALLED AND SPECIFIED AS SET OUT IN THE SPECIFICATION "NZTA F/7 2003, GEOTEXTILES".
  3. JOINTS IN THE FILTER CLOTH MUST BE OVERLAPPED BY A MINIMUM OF 500mm.
  4. MATERIAL AND INSTALLATION OF DRAINAGE FILTER AROUND CULVERT AS PER NZTA F2 SPECIFICATIONS.
  5. FILTER CLOTH TO BE INSTALLED AND SPECIFIED AS SET OUT IN SPECIFICATION "NZTA F/7 2003, GEOTEXTILES."



**TYPICAL SECTION - PIPE PENETRATIONS**

SCALE (A1) 1:50  
SCALE (A3) 1:100

| CULVERT ID | CULVERT GRADE (%) | CULVERT LENGTH (m) | PIPE MATERIAL | SIZE (mm) | INLET ARRANGEMENT (OR EQUIVALENT) |
|------------|-------------------|--------------------|---------------|-----------|-----------------------------------|
| C1         | 1.0               | 21.3               | RCRRJ CLASS 2 | 525       | TYPE 2: WINGWALL                  |
| C2         | 3.4               | 20                 | RCRRJ CLASS 2 | 450       | TYPE 2: WINGWALL                  |
| C3         | 1.0               | 20                 | RCRRJ CLASS 2 | 450       | TYPE 1: SCRUFFY DOME              |
| C4         | 0.4               | 24.5               | RCRRJ CLASS 2 | 600       | TYPE 1: SCRUFFY DOME              |
| C5         | 1.0               | 17                 | RCRRJ CLASS 2 | 525       | TYPE 2: WINGWALL                  |
| C6         | 1.0               | 13.5               | RCRRJ CLASS 2 | 300       | TYPE 2: WINGWALL                  |
| C6.1       | 4.2               | 12.8               | RCRRJ CLASS 2 | 300       | TYPE 2: WINGWALL                  |
| C7         | 1.0               | 20                 | RCRRJ CLASS 2 | 450       | TYPE 1: SCRUFFY DOME              |
| C8         | 1.0               | 24                 | RCRRJ CLASS 2 | 375       | TYPE 1: SCRUFFY DOME              |
| C9         | 1.0               | 19.5               | RCRRJ CLASS 2 | 300       | TYPE 1: SCRUFFY DOME              |
| C10        | 1.0               | 20                 | RCRRJ CLASS 2 | 1050      | TYPE 2: WINGWALL                  |
| C11        | 1.0               | 19                 | RCRRJ CLASS 2 | 675       | TYPE 1: SCRUFFY DOME              |
| C12        | 1.3               | 16.8               | RCRRJ CLASS 2 | 600       | TYPE 1: SCRUFFY DOME              |
| C13        | 2.8               | 19.88              | RCRRJ CLASS 2 | 525       | TYPE 1: SCRUFFY DOME              |
| C14.1      | 1.0               | 15.5               | RCRRJ CLASS 2 | 300       | TYPE 2: WINGWALL                  |
| C14        | 1.4               | 18.3               | RCRRJ CLASS 2 | 525       | TYPE 2: WINGWALL                  |
| C15        | 1.0               | 21.2               | RCRRJ CLASS 2 | 825       | TYPE 2: WINGWALL                  |
| C16        | 1.0               | 20                 | RCRRJ CLASS 2 | 525       | TYPE 1: SCRUFFY DOME              |
| C17        | 1.0               | 18.8               | RCRRJ CLASS 2 | 450       | TYPE 2: WINGWALL                  |
| C17.1      | 1.8               | 14.2               | RCRRJ CLASS 2 | 300       | TYPE 2: WINGWALL                  |



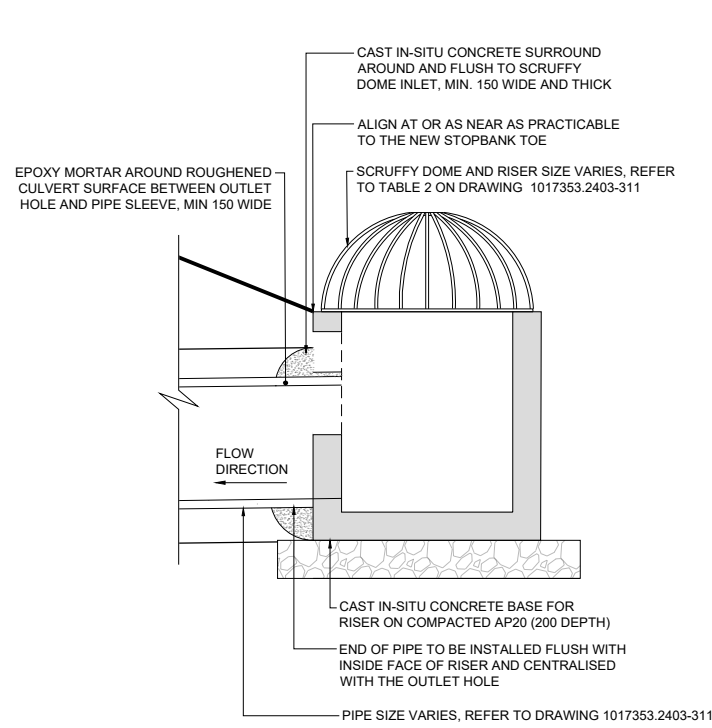
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|   |                    |      |      |          |                      |      |  |                |                    |
|---|--------------------|------|------|----------|----------------------|------|--|----------------|--------------------|
| 1 | PRELIMINARY DESIGN | KATU | JEMC | 04.09.25 | DESIGNED             | JEMC | JUN.25   | DRAWING STATUS | PRELIMINARY DRAFT  |
|   |                    |      |      |          | DRAWN                | KATU | JUN.25   | PROJECT PHASE  | PRELIMINARY DESIGN |
|   |                    |      |      |          | DESIGN CHECKED       | JWY  | SEP.25   |                |                    |
|   |                    |      |      |          | DRAWING CHECKED      | HUGO | SEP.25   |                |                    |
|   |                    |      |      |          | NOT FOR CONSTRUCTION |      | THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED |                |                    |
|   |                    |      |      |          | APPROVED             |      | DATE   |                |                    |

|            |  |
|------------|--|
| CLIENT     | <b>HAWKE'S BAY REGIONAL COUNCIL</b>                    |
| PROJECT    | <b>PĀKŌWHAI SECONDARY STOPBANK</b>                     |
| TITLE      | DETAILS<br>TYPICAL STORMWATER DRAINAGE DETAILS SHEET 1 |
| SCALE (A1) | 1:50   |
| DWG No.    | 1017353.2403-311                                       |
| REV        | 1  |

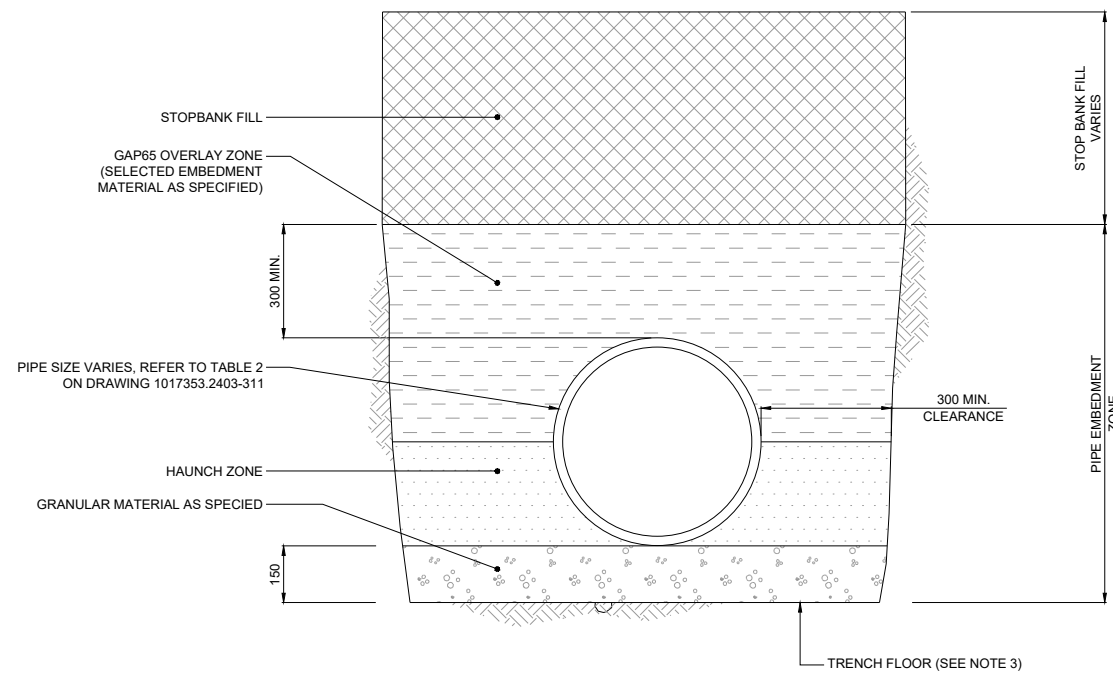
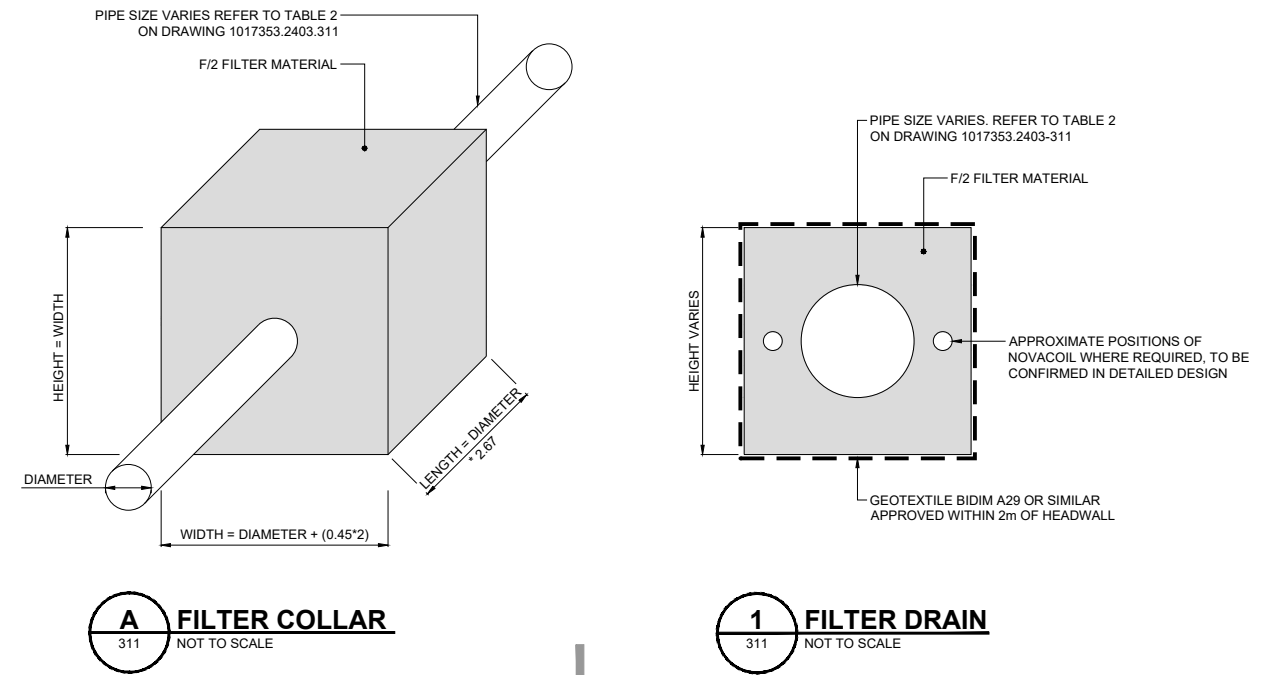
**NOTES**

- ALL DIMENSIONS IN MILLIMETRES UNLESS NOTED OTHERWISE.
- PLACEMENT OF EMBEDMENT, TRENCHFILL, AND COMPACTION TO MEET THE REQUIREMENTS OF THE CONTRACT SPECIFICATIONS.
- EXCAVATE OR COMPACT TRENCH FLOOR TO PROVIDE FIRM BASE (MIN. 50kPa) OR 3 BLOWS PER 100mm TO SUPPORT BEDDING MATERIAL AND MINIMISE PIPELINE SETTLEMENT.
- TRENCH SUPPORT OR BATTERING DETAILS TO BE CONFIRMED BY THE CONTRACTOR.
- GEOTEXTILE OVERLAY IS REQUIRED FOR PIPE BEDDING RIPRAP DETAIL. LAY GEOTEXTILE FILTER FABRIC AGAINST TRENCH FLOOR AND WALLS SUCH THAT IT FULLY ENCASE THE EMBEDMENT:
  - PRESS FILTER FABRIC INTO THE VOIDS BEFORE INSTALLING EMBEDMENT TO PREVENT FABRIC TEARING.
  - PROVIDE A MINIMUM OF 250mm OVERLAP AT ALL FILTER FABRIC JOINTS.
- FILTER TO COMPRISE MEDIUM TO COARSE SAND WITH D15 =0.7mm OR F2 COMPLIANT GRADING.
- SAND FILTER MUST BE SUFFICIENTLY WET DURING COMPACTION TO AVOID SATURATION COLLAPSE.
- FILTER COLLAR GRADING DETAILS PROVIDED IN T+T SPECIFICATION, DATED OCTOBER 2022.
- CONCRETE STRENGTH TO BE MINIMUM 17.5 MPa AT 28 DAYS.



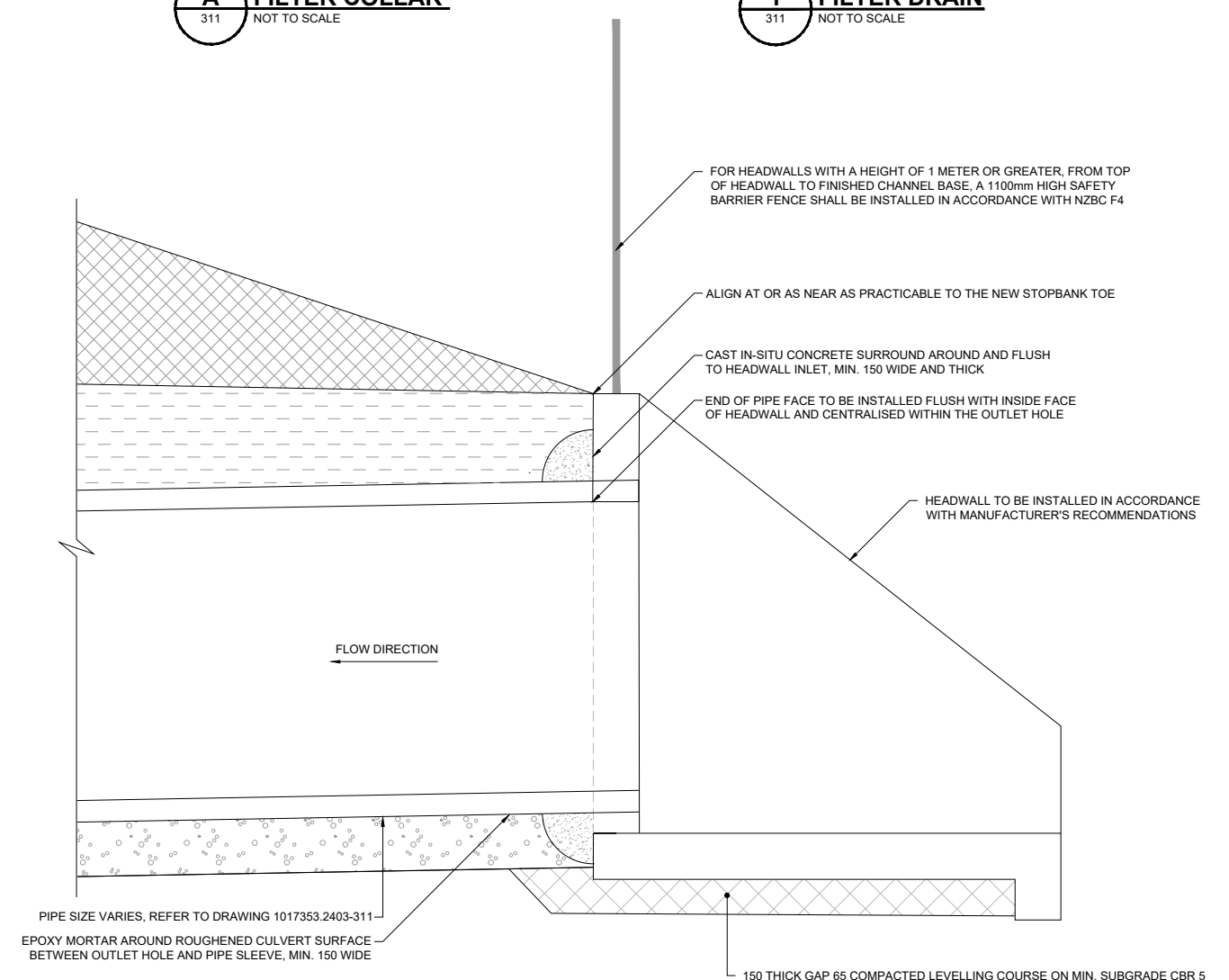
**INLET ARRANGEMENT TYPE 1: SCRUFFY DOME DETAIL**

