HYDRO ELECTRIC CORPORATION
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Tasmania, Australia

# Basslink Monitoring Program

## Gordon River Basslink Monitoring Annual Report

## 2010–11

## Volume II: The Appendices

Prepared by

Hydro Tasmania

September 2011

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# Figures

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# A1 Power station discharges graphed per month

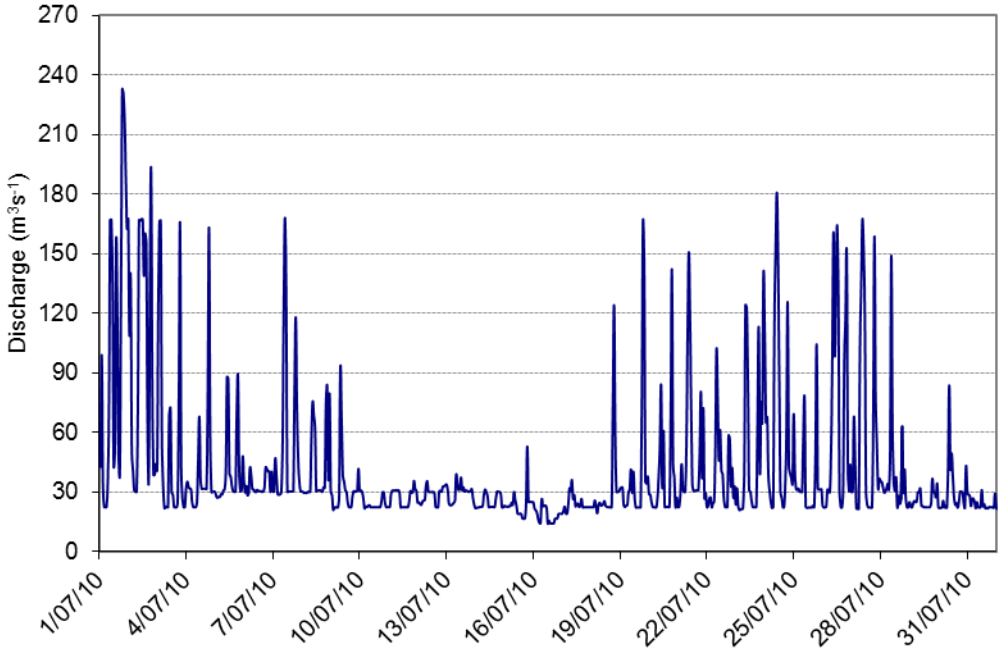