SCALE (A1) 1:20  
SCALE (A3) 1:40



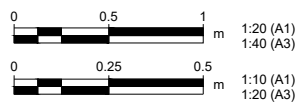
**TYPICAL DETAIL: CULVERT TRENCH**

SCALE (A1) 1:10  
SCALE (A3) 1:20



**INLET ARRANGEMENT TYPE 2: WINGWALL DETAIL**

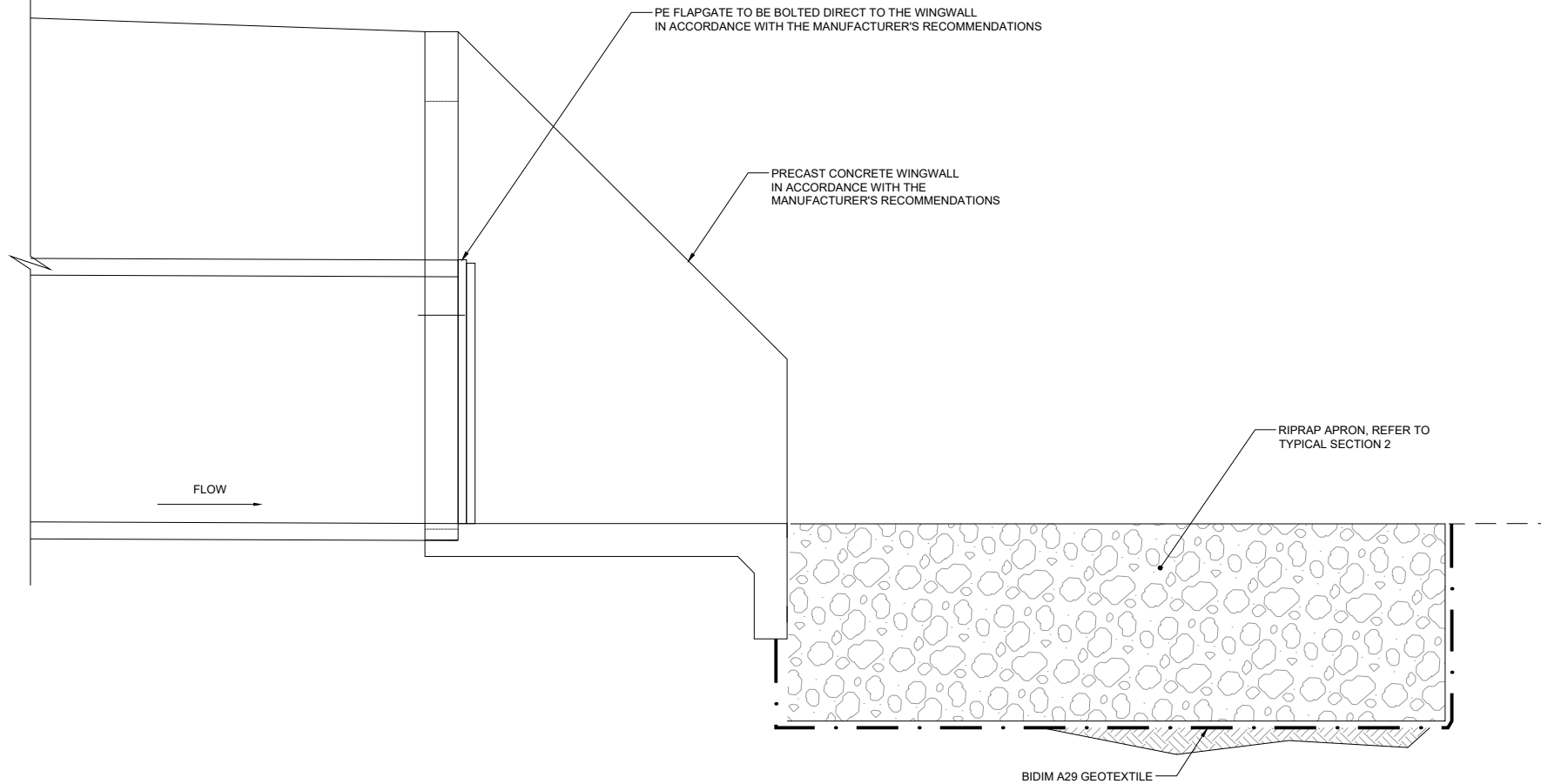
SCALE (A1) 1:10  
SCALE (A3) 1:20



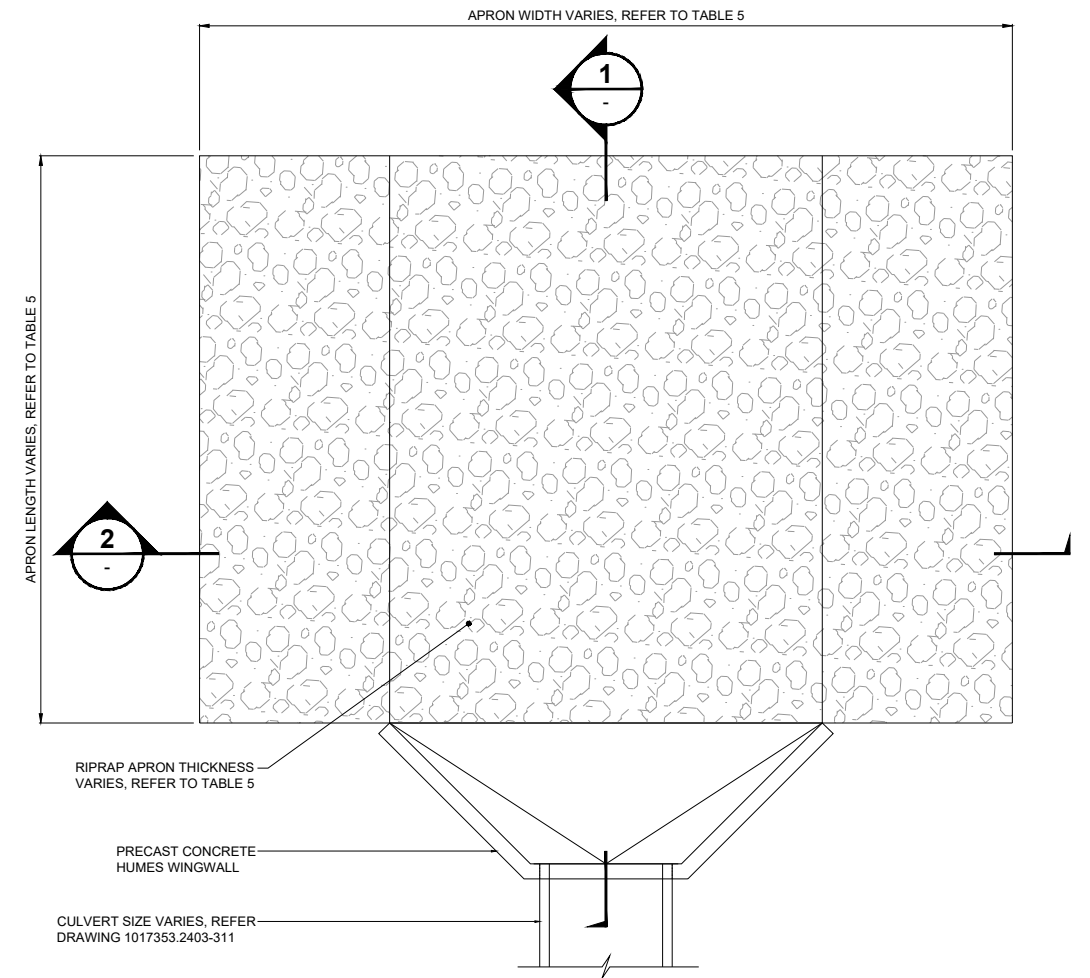
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|                      |                    |      |      |          |  |      |        |                |                    |  |                          |       |
|----------------------|--------------------|------|------|----------|--|------|--------|----------------|--------------------|--|--------------------------|-------|
| 1                    | PRELIMINARY DESIGN | KATU | JEMC | 04.09.25 | DESIGNED   | JEMC | JUN.25 | DRAWING STATUS | PRELIMINARY DRAFT  | CLIENT <b>HAWKE'S BAY REGIONAL COUNCIL</b><br>PROJECT <b>PĀKŌWHAI SECONDARY STOPBANK</b> |                          |       |
|                      |                    |      |      |          | DRAWN  | KATU | JUN.25 | PROJECT PHASE  | PRELIMINARY DESIGN |  |                          |       |
|                      |                    |      |      |          | DESIGN CHECKED   | JWY  | SEP.25 |                |                    | TITLE DETAILS  |                          |       |
|                      |                    |      |      |          | DRAWING CHECKED  | HUGO | SEP.25 |                |                    | TYPICAL STORMWATER DRAINAGE DETAILS SHEET 2  |                          |       |
| NOT FOR CONSTRUCTION |                    |      |      |          | THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED |      |        |                |                    | SCALE (A1) AS SHOWN  | DWG No. 1017353.2403-312 | REV 1 |
| REV                  | DESCRIPTION        | CAD  | CHK  | DATE     | APPROVED   | DATE |        |                |                    |  |                          |       |

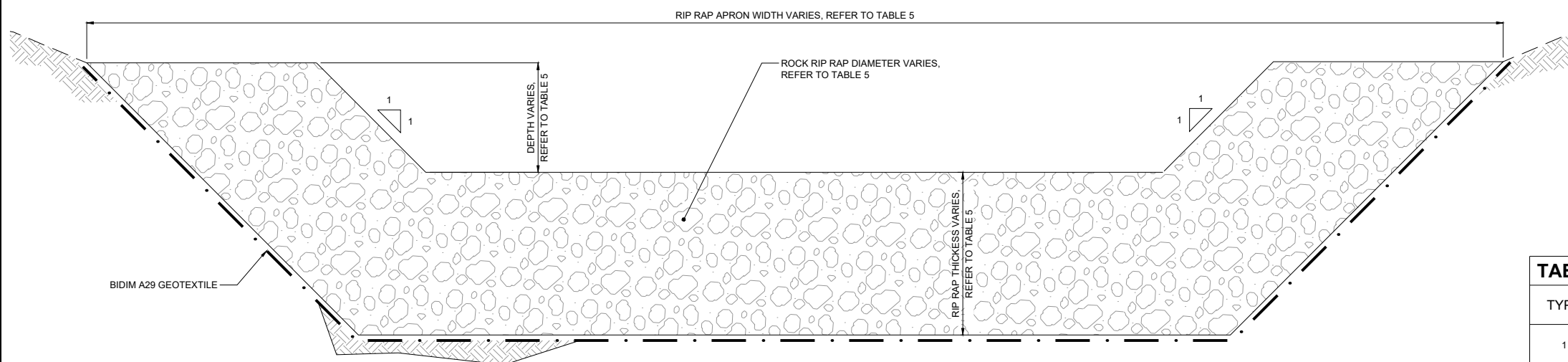
**NOTES**  
 1. ALL DIMENSIONS IN MILLIMETRES UNLESS NOTED OTHERWISE.



**1 TYPICAL SECTION**  
 SCALE (A1) 1:10  
 SCALE (A3) 1:20



**A CULVERT OUTLET PLAN**  
 SCALE (A1) 1:20  
 SCALE (A3) 1:40



**2 TYPICAL SECTION**  
 SCALE (A1) 1:10  
 SCALE (A3) 1:20

0 0.5 1 m  
 1:20 (A1)  
 1:40 (A3)

| TYPE | APPLICABLE CULVERT ID'S            | APRON LENGTH (m) | APRON WIDTH (m) | APRON THICKNESS (m) | ROCK D50 SIZE (m) |
|------|------------------------------------|------------------|-----------------|---------------------|-------------------|
| 1    | C4, C6, C6.1, C8, C9, C14.1, C17.1 | 6.3              | 2.3             | 0.3                 | 0.15              |
| 2    | C7, C11, C12, C14, C16, C17        | 4.5              | 1.2             | 0.4                 | 0.2               |
| 3    | C10, C13, C15                      | 4.8              | 1.8             | 0.6                 | 0.3               |

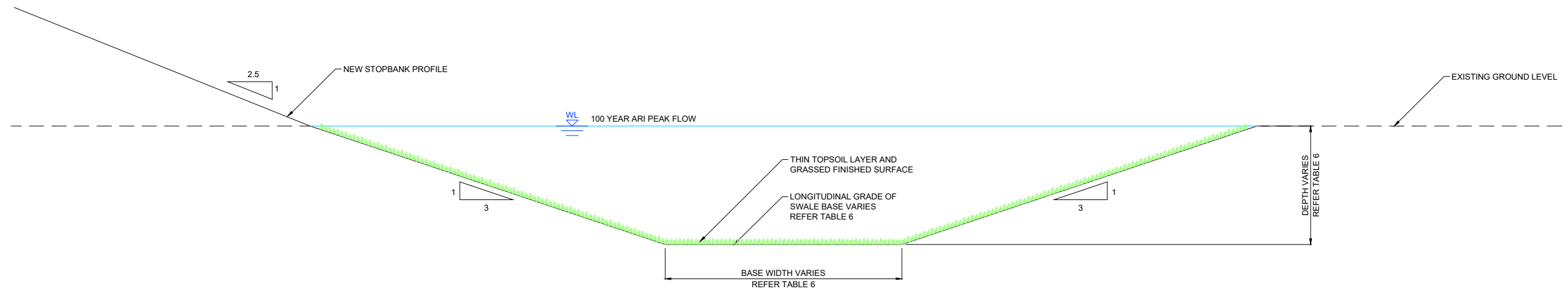


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|                 |                    |        |  |                    |               |
|-----------------|--------------------|--------|--|--------------------|---------------|
| DESIGNED        | JEMC               | JUN.25 | DRAWING STATUS   | PRELIMINARY DRAFT  |               |
| DRAWN           | KATU               | JUN.25 | PROJECT PHASE  | PRELIMINARY DESIGN |               |
| DESIGN CHECKED  | JWY                | SEP.25 | NOT FOR CONSTRUCTION   |                    |               |
| DRAWING CHECKED | HUGO               | SEP.25 | THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED |                    |               |
| 1               | PRELIMINARY DESIGN | KATU   | JEMC   | 04.09.25           |               |
| REV             | DESCRIPTION        | CAD    | CHK  | DATE               | APPROVED DATE |

|            |   |                          |
|------------|---|--------------------------|
| CLIENT     | <b>HAWKE'S BAY REGIONAL COUNCIL</b>         |                          |
| PROJECT    | <b>PĀKŌWHAII SECONDARY STOPBANK</b>         |                          |
| TITLE      | DETAILS                                     |                          |
|            | TYPICAL STORMWATER DRAINAGE DETAILS SHEET 3 |                          |
| SCALE (A1) | AS SHOWN                                    | DWG No. 1017353.2403-313 |
| REV        | 1   |                          |

**NOTES**  
 1. ALL DIMENSIONS IN MILLIMETRES UNLESS NOTED OTHERWISE.



**TYPICAL NEW SWALE DETAIL**

SCALE (A1) 1:20  
 SCALE (A3) 1:40

| SWALE ID | RECEIVING CULVERT ID | BASE WIDTH (mm) | SIDE SLOPES | LENGTH (m) | LONGITUDINAL GRADE % | TYPICAL DEPTH (mm) |
|----------|----------------------|-----------------|-------------|------------|----------------------|--------------------|
| DC1-0    | C1                   | 500             | 3H:1V       | 13.3       | 0.9                  | 305                |
| DC1-1    | C1                   | 500             | 3H:1V       | 35.1       | 0.5                  | 330                |
| DC1-2    | C1                   | 500             | 3H:1V       | 52.1       | 0.4                  | 140                |
| DC2-1    | C2                   | 500             | 3H:1V       | 241.7      | 0.3                  | 200                |
| DC2-2    | C2                   | 500             | 3H:1V       | 158.4      | 0.7                  | 120                |
| DC3-0    | C3                   | 500             | 3H:1V       | 120.1      | 1.2                  | 205                |
| DC4-0    | C4                   | 500             | 3H:1V       | 33.2       | 0.6                  | 305                |
| DC4-1    | C4                   | 500             | 3H:1V       | 178.9      | 0.9                  | 255                |
| DC4-2    | C4                   | 500             | 3H:1V       | 80.0       | 0.4                  | 135                |
| DC5-0    | C5                   | 500             | 3H:1V       | 8.2        | 1.0                  | 230                |
| DC5-1    | C5                   | 500             | 3H:1V       | 158.8      | 0.2                  | 240                |
| DC10-1   | C10                  | 500             | 3H:1V       | 182.5      | 0.3                  | 95                 |
| DC11-1   | C11                  | 500             | 3H:1V       | 526.6      | 0.3                  | 265                |
| DC11-2   | C11                  | 500             | 3H:1V       | 131.3      | 0.6                  | 260                |
| DC12-0   | C12                  | 500             | 3H:1V       | 9.7        | 5.8                  | 185                |
| DC12-1   | C12                  | 500             | 3H:1V       | 249.8      | 0.2                  | 270                |
| DC12-2   | C12                  | 500             | 3H:1V       | 33.5       | 0.2                  | 300                |
| DC14-0   | C14                  | 500             | 3H:1V       | 5.2        | 4.3                  | 175                |
| DC14-1   | C14                  | 500             | 3H:1V       | 196.5      | 0.6                  | 210                |
| DC14-2   | C14                  | 500             | 3H:1V       | 71.8       | 0.4                  | 200                |
| DC15-1   | C15                  | 500             | 3H:1V       | 81.8       | 0.3                  | 170                |
| DC15-2   | C15                  | 500             | 3H:1V       | 74.8       | 0.0                  | 705                |
| DC15-3   | C15                  | 500             | 3H:1V       | 69.0       | 2.1                  | 80                 |
| DC16-1   | C16                  | 500             | 3H:1V       | 274.4      | 1.0                  | 220                |
| DC17-1   | C17                  | 500             | 3H:1V       | 158.1      | 0.2                  | 195                |
| DC17-2   | C17                  | 500             | 3H:1V       | 231.4      | 0.4                  | 165                |



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|   |                    |      |      |          |                      |      |  |                    |                  |   |   |
|---|--------------------|------|------|----------|----------------------|------|--|--------------------|------------------|---|---|
| 1 | PRELIMINARY DESIGN | KATU | JEMC | 04.09.25 | DESIGNED             | JEMC | JUN.25   | DRAWING STATUS     | CLIENT           | <b>HAWKE'S BAY REGIONAL COUNCIL</b>         |   |
|   |                    |      |      |          | DRAWN                | KATU | JUN.25   | PRELIMINARY DRAFT  | PROJECT          | <b>PĀKŌWHAI SECONDARY STOPBANK</b>          |   |
|   |                    |      |      |          | DESIGN CHECKED       | JWY  | SEP.25   | PROJECT PHASE      | TITLE            | DETAILS                                     |   |
|   |                    |      |      |          | DRAWING CHECKED      | HUGO | SEP.25   | PRELIMINARY DESIGN |                  | TYPICAL STORMWATER DRAINAGE DETAILS SHEET 4 |   |
|   |                    |      |      |          | NOT FOR CONSTRUCTION |      | THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED |                    | SCALE (A1)       | 1:20  |   |
|   |                    |      |      |          | APPROVED             | DATE |  | DWG No.            | 1017353.2403-314 | REV   | 1 |

## **Appendix B      Schedule of quantities**

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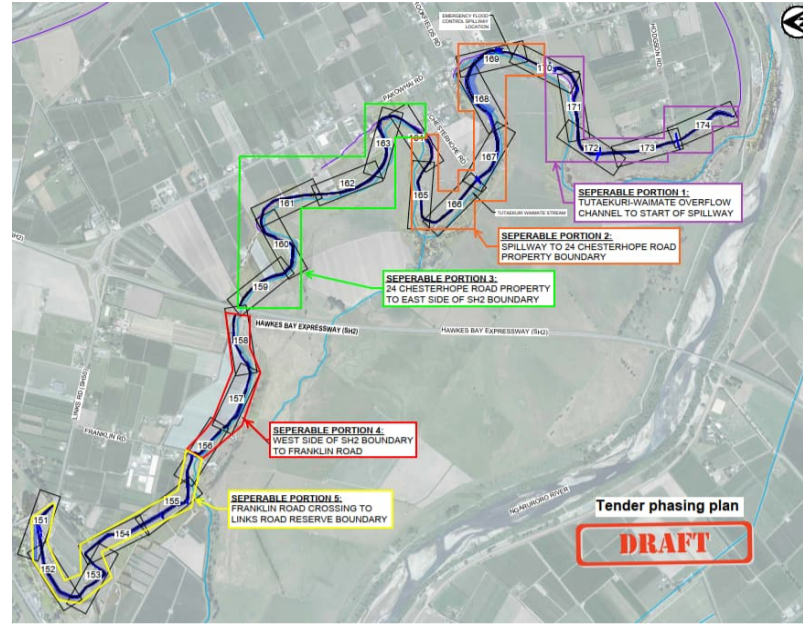
**Pakowhai Stopbank: Schedule of Quantities**

Stage: Preliminary design  
 Confidence Interval: +/- 20%  
 Version 1

Author: JEMC  
 Reviewer: MIBU/WIED  
 3/09/2025  
 9/09/2025

| No.                        | Description  | Quantity  | Unit           | Rate | Amount |
|----------------------------|--|-----------|----------------|------|--------|
| <b>Seperable portion 1</b> |  |           |                |      |        |
| 1.01                       | Strip vegetation and topsoil   | 25,590.0  | m <sup>2</sup> | \$   | -      |
| 1.02                       | Cut to waste - Removal of old stopbanks and/or old stream  | 2,559.0   | m <sup>3</sup> | \$   | -      |
| 1.03                       | Undercut for 0.5 m key   | 12,795.0  | m <sup>3</sup> | \$   | -      |
| 1.04                       | Imported Fill - Supply, stockpile, place, compact and shape stopbank, based on rates provided by HBRC, allowance for uplift from stockpile and place in embankment   | 35,630.0  | m <sup>3</sup> | \$   | -      |
| 1.05                       | Topsoiling, regrassing, and finishing- reuse stripped topsoil (no allowance for imported topsoil)  | 25,590.0  | m <sup>2</sup> | \$   | -      |
| 1.06                       | Fencing (assume standard wire fence along bank on landward side)   | 1,490.0   | m              | \$   | -      |
| 1.07                       | Gates (assume 1 per crossing)  | 4.0       | No             | \$   | -      |
| 1.08                       | Vehicle crossings - general earthworks, additional compaction, profiling, and gravel surfacing   | 4.0       | No             | \$   | -      |
| 1.09                       | Culvert - supply and install DN450 RCRR Class 2 pipe with headwalls at inlet and outlet with PE flaggate, in accordance with the drawings  | 18.8      | m              | \$   | -      |
| 1.10                       | Culvert - supply and install DN300 RCRR Class 2 pipe with headwalls at inlet and outlet, in accordance with the drawings   | 14.2      | m              | \$   | -      |
| 1.11                       | Rip rap around aprons etc (in accordance with drawings for C17 and C17.1) assume d50 is 200mm.   | 5.0       | m <sup>3</sup> | \$   | -      |
| 1.12                       | Supply and install Bidim A29 geotextile under aprons   | 20.5      | m <sup>2</sup> | \$   | -      |
| 1.13                       | Drainage channel cut-in, form, and grass   | 400.0     | m              | \$   | -      |
| <b>SP1: Base cost</b>      |  |           |                |      |        |
| <b>Seperable portion 2</b> |  |           |                |      |        |
| 2.01                       | Strip vegetation and topsoil   | 56,934.00 | m <sup>2</sup> | \$   | -      |
| 2.02                       | Cut to waste - Removal of old stopbanks and/or old stream  | 8,928.40  | m <sup>3</sup> | \$   | -      |
| 2.03                       | Undercut for 0.5 m key   | 28,467.00 | m <sup>3</sup> | \$   | -      |
| 2.04                       | Imported Fill - Supply, stockpile, place, compact and shape stopbank, based on rates provided by HBRC, allowance for uplift from stockpile and place in embankment   | 60,901.00 | m <sup>3</sup> | \$   | -      |
| 2.05                       | Imported Drainage Fill (Holcim 4mm sand) - Supply, stockpile, place, compact and shape stopbank, based on rates provided by HBRC, allowance for uplift from stockpile and place in embankment                        | 1,585.00  | m <sup>3</sup> | \$   | -      |
| 2.06                       | 300mm DIA headwall outlets at every 200mm to discharge seepage captured in novacool subsoil drain  | 3.00      | No             | \$   | -      |
| 2.07                       | 110mm perforated novacool subsoil drain wrapped in filter cloth  | 440.00    | m              | \$   | -      |
| 2.08                       | Topsoiling, regrassing, and finishing- reuse stripped topsoil, no allowance for imported topsoil   | 56,934.00 | m <sup>2</sup> | \$   | -      |
| 2.09                       | Fencing (assume standard wire fence along bank on landward side)   | 1,870.00  | m              | \$   | -      |
| 2.10                       | Gates (assume 2 No total across properties)  | 2.00      | No             | \$   | -      |
| 2.11                       | Vehicle crossings - general earthworks, profiling, and gravel surfacing  | 2.00      | No             | \$   | -      |
| 2.12                       | Stream realignment - Cut to fill from channel to stopbank  | 16,175.00 | m <sup>3</sup> | \$   | -      |
| 2.13                       | Culvert - supply and install DN825 RCRR Class 2 pipe with headwalls at inlet and outlet with PE flaggate, in accordance with the drawings  | 21.20     | m              | \$   | -      |
| 2.14                       | Culvert - supply and install DN525 RCRR Class 2 pipe with scruddy dome at inlet, and headwalls at outlet with PE flaggate, in accordance with the drawings   | 20.00     | m              | \$   | -      |
| 2.15                       | Culvert - supply and install DN525 RCRR Class 2 pipe with headwalls at inlet and outlet with PE flaggate, in accordance with the drawings  | 18.30     | m              | \$   | -      |
| 2.16                       | Culvert - supply and install DN300 RCRR Class 2 pipe with scruddy dome at inlet, and headwalls at outlet, in accordance with the drawings  | 15.50     | m              | \$   | -      |
| 2.17                       | Rip rap around aprons etc (in accordance with drawings for C14.1, C14, C15, and C16) assume d50 is 200mm.  | 21        | m <sup>3</sup> | \$   | -      |
| 2.18                       | Supply and install Bidim A29 geotextile under aprons   | 59.00     | m <sup>2</sup> | \$   | -      |
| 2.19                       | Drainage channel cut-in, form, and grass   | 780.00    | m              | \$   | -      |
| 2.20                       | Supply and place concrete in reinforced concrete spillway sill in accordance with the drawings   | 192.00    | m <sup>3</sup> | \$   | -      |
| 2.21                       | Supply and install spillway erosion protection surfacing (assumed Enkamat 7018 or similar)   | 6,900     | m <sup>2</sup> | \$   | -      |
| 2.22                       | Road works - Pavement build up subbase   | 17.00     | m <sup>3</sup> | \$   | -      |
| 2.23                       | Road works - Pavement build up basecourse  | 17.00     | m <sup>3</sup> | \$   | -      |
| 2.24                       | Road works - Pavement seat   | 385.00    | m <sup>2</sup> | \$   | -      |
| 2.25                       | Provisional - Supply and install reinforcement into concrete spillway sill   | 1.00      | No             | \$   | -      |
| 2.26                       | Provisional - Supply and install rock armouring on stream side slope   | 75        | T              | \$   | -      |
| <b>SP2: Base Cost</b>      |  |           |                |      |        |
| <b>Seperable portion 3</b> |  |           |                |      |        |
| 3.01                       | Strip vegetation and topsoil   | 30,872.40 | m <sup>2</sup> | \$   | -      |
| 3.02                       | Cut to waste - Removal of old stopbanks and/or old stream  | 3,087.24  | m <sup>3</sup> | \$   | -      |
| 3.03                       | Undercut for 0.5 m key   | 15,436.20 | m <sup>3</sup> | \$   | -      |
| 3.04                       | Imported Fill - Supply, stockpile, place, compact and shape stopbank, based on rates provided by HBRC, allowance for uplift from stockpile and place in embankment   | 48,770.00 | m <sup>3</sup> | \$   | -      |
| 3.05                       | Topsoiling, regrassing, and finishing- reuse stripped topsoil, no allowance for imported topsoil   | 30,872.40 | m <sup>2</sup> | \$   | -      |
| 3.06                       | Fencing (assume standard wire fence along bank on landward side)   | 2,175.00  | m              | \$   | -      |
| 3.07                       | Gates (assume 1 No total across properties)  | 1.00      | No             | \$   | -      |
| 3.08                       | Culvert - supply and install DN675 RCRR Class 2 pipe with scruddy dome inlet and headwalls at outlet with PE flaggate, in accordance with the drawings   | 19.00     | m              | \$   | -      |
| 3.09                       | Culvert - supply and install DN600 RCRR Class 2 pipe with scruddy dome inlet and headwalls at outlet with PE flaggate, in accordance with the drawings   | 16.80     | m              | \$   | -      |
| 3.10                       | Culvert - supply and install DN525 RCRR Class 2 pipe with scruddy dome inlet and headwalls at outlet with PE flaggate, in accordance with the drawings   | 20.00     | m              | \$   | -      |
| 3.11                       | Rip rap around aprons etc (in accordance with drawings for C11, C12, and C13) assume d50 is 200mm.   | 15.55     | m <sup>3</sup> | \$   | -      |
| 3.12                       | Supply and install Bidim A29 geotextile under aprons   | 44.00     | m <sup>2</sup> | \$   | -      |
| 3.13                       | Steel UC-beam and dead man anchor retaining wall - supply and install (40m long, 3.5m max ret height)<br>OR<br>Driven Timber ground improvement and bored timber pole retaining wall (40m long, 1.5m max ret height) | 1.00      | No             | \$   | -      |
| 3.14                       | Drainage channel cut-in, form, and grass   | 953.00    | m              | \$   | -      |
| 3.15                       | Provisional - Supply and install rock armouring on stream side slope   | 100.00    | T              | \$   | -      |
| 3.16                       | Provisional - Landfill capping and remediation (assume cut to authorised landfill disposal over 700mm deep and 5000m <sup>2</sup> area, and imported clay fill & placement)  | 1.00      | No             | \$   | -      |
| <b>SP3: Base Cost</b>      |  |           |                |      |        |
| <b>Seperable portion 4</b> |  |           |                |      |        |
| 4.01                       | Strip vegetation and topsoil   | 11,520.00 | m <sup>2</sup> | \$   | -      |
| 4.02                       | Cut to waste - Removal of old stopbanks and/or old stream  | 1,152.00  | m <sup>3</sup> | \$   | -      |
| 4.03                       | Undercut for 0.5 m key   | 5,760.00  | m <sup>3</sup> | \$   | -      |
| 4.04                       | Imported Fill - Supply, stockpile, place, compact and shape stopbank, based on rates provided by HBRC, allowance for uplift from stockpile and place in embankment   | 16,340.00 | m <sup>3</sup> | \$   | -      |
| 4.05                       | Topsoiling, regrassing, and finishing- reuse stripped topsoil, no allowance for imported topsoil   | 11,520.00 | m <sup>2</sup> | \$   | -      |
| 4.06                       | Fencing (assume standard wire fence along bank on landward side)   | 985.00    | m              | \$   | -      |
| 4.07                       | Gates (assume 2 No total across properties)  | 2.00      | No             | \$   | -      |
| 4.08                       | Supply and install STU1800 steel sheet pile in accordance with the drawings. Assume a total sheet length of between 6m and 9m free standing.   | 700.00    | m              | \$   | -      |
| 4.09                       | Culvert - supply and install DN450 RCRR Class 2 pipe with scruddy dome inlet and headwalls at outlet with PE flaggate, in accordance with the drawings   | 20.00     | m              | \$   | -      |
| 4.10                       | Culvert - supply and install DN375 RCRR Class 2 pipe with scruddy dome inlet and headwalls at outlet with PE flaggate, in accordance with the drawings   | 24.00     | m              | \$   | -      |
| 4.11                       | Culvert - supply and install DN300 RCRR Class 2 pipe with scruddy dome inlet and headwalls at outlet with PE flaggate, in accordance with the drawings   | 19.50     | m              | \$   | -      |
| 4.12                       | Culvert - supply and install DN1050 RCRR Class 2 pipe with headwalls at inlet and outlet with PE flaggate, in accordance with the drawings   | 20.00     | m              | \$   | -      |
| 4.13                       | Rip rap around aprons etc (in accordance with drawings for C8, C9, and C10) assume d50 is 200mm.   | 20.7      | m <sup>3</sup> | \$   | -      |
| 4.14                       | Supply and install Bidim A29 geotextile under aprons   | 59.0      | m <sup>2</sup> | \$   | -      |
| 4.15                       | Drainage channel cut-in, form, and grass   | 165.00    | m              | \$   | -      |
| 4.16                       | Provisional - Supply and install rock armouring on stream side slope   | 250.00    | T              | \$   | -      |
| <b>SP4: Base Cost</b>      |  |           |                |      |        |
| <b>Seperable portion 5</b> |  |           |                |      |        |
| 5.01                       | Strip vegetation and topsoil   | 39,282.00 | m <sup>2</sup> | \$   | -      |
| 5.02                       | Cut to waste - Removal of old stopbanks and waste materials  | 3,928.20  | m <sup>3</sup> | \$   | -      |
| 5.03                       | Undercut for 0.5 m key   | 19,641.00 | m <sup>3</sup> | \$   | -      |
| 5.04                       | Imported Fill - Supply, stockpile, place, compact and shape stopbank, based on rates provided by HBRC, allowance for uplift from stockpile and place in embankment   | 66,059.00 | m <sup>3</sup> | \$   | -      |
| 5.05                       | Imported Drainage Fill (Holcim 4mm sand) - Supply, stockpile, place, compact and shape stopbank, based on rates provided by HBRC, allowance for uplift from stockpile and place in embankment                        | 6,210.00  | m <sup>3</sup> | \$   | -      |
| 5.06                       | 300mm DIA headwall outlets at every 200mm to discharge seepage captured in novacool subsoil drain  | 9.00      | No             | \$   | -      |
| 5.07                       | 110mm perforated novacool subsoil drain wrapped in filter cloth  | 1,725.00  | m              | \$   | -      |
| 5.08                       | Topsoiling, regrassing, and finishing- reuse stripped topsoil, no allowance for imported topsoil   | 39,282.00 | m <sup>2</sup> | \$   | -      |
| 5.09                       | Fencing (assume standard wire fence along bank on landward side)   | 1,980.00  | m              | \$   | -      |
| 5.10                       | Gates (assume 5 No total across properties)  | 5.00      | No             | \$   | -      |
| 5.11                       | Culvert - supply and install DN525 RCRR Class 2 pipe with headwalls at inlet and outlet with PE flaggate, in accordance with the drawings  | 21.30     | m              | \$   | -      |
| 5.12                       | Culvert - supply and install DN450 RCRR Class 2 pipe with scruddy dome at inlet and headwalls outlet with PE flaggate, in accordance with the drawings   | 20.00     | m              | \$   | -      |
| 5.13                       | Culvert - supply and install DN600 RCRR Class 2 pipe with scruddy dome at inlet and headwalls outlet with PE flaggate, in accordance with the drawings   | 20.00     | m              | \$   | -      |
| 5.14                       | Culvert - supply and install DN525 RCRR Class 2 pipe with headwalls at inlet and outlet with PE flaggate, in accordance with the drawings  | 24.50     | m              | \$   | -      |
| 5.15                       | Culvert - supply and install DN300 RCRR Class 2 pipe with headwalls at inlet and outlet with PE flaggate, in accordance with the drawings  | 17.00     | m              | \$   | -      |
| 5.16                       | Culvert - supply and install DN300 RCRR Class 2 pipe with headwalls at inlet and outlet with PE flaggate, in accordance with the drawings  | 13.50     | m              | \$   | -      |
| 5.17                       | Culvert - supply and install DN525 RCRR Class 2 pipe with headwalls at inlet and outlet with PE flaggate, in accordance with the drawings  | 12.80     | m              | \$   | -      |
| 5.18                       | Drainage channel cut-in, form, and grass   | 1,080     | m              | \$   | -      |
| 5.19                       | Stream channel cut-in, form, grass & plant   | 240.00    | m              | \$   | -      |
| 5.20                       | Road works - Pavement build up subbase   | 41.00     | m <sup>3</sup> | \$   | -      |
| 5.21                       | Road works - Pavement build up basecourse  | 41.00     | m <sup>3</sup> | \$   | -      |
| 5.22                       | Road works - Pavement seat   | 859.00    | m <sup>2</sup> | \$   | -      |
| 5.23                       | Vehicle crossings - general earthworks, profiling, and gravel surfacing  | 4.00      | No             | \$   | -      |
| 5.24                       | Rip rap around aprons etc (in accordance with drawings for C1, C2, C3, C4, C5, C6 and C6.1) assume d50 is 200mm.   | 36.3      | m <sup>3</sup> | \$   | -      |
| 5.25                       | Supply and install Bidim A29 geotextile under aprons   | 84.0      | m <sup>2</sup> | \$   | -      |
| 5.26                       | Provisional - Rock armouring   | 40.00     | T              | \$   | -      |
| <b>SP5: Base Cost</b>      |  |           |                |      |        |

Seperable portions for tender (agreed with HBRC):



**Exclusions/Assumptions:**

- SoQ intended use is to update/ revise total project cost estimates.
- SoQ not to be used for the pre-ordering of any items.
- Preliminary, general, and/or any other admin costs
- MSQA (including testing) costs
- Design, Consenting and surveying costs
- Professional services fees
- Consent application fees
- Erosion and sediment control costs
- Dust suppression costs
- Orchard reinstatement costs
- Bore relocations and headworks costs
- Planting or ecological offsets costs
- Land acquisition costs
- TMP costs, including permits and TMP provisions for incoming fill
- Buildings demolition costs such as asbestos removal and services decommissioning
- Consents and permits costs
- Vegetation clearance is limited to small brush and bush, and does not include tree clearance etc. Tree clearance and larger vegetation clearance assumed to be part of enabling works.
- Enabling Works costs are provisional TBC by others
- Utilities costs are provisional subject to asset owners design
- Arborists costs
- In stream works for erosion control (if required).
- Site re-establishment costs due to staging of works.
- Supply cost for Enkamat 7018 turf reinforcement \$6.78 per m<sup>2</sup>, excl GST and freight from Auckland, supplied to T+T on 26/8/25.
- Relocation of any utilities outside of the construction corridor are assumed to be part of the enabling works (not covered in this SoQ)

## **Appendix C      Selected key correspondence**

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- C1      Unison power supply – Existing infrastructure implications.**
- C2      Chorus communications network – Existing infrastructure implications.**
- C3      Correspondence with spillway erosion protection system suppliers.**

**From:** Ruben Smith <Ruben.Smith@unison.co.nz>  
**Sent:** Wednesday, 20 August 2025 8:13 am  
**To:** Harry Donnelly  
**Cc:** Jesse McCall  
**Subject:** 214845 - Pakowhai Stop Banks - Offer Letter  
**Attachments:** ECM\_785065\_v1\_214845 - Pakowhai Stop Banks - Offer Letter.pdf

PDF's provided not included in appendix for clarity. They may be provided at request.

Hello Harry,

Please find attached the offer letter for the above project. Please read to confirm all details are correct before signing and returning to new connections.

If you have any questions or require changes, please feel free to contact me.

Regards,

**Ruben Smith**

Customer Project Planning

**Unison Networks Limited**

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**Subject:** RE: Unison Infrastructure - proposed new stop bank.  
**Sent:** 12/08/2025, 2:50:04 pm  
**From:** Ruben Smith<Ruben.Smith@unison.co.nz>  
**To:** Jesse McCall  
**Cc:** Harry Donnelly

---

Hi Jesse,

Thank you for providing the updated plans.  
After discussing with our Design Manager at Unison, we are pleased to proceed with this as a single, integrated project. Our design team will collaborate closely with you to develop the necessary design for the required work.

Once the design is finalized and the scope of work is clearly understood, it will be returned to me to prepare the costings.

To move forward, I will issue an offer letter outlining the design fee. Could you please confirm the appropriate recipient for this offer letter for payment purposes? Should it be addressed to you directly or to the regional council? Please provide the relevant contact details at your earliest convenience so we can proceed accordingly.  
Best regards,

**Ruben Smith**

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**Unison Networks Limited**  
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---

**From:** Jesse McCall <[JMcCall@tonkintaylor.co.nz](mailto:JMcCall@tonkintaylor.co.nz)>  
**Sent:** Thursday, 7 August 2025 5:18 pm  
**To:** Ruben Smith <[Ruben.Smith@unison.co.nz](mailto:Ruben.Smith@unison.co.nz)>  
**Cc:** Harry Donnelly <[harry.donnelly@hbrc.govt.nz](mailto:harry.donnelly@hbrc.govt.nz)>  
**Subject:** RE: Unison Infrastructure - proposed new stop bank.

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Hi Ruben,

Thanks for your response. We'd like to proceed with filing an application for Unison to develop a concept design plan and estimate a fee for the works across the project, as well as any engineering assessments required to do so.

I've gone over our design in relation to the available data we have on Unison infrastructure in the area, and I have identified the areas where our works do not comply with ECP-34 in the attached drawings set. Note that although the Franklin Rd HV junction pole is probably the highest risk, we may require relocations elsewhere along our work extents.

The procedure you are showing below is for an individual pole and lines but we were hoping, if possible, to do all the areas under one application (for our admins' sake and yours). Please let me know if this is achievable, otherwise we can file all our requests individually via the links you sent through previously.

Ngā mihi | Kind regards,

**Jesse McCall | Civil Engineer**

BE(hons), CMEngNZ, CPEng, MEngAU



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**From:** Ruben Smith <[Ruben.Smith@unison.co.nz](mailto:Ruben.Smith@unison.co.nz)>  
**Sent:** Wednesday, 6 August 2025 11:12 am  
**To:** Jesse McCall <[JMcCall@tonkintaylor.co.nz](mailto:JMcCall@tonkintaylor.co.nz)>  
**Subject:** RE: Unison Infrastructure - proposed new stop bank.

Hi Jesse,

The asset team have responded.

They have no objections provided Unison's assets are not encroached upon as far as ECP 34 required clearances define.

If the proposed work does compromise the specified distances the requestor will need to arrange for a line alteration as necessary to maintain those correct distances(along with any engineering assessment required).

Any realignment should be aimed to be on the safe side of the stopbank where possible, and all construction work would require the necessary close approach consents etc,

Please see attached links.

- for the close approach forms. [Close Approach Consent Request](#)
- Engineering assessment [Engineering Assessment](#)
- Safety disconnection [Safety disconnection and reconnection](#)
- Cable locates [Find underground cables](#)

For your reference, the estimated timeframe to move a large pole and lines is shown below.



I hope the above information give you some idea of the process and timeframes.  
Looking forward to hearing back from you on how you would like Unison to proceed.

Regards,

**Ruben Smith**

Customer Project Planning

**Unison Networks Limited**

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---

**From:** Jesse McCall <[JMcCall@tonkintaylor.co.nz](mailto:JMcCall@tonkintaylor.co.nz)>  
**Sent:** Tuesday, 5 August 2025 3:26 pm  
**To:** Ruben Smith <[Ruben.Smith@unison.co.nz](mailto:Ruben.Smith@unison.co.nz)>  
**Subject:** RE: Unison Infrastructure - proposed new stop bank.

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Hi Ruben,

I appreciate the prompt response, attached is our work in progress plan drawing for the area and I have sketched on a section where the junction HV pole is for reference.

If you could please progress this to the asset management staff for initial feedback that would be great. I'll check in with HBRC following that to see how they'd prefer to proceed if a Unison eng assessment or a detailed design etc is required.

Thanks,

Ngā mihi | Kind regards,

**Jesse McCall | Civil Engineer**

BE(hons), CMEngNZ, CPEng, MEngAU

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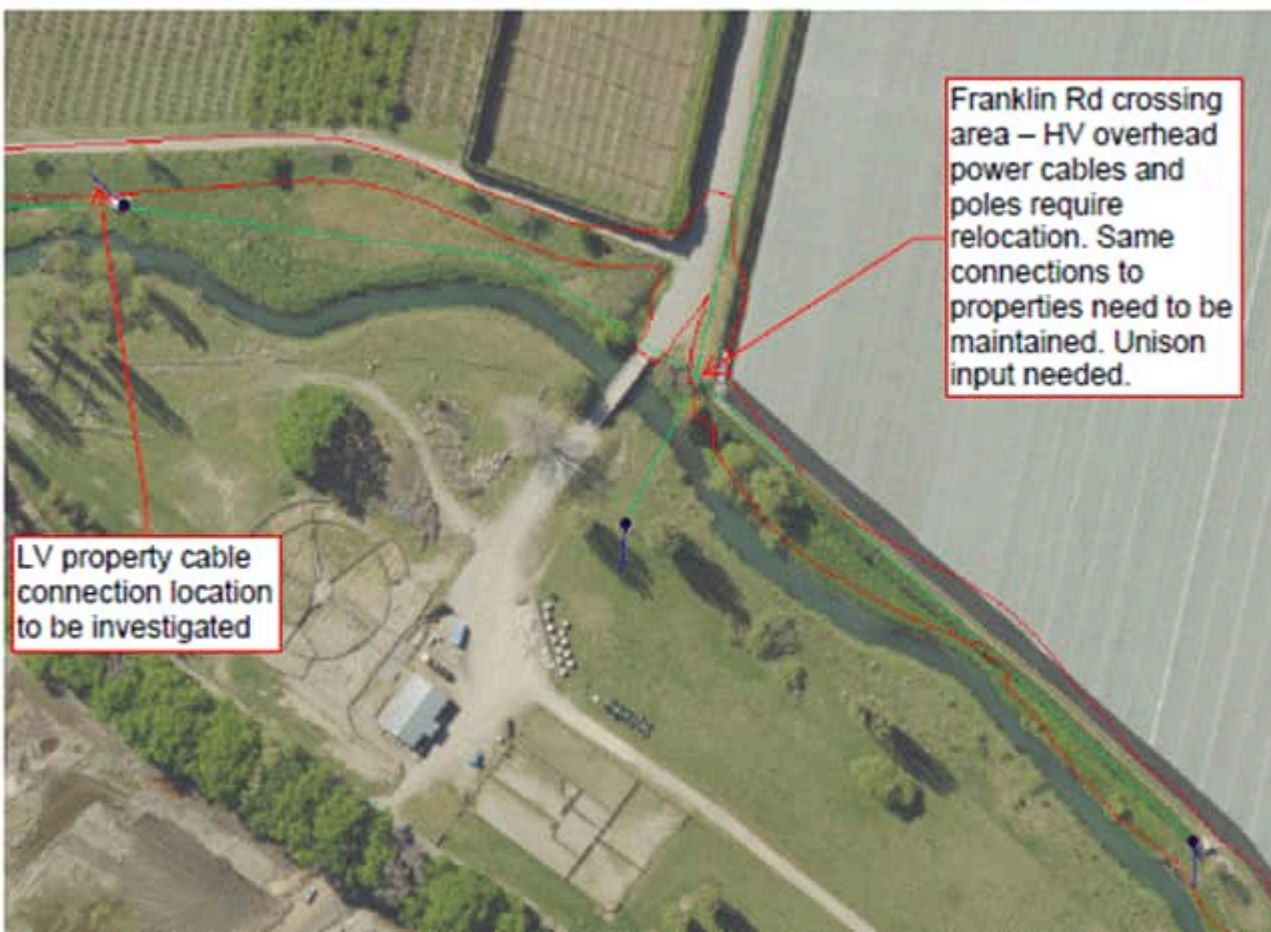
---

**From:** Ruben Smith <[Ruben.Smith@unison.co.nz](mailto:Ruben.Smith@unison.co.nz)>  
**Sent:** Monday, 4 August 2025 1:45 pm  
**To:** Jesse McCall <[JMcCall@tonkintaylor.co.nz](mailto:JMcCall@tonkintaylor.co.nz)>  
**Subject:** FW: Unison Infrastructure - proposed new stop bank.

Hello Jesse,

A quick update for you.  
My colleague Stephen is currently on leave, and I will be looking into this project for you.

I have reviewed your plans and can see some issues with the Franklin Rd site.  
I will need to run this project past the asset team to review. Can you please provide me with the design profiles of the stop banks e.g height and width of the stop banks.  
An engineering assessment or a detailed design may need to be completed by Unison, if the customer requests to relocate any Unison assets or build any structure within the electrical safe distances as set out in **ECP 34 attached**.  
Please see the below snip of the Unison High-voltage overhead assets (shown in orange solid line) in the area at the end of Franklin Rd.