Figure A1-1 Gordon Power Station discharge (hourly data) for July 2010

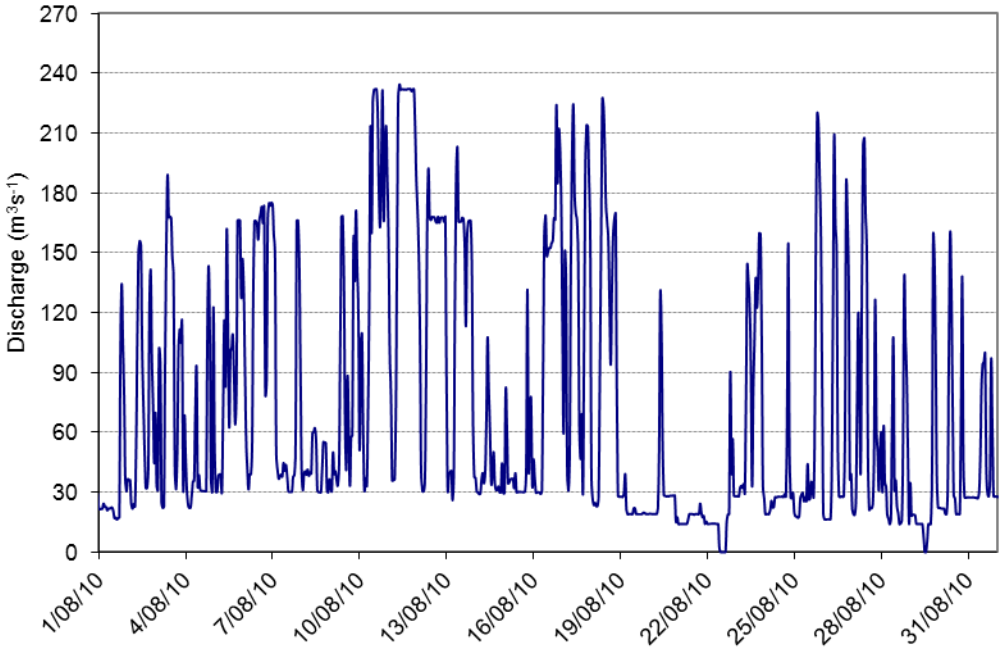


Figure A1-2 Gordon Power Station discharge (hourly data) for August 2010

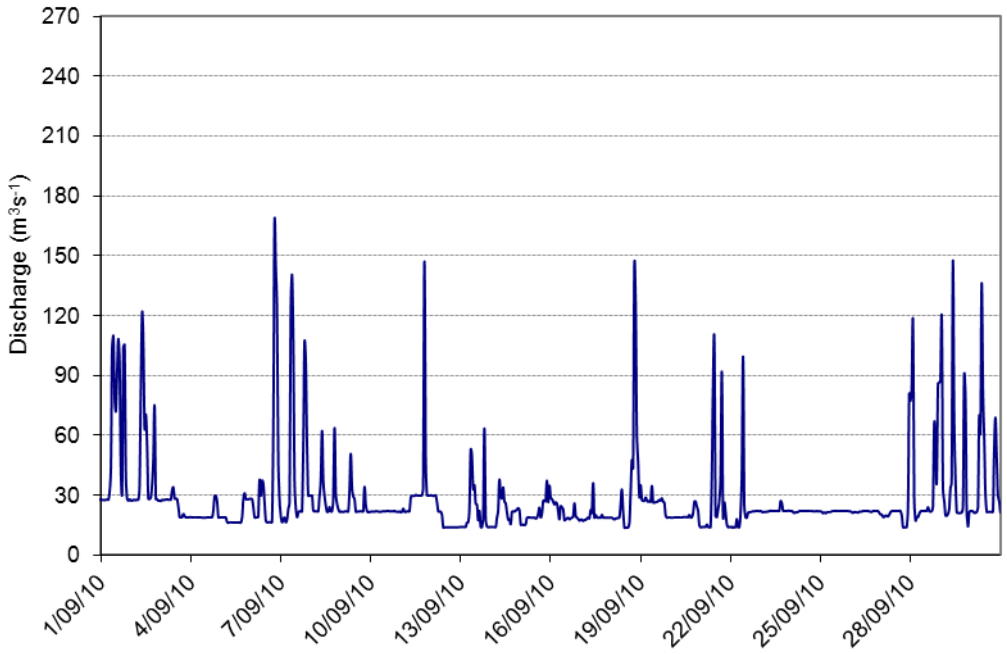


Figure A1-3 Gordon Power Station discharge (hourly data) for September 2010

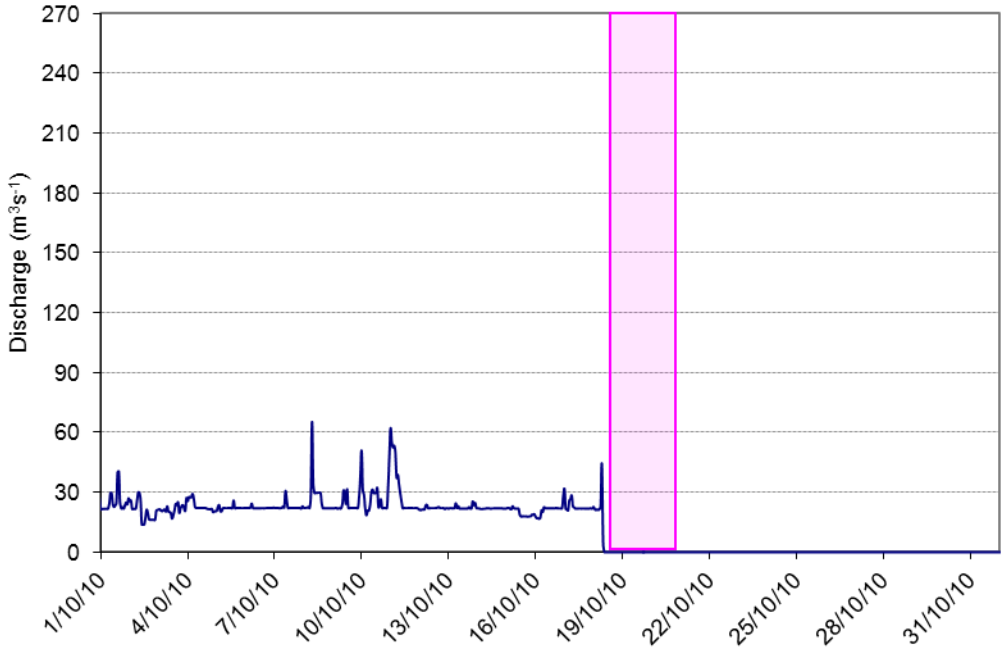


Figure A1-4 Gordon Power Station discharge (hourly data) for October 2010. Pink block indicates a monitoring shutdown