Franklin Rd crossing area – HV overhead power cables and poles require relocation. Same connections to properties need to be maintained. Unison input needed.

LV property cable connection location to be investigated



Once I have the stop bank profiles I can progress this to the asset management staff for feedback.

Feel free to contact myself if you need more clarity or have further questions. Regards,

**Ruben Smith**  
Customer Project Planning  
**Unison Networks Limited**  
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E [ruben.smith@unison.co.nz](mailto:ruben.smith@unison.co.nz)

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**From:** Jesse McCall <[JMcCall@tonkintaylor.co.nz](mailto:JMcCall@tonkintaylor.co.nz)>  
**Sent:** Wednesday, July 30, 2025 10:27:33 AM  
**To:** Stephen Whitaker <[Stephen.Whitaker@unison.co.nz](mailto:Stephen.Whitaker@unison.co.nz)>  
**Subject:** RE: Unison Infrastructure - proposed new stop bank.

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Hi Stephen,

Thanks for your prompt response, I have provided responses to your questions in red text in your email below.

I have attached a dwg file showing all the Unison infrastructure (provided by your GIS team) overlaid with our current proposed stopbank work extents (in red).

I also attached a pdf showing the areas of interest and our thoughts on the impacts, but we would like to get your thoughts to ultimately confirm a plan approval in principle with Unison for our prelim design.

Note that our work extents are subject to change with alignment refinements etc but the general construction corridor is unlikely to change.

Ngā mihi | Kind regards,

**Jesse McCall | Civil Engineer**

BE(hons), CMEngNZ, CPEng, MEngAU

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**From:** Stephen Whitaker <[Stephen.Whitaker@unison.co.nz](mailto:Stephen.Whitaker@unison.co.nz)>  
**Sent:** Monday, 28 July 2025 1:19 pm  
**To:** Jesse McCall <[JMcCall@tonkintaylor.co.nz](mailto:JMcCall@tonkintaylor.co.nz)>  
**Subject:** RE: Unison Infrastructure - proposed new stop bank.

Hi Jesse

I have had a brief look at the proposed stop bank rout and possible conflicts with your works and our existing assets.

We would not only look at overhead lines which would be the majority but also underground cables that might need a change in burial depth.

It would help if you had specific areas of conflict that we could work with, each location would need to be looked at separately. **See attached pdf and dwg files.**

Any change in Unison asset positions would require relative property owners' approval and possible easements created.

All affected property owners have been notified about the project. If you could please let us know which cases this will be required, and if any possible easements are required, then we can get HBRC to liaise with property owners.

Have you contacted Transpower as there could also be conflicts with their overlines. **We have their GIS layer, and from site walkovers, their infrastructure doesn't appear to be impacted.**

Please send as much info as possible and if you have a dwg file, that too will help.

Kind Regards

**Stephen Whitaker**

Customer Projects Planner

**Unison Networks Limited**

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---

**From:** Jesse McCall <[JMcCall@tonkintaylor.co.nz](mailto:JMcCall@tonkintaylor.co.nz)>  
**Sent:** Friday, 25 July 2025 9:13 am  
**To:** Stephen Whitaker <[Stephen.Whitaker@unison.co.nz](mailto:Stephen.Whitaker@unison.co.nz)>  
**Subject:** Unison Infrastructure

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Hi Stephen,

I am a Civil Engineer at Tonkin + Taylor, and I was forwarded your contact details from my colleague Jamie Yule as I'm working on a stopbank project with him in Pakowhai. The project involves new stopbanks to protect the Pakowhai area from nearby river and stream flooding in high rainfall events. We are currently at the preliminary design stage and our proposed stopbank corridor has been confirmed with council and other key stakeholders, however the exact alignment is still in the refinement stage.

Our proposed stopbank corridor passes in proximity to Unison infrastructure at various locations, and we may require relocation of some assets to enable safe construction and/ or maintenance of the stopbank over time. I have annotated a draft plan as attached to show the areas we would like to highlight to Unison. For the area near Franklin Road where relocation of Unison infrastructure is likely required, we would like to better understand what the preferable solution would be to Unison, including rough order costs to complete, to help inform our prelim design in this area.

Feel free to give me a call to discuss if it's easier,

Ngā mihi | Kind regards,

**Jesse McCall | Civil Engineer**

BE(hons), CMEngNZ, CPEng, MEngAU

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**From:** Jesse McCall  
**Sent:** Monday, 18 August 2025 4:57 pm  
**To:** Anton McDonald  
**Cc:** Harry Donnelly  
**Subject:** RE: JT330412 1912 Pakowai Road RDWRKS - Chorus  
**Attachments:** JT330412 Chorus network-TT edits.pdf

Hi Anton,

Thank you for that, I have annotated your plans to show approximately where the chorus network sits in relation to our work extents as attached.

I think we'll need a service locate and check to see if the leads are live in localised areas at Hodgson Road, Chesterhope Road, Franklin Road, and Links Road areas, to inform our design plans. But please let me know what you think, and how you would recommend we proceed.

Ngā mihi | Kind regards,  
**Jesse McCall | Civil Engineer**  
BE(hons), CMEngNZ, CPEng, MEngAU  
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**From:** Anton McDonald <[Anton.McDonald@downer.co.nz](mailto:Anton.McDonald@downer.co.nz)>  
**Sent:** Monday, 18 August 2025 3:06 pm  
**To:** Jesse McCall <[jmccall@tonkintaylor.co.nz](mailto:jmccall@tonkintaylor.co.nz)>  
**Subject:** FW: JT330412 1912 Pakowai Road RDWRKS - Chorus

Hi Jesse

I have drawn up some plans with the possible areas that may conflict with the Chorus network. I was unsure about the Link Rd area, but can you let me know what areas will be affected? Seems to be all copper cables / service leads, but may be still live.

Regards  
Anton

**Anton McDonald**  
**Outside Plant Designer**  
Energy and Utilities



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Hamilton 3200  
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---

**From:** Anton McDonald  
**Sent:** Wednesday, 13 August 2025 11:53 am

To: [jmccall@tonkintaylor.co.nz](mailto:jmccall@tonkintaylor.co.nz)

Subject: JT330412 1912 Pakowai Road RDWRKS - Chorus

Hi Jesse

I currently have this job from Chorus with the overall draft plan of the stream realignment works. I will investigate and forward on some plans with the conflicts areas.

It looks fairly extensive area wise, but I will identify the intersect locations and advise.

Regards

Anton

**Anton McDonald**  
**Outside Plant Designer**  
Energy and Utilities



M | +64211975658

E | [Anton.McDonald@downer.co.nz](mailto:Anton.McDonald@downer.co.nz)

16 Manchester Place

Hamilton 3200

[www.downergroup.co.nz](http://www.downergroup.co.nz)



**Subject:** 11311406 | Roadworks | 1912 Pakowhai Road, Pakowhai 4183  
**Sent:** 5/08/2025, 5:53:44 pm  
**From:** CNO - Network Services<networkservices@chorus.co.nz>  
**To:** Jesse McCall

---

Thanks for confirming Jesse,

I've updated the billing details for this job.

It is currently with our service company for assessment, and they will be in touch with a design proposal once completed.

We'll keep you informed of any further updates as they become available.

Regards,

Zara Beecroft  
Network specialist

**\*\*Please ensure you reply with your Chorus Case Number in the subject line for all future communications regarding this job, this will prevent a delay in any correspondence \*\***

----- Original Message -----

From: Jesse McCall [[jmccall@tonkintaylor.co.nz](mailto:jmccall@tonkintaylor.co.nz)]  
Sent: 5/08/2025, 3:49 pm  
To: [networkservices@chorus.co.nz](mailto:networkservices@chorus.co.nz)  
Subject: RE: 11311406 | Roadworks | 1912 Pakowhai Road, Pakowhai 4183

Hi Zara,

I'm acting on behalf of Hawkes Bay Regional Council (HBRC) and our council contact is Harry Donnelly ([harry.donnelly@hbrc.govt.nz](mailto:harry.donnelly@hbrc.govt.nz)<mailto:[harry.donnelly@hbrc.govt.nz](mailto:harry.donnelly@hbrc.govt.nz)>).

The billing address will be to HBRC offices at 159 Dalton Street, Napier 4110.

And just to be clear, we're at the preliminary design phase just hoping to get input from Chorus if any asset relocations etc are required or not.

Let me know if there's any further info you need,

Ng? mihi | Kind regards,

Jesse McCall | Civil Engineer

BE(hons), CEngNZ, CPEng, MEngAU

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[cid:image001.png@01DC0620.8A811DF0] <[https://chorusnz.my.salesforce.com/apex/AFSC\\_\\_UrlCheck?id=05a5DMp000002KriBMAS](https://chorusnz.my.salesforce.com/apex/AFSC__UrlCheck?id=05a5DMp000002KriBMAS) (https://www.linkedin.com/company/tonkin-&-taylor)> [MYTT]

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[logo]<[https://chorusnz.my.salesforce.com/apex/AFSC\\_\\_UrlCheck?id=05a5DMp000002KriCMAS](https://chorusnz.my.salesforce.com/apex/AFSC__UrlCheck?id=05a5DMp000002KriCMAS) (https://www.tonkintaylor.co.nz)>

To send me large files you can use my file drop <[https://chorusnz.my.salesforce.com/apex/AFSC\\_\\_UrlCheck?id=05a5DMp000003GirOMAS](https://chorusnz.my.salesforce.com/apex/AFSC__UrlCheck?id=05a5DMp000003GirOMAS) (https://transfer.tonkinandtaylorgroup.com/filedrop?JMcCall@tonkintaylor.co.nz)>

From: CNO - Network Services <[networkservices@chorus.co.nz](mailto:networkservices@chorus.co.nz)>  
Sent: Wednesday, 30 July 2025 8:31 am  
To: [harry.donnelly@hbrc.govt.nz](mailto:harry.donnelly@hbrc.govt.nz); Jesse McCall <[jmccall@tonkintaylor.co.nz](mailto:jmccall@tonkintaylor.co.nz)>  
Subject: 11311406 | Roadworks | 1912 Pakowhai Road, Pakowhai 4183

[Image removed by sender.]

Good morning Jesse & Harry,

Thank you for your request.

Could you please confirm whether you are acting on behalf of a council?

If so, kindly provide the name of your council contact and their associated Roding Corridor Authority (RCA).

Additionally, we would appreciate it if you could confirm the billing details for this job request.

Kind Regards,  
Zara Beecroft  
Network Specialist

Regards,

Zara Beecroft  
Network specialist

\*\*Please ensure you reply with your Chorus Case Number in the subject line for all future communications regarding this job, this will prevent a delay in any correspondence \*\*  
[Image removed by sender.]

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**Subject:** RE: Chorus Infrastructure Impacts - Pakowhai  
**Sent:** 25/07/2025, 12:51:18 pm  
**From:** Henry Geary<henry.geary@downer.co.nz>  
**To:** Jesse McCall

---

Kia ora Jesse

Yes, Downer build and maintain the Chorus network throughout Hawkes Bay. However, Chorus do not keep GIS records of their assets so PDF is the best we can offer.

In order for us to help you with your queries, you will need to create a job with Chorus first. Please copy and paste the following URL into your web browser:

<https://www.chorus.co.nz/help/services/moving-network-equipment/request>

Select "Other" from the drop-down box at the bottom. Please write "Roadworks" on any of the fillable cells on the pages after that.

Basically, Chorus need to know:

- Your Contact Details (Name/contact number/e-mail etc).
- Site Contact Details (Name/contact number/e-mail etc).
- Billing Details (The company who will be paying the costs involved/their physical Postal Address/contact number/e-mail etc)  
Usually this should be the principal as in the local council/Waka Kotahi etc but sometimes the sub-contractor for the roadworks. Chorus need these details at the outset.
- A description of the work that is required.
- Attach your site/construction plans of the roadworks.

Chorus will then create a job with Downer and one of our design team (may not necessarily be me) will be in touch to discuss further.

Hope this helps.

Ngā mihi

**Henry Geary**  
**Specialist Designer**  
Energy and Utilities



M | +64274802198 F | +6468420351

E | [henry.geary@downer.co.nz](mailto:henry.geary@downer.co.nz)

1436 Omaha Rd

Hastings 4175

[www.downergroup.co.nz](http://www.downergroup.co.nz)



---

**From:** Jesse McCall <[JMcCall@tonkintaylor.co.nz](mailto:JMcCall@tonkintaylor.co.nz)>

**Sent:** Friday, 25 July 2025 9:55 am

**To:** Henry Geary <[henry.geary@downer.co.nz](mailto:henry.geary@downer.co.nz)>

**Subject:** Chorus Infrastructure Impacts - Pakowhai

[External Email] This email was sent from outside the organisation – be cautious, particularly with links and attachments.

Hi Henry,

I am a Civil Engineer at Tonkin + Taylor, and I was forwarded your contact details from my colleague Jamie Yule as I'm working on a stopbank project with him in Pakowhai. He has let me know that the Chorus Infrastructure network is partly managed by Downer in this area but please let me know if I should go elsewhere regarding this request.

The project involves new stopbanks to protect the Pakowhai area from nearby river and stream flooding in high rainfall events. We are currently at the preliminary design stage and our proposed stopbank corridor has been confirmed with council and other key stakeholders, however the exact alignment is still in the refinement stage.

Our proposed stopbank corridor passes over and in proximity to Chorus infrastructure at various locations, and we may require relocation of some assets to enable safe construction and/ or maintenance of the stopbank over time. I have attached a draft plan showing the approx. work extents. Due to the large site area and to mitigate risk, we would like to obtain GIS data of the Chorus network in this area (if possible) rather than pdf plans which we have already obtained through before u dig. Once we bring this info in, we would like to highlight areas to Chorus where their infrastructure may be impacted as soon as possible so would appreciate a common contact as the project progresses.

Feel free to give me a call if it's easier to discuss,

Ngā mihi | Kind regards,

**Jesse McCall | Civil Engineer**

BE(hons), CMEngNZ, CPEng, MEngAU

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**Subject:** RE: Spillway erosion protection: turf reinforcement options and cost  
**Sent:** 11/08/2025, 12:18:44 pm  
**From:** Chris Brockliss<chrisbrockliss@gpil.co.nz>  
**To:** Jesse McCall  
**Attachments:** [PYRAMAT-25-PDS.pdf](#)  
[PYRAMAT-75-PDS.pdf](#)  
[PYRAMAT-Patching-Guidelines-2019.pdf](#)  
[PYRAMAT-Slope-Installation-and-Maintenance-Guidelines-2019.pdf](#)  
[Slope-Installation-Details-PYRAMAT-75.pdf](#)  
[ARMORMAX-Brochure.pdf](#)  
[HPTRM Durability Position 02022018 Pyramat75 UV vs copies.pdf](#)  
[ARMORMAX-75-EC-B1-PDS.pdf](#)  
[ARMORMAX-for-Slopes-Installation-and-Maintenance-Guidelines-2019.pdf](#)  
[Slope-Installation-Details-ARMORMAX-75-EC.pdf](#)  
[Slope-Installation-Details-ARMORMAX-75-SS.pdf](#)

PDF's provided not included in appendix for clarity. They may be provided at request.

Hi Jesse.

Thanks for your email and description of the spillway and related hydraulics.

As you may likely know we are assisting T&T with the Waiohiki stopbank also for HBRC that requires a much higher level of protection due to the hydraulics.

Based on the flows of circa 2.2m/s and without looking at full shear analyses, I believe it is likely that you could use the lighter grade Pyramat 25 product. Pinning and trenching details need to be confirmed.

I will get the designers at Solmax to review the data that you have provided and seek their proposal. I should have back this week on a preliminary design suggestion.

In the meantime, you can consider the following guide on pricing for the Pyramat 75 and 25 products. The pins and ground anchors are additional to the Pyramat costs and can be provided once we know suggested pinning and trenching details from Solmax. You may get a good idea on installed rates based on what we provided to contractors for Waiohiki that had elaborate and extensive pinning requirements.

#### **Guiding Rates.**

##### **Pyramat 75**

**Rolls 4x50m from current stock = 4,600m<sup>2</sup> = \$17.80/m<sup>2</sup>.**

**Replacement new stocks ex the USA factory will only be available as 4.57m x 36.3m. Rate = \$19.96/m<sup>2</sup>.**

##### **Pyramat 25**

**Rolls 4.57m x 36.3m. Rate = \$13.26/m<sup>2</sup>.**

Rates: Ex store Wiri, Auckland and exclude GST.

Availability: USA supply, allow 10 weeks approximately.

Validity: End August 2025.

Terms: As per GPIL standard Terms of Trade.

I will be back in touch as soon as I have further analyses from Solmax.

Please find attached various information on Pyramat 75 and 25 and Armormax (version when supplied c/w ground anchors and pins etc).

Cheers,

Chris

**CHRIS BROCKLISS**  
Managing Director

Mobile: +64 21 270 3139

Email: [chrisbrockliss@gpil.co.nz](mailto:chrisbrockliss@gpil.co.nz)

[www.gpil.co.nz](http://www.gpil.co.nz)



---

**From:** Jesse McCall <[JMcCall@tonkintaylor.co.nz](mailto:JMcCall@tonkintaylor.co.nz)>

**Sent:** Friday, 8 August 2025 4:41 pm

**To:** Chris Brockliss <[chrisbrockliss@gpil.co.nz](mailto:chrisbrockliss@gpil.co.nz)>

**Subject:** Spillway erosion protection: turf reinforcement options and cost

Hi Chris,

I was forwarded your info from a colleague – Jamie Yule and reason for my email is we're looking at turf reinforcement options for a flood spillway located on a new stopbank in the Pakowhai area in the Hawkes Bay region. I'd like to please get a per metre rate for your best option(s), on the widest roll size available, to suit our design case if possible?

Key design info is as follows:

- The spillway is only expected to operate in extreme flood events (1 in 500-year ARI+) so very minimal frequency of use, and would prefer a turf with a cost-effective long design life ideally.
- The spillway is approx. 230m long, has a spillway slope of 1V:15H, and is expected to overtop at a maximum spillover depth of 500mm in our worst case 1 in 500-year ARI event scenario.
- In this worst-case scenario, we're expecting approx ~2.2 m/s peak velocity down the spillway slope with average grass cover and a weak hydraulic jump over only 2m at the toe.
- We're looking at 9200m<sup>2</sup> of coverage required (over crest, spillway slope, 3m beyond toe), or just on the spillway slope and 3m beyond toe; 8100 m<sup>2</sup> (still to be decided, and design is still a work in progress so totals may change).
- Although our calcs show we may not actually need turf reinforcement for erosion protection, we'd like to include it if cost-effective to ensure slope stability and resilience redundancy.

Let me know if there's any questions or further info you need,

Ngā mihi | Kind regards,

**Jesse McCall | Civil Engineer**

BE(hons), CMEngNZ, CPEng, MEngAU

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**Subject:** RE: Pakowhai Spillway erosion protection: turf reinforcement options and cost  
**Sent:** 18/08/2025, 10:36:32 am  
**From:** Chris Brockliss<chrisbrockliss@gpil.co.nz>  
**To:** Jesse McCall  
**Cc:** Drew Loizeaux; Phil Ball; Jared Hill

---

Hi Jesse.

The Pyramat HPTRM is a highly UV stabilised synthetic material and is essentially buried in the upper topsoil or hydroseeded zone above the underlying topsoil and fill of the embankment / spillway. My understanding is that the 25mm product uses the same filaments as the thicker 75mm product and has the same UV rating, so I am not clear in my mind why Drew refers to a lower design life for the 25mm product. I will raise this with him.

Can you clarify the thickness of topsoil on the current site situation used to support the vegetation? If this layer is relatively thin, then we need to know what the underlying embankment / spillway soil is because the pinning detail and anchoring detail into these soils is part of the system design.

Is the underlying soil a typical loamy silt from weathered siltstones and sandstones or is it some type of residual reworked silty clay? Please advise.

Appreciate your response so that Drew and his team can have a closer look at a design suggestion.

Cheers,  
Chris

**CHRIS BROCKLISS**  
*Managing Director*

**Mobile:** +64 21 270 3139  
**Email:** [chrisbrockliss@gpil.co.nz](mailto:chrisbrockliss@gpil.co.nz)  
**www.gpil.co.nz**



---

**From:** Jesse McCall <[jmccall@tonkintaylor.co.nz](mailto:jmccall@tonkintaylor.co.nz)>  
**Sent:** Friday, 15 August 2025 3:31 pm  
**To:** Chris Brockliss <[chrisbrockliss@gpil.co.nz](mailto:chrisbrockliss@gpil.co.nz)>  
**Subject:** RE: Pakowhai Spillway erosion protection: turf reinforcement options and cost

Hi Chris,

Thanks for the response and the costings provided. I'm unsure of the soil type as of yet but it'll re-used topsoil from near the spillway location shown in the snip below if that helps. The vegetation will be a standard type

grass with a relatively strong root structure and we're expecting it to have good thick grass cover over its life. We've agreed Pyramat 75 is overkill for this one, but we're interested in Pyramat 25 or any other similar cost alternatives you might have.

Given the expected frequency of operation of this spillway (1 in 500-year event) we're looking for a design life of 50-100+ years ideally, to make it economically viable long term. I see Pyramat is non-degradable so when you say design life, is that the life it's able to reasonably achieve the erosion protection performance stated in your specs; and not necessarily when it'll start falling apart? If so, have you tested/ do you have an idea when it'll start falling apart/ loose its matrix structure?



Thanks,  
Ngā mihi | Kind regards,  
**Jesse McCall | Civil Engineer**  
BE(hons), CMEngNZ, CPEng, MEngAU  
**Tonkin + Taylor - Together we create and sustain a better world**  
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From: Chris Brockliss <[chrisbrockliss@gpil.co.nz](mailto:chrisbrockliss@gpil.co.nz)>  
Sent: Wednesday, 13 August 2025 8:11 am

To: Jesse McCall <[jmccall@tonkintaylor.co.nz](mailto:jmccall@tonkintaylor.co.nz)>

Subject: FW: Pakowhai Spillway erosion protection: turf reinforcement options and cost

Hi Jesse.

Initial response from Drew Loizeaux, Solmax's Director of Civil Engineering & Construction, as noted below.

My reading of your initial email is that the 500-year event has the 500mm overtopping levels and approximately 2.2m/s peak velocity. Please confirm.

Drew asks.

If we can confirm soil type and expected vegetation, then we can validate the expected performance is sufficient. The only other aspect would be to confirm their requirements for material durability and design life, with Pyramat 25 offering a design life of up to 25 years in exposed conditions.

Cheers,  
Chris

**CHRIS BROCKLISS**  
*Managing Director*

Mobile: +64 21 270 3139

Email: [chrisbrockliss@gpil.co.nz](mailto:chrisbrockliss@gpil.co.nz)

[www.gpil.co.nz](http://www.gpil.co.nz)



---

**From:** Drew Loizeaux <[dloizeaux@solmax.com](mailto:dloizeaux@solmax.com)>

**Sent:** Wednesday, 13 August 2025 2:11 am

**To:** Glenn Gillan <[ggillan@solmax.com](mailto:ggillan@solmax.com)>; Chris Brockliss <[chrisbrockliss@gpil.co.nz](mailto:chrisbrockliss@gpil.co.nz)>; Phil Ball <[pball@solmax.com](mailto:pball@solmax.com)>

**Cc:** Jared Hill <[jthill@solmax.com](mailto:jthill@solmax.com)>

**Subject:** Re: Pakowhai Spillway erosion protection: turf reinforcement options and cost

Chris,

Thanks for passing this information along. I do agree that Pyramat 25 could be a good option here due to the lower velocities. Is the 2.2 m/s during the 500 yr event? If we can confirm soil type and expected vegetation, then we can validate the expected performance is sufficient. The only other aspect would be to confirm their requirements for material durability and design life, with Pyramat 25 offering a design life of up to 25 years in exposed conditions.

Let me know what you think.

Thanks,

**Drew Loizeaux**, PE



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**From:** Jesse McCall <[JMcCall@tonkintaylor.co.nz](mailto:JMcCall@tonkintaylor.co.nz)>  
**Sent:** Friday, 8 August 2025 4:41 pm  
**To:** Chris Brockliss <[chrisbrockliss@gpil.co.nz](mailto:chrisbrockliss@gpil.co.nz)>  
**Subject:** Spillway erosion protection: turf reinforcement options and cost

Hi Chris,

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- In this worst-case scenario, we're expecting approx ~2.2 m/s peak velocity down the spillway slope with average grass cover and a weak hydraulic jump over only 2m at the toe.
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Let me know if there's any questions or further info you need,

Ngā mihi | Kind regards,

**Jesse McCall | Civil Engineer**

BE(hons), CMEngNZ, CPEng, MEngAU

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**Subject:** Your Australian Concrete Mats 'Quick Cost" details  
**Sent:** 18/08/2025, 9:55:21 am  
**From:** Australian Concrete Mats<sales@concretemats.com.au>  
**To:** Jesse McCall  
**Attachments:** [ACM-LFLT-A4-Info-EM-01-96dpi.pdf](#)

PDF's provided not included in appendix for clarity. They may be provided at request.



**Hi Jesse**

Thank you for taking the time to enquire about costs of Australian Concrete Mats.

**PRICING**

FLEXIBLE MAT is \$38 per square metre (ex GST)

FIRM MAT is \$39.50 per square metre (ex GST)

*The prices above INCLUDE Geotextile Underlay (if applicable)*

But DOES NOT include:

- Freight and delivery
- Anchoring ubars or clamps
- Installation

**FLEXIBLE OR FIRM** - TYPES OF MATS IN A ROLL:

There are two types of mats available, with little difference in their cost, but one is slightly better for curved drains or slopes than the other. This link will help to explain the difference:

<https://www.concretemats.com.au/flexible-or-firm-concrete-mats/>

**THEY ARRIVE READY TO INSTALL**

Concrete Mats come in rolls with pre-cut lengths and widths. They can be joined or cut easily to your project area requirements.

**WIDTHS** of 1.2 & 2.4m Wide

**LENGTHS** of 6/8/10/12/15m rolls

**UNDERLAY GEOTEXTILE INCLUDED**

Each mat has a layer of geotextile underlay **included** in the roll.

1. Non-Woven Geotextile Underlay

This is the standard underlay that will help stabilise the mat long term, it will help filter fine sediment particles, and protect from washout underneath the mat.

2. Biodegradable Nutrition Geotextile

This underlay encourages vegetation growth through the mats. However, it will biodegrade over time, releasing nutrients into the soil, relying on the vegetation growth to help stabilise the mat long term.

**HOW MATS COSTS STACK UP AND COMPARE TO LOOSE ROCK DRAINS**

- In coverage, 1 truck of concrete mats is equivalent to 20 trucks of loose rock or stone
- On a driveway, Concrete Mats are 30% cheaper than a gravel driveway

- All-in-one roll is quick and easy to install
- No specialised equipment needed
- Reduces erosion from washouts
- Minimises gravel wash out
- Slows the flow to help filter fine soil particles from entering waterways.



**1**

1 truck of flexible concrete mats is equivalent to 20 truckloads of rock

**20**

Up to 20 times faster to install than rip rap or poured concrete

**1000**

Up to 1000m<sup>2</sup> of Australian Concrete Mats can be installed per day

**12,000**

12,000m<sup>2</sup> can be manufactured per week by Australian Concrete Mats

### **NEED MORE INFO?**

Would you like a more detailed quotation that includes delivery and anchoring costs? If so, please [Click Here](#)

Would you like more information about the mats and how they work? Explore the website [Click Here](#)

### **Would you prefer to talk to us about your project?**

[Click Here](#) to send us your contact details and we will contact you by the next business day

Alternatively, you can always contact us directly:

Phone: **02 5629 1223** or **0480 234 521** or

Email: [sales@concretemats.com.au](mailto:sales@concretemats.com.au)

Thank you.

We look forward to helping you resolve your erosion and drainage issues.

**From the Australian Concrete Mats Team**

[www.ConcreteMats.com.au](http://www.ConcreteMats.com.au)

**PO Box 94 Alstonville NSW 2477**



**Phone call summary post-quote 18/08/2025:**

Australian concrete mats don't believe they could be a cost competitive option in NZ at the moment, as the rolls would need to be shipped via shipping containers. Noting that there are no other competitors/ no other option for concrete mats in NZ. If they could get a guarantee that they would win this job, they could send over a machine to NZ to start manufacturing locally, meaning the project could obtain the costs as advertised in the quote. Jesse McCall confirmed that HBRC are not currently in a position to award this part of the scope and a guarantee is unlikely. Australian concrete mats noted this, and said to give them a call if anything changes.



Jesse McCall <jesse.mccall.mail@gmail.com>

**Enkamat**

1 message

**Geofabrics Quotes** <quotes@geofabrics.co.nz>  
To: "jesse.mccall.mail@gmail.com" <jesse.mccall.mail@gmail.com>  
Cc: Wayde Hastings <w.hastings@geofabrics.co.nz>

26 August 2025 at 11:30

Dear Jesse

We appreciate the opportunity to submit the confidential estimate for your project.

Please see the details of the estimate below. **Please always quote your Geofabrics reference number for your project pricing to be applied correctly.**

Key personnel to assist you with your project will be:

- Wayde Hastings -021 540 386 [w.hastings@geofabrics.co.nz](mailto:w.hastings@geofabrics.co.nz)
- Customer Services, to place an order or for any general enquiries, [sales@geofabrics.co.nz](mailto:sales@geofabrics.co.nz), 0800606020
- Project Support Coordinators, for any updated project and pricing requests, [quotes@geofabrics.co.nz](mailto:quotes@geofabrics.co.nz), 0800606020

If you have any questions regarding any aspect of this estimate, please don't hesitate to contact me.

Kind Regards,

Michelle

**Geofabrics Ref:** C65023

**Proposal to:** Tonkin & Taylor - Jesse McCall – 0277775143  
[jesse.mccall.mail@gmail.com](mailto:jesse.mccall.mail@gmail.com)

**Estimate Expiry:** 21-09-2025

| ITEM | DESCRIPTION | UNIT | APPROX QTY | RATE (\$) |
|------|-------------|------|------------|-----------|
|------|-------------|------|------------|-----------|

| Enkamat – Permanent Turf Reinforcement Matting   |   |                |           |        |
|--|---|----------------|-----------|--------|
|  | Enkamat 7010 Turf reinforcement blanket<br>(roll size 1.02 x 150m or 1.95 x 150m) | M <sup>2</sup> | Rate only | \$5.87 |
|  | Enkamat 7018 Turf reinforcement blanket<br>(roll size 1.95 x 120m)                | M <sup>2</sup> | Rate only | \$6.78 |
| <p><b>Freight to site is extra.</b></p> <p><b>Accurate freight delivery charges can be determined and advised at time of delivery.</b></p> <p><b>Unloading is at customer's care (except when delivered by Hiab)</b></p> |   | TBC            |           |        |

The quantity of Goods as included in this quote is in no way a representation or recommendation by Geofabrics of the required quantity of Goods as required by the Buyer. It is the obligation of the Buyer, not Geofabrics, to ensure that the quantity of Goods ordered by the Buyer and included in this Quote are sufficient to meet the specific purpose or purposes for which the Buyer intends to use these Goods.

### TERMS AND CONDITIONS OF CONFIDENTIAL ESTIMATE

**Prices**

Ex-store Wiri, Auckland. Exclusive of GST. Prices are for information purposes only – refer note below and under “Validity”. Please advise the project reference number when ordering to ensure correct invoicing. If the estimate is only accepted in part, we reserve the right to amend prices.

**Availability**

Please check availability when ordering. While Geofabrics carry significant stocks nationwide, due to significant variations with market demand and project timing outside of our reasonable control, we cannot guarantee to have materials available at all times. To minimise risk, we strongly suggest that once you know your indicative project needs, that we will, against your firm order, allocate current stock for delivery staged to meet your programme.

**Validity**

30 days from date of estimate, thereafter prices may be subject to change.

**Quantity**

Quantities reflected in this document are indicative only. Accurate measurement and calculation of actual quantities should be done by your suitably qualified estimator. If quantities vary by more than 10%, we reserve the right to amend prices.

**Freight**

Local freight is excluded from unit rates.

Where freight is shown for delivery to site the rate is an estimate only and based on the quantities shown as one shipment or full truck loads. Small lot or partial deliveries may incur additional charges and delivery is subject to suitable and practicable site access limitations of line haul and local transport highway trucks. Unloading is to your care.

**Payment**

Payment 20th of the month following dispatch (for established accounts within current credit limits) as per the Terms below or agreed variations approved by the Managing Director in writing. For non-account holders, terms are strictly cash prior to dispatch.

**Delivery**

Please note, when ordering project specific or bespoke materials, delivery from our store to your site will be arranged as soon as possible. Allowance should be made to accept delivery at the date agreed upon at order acceptance.

**Terms**

Subject to our current "**Terms of Trade**", which are available under *Our Company* on our website – [www.geofabrics.co.nz](http://www.geofabrics.co.nz)

**Product Information and Alternatives:**

The information presented herein and in any supporting documentation or that referenced to our website is, to the best of our knowledge and belief, correct. It is subject to periodic review and revision. The validity of the information relative to all necessary engineering or other conditions must be ascertained by a suitably qualified person. No warranty is either expressed or implied. Unauthorized reproduction or distribution is prohibited.

Where we have suggested alternative products or solutions, it is opportune to emphasize the point that these are provided for evaluation purposes only and it is not to be considered a full design as; we are not consulting engineers or designers and; we are not privy to all the information pertaining to this matter and; we have no control over the project or installation of the product. We accept no responsibility for design verification and no warranty is implied or granted in any suggestion or design assistance we may give. Accordingly, our suggestions should not be used for construction and we recommend that complete engineering and design be performed by a suitably qualified engineer or industry approved expert.

Responsibility for acceptance and approval by the client or its representative is to your care.

**Information Purposes Only:**

This estimate and letter is not an offer but is for information purposes and estimates only. Should you desire to place an order on the basis of this estimate, such order is subject to confirmation of acceptance by Geofabrics at that time and will only be accepted in accordance with its current Terms of Trade. While we endeavour to supply accurate information, errors and omissions may occur. Geofabrics does not accept any liability for any loss or damage which may directly or indirectly result from any advice, opinion, information, representation or omission whether negligent or otherwise, contained in this estimate. The estimate is based on limited information supplied by you to us in your request for pricing and we specifically exclude any acceptance of any conditions imposed by you, or third parties, including conditions that attempt to deem that any estimate supplied by Geofabrics is acceptance of conditions of a separate contract or contract documents that may or may not have been available for inspection at your, or any third parties, premises.

GEOFABRICS QUOTES | GEOFABRICS PROJECT SUPPORT  
TEAM

T 0800 60 60 20  
E [quotes@geofabrics.co.nz](mailto:quotes@geofabrics.co.nz)

19 DRUCES ROAD, WIRI  
AUCKLAND 2104 NEW ZEALAND

W [geofabrics.co.nz](http://geofabrics.co.nz)



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[V011]

## **Appendix D    Project risk register**

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Use this page to record the names and dates of any risk workshops or risk reviews undertaken on your project

| Date       | Phase              | Review By<br>(list all names who were at the risk review) | Actions/Comments               |
|------------|--------------------|---|--------------------------------|
| 28/07/2025 | Preliminary Design | Jesse McCall, Miles Buob, Tim Morris                      | Informed prelim design package |
|            |                    |   |                                |
|            |                    |   |                                |

|                |                    |              |            |
|----------------|--------------------|--------------|------------|
| Project Name   | Pakowhai Stopbank  | Prepared by: | JEMC       |
| Project Number | 1017353.2403       | Reviewed by: | MIBU       |
| Phase          | Preliminary design | Date:        | 18/07/2025 |

| ID | Threat/<br>Opportunity | Risk Name   | Risk Description   | Risk Category<br>(edit on Reference Tab) | Existing Control(s)<br>(if any)   | Risk Assessment (with Existing Controls) |             |             | Possible treatment/mitigation   | Risk Assessment (after treatment) |             |             | Risk Owner          |
|----|------------------------|---|--|--|---|--|-------------|-------------|---|-----------------------------------|-------------|-------------|---------------------|
|    |                        |   |  |  |   | Likelihood                               | Consequence | Risk Rating |   | Likelihood                        | Consequence | Risk Rating |                     |
| 1  | Threat                 | Weather   | Poor weather leading to contract delays and material too wet to compact and achieve specification.                                     | Environmental                            | Works scheduled for summer months.  | Likely                                   | Moderate    | Moderate    | Cover works areas to minimise moisture ingress and saturation of embankments. Allowance for wet weather days in programme schedule.   | Likely                            | Minor       | Moderate    | HBRC/Contractor     |
| 2  | Threat                 | Flooding  | Flooding leading to disruption of site works and potential scour of worksites/open faces.  | Environmental                            | Specification requirements to include emergency procedures for flooding.        | Possible                                 | Major       | Moderate    | Contractor to manage site and have preparation and layout down areas above stopbank. Forecast to be monitored and a working procedure if flooding arises to be developed and managed on site. Minimise open faces to prevent scour or protect works areas prior to floodwaters arise. | Possible                          | Minor       | Moderate    | Contractor and HBRC |
| 3  | Threat                 | Scour and erosion   | Heavy rainfall leading to scour of existing open faces during works  | Construction                             | Minimise open faces and plans works with non-erosive material where possible.   | Likely                                   | Minor       | Moderate    | Contractor to manage slope and grade away from working area. Contractor to stabilise areas where necessary to protect erosion.  | Possible                          | Moderate    | Moderate    | Contractor          |
| 4  | Threat                 | Programme Delays and Coordination with landowners/ stakeholders | Programme delays and associated costs due to delays in coordinating with neighbouring sites.   | Stakeholder                              | TPG engaged to negotiate with landholders.                                      | Possible                                 | Moderate    | Moderate    | Coordinate works around stakeholder key working windows.  | Unlikely                          | Minor       | Low         | HBRC                |
| 5  | Threat                 | Access to private property to complete works                    | Programme delays and associated costs due to delays in accessing private property to complete works.                                   | Stakeholder                              | TPG engaged to negotiate with landholders.                                      | Possible                                 | Moderate    | Moderate    | Timing of works to be scheduled to allow for negotiations to be completed.  | Unlikely                          | Minor       | Low         | HBRC                |
| 6  | Threat                 | Procurement of materials  | Delays to project due to procurement constraints from suppliers.   | Stakeholder                              | Materials are relatively limited (i.e. pipe section and culverts)               | Possible                                 | Minor       | Moderate    | Programme works around long lead time items   | Unlikely                          | Minor       | Low         | Contractor          |
| 7  | Threat                 | Dust  | Excessive dust caused by project works, leading to complaints and enforcement action. Particularly when working near orchards.         | Environmental                            | Works schedule to be undertaken in stages to minimise open faces.               | Likely                                   | Moderate    | Moderate    | Contractor to prepare ESCP and maintain operation effectiveness of devices. Water usage from stream/river as dust suppression.  | Possible                          | Minor       | Moderate    | Contractor          |
| 8  | Threat                 | Erosion Controls  | Erosion and Sediment Control failures, leading to environmental discharge and enforcement.   | Environmental                            | ESCP requirements to be defined by HBRC as part of tender documents.            | Possible                                 | Major       | Moderate    | Contractor to prepare ESCP and maintain operation effectiveness of devices.   | Unlikely                          | Minor       | Low         | Contractor          |
| 9  | Threat                 | Contamination   | Contaminated soils identified during contract works. Leads to additional costs for disposal, delays and additional management on site. | Environmental                            | Geotechnical investigations undertaken.   | Unlikely                                 | Major       | Moderate    | Include contingency for existing two contamination sites.   | Unlikely                          | Minor       | Low         | HBRC                |
| 10 | Threat                 | QA  | QA testing delayed or not provided to designer with sufficient notice to review. Reworks to remediate areas identified.                | Engineering/Design                       | QA requirements in specification clearly laid out.                              | Unlikely                                 | Minor       | Low         | Contractor to provide Quality management plan to ensure clear outside of QA testing requirements and hold periods.  | Rare                              | Minor       | Low         | Contractor          |
| 11 | Threat                 | Consenting Requirements   | Works delayed due to requirements for consents or permits (for example water abstraction or fill import).                              | Consenting                               | HBRC to manage permit requirements and clearly lay out in the tender documents. | Possible                                 | Moderate    | Moderate    | HBRC to confirm consent requirements ahead of works commencement and manage permit requirements to assist contractor.   | Unlikely                          | Minor       | Low         | HBRC                |

| Risk Category      |
|--------------------|
| Consenting         |
| Engineering/Design |
| Environmental      |
| Stakeholder        |
| Reputation         |
| Project Risk       |
| Safety             |
| Communication      |
| Construction       |

| Likelihood     | Consequence   |
|----------------|---------------|
| Rare           | Insignificant |
| Unlikely       | Minor         |
| Possible       | Moderate      |
| Likely         | Major         |
| Almost Certain | Extreme       |

| Consequence/Likelihood | Insignificant | Minor    | Moderate | Major    | Extreme  |
|------------------------|---------------|----------|----------|----------|----------|
| Almost Certain         | Moderate      | Moderate | High     | High     | High     |
| Likely                 | Moderate      | Moderate | Moderate | High     | High     |
| Possible               | Low           | Moderate | Moderate | Moderate | High     |
| Unlikely               | Low           | Low      | Moderate | Moderate | Moderate |
| Rare                   | Low           | Low      | Low      | Moderate | Moderate |

## **Appendix E      Safety in design hazard register**

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Use this page to record the names and dates of any risk workshops or risk reviews undertaken on your project

| Date       | Phase              | Review By<br>(list all names who were at the risk review) | Actions/Comments               |
|------------|--------------------|---|--------------------------------|
| 28/07/2025 | Preliminary Design | Jesse McCall, Miles Buob, Tim Morris                      | Informed prelim design package |
|            |                    |   |                                |
|            |                    |   |                                |