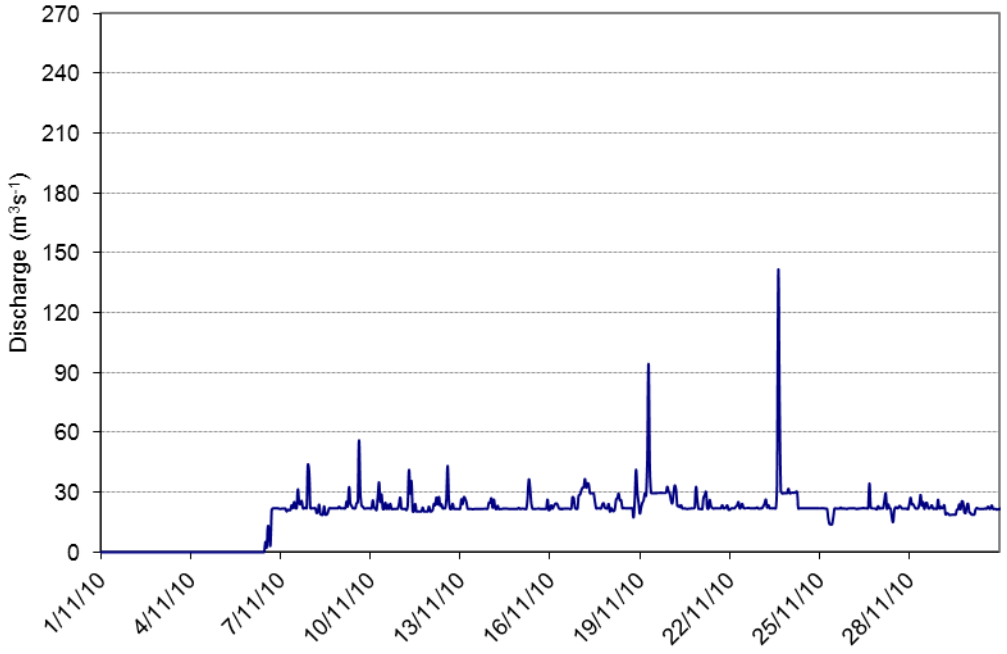


Figure A1-5 Gordon Power Station discharge (hourly data) for November 2010

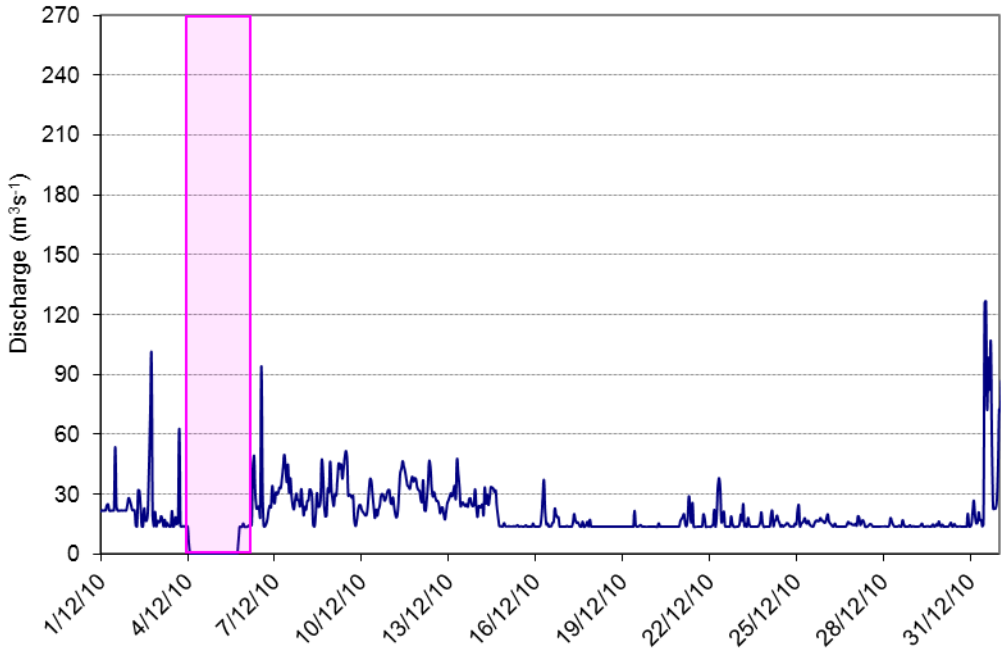


Figure A1-6 Gordon Power Station discharge (hourly data) for December 2010. Pink block indicates a monitoring shutdown

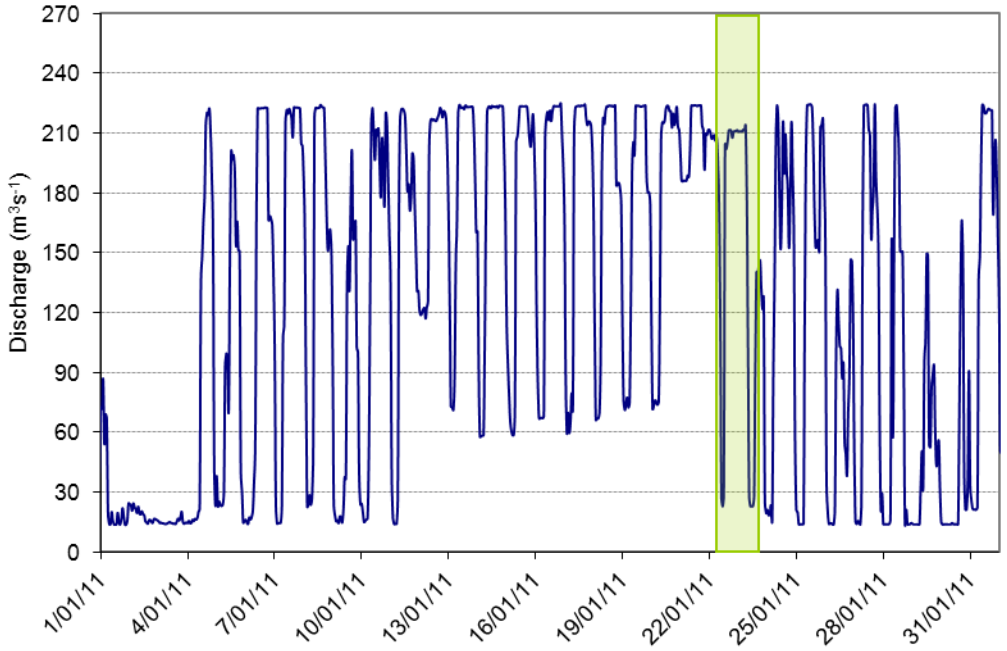


Figure A1-7 Gordon Power Station discharge (hourly data) for January 2011. Green block indicates the period of seepage monitoring