SAFETY IN DESIGN HAZARD REGISTER

|                     |                    |
|---------------------|--------------------|
| Project             | Pakowhai Stopbank  |
| Project Number      | 1017353.2403       |
| Design Stage        | Preliminary Design |
| Works Area/Location | Full alignment     |



|          |           |
|----------|-----------|
| Date     | 18.7.2025 |
| Revision | 1         |

| ID   | Project Lifecycle    | Hazard Assessment   |  |   |  | Risk Assessment   |                           |      | Mitigation options  | Residual Risk   |   |      | Considerations   | Go?  | Owner  |            |
|------|----------------------|---|--|---|--|---|---------------------------|------|---|---|---|------|--|--|--|------------|
|      |                      | Action/Work/Event   | Hazard   | Harm/Consequence  | Existing Controls  | C   | L                         | Risk |   | C   | L   | Risk |  |  |  |            |
| R001 | Earthworks           | General earthworks activities   | Light traffic vs heavy traffic                 | Serious Harm/death  | signs, radio, communications   | 5   | D                         | High | Site signage to separate borrow area traffic from light vehicles.                                       | 3   | D   | Mod  | Include traffic management requirements from tenderers | Yes  | Contractor   |            |
|      |                      |   | Falling from heights (i.e. top of embankments) | Serious harm/death  | signs, working procedures  | 3   | B                         | High | include signage requirements and safety fencing/barricades in H&S Plan                                  | 3   | D   | Mod  | Include H&S management plan from tenderers             | Yes  | Contractor   |            |
|      |                      |   | Personnel vs heavy vehicles                    | Serious harm/death  | signs, working procedures  | 5   | D                         | High | Site signage to separate borrow area traffic from light vehicles.                                       | 3   | D   | Mod  | Include traffic management requirements from tenderers | Yes  | Contractor   |            |
|      |                      |   | Interface with existing bridge                 | Damage to bridge structure by striking it with mobile plant | Working procedures, signage  | 5   | C                         | Ex   | Addressed via enabling works grades under bridge. Height bars in place as part of enabling works design | 4   | D   | High | Include H&S management plan from tenderers             | Yes  | Contractor   |            |
|      |                      |   | Farm interface                                 | Plant bogging; partial embankment slump                     | Serious injury/fatality, rollover  | Geotech verification and construction staging limits; exclusion zones downslope; proof-rolling and soft-spot treatment plan; emergency recovery | 4                         | D    | High  | Applies where groundwater < 1 m near channel and soft area near Burgess Property; align with staged construction sequencing | 2   | D    | Mod  | Include H&S management plan from tenderers   | Yes  | Contractor |
|      |                      |   |  | Electric fence shock; vehicle-stock conflict                | Injury   | Site inductions   | 3                         | C    | High  | Isolate/lock-out electric fences; temporary stock exclusion; landowner coordination   | 2   | E    | Low  | HBRC to coordinate with landowners as part of tender to ensure stock are removed from work areas | Yes  | HBRC       |
|      |                      |   |  | Earthworks in historic landfill zones                       | Exposure to ACM/other contaminants                                       | Serious Harm/death  | Unexpected finds protocol | 3    | C   | High  | SOEP-led assessment; Asbestos/CLM plan; licensed removal/disposal if required. Currently proposed to limit undercut, leave in place and monitor settlements | 2    | D  | Mod  | Two known contaminated zones. T+T to annotate known extents on design drawings | Yes        |
| R002 | Culvert Construction | Hazards associated with culvert construction (eg excavation, trenching etc) | Trench or excavation collapse                  | Serious harm/death  | Working procedures, guideline on   | 5   | E                         | High | Lay slopes back and include provision for benching and  | 2   | E   | Low  | Include in H&S management plan                         | Yes  | Contractor   |            |
|      |                      |   | Lifting risk                                   | Serious harm/death  | Working on level slopes, minimise benching and trenching where possible. | 5   | D                         | High | Lifting protocols, use spotters, do not stay under loads  | 3   | E   | Low  | Include in H&S management plan from tenderers          | Yes  | Contractor   |            |
|      | Underground services | Hazards associated with excavation and relocation of underground services   | Striking electrical cables                     | Serious harm/death  | Working procedures, guideline on excavation                              | 5   | D                         | High | Undertaking service locations and protections as part of project scope. Include review and hold         | 4   | E   | Mod  | Include in H&S management plan from tenderers          | Yes  | Contractor   |            |

SAFETY IN DESIGN HAZARD REGISTER

|                     |                    |
|---------------------|--------------------|
| Project             | Pakowhai Stopbank  |
| Project Number      | 1017353.2403       |
| Design Stage        | Preliminary Design |
| Works Area/Location | Full alignment     |



|          |           |
|----------|-----------|
| Date     | 18.7.2025 |
| Revision | 1         |

|       |  |   |  |                    |  |   |   |      |   |   |   |     |  |     |                     |
|-------|--|---|--|--------------------|--|---|---|------|---|---|---|-----|--|-----|---------------------|
| R0003 |  | Hazards associated with overhead services   | Striking electrical cables                                       | Serious harm/death | Design to avoid overhead services where possible                                       | 5 | D | High | Follow and seek close approach permits.   | 4 | E | Mod | Include in H&S management plan from tenderers    | Yes | Contractor          |
| R0004 | Working near water and flood prone areas | Hazards associated with working near water and during potential flood conditions. | Personel drowning in flood waters or falls due to strong current | Serious Harm/death | Working procedures, set backs and HBRC forecasting                                     | 4 | D | High | Review forecast during works, allowing for coordination of flood management as part of H&S requirements. Working around water procedure to be developed if near water bodies. | 4 | E | Mod | Include in H&S management plan from tenderers    | Yes | Contractor          |
| R0005 | Traffic and road safety                  | Hazards associated with crossing points and truck safety                          | Vehicle veering off the road or collision with oncoming traffic. | Serious Harm/death | Design to account for tracking, manouvering. Dedicated entry/exit road to remain until | 5 | D | High | HBRC to consider long term signage and vehicle management (i.e. preference or traffic lights). Contractor to include construction traffic mangement as part of H&S            | 3 | D | Mod | Include traffic management plan from Contractor. | Yes | Designer/Contractor |

| RISK MATRIX |       |               |       |             |       |          |
|-------------|-------|---------------|-------|-------------|-------|----------|
| LIKELIHOOD  |       | CONSEQUENCE   |       |             |       |          |
|             |       | Insignificant | Minor | Significant | Major | Critical |
|             | Likel | 1             | 2     | 3           | 4     | 5        |
| Very high   | A     | Mod           | High  | High        | Ex    | Ex       |
| High        | B     | Mod           | Mod   | High        | Ex    | Ex       |
| Medium      | C     | Low           | Mod   | High        | High  | Ex       |
| Low         | D     | Low           | Mod   | Mod         | High  | High     |
| Very low    | E     | Low           | Low   | Low         | Mod   | High     |
|             |       |               |       |             |       |          |

| LEVEL OF RISK |                       |  |
|---------------|-----------------------|--|
| Level of Risk | Acceptability of Risk | Required action for residual risk after controls         |
| Extreme       | Intolerable           | Do not proceed with design                               |
| High          | Undesirable           | Proceed design with controls and with PM and PD approval |
| Moderate      | Tolerable             | Proceed design with controls and with PM approval        |
| Low           | Acceptable            | Proceed design with controls and with PM approval        |

**Appendix F      Civil design calculations and  
assessments**

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**Stormwater Culvert Capacity Assessment**

Calc by: WIED  
 Check by: JEMC  
 Date: 21/07/2025

n, concrete = 0.013  
 Freeboard reqd, m = 0

Stop corr (0-5%) = -0.05  
 Stop corr (5-10%) = 0  
 Stop corr (10-20%) = 0.05  
 Stop corr (20%+) = 0.1

Self Cleansing, upper limit = 3 m<sup>3</sup>/s  
 Self Cleansing, lower limit = 0.65 m<sup>3</sup>/s

| Data obtained from drawings and top of the south maps and approx. grade calculated |            |                     |                       |                          | Pipe Dia for Calcs |                    | Mannings eq Capacity (outlet controlled flow) |            |               |               | Capacity using Orifice equation (inlet controlled flow) |               |                             |            | What controls flow? | Design Capacity | Runoff Coefficient and Time of Concentration Calculations (Refer to tab: "RC_TC_Calcs") |                           |           |                    | 2100yr Runoff (L/s)            | 2100yr Runoff (L/s) | Chosen Pipe Diameter (mm) |            |
|--|------------|---------------------|-----------------------|--------------------------|--------------------|--------------------|---|------------|---------------|---------------|---|---------------|-----------------------------|------------|---------------------|-----------------|---|---------------------------|-----------|--------------------|--------------------------------|---------------------|---------------------------|------------|
| Culvert ID   | Length (m) | Upstream Culvert IL | Downstream Culvert IL | Approx. Grade (1 in ...) | Diameter (mm)      | Pipe Diameter (mm) | Velocity (m <sup>3</sup> /s)                  | Flow (L/s) | r, Radius (m) | Orifice CL IL | Head above inlet IL                                     | Blockages (%) | Flow Area (m <sup>2</sup> ) | Flow (L/s) | (Inlet or Outlet)   | Flow (L/s)      | Catchment area (ha)   | Runoff Coefficient ("RC") | Slope (%) | Slope Corrected RC | Concentration time ("tc") mins | 10yr RCP6.0         | 100yr RCP6.0              | from HYNDS |
| C1   | 21.33      | 9.59                | 9.46                  | 100.00                   | 509.30             | 509.30             | 1.95  | 396.62     | 0.25          | 0.25          | 0.51  | 0             | 0.20                        | 282.33     | INLET               | 282.33          | 4.19  | 0.30                      | 0.19      | 0.25               | 20                             | 158.76              | 282.33                    | 525        |
| C2   | 20         | 9.32                | 8.64                  | 29.41                    | 411.29             | 411.29             | 3.11  | 413.60     | 0.21          | 0.21          | 0.41  | 0             | 0.13                        | 165.46     | INLET               | 165.46          | 2.10  | 0.30                      | 0.33      | 0.25               | 16                             | 78.18               | 165.46                    | 450        |
| C3   | 20         |                     |                       | 100.00                   | 437.16             | 437.16             | 1.76  | 263.93     | 0.22          | 0.22          | 0.44  | 0             | 0.15                        | 192.72     | INLET               | 192.72          | 1.53  | 0.39                      | 0.79      | 0.34               | 11                             | 75.73               | 192.72                    | 450        |
| C4   | 24.5       | 8.60                | 8.49                  | 222.73                   | 563.30             | 563.30             | 1.40  | 347.69     | 0.28          | 0.28          | 0.56  | 0             | 0.25                        | 363.22     | OUTLET              | 347.69          | 3.76  | 0.31                      | 0.82      | 0.26               | 12                             | 138.28              | 347.69                    | 600        |
| C5   | 17         |                     |                       | 100.00                   | 479.27             | 479.27             | 1.87  | 337.28     | 0.24          | 0.24          | 0.48  | 0             | 0.18                        | 242.53     | INLET               | 242.53          | 2.48  | 0.30                      | 0.59      | 0.25               | 10                             | 89.00               | 242.53                    | 525        |
| C6   | 13.5       |                     |                       | 100.00                   | 265.80             | 265.80             | 1.26  | 70.02      | 0.13          | 0.13          | 0.27  | 0             | 0.06                        | 55.55      | INLET               | 55.55           | 0.21  | 0.74                      | 0.97      | 0.69               | 10                             | 19.98               | 55.55                     | 300        |
| C6.1   | 12.8       | 9.9                 | 9.36                  | 23.70                    | 198.10             | 198.10             | 2.13  | 65.67      | 0.10          | 0.10          | 0.20  | 0             | 0.03                        | 26.64      | INLET               | 26.64           | 0.14  | 0.56                      | 0.36      | 0.51               | 10                             | 9.39                | 26.64                     | 300        |
| C7   | 20         |                     |                       | 100.00                   | 388.90             | 388.90             | 1.63  | 193.20     | 0.19          | 0.19          | 0.39  | 0             | 0.12                        | 143.85     | INLET               | 143.85          | 1.50  | 0.30                      | 0.91      | 0.25               | 10                             | 49.69               | 143.85                    | 450        |
| C8   | 24         |                     |                       | 100.00                   | 369.56             | 369.56             | 1.57  | 168.63     | 0.18          | 0.18          | 0.37  | 0             | 0.11                        | 126.63     | INLET               | 126.63          | 1.31  | 0.30                      | 0.99      | 0.25               | 10                             | 42.83               | 126.63                    | 375        |
| C9   | 19.5       |                     |                       | 100.00                   | 217.56             | 217.56             | 1.10  | 41.05      | 0.11          | 0.11          | 0.22  | 0             | 0.04                        | 33.67      | INLET               | 33.67           | 0.35  | 0.30                      | 1.01      | 0.25               | 10                             | 11.15               | 33.67                     | 300        |
| C10  | 20         |                     |                       | 100.00                   | 906.55             | 906.55             | 2.86  | 1845.66    | 0.45          | 0.45          | 0.91  | 0             | 0.65                        | 1193.43    | INLET               | 1193.43         | 26.68   | 0.37                      | 0.19      | 0.32               | 74                             | 1069.21             | 1193.43                   | 1050       |
| C11  | 19         |                     |                       | 100.00                   | 603.81             | 603.81             | 2.18  | 624.48     | 0.30          | 0.30          | 0.60  | 0             | 0.29                        | 432.09     | INLET               | 432.09          | 7.24  | 0.30                      | 0.28      | 0.25               | 26                             | 222.51              | 432.09                    | 675        |
| C12  | 16.8       | 6.60                | 6.39                  | 80.00                    | 568.84             | 568.84             | 2.34  | 595.49     | 0.28          | 0.28          | 0.57  | 0             | 0.25                        | 372.22     | INLET               | 372.22          | 5.74  | 0.30                      | 0.22      | 0.25               | 22                             | 174.64              | 372.22                    | 600        |
| C13  | 19.88      | 6.65                | 6.09                  | 35.76                    | 459.81             | 459.81             | 3.04  | 505.03     | 0.23          | 0.23          | 0.46  | 0             | 0.17                        | 218.66     | INLET               | 218.66          | 3.76  | 0.32                      | 0.15      | 0.27               | 31                             | 122.08              | 218.66                    | 525        |
| C14.1  | 15.5       |                     |                       | 100.00                   | 199.96             | 199.96             | 1.04  | 32.78      | 0.10          | 0.10          | 0.20  | 0             | 0.03                        | 27.27      | INLET               | 27.27           | 0.33  | 0.30                      | 0.05      | 0.25               | 15                             | 9.96                | 27.27                     | 300        |
| C14  | 18.3       | 5.61                | 5.36                  | 71.21                    | 501.16             | 501.16             | 2.28  | 450.25     | 0.25          | 0.25          | 0.50  | 0             | 0.20                        | 271.18     | INLET               | 271.18          | 3.01  | 0.30                      | 0.62      | 0.25               | 12                             | 88.74               | 271.18                    | 525        |
| C15  | 21.16      | 5.56                | 5.34                  | 96.18                    | 759.70             | 759.70             | 2.59  | 1174.75    | 0.38          | 0.38          | 0.76  | 0             | 0.45                        | 767.23     | INLET               | 767.23          | 15.77   | 0.31                      | 0.21      | 0.26               | 44                             | 480.93              | 767.23                    | 825        |
| C16  | 20         |                     |                       | 100.00                   | 463.85             | 463.85             | 1.83  | 309.11     | 0.23          | 0.23          | 0.46  | 0             | 0.17                        | 223.49     | INLET               | 223.49          | 3.22  | 0.31                      | 0.30      | 0.26               | 20                             | 95.74               | 223.49                    | 525        |
| C17  | 18.8       |                     |                       | 100.00                   | 387.94             | 387.94             | 1.62  | 191.93     | 0.19          | 0.19          | 0.39  | 0             | 0.12                        | 142.96     | INLET               | 142.96          | 1.44  | 0.33                      | 0.56      | 0.28               | 12                             | 45.32               | 142.96                    | 450        |
| C17.1  | 14.2       | 6.32                | 6.07                  | 56.80                    | 289.79             | 289.79             | 1.77  | 116.99     | 0.14          | 0.14          | 0.29  | 0             | 0.07                        | 68.95      | INLET               | 68.95           | 0.70  | 0.33                      | 0.38      | 0.28               | 12                             | 23.46               | 68.95                     | 300        |

**Clarifications:**  
 Where at least 1 in 100 grade could not be achieved with existing ground profile, 1 in 100 was assumed (ground regrading would be required).

| Nominal Pipe Dia Internal Diameter (mm) |      |
|---|------|
| 225                                     | 222  |
| 300                                     | 302  |
| 375                                     | 380  |
| 450                                     | 457  |
| 525                                     | 533  |
| 600                                     | 610  |
| 675                                     | 686  |
| 750                                     | 762  |
| 825                                     | 838  |
| 900                                     | 914  |
| 1050                                    | 1067 |
| 1200                                    | 1219 |
| 1350                                    | 1372 |
| 1600                                    | 1590 |
| 1800                                    | 1830 |

**Runoff Coefficients (RC) and Time of Concentration (TC) Calculations**

| Culvert ID | Runoff coefficients (change as you need) - table values are the areas of each (in sq km) |                                     |                             |                                    |                          |                |                                      |                                      |                     |                            | Overall Runoff Coefficient (RC) | Slope of Equal Areas Method |       |        |        |        |        | Time of Concentration (TC) Calculation |            |      |         |       |          |       |         |
|------------|--|-------------------------------------|-----------------------------|------------------------------------|--------------------------|----------------|--------------------------------------|--------------------------------------|---------------------|----------------------------|---------------------------------|-----------------------------|-------|--------|--------|--------|--------|--|------------|------|---------|-------|----------|-------|---------|
|            | Heavy Clay Soil/ Pasture cover   | Heavy Clay Soil/ Bush & Scrub cover | Heavy Clay Soil/ Cultivated | Ashphalt & concrete paved surfaces | Fully roofed development | Unsealed roads | Medium Soakage/ Pasture/ Grass cover | Medium Soakage/ Bush and Scrub cover | Mainly Park Grassed | Overall Runoff Coefficient |                                 | Length                      | Area  | Max RL | Min RL | Diff   | Slope  | Slope (equal areas)                    | Mannings n | Stds | Kirpich | USDA  | Williams | USSCS | Average |
| C1         |  |                                     |                             |                                    |                          |                | 0.04187                              |                                      |                     | 0.30                       | 353.96                          | 41870                       | 11.12 | 9.39   | 1.74   | 0.0049 | 0.0019 | 0.045                                  | 36.0       | 20.1 | 59.4    | 20.2  | 13.9     | 29.9  | 20      |
| C2         |  |                                     |                             |                                    |                          |                | 0.02100                              |                                      |                     | 0.30                       | 353.60                          | 21000                       | 11.48 | 9.37   | 2.11   | 0.0060 | 0.0033 | 0.045                                  | 34.6       | 16.2 | 49.5    | 20.8  | 12.8     | 26.8  | 16      |
| C3         |  |                                     |                             | 0.00185                            | 0.00056                  |                | 0.01290                              |                                      |                     | 0.39                       | 341.63                          | 15310                       | 11.39 | 9.04   | 2.35   | 0.0069 | 0.0079 | 0.045                                  | 33.3       | 11.2 | 36.4    | 20.2  | 11.8     | 22.6  | 11      |
| C4         |  |                                     |                             |                                    |                          | 0.00118        | 0.03644                              |                                      |                     | 0.31                       | 408.59                          | 37620                       | 11.21 | 8.66   | 2.55   | 0.0062 | 0.0082 | 0.045                                  | 36.0       | 12.7 | 38.2    | 22.5  | 14.1     | 24.7  | 12      |
| C5         |  |                                     |                             |                                    |                          | 0.00058        | 0.02426                              |                                      |                     | 0.30                       | 247.56                          | 24840                       | 9.93  | 8.91   | 1.02   | 0.0041 | 0.0059 | 0.045                                  | 33.1       | 9.8  | 36.0    | 15.4  | 11.2     | 21.1  | 10      |
| C6         |  |                                     |                             | 0.00168                            |                          |                | 0.00042                              |                                      |                     | 0.74                       | 120.84                          | 2100                        | 10.06 | 9.14   | 0.92   | 0.0076 | 0.0097 | 0.045                                  | 23.1       | 4.7  | 24.1    | 8.5   | 5.1      | 13.1  | 10      |
| C6.1       |  |                                     |                             | 0.000472                           |                          | 0.000472       | 0.00042                              |                                      |                     | 0.56                       | 98.82                           | 1364                        | 10.06 | 9.14   | 0.92   | 0.0094 | 0.0036 | 1.045                                  | 482.2      | 5.9  | 729.2   | 7.0   | 4.0      | 245.7 | 10      |
| C7         |  |                                     |                             |                                    |                          |                | 0.01501                              |                                      |                     | 0.30                       | 323.27                          | 15010                       | 10.05 | 7.70   | 2.36   | 0.0073 | 0.0091 | 0.045                                  | 32.3       | 10.2 | 34.1    | 18.9  | 11.1     | 21.3  | 10      |
| C8         |  |                                     |                             |                                    |                          | 0.00113        | 0.01298                              |                                      |                     | 0.30                       | 166.41                          | 13110                       | 9.40  | 7.82   | 1.57   | 0.0095 | 0.0099 | 0.045                                  | 24.6       | 5.9  | 26.6    | 9.4   | 6.0      | 14.5  | 10      |
| C9         |  |                                     |                             |                                    |                          |                | 0.00351                              |                                      |                     | 0.30                       | 91.90                           | 3513                        | 8.66  | 7.79   | 0.88   | 0.0095 | 0.0101 | 0.045                                  | 20.2       | 3.7  | 21.7    | 5.9   | 3.8      | 11.1  | 10      |
| C10        |  |                                     |                             | 0.01691                            | 0.01685                  |                | 0.23304                              |                                      |                     | 0.37                       | #####                           | 266800                      | 12.38 | 8.12   | 4.26   | 0.0022 | 0.0019 | 0.045                                  | 74.0       | 74.6 | 105.3   | 107.9 | 69.8     | 86.3  | 74      |
| C11        |  |                                     |                             |                                    |                          |                | 0.07240                              |                                      |                     | 0.30                       | 621.02                          | 72400                       | 9.66  | 6.86   | 2.80   | 0.0045 | 0.0028 | 0.045                                  | 44.1       | 26.6 | 62.9    | 34.2  | 22.1     | 38.0  | 26      |
| C12        |  |                                     |                             |                                    |                          |                | 0.05740                              |                                      |                     | 0.30                       | 434.01                          | 57400                       | 7.99  | 6.49   | 1.50   | 0.0035 | 0.0022 | 0.045                                  | 41.3       | 22.2 | 60.6    | 25.8  | 18.6     | 33.7  | 22      |
| C13        |  |                                     |                             | 0.00066                            | 0.00060                  |                | 0.03638                              |                                      |                     | 0.32                       | 550.41                          | 37640                       | 8.29  | 6.51   | 1.78   | 0.0032 | 0.0015 | 0.045                                  | 45.3       | 31.0 | 74.8    | 34.5  | 22.9     | 41.7  | 31      |
| C14.1      |  |                                     |                             |                                    |                          |                | 0.00334                              |                                      |                     | 0.30                       | 129.26                          | 3340                        | 7.37  | 6.91   | 0.46   | 0.0036 | 0.0005 | 0.045                                  | 27.5       | 15.9 | 68.1    | 10.1  | 7.2      | 25.8  | 15      |
| C14        |  |                                     |                             |                                    |                          |                | 0.03008                              |                                      |                     | 0.30                       | 343.63                          | 30080                       | 7.37  | 5.61   | 1.76   | 0.0051 | 0.0062 | 0.045                                  | 35.4       | 12.4 | 39.5    | 20.1  | 13.3     | 24.1  | 12      |
| C15        |  |                                     |                             | 0.00118                            | 0.00185                  |                | 0.15467                              |                                      |                     | 0.31                       | #####                           | 157700                      | 8.09  | 5.55   | 2.54   | 0.0024 | 0.0021 | 0.045                                  | 59.6       | 44.5 | 82.2    | 61.1  | 42.4     | 57.9  | 44      |
| C16        |  |                                     |                             |                                    | 0.00039                  |                | 0.03182                              |                                      |                     | 0.31                       | 471.06                          | 32210                       | 7.16  | 3.90   | 3.26   | 0.0069 | 0.0030 | 0.045                                  | 36.9       | 20.9 | 56.1    | 25.8  | 15.1     | 31.0  | 20      |
| C17        |  |                                     |                             |                                    | 0.00060                  |                | 0.01381                              |                                      |                     | 0.33                       | 341.46                          | 14410                       | 7.91  | 5.95   | 1.96   | 0.0057 | 0.0056 | 0.045                                  | 34.5       | 12.9 | 40.9    | 21.0  | 12.7     | 24.4  | 12      |