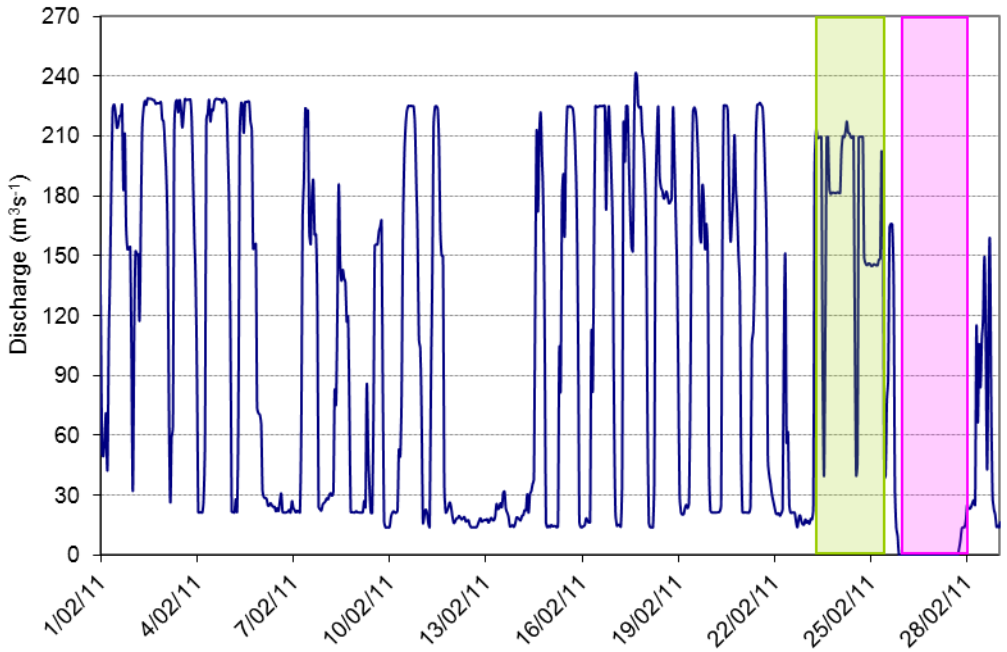


Figure A1-8 Gordon Power Station discharge (hourly data) for February 2011. Green block indicates the period of seepage monitoring. Pink block indicates a monitoring shutdown

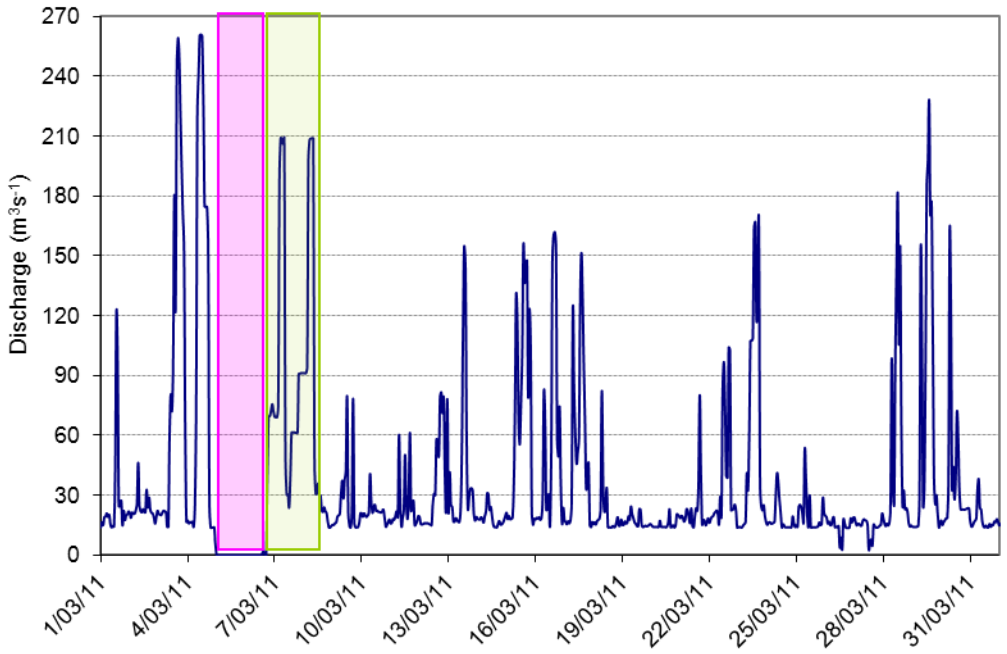


Figure A1-9 Gordon Power Station discharge (hourly data) for March 2011. Pink block indicates a monitoring shutdown. Green block indicates the period of seepage monitoring

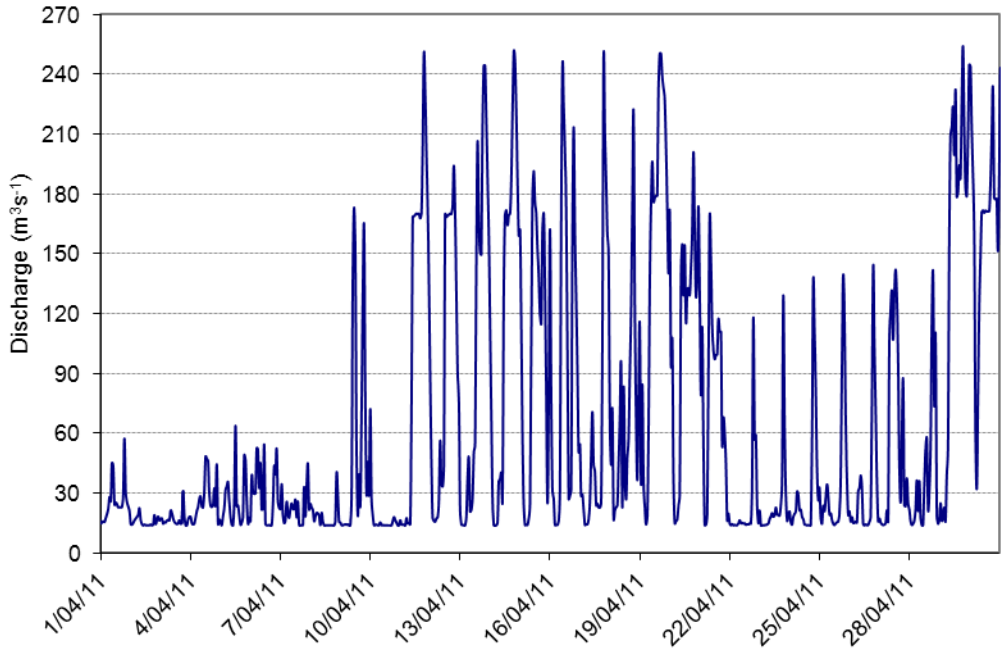


Figure A1-10 Gordon Power Station discharge (hourly data) for April 2011 . Pink block indicates a monitoring shutdown