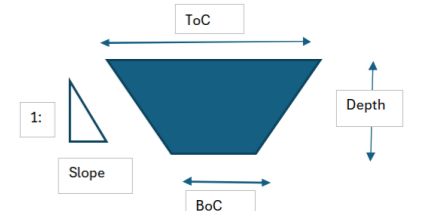
**Culvert outlet erosion protection assessment:**

| Culvert ID | Peak flow rate (m <sup>3</sup> /s) | Peak flow velocity (m/s) | Sized pipe diameter (mm) | Peak runoff depth (mm) | Froude number | Rock riprap apron required? | Median riprap diameter (m) | Riprap thickness (m) | Min apron width (m) | Min apron length (m) | Apron width chosen (m) | Apron length chosen (m) |
|------------|------------------------------------|--------------------------|--------------------------|------------------------|---------------|-----------------------------|----------------------------|----------------------|---------------------|----------------------|------------------------|-------------------------|
| C1         | 0.28                               | 1.95                     | 525                      | 393.8                  | 0.99          | YES                         | 0.20                       | 0.40                 | 1.58                | 4.16                 | 1.6                    | 4.2                     |
| C2         | 0.17                               | 3.11                     | 450                      | 337.5                  | 1.71          | NO                          | 0.20                       | 0.40                 | 1.35                | 5.38                 | 1.4                    | 5.4                     |
| C3         | 0.19                               | 1.76                     | 450                      | 337.5                  | 0.97          | YES                         | 0.20                       | 0.40                 | 1.35                | 3.49                 | 1.4                    | 3.5                     |
| C4         | 0.35                               | 1.40                     | 600                      | 450.0                  | 0.66          | YES                         | 0.15                       | 0.30                 | 1.80                | 2.99                 | 1.8                    | 3.0                     |
| C5         | 0.24                               | 1.87                     | 525                      | 393.8                  | 0.95          | YES                         | 0.20                       | 0.40                 | 1.58                | 4.01                 | 1.6                    | 4.1                     |
| C6         | 0.06                               | 1.26                     | 300                      | 225.0                  | 0.85          | YES                         | 0.15                       | 0.30                 | 0.90                | 2.04                 | 0.9                    | 2.1                     |
| C6.1       | 0.03                               | 2.13                     | 300                      | 225.0                  | 1.43          | YES                         | 0.15                       | 0.30                 | 0.90                | 3.20                 | 0.9                    | 3.2                     |
| C7         | 0.14                               | 1.63                     | 450                      | 337.5                  | 0.89          | YES                         | 0.20                       | 0.40                 | 1.35                | 3.23                 | 1.4                    | 3.3                     |
| C8         | 0.13                               | 1.57                     | 375                      | 281.3                  | 0.95          | YES                         | 0.15                       | 0.30                 | 1.13                | 2.85                 | 1.2                    | 2.9                     |
| C9         | 0.03                               | 1.10                     | 300                      | 225.0                  | 0.74          | YES                         | 0.15                       | 0.30                 | 0.90                | 1.74                 | 0.9                    | 1.8                     |
| C10        | 1.19                               | 2.86                     | 1050                     | 787.5                  | 1.03          | YES                         | 0.30                       | 0.60                 | 3.15                | 8.62                 | 3.2                    | 8.7                     |
| C11        | 0.43                               | 2.18                     | 675                      | 506.3                  | 0.98          | YES                         | 0.20                       | 0.40                 | 2.03                | 5.29                 | 2.1                    | 5.3                     |
| C12        | 0.37                               | 2.34                     | 600                      | 450.0                  | 1.12          | YES                         | 0.20                       | 0.40                 | 1.80                | 5.28                 | 1.8                    | 5.3                     |
| C13        | 0.22                               | 3.04                     | 525                      | 393.8                  | 1.55          | YES                         | 0.30                       | 0.60                 | 1.58                | 5.89                 | 1.6                    | 5.9                     |
| C14.1      | 0.03                               | 1.04                     | 300                      | 225.0                  | 0.70          | YES                         | 0.15                       | 0.30                 | 0.90                | 1.62                 | 0.9                    | 1.7                     |
| C1         |                                    |                          |                          |                        |               |                             |                            |                      |                     |                      |                        |                         |

# Stormwater swale capacity assessment

| Swale ID           | Length | Inlet (IL) | Outlet (IL) | Grade (1in..) | BoC (mm) | Side Slope | ToC (mm) | Full Depth (mm) | Req Freeboard (mm) | Flow Depth | Mannings roughness | Flow Area (m <sup>2</sup> ) | Wetted perimeter (m <sup>2</sup> ) | Velocity (m/s) | Flow capacity (L/s) | Design Flow | Notes | 10 year-ARI Residence Time (min) |
|--------------------|--------|------------|-------------|---------------|----------|------------|----------|-----------------|--------------------|------------|--------------------|-----------------------------|------------------------------------|----------------|---------------------|-------------|-------|----------------------------------|
| <b>BoC= 500 mm</b> |        |            |             |               |          |            |          |                 |                    |            |                    |                             |                                    |                |                     |             |       |                                  |
| DC1-0              | 13.3   | 9.446      | 9.32        | 105.5555556   | 500      | 3          | 2330     | 305             | 0                  | 208        | 0.03               | 0.2333                      | 2.4289894                          | 0.68           | 158.76              | 158.76      | OK    | 0.33                             |
| DC1-1              | 35.14  | 9.781      | 9.595       | 188.9247312   | 500      | 3          | 2480     | 330             | 0                  | 225        | 0.03               | 0.2636                      | 2.5871033                          | 0.53           | 139.46              | 139.46      | OK    | 1.11                             |
| DC1-2              | 52.07  | 9.81       | 9.595       | 242.1860465   | 500      | 3          | 1340     | 140             | 0                  | 88         | 0.03               | 0.0675                      | 1.3854377                          | 0.29           | 19.30               | 19.30       | OK    | 3.04                             |
| DC2-1              | 241.7  | 10.087     | 9.324       | 316.7758847   | 500      | 3          | 1700     | 200             | 0                  | 148        | 0.03               | 0.1400                      | 1.7649111                          | 0.35           | 48.40               | 48.40       | OK    | 11.65                            |
| DC2-2              | 158.4  | 10.505     | 9.324       | 134.123624    | 500      | 3          | 1220     | 120             | 0                  | 84         | 0.03               | 0.0628                      | 1.2589466                          | 0.39           | 24.50               | 24.50       | OK    | 6.77                             |
| DC3-0              | 120.1  | 9.292      | 7.813       | 81.20351589   | 500      | 3          | 1730     | 205             | 0                  | 135        | 0.03               | 0.1226                      | 1.7965338                          | 0.62           | 75.73               | 75.73       | OK    | 3.24                             |
| DC4-0              | 33.16  | 8.488      | 8.286       | 164.1584158   | 500      | 3          | 2330     | 305             | 0                  | 214        | 0.03               | 0.2452                      | 2.4289894                          | 0.56           | 138.28              | 138.28      | OK    | 0.98                             |
| DC4-1              | 178.88 | 10.229     | 8.602       | 109.9446835   | 500      | 3          | 2030     | 255             | 0                  | 177        | 0.03               | 0.1822                      | 2.1127616                          | 0.62           | 113.06              | 113.06      | OK    | 4.80                             |
| DC4-2              | 79.93  | 8.914      | 8.602       | 256.1858974   | 500      | 3          | 1310     | 135             | 0                  | 91         | 0.03               | 0.0699                      | 1.353815                           | 0.29           | 20.19               | 20.18       | OK    | 4.61                             |
| DC5-0              | 8.2    | 8.964      | 8.881       | 98.79518072   | 500      | 3          | 1880     | 230             | 0                  | 154        | 0.03               | 0.1482                      | 1.9546477                          | 0.60           | 89.00               | 89.00       | OK    | 0.23                             |
| DC5-1              | 158.8  | 9.173      | 8.929       | 650.8196721   | 500      | 3          | 1940     | 240             | 0                  | 160        | 0.03               | 0.1564                      | 2.0178933                          | 0.24           | 37.15               | 37.15       | OK    | 11.14                            |
| DC10-1             | 182.5  | 8.745      | 8.178       | 321.8694885   | 500      | 3          | 1070     | 95              | 0                  | 89         | 0.03               | 0.0685                      | 1.1008328                          | 0.29           | 19.97               | 19.97       | OK    | 10.43                            |
| DC11-1             | 526.6  | 8.408      | 6.799       | 327.2840273   | 500      | 3          | 2090     | 265             | 0                  | 206        | 0.03               | 0.2297                      | 2.1760072                          | 0.41           | 94.51               | 94.51       | OK    | 21.33                            |
| DC11-2             | 131.3  | 7.648      | 6.799       | 154.6525324   | 500      | 3          | 2060     | 260             | 0                  | 200        | 0.03               | 0.2193                      | 2.1443844                          | 0.59           | 128.56              | 128.56      | OK    | 3.73                             |
| DC12-0             | 9.7    | 6.871      | 6.31        | 17.29052528   | 500      | 3          | 1610     | 185             | 0                  | 136        | 0.03               | 0.1236                      | 1.6700427                          | 1.41           | 174.64              | 174.64      | OK    | 0.11                             |
| DC12-1             | 249.8  | 7.023      | 6.488       | 466.9158879   | 500      | 3          | 2120     | 270             | 0                  | 201        | 0.03               | 0.2214                      | 2.2076299                          | 0.33           | 73.72               | 73.72       | OK    | 12.50                            |
| DC12-2             | 33.5   | 6.57       | 6.488       | 408.5365854   | 500      | 3          | 2300     | 300             | 0                  | 226        | 0.03               | 0.2654                      | 2.3973666                          | 0.38           | 100.92              | 100.92      | OK    | 1.47                             |
| DC14-0             | 5.2    | 5.355      | 5.133       | 23.42342342   | 500      | 3          | 1550     | 175             | 0                  | 108        | 0.03               | 0.0888                      | 1.6067972                          | 1.00           | 88.74               | 88.74       | OK    | 0.09                             |
| DC14-1             | 196.5  | 6.826      | 5.612       | 161.8616145   | 500      | 3          | 1760     | 210             | 0                  | 133        | 0.03               | 0.1201                      | 1.8281566                          | 0.43           | 51.22               | 51.22       | OK    | 7.68                             |
| DC14-2             | 71.8   | 5.877      | 5.612       | 270.9433962   | 500      | 3          | 1700     | 200             | 0                  | 127        | 0.03               | 0.1117                      | 1.7649111                          | 0.32           | 35.91               | 35.91       | OK    | 3.72                             |
| DC15-1             | 81.8   | 5.805      | 5.556       | 328.5140562   | 500      | 3          | 1520     | 170             | 0                  | 140        | 0.03               | 0.1286                      | 1.5751744                          | 0.35           | 44.52               | 44.52       | OK    | 3.94                             |
| DC15-2             | 74.8   | 5.591      | 5.556       | 2137.142857   | 500      | 3          | 4730     | 705             | 0                  | 601        | 0.03               | 1.3858                      | 4.9588115                          | 0.31           | 427.14              | 427.14      | OK    | 4.04                             |
| DC15-3             | 69     | 7.954      | 6.481       | 46.84317719   | 500      | 3          | 980      | 80              | 0                  | 63         | 0.03               | 0.0430                      | 1.0059644                          | 0.60           | 25.59               | 25.59       | OK    | 1.93                             |
| DC16-1             | 274.4  | 0          | 0           | 100           | 500      | 3          | 1820     | 220             | 0                  | 158        | 0.03               | 0.1533                      | 1.8914022                          | 0.62           | 95.74               | 95.74       | OK    | 7.32                             |
| DC17-1             | 158.1  | 6.225      | 5.958       | 592.1348315   | 500      | 3          | 1670     | 195             | 0                  | 121        | 0.03               | 0.1041                      | 1.7332883                          | 0.21           | 21.86               | 21.86       | OK    | 12.55                            |
| DC17-2             | 231.4  | 6.848      | 5.958       | 260           | 500      | 3          | 1490     | 165             | 0                  | 101        | 0.03               | 0.0810                      | 1.5435516                          | 0.29           | 23.46               | 23.46       | OK    | 13.31                            |

**Notes**  
 assumed symmetrical layout of channel  
 can calculate square or trapezoidal channels  
 side slope 3H:1V (match stopbank geometry)



## Mannings n reference

Chapter 22: Hydraulics 22-5

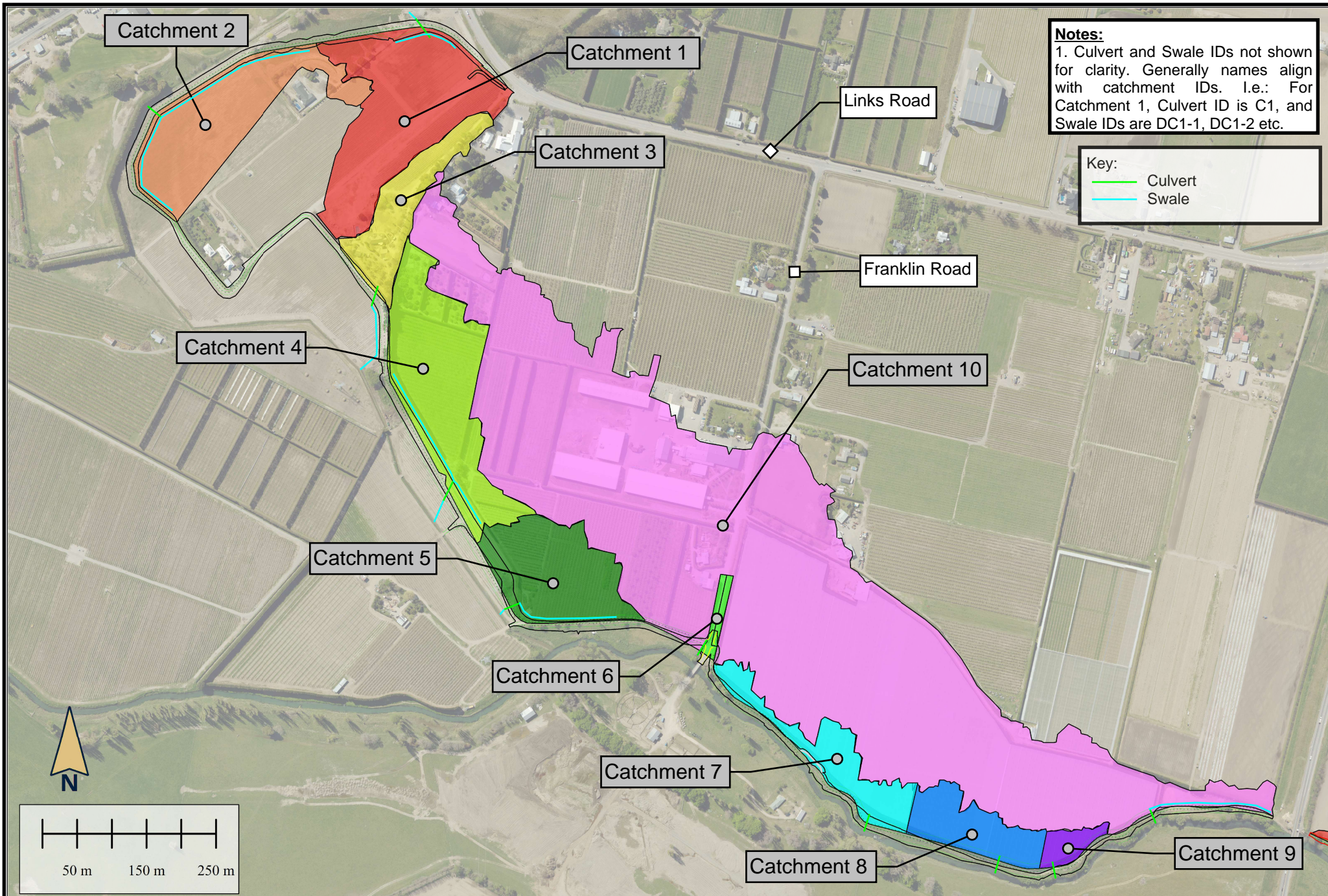
Table 22-1. Manning's Roughness Coefficients

| Manning's Roughness Coefficients   |   |
|--|---|
| <b>I. Closed Conduits:</b>   | <b>IV. Roadside Channels and Swales with Maintained Vegetation</b> (for velocities of 0.6 m/s to 1.8 m/s):        |
| A. Concrete pipe.....0.011 - 0.013   | A. Depth of flow up to 210 mm:  |
| B. Corrugated metal pipe or pipe arch:                                       | 1. Good stand, any grass:   |
| 1. 68 mm by 13 mm corrugation.....0.024                                      | a. Mowed to 50 mm.....0.070 - 0.045   |
| 2. 150 mm by 50 mm corrugation (field holes).....0.030                       | b. Length 100 mm to 150 mm.....0.090 - 0.050  |
| C. Vitrified clay pipe.....0.012 - 0.014                                     | 2. Fair stand, any grass:   |
| D. Cast iron pipe, uncoated.....0.013  | a. Length about 300 mm.....0.140 - 0.080  |
| E. Steel pipe.....0.009 - 0.011  | b. Length about 600 mm.....0.250 - 0.120  |
| F. Brick.....0.014 - 0.017   | B. Depth of flow 210 mm to 460 mm:  |
| G. Monolithic concrete:  | 1. Good stand, any grass:   |
| 1. Wood forms, rough.....0.015 - 0.017                                       | a. Mowed to 50 mm.....0.120 - 0.070   |
| 2. Wood forms, smooth.....0.012 - 0.014                                      | b. Length 100 mm to 150 mm.....0.200 - 0.100  |
| 3. Steel forms.....0.012 - 0.013   | 2. Fair stand, any grass:   |
| <b>II. Open Channels, Lined (straight alignment):</b>                        | a. Length about 300 mm.....0.100 - 0.060  |
| A. Concrete, with surfaces as indicated:                                     | b. Length about 600 mm.....0.170 - 0.090  |
| 1. Formed, no finish.....0.013 - 0.017                                       | <b>V. Roadside Concrete Side-Channels:</b>  |
| 2. Flout finish.....0.013 - 0.015  | A. Concrete channel, towelled finish.....0.012  |
| 3. Flout finish, some gravel on bottom.....0.015 - 0.017                     | B. Asphalt pavement:  |
| 4. Sprayed concrete, good section.....0.016 - 0.019                          | 1. Smooth texture.....0.013   |
| 5. Sprayed concrete, wavy section.....0.018 - 0.022                          | 2. Rough texture.....0.016  |
| B. Concrete, bottom flat finished, sides as indicated:                       | C. Concrete side-channel with asphalt pavement:   |
| 1. Random stone in mortar.....0.017 - 0.020                                  | 1. Smooth.....0.012   |
| 2. Dry rubble (pipap).....0.020 - 0.030                                      | 2. Rough.....0.013  |
| C. Gravel bottom, sides as indicated:  | D. Concrete pavement:   |
| 1. Formed concrete.....0.017 - 0.020   | 1. Flout finish.....0.014   |
| 2. Random stone in mortar.....0.020 - 0.023                                  | 2. Broom finish.....0.016   |
| 3. Dry rubble (pipap).....0.023 - 0.033                                      | E. For side-channels with small slope, where sediment may accumulate, increase above values of n by.....0.002     |
| D. Brick.....0.014 - 0.017   | <b>VI. Natural Stream Channels:</b>   |
| <b>III. Open Channels, Excavated (straight alignment, natural lining):</b>   | A. Streams:   |
| A. Earth, uniform section:   | 1. Fairly regular section:  |
| 1. Clean, after weathering.....0.018 - 0.020                                 | a. Some grass & weeds, little/no shrubs 0.030 - 0.035   |
| 2. With short grass, few weeds.....0.022 - 0.027                             | b. Dense growth of weeds, depth of flow greater than weed height.....0.035 - 0.050                                |
| 3. In gravelly soil, uniform section, clean.....0.022 - 0.025                | c. Light shrubbery on banks.....0.035 - 0.060   |
| B. Earth, fairly uniform section:  | d. Heavy shrubbery on banks.....0.050 - 0.070   |
| 1. No vegetation.....0.022 - 0.025   | e. Some weeds, dense willow on banks.....0.060 - 0.080  |
| 2. Grass, some weeds.....0.025 - 0.030                                       | f. For trees within channel & branches submerged at high stage, increase above values by.....0.010 - 0.020        |
| 3. Dense aquatic plants in deep channel.....0.030 - 0.035                    | 2. Irregular sections, with pools, slight channel meander:  |
| 4. Sides clean, gravel bottom.....0.025 - 0.030                              | Increase values given in 1a. to 1c. by.....0.010 - 0.020  |
| 5. Sides clean, cobble bottom.....0.030 - 0.040                              | 3. Mountain streams, no channel vegetation, banks usually steep, trees & shrubs on banks submerged at high stage: |
| C. Dragline excavated or dredged:  | a. Gravel, cobble, few boulders on bed.....0.040 - 0.050  |
| 1. No vegetation.....0.028 - 0.033   | b. Cobbles and large boulders on bed.....0.050 - 0.070  |
| 2. Light shrubbery on banks.....0.035 - 0.050                                | <b>B. Flood plains, adjacent to natural streams:</b>  |
| D. Rocks:  | 1. Pasture, no shrubs:  |
| 1. Smooth and uniform.....0.035 - 0.040                                      | a. Short grass.....0.030 - 0.035  |
| 2. Jagged and irregular.....0.040 - 0.045                                    | b. High grass.....0.035 - 0.050   |
| E. Channels not maintained:  | 2. Cultivated area:   |
| 1. Dense weeds, high as flow depth.....0.080 - 0.120                         | a. No crop.....0.030 - 0.040  |
| 2. Clean bottom, shrubbery on sides.....0.050 - 0.080                        | b. Mature row crops.....0.035 - 0.045   |
| 3. Clean bottom, shrubbery on sides, highest stage of flow.....0.070 - 0.110 | c. Mature field crops.....0.040 - 0.050   |
| 4. Dense shrubbery, high stage.....0.100 - 0.140                             | 3. Heavy weeds, scattered shrubbery.....0.050 - 0.070   |
|  | 4. Light shrubbery and trees:   |
|  | a. Winter.....0.050 - 0.060   |
|  | b. Summer.....0.060 - 0.080   |
|  | 5. Medium to dense shrubbery:   |
|  | a. Winter.....0.070 - 0.110   |
|  | b. Summer.....0.100 - 0.160   |
|  | 6. Dense willows.....0.150 - 0.200  |

Note: the value of 'n' for natural channels must be increased to allow for the additional energy loss caused by bends. The increase may be in the range of perhaps 3 to 15 %

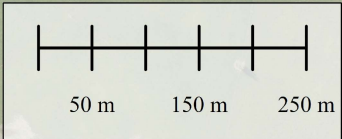
## Hastings District Council Engineering code reference:

| Table 7-1 Swale design elements                       |  |
|---|--|
| Design parameter                                      | Criteria   |
| Longitudinal slope                                    | < 5%   |
| Maximum velocity                                      | 0.8 m/s for water quality storm  |
| Maximum water depth above vegetation                  | The water quality design water depth should <u>not</u> exceed design height for grass. This is a key criterion for ensuring Manning roughness coefficient is provided. |
| Design vegetation height                              | 100 - 150 mm   |
| Manning coefficient                                   | 0.25 for WQ storm, 0.03 for submerged flow (10-yr. Storm)  |
| Maximum bottom width                                  | 2 m  |
| Minimum hydraulic residence time                      | 9 minutes  |
| Minimum length  | 30 m   |
| Maximum catchment area served                         | 4 hectares   |
| Maximum lateral slope                                 | 0%   |
| Maximum side slope                                    | 4 H:1V (shallow as possible for mowing purposes)   |
| Where longitudinal slope < 2%                         | Perforated underdrains shall be provided   |
| Where longitudinal slope > 5%                         | Check dams shall be provided to ensure effective slope < 5%  |
| Where concentrated flows enter the swale (from pipes) | Level spreaders shall be placed at the head of the swale to disperse flows   |
| 10-year storm velocities                              | < 1.5 m/s unless erosion protection is provided  |



**Notes:**  
 1. Culvert and Swale IDs not shown for clarity. Generally names align with catchment IDs. I.e.: For Catchment 1, Culvert ID is C1, and Swale IDs are DC1-1, DC1-2 etc.

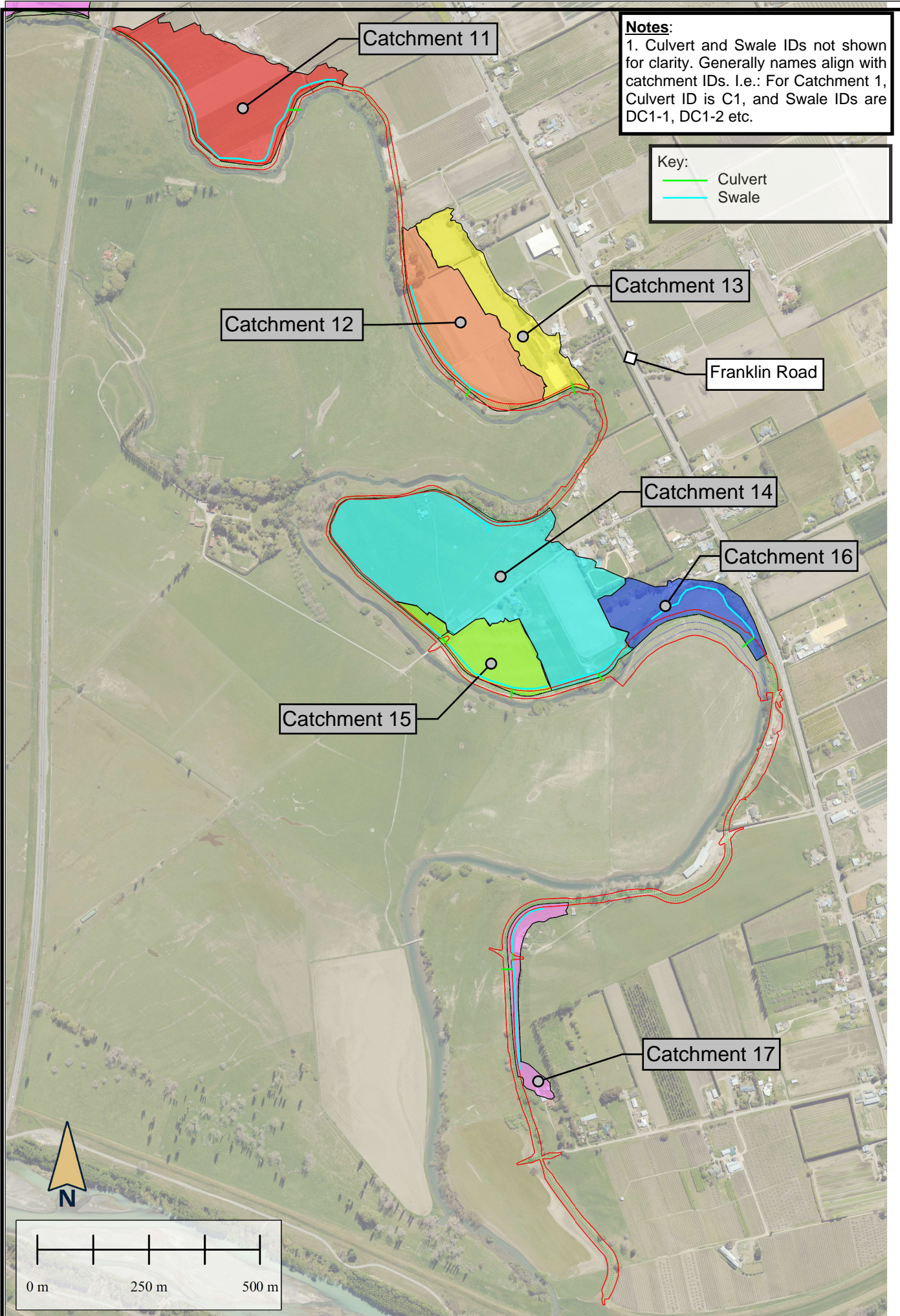
**Key:**  
 — Culvert  
 — Swale



**TITLE:** OVERALL CATCHMENT PLAN FOR STORMWATER ASSESSMENT  
**CLIENT:** HAWKES BAY REGIONAL COUNCIL

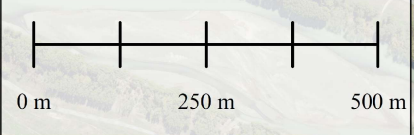
**DRAWN:** WIED  
**CHECKED:**  
**APPROVED:**  
**DATED:** 22/08/25

**SCALE:** A3 SCALE SHOWN  
**FIGURE No. 1**  
**PROJECT No.** 1017353.2403



**Notes:**  
 1. Culvert and Swale IDs not shown for clarity. Generally names align with catchment IDs. I.e.: For Catchment 1, Culvert ID is C1, and Swale IDs are DC1-1, DC1-2 etc.

**Key:**  
 ———— Culvert  
 ———— Swale



## Spillway design calculations and erosion protection requirements assessment:

### Flow down stopbank face

CLIENT: HBRC

DSN BY: RIBR

DATE: 2025-07-29

CHK BY: JEMC

DATE: 2025-08-06

Maximum water level at crest of stopbank from hydraulic flood model (TUFLOW)

\\ttgroup.local\corporate\Wellington\TT Projects\1017353\1017353.2401\WorkingMaterial\FloodModel\TUFLOW Model Results

|                       | 200  | 250   | 300 |   |
|-----------------------|------|-------|-----|---|
| Max overtopping depth | 0.23 | 0.348 | 0.5 | m |

Overtopping discharge  $Q = CLH^{\frac{3}{2}}$

|        |      |       |     |                                    |
|--------|------|-------|-----|------------------------------------|
| L      | 230  |       |     | Assume L >> H                      |
| H      | 0.23 | 0.348 | 0.5 |                                    |
| C low  | 1.5  |       |     | HEC-RAS Technical Reference Manual |
| C high | 1.8  |       |     |                                    |

|       |    |    |     |
|-------|----|----|-----|
| Q low | 38 | 71 | 119 |
| Q low | 46 | 85 | 143 |

$V = R^{2/3}S^{1/2} / n$  Mannings 'n'

|        |       |      |      |                                 |
|--------|-------|------|------|---------------------------------|
| n      | 0.03  |      |      | Manning's roughness coefficient |
| S      | 6.67% |      |      | Channel Slope                   |
| Lb     | 230   |      |      | m Base width                    |
| d low  | 0.05  | 0.08 | 0.12 | m Flow depth                    |
| d high | 0.06  | 0.10 | 0.13 | m                               |

|   |      |      |      |                |                            |
|---|------|------|------|----------------|----------------------------|
| A | 13   | 19   | 27   | m <sup>2</sup> | Cross section area of flow |
| P | 230  | 230  | 230  | m              | Wetted perimeter           |
| R | 0.05 | 0.08 | 0.12 |                | Hydraulic radius           |

|   |      |      |      |                |                            |
|---|------|------|------|----------------|----------------------------|
| A | 14   | 22   | 31   | m <sup>2</sup> | Cross section area of flow |
| P | 230  | 230  | 230  | m              | Wetted perimeter           |
| R | 0.06 | 0.09 | 0.13 |                | Hydraulic radius           |

| Low | 200 m <sup>3</sup> /s | 250 m <sup>3</sup> /s | 300 m <sup>3</sup> /s |                   |
|-----|-----------------------|-----------------------|-----------------------|-------------------|
| v   | 1.2                   | 1.7                   | 2.1                   | m/s               |
| q   | 16                    | 32                    | 57                    | m <sup>3</sup> /s |

| High | 200 m <sup>3</sup> /s | 250 m <sup>3</sup> /s | 300 m <sup>3</sup> /s |                   |
|------|-----------------------|-----------------------|-----------------------|-------------------|
| v    | 1.4                   | 1.8                   | 2.2                   | m/s               |
| q    | 20                    | 39                    | 69                    | m <sup>3</sup> /s |

## Spillway design calculations and erosion protection requirements assessment:

| Surface Material   | Manning's Roughness Coefficient<br>- n - |
|--|--|
| Asbestos cement  | 0.011                                    |
| Asphalt  | 0.016                                    |
| Brass  | 0.011                                    |
| Brick and cement mortar sewers                           | 0.015                                    |
| Canvas   | 0.012                                    |
| Cast or Ductile iron, new                                | 0.012                                    |
| Clay tile  | 0.014                                    |
| Concrete - steel forms                                   | 0.011                                    |
| Concrete (Cement) - finished                             | 0.012                                    |
| Concrete - wooden forms                                  | 0.015                                    |
| Concrete - centrifugally spun                            | 0.013                                    |
| Copper   | 0.011                                    |
| Corrugated metal   | 0.022                                    |
| Earth, smooth  | 0.018                                    |
| Earth channel - clean                                    | 0.022                                    |
| Earth channel - gravelly                                 | 0.025                                    |
| Earth channel - weedy                                    | 0.030                                    |
| Earth channel - stony, cobbles                           | 0.035                                    |
| Floodplains - pasture, farmland                          | 0.035                                    |
| Floodplains - light brush                                | 0.050                                    |
| Floodplains - heavy brush                                | 0.075                                    |
| Floodplains - trees                                      | 0.15                                     |
| Galvanized iron  | 0.016                                    |
| Glass  | 0.010                                    |
| Gravel, firm   | 0.023                                    |
| Lead   | 0.011                                    |
| Masonry  | 0.025                                    |
| Metal - corrugated                                       | 0.022                                    |
| Natural streams - clean and straight                     | 0.030                                    |
| Natural streams - major rivers                           | 0.035                                    |
| Natural streams - sluggish with deep pools               | 0.040                                    |
| Natural channels, very poor condition                    | 0.060                                    |
| Plastic  | 0.009                                    |
| Polyethylene PE - Corrugated with smooth inner walls     | 0.009 - 0.015                            |
| Polyethylene PE - Corrugated with corrugated inner walls | 0.018 - 0.025                            |
| Polyvinyl Chloride PVC - with smooth inner walls         | 0.009 - 0.011                            |
| Rubble Masonry   | 0.017 - 0.022                            |
| Steel - Coal-tar enamel                                  | 0.010                                    |
| Steel - smooth   | 0.012                                    |
| Steel - New unlined                                      | 0.011                                    |
| Steel - Riveted  | 0.019                                    |
| Vitrified clay sewer pipe                                | 0.013 - 0.015                            |
| Wood - planed  | 0.012                                    |
| Wood - unplaned  | 0.013                                    |
| Wood stave pipe, small diameter                          | 0.011 - 0.012                            |
| Wood stave pipe, large diameter                          | 0.012 - 0.013                            |

# Spillway design calculations and erosion protection requirements assessment:



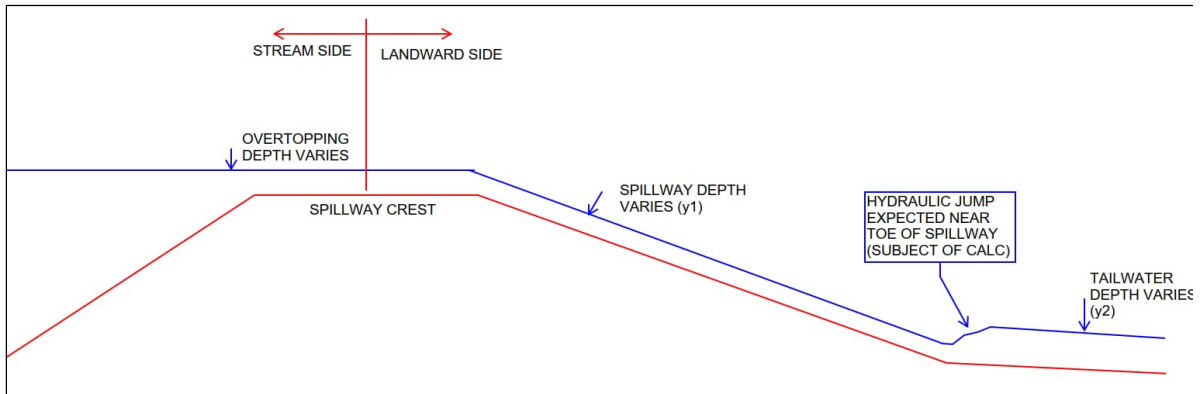
|                 |   |           |            |
|-----------------|---|-----------|------------|
| Project:        | Pakowhai Stopbank   | Calc by:  | JEMC       |
| Project Number: | 1017353.24  | Check by: |            |
| Client:         | HBRC  | Date:     | 30/07/2025 |
| File Path       | 017353.2403\WorkingMaterial\W09 Preliminary Design\Civil\08_Spillway\20 |           |            |

## Spillway hydraulic jump calculation

Calculates the type of hydraulic jump

References: refer to design references sheet

**Calculation:** hydraulic jump characteristics at toe of spillway slope where flow changes from super critical to sub critical flow type.



Calculating min and max depth of flow down spillway slope

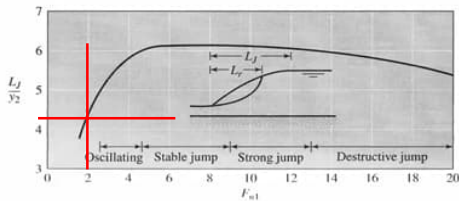
### Maximum flow scenario:

|                         |  |
|-------------------------|--|
| y1 (m) =                | 0.13 upstream flow depth   |
| Q (m <sup>3</sup> /s) = | 69.03 flow rate over spillway slope  |
| b1 (m) =                | 230 Top of channel width   |
| FA1 (m <sup>2</sup> ) = | 30.71622883  |
| Fr1 =                   | 1.96 Weak jump expected, eddies and rollers are expected to form on water surface  |
| y2 (m) =                | 0.31 downstream flow depth   |
| Change in Energy (m) =  | 0.033  |
| v1 (m/s) =              | 2.247  |
| E1 (m) =                | 0.39   |
| % Energy loss in jump = | 8% Energy loss expected not to be directed downward to base of spillway/ ground  |
| E2 (m) =                | 0.03   |
| v2 (m/s) =              | 2.33   |
| Lf (m) =                | 2.0 Jump length, get formula from graph. Energy dissipated over jump length. Additional erosion protection required, for hydraulic jump length |

## Jump Length

- Many empirical estimations of jump length
  - Challenge with all of them is identifying y<sub>2</sub>: where the jump ends

US Bureau of Reclamation nomograph (p. 413)



Roller length vs. Jump Length  
L<sub>r</sub> varies between 0.4 L<sub>j</sub> (Fr<sub>1</sub> = 3) to 0.7 L<sub>j</sub> (Fr<sub>1</sub> = 9)

Hager Jump Length Equation

$$\frac{L_J}{y_1} = 220 \tanh \frac{F_{r1}}{22}$$

"Another" Jump Length Equation

$$L_J = a(y_2 - y_1)$$

Where a varies from 5.0 to 6.9

# Spillway design calculations and erosion protection requirements assessment:



|                 |  |           |            |
|-----------------|--|-----------|------------|
| Project:        | Pakowhai Stopbank  | Calc by:  | JEMC       |
| Project Number: | 1017353.24   | Check by: |            |
| Client:         | HBRC   | Date:     | 30/07/2025 |
| File Path       | /353.2403\WorkingMaterial\V09 Preliminary Design\Civil\08_Spillway\20250 |           |            |

## Erosion potential at hydraulic jump

Calculates the erosion potential on Pyramat

References: refer to design references tab

Assume change in energy in oscillating hydraulic jump is directed toward Pyramat at critical angle.

Change in energy (m) = 0.03

Looking at a 1m<sup>2</sup> area of the turf reinforcement, the force transferred to the mat is as follows:

|                                     |  |
|-------------------------------------|--|
| Area (m <sup>2</sup> ) =            | 1  |
| Max depth of water (m) =            | 0.31   |
| Mass of water (kg) =                | 310.0  |
| Equivalent force due to jump (kg) = | 16.6 Conservatively assuming 50% is transmitted downward |

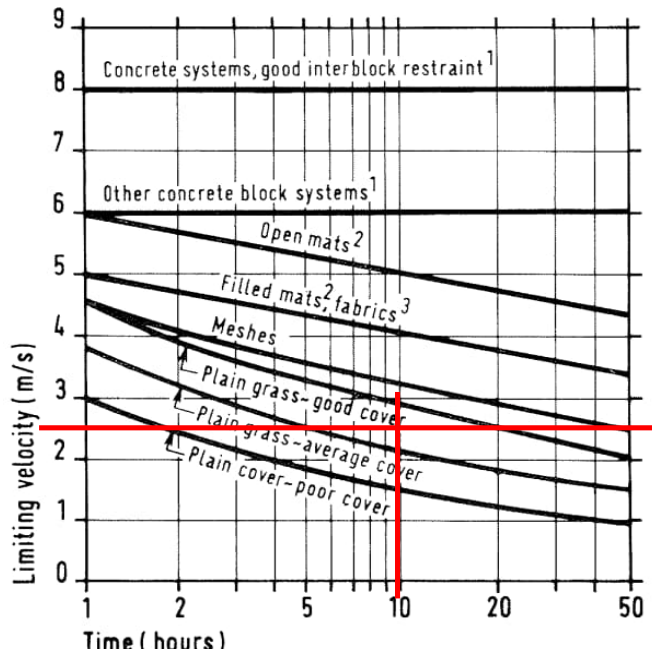
Assume that the force direction equates to vector difference between spillway slope (~5.7 deg) and slope of ground downstream (~0.6 deg).

1% grade in deg = 84.9

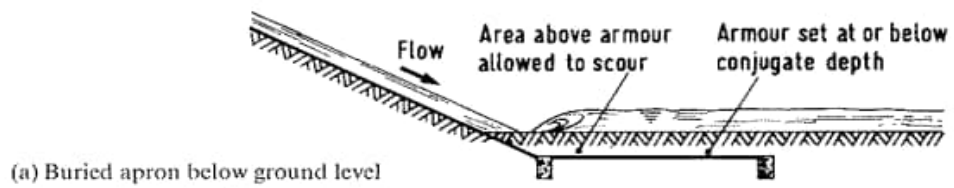
|                                      |      |
|--------------------------------------|------|
| Vertical force acting on mat (N) =   | 3204 |
| Horizontal force acting on mat (N) = | 285  |
| shear stress (Pa) =                  | 285  |
| FoS =                                | 1.2  |
| Permissible shear stress (Pa) =      | 342  |
| Allowable shear stress (vegetated)   | 575  |
| Pyramat 25 in Pa =                   |      |

Pyramat 25 considered to offer adequate erosion protection

To collaborate the calculation, a check was done using CIRA 1987 erosion potential method for grass lined channels, as shown on the figure below. A conservative time of 10 hours peak flow was used for the check. This found that average to good plain grass can resist the erosion potential down the spillway slope. For slope stabilisation and resiliency long term, turf reinforcement was specified not only for the hydraulic jump area but along the spillway slope too.



## Spillway design calculations and erosion protection requirements assessment:



The worst case spillway crest erosion mechanism is difficult to predict or estimate. The accumulation of debris in extreme flood events (when this spillway is due to operate), is considered the worst case erosion mechanism. To protect against this risk, the spillway crest was specified with reinforced concrete allowing for the turf reinforcement to be cast into the anchor trench further protecting the edges of the spillway crest from the debris pulling out/ or peeling off the turf reinforcement matting.