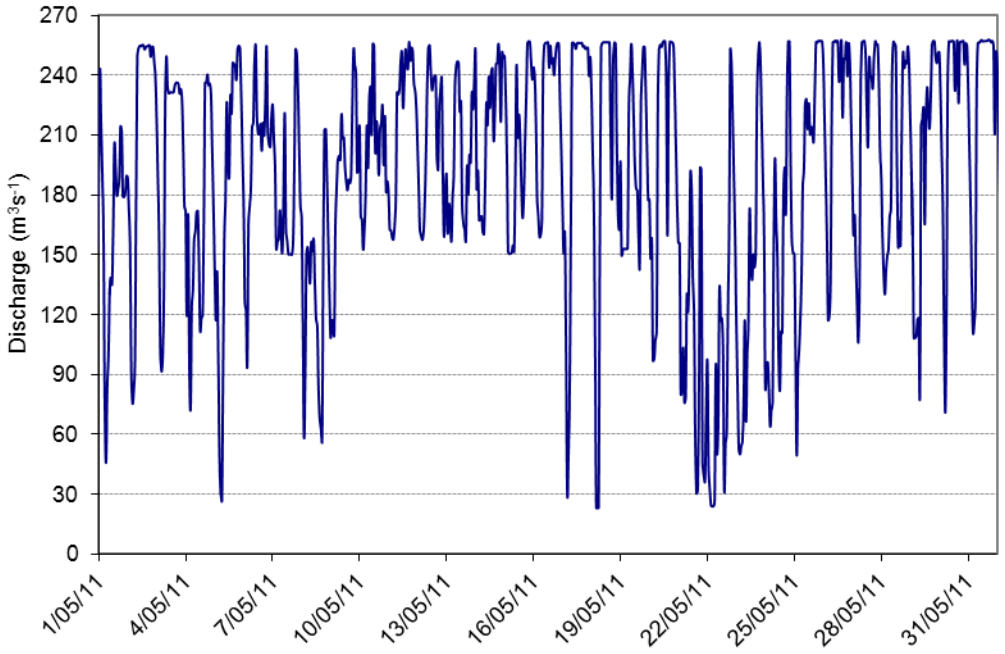


Figure A1-11 Gordon Power Station discharge (hourly data) for May 2011

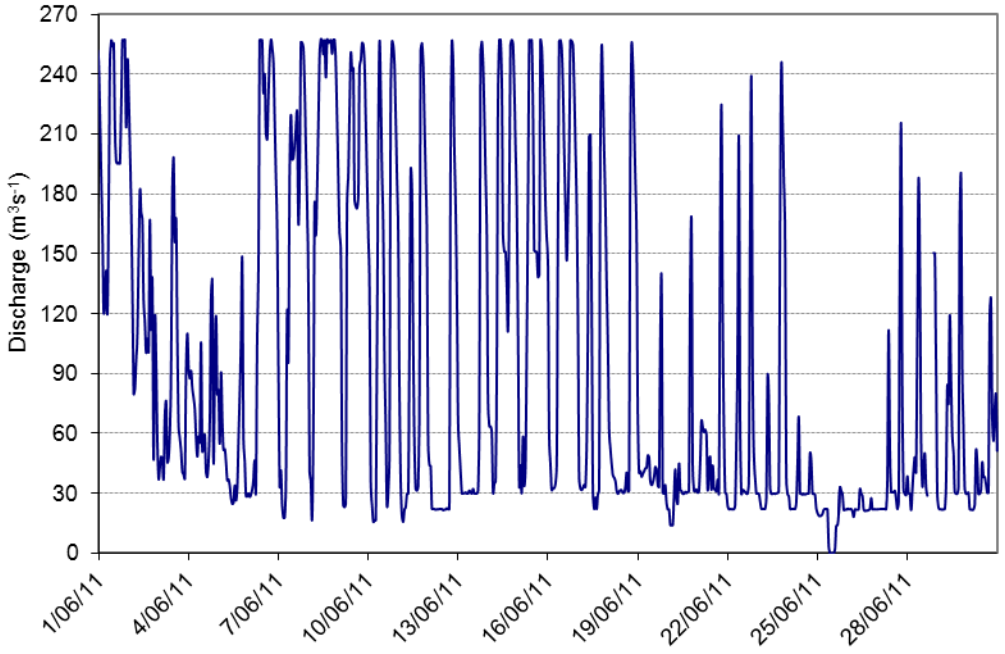


Figure A1-12 Gordon Power Station discharge (hourly data) for June 2011

# A2 Fluvial geomorphology erosion pin and scour chain data

## A2.1 Abbreviations used in graphs

| Abbreviation | Interpretation |
|---|---|
| a,b,c | at Site 1A, three pipes at one site distinguished by a,b,c |
| b/slope | back slope – slope behind crest of bank |
| b/water | back water |
| bench | elevated flat area on bank |
| cavity | bank cavity |
| cob | vertical cobble bank |
| col | vertical colluvial bank |
| crest | crest of bank |
| flow | sediment flow |
| HW | Star picket at 3-turbine power station on high water level |
| pipe | casing for piezometer measured as erosion pin |
| slope | sandy bank slope |
| toe | sandy bank toe |
| top | top of bank |
| Top/Bot | Top or bottom (upslope/downslope) of pin measurement |
| Wall | scarp at back of bank |
| <1 | below 1-turbine level |
| 1–2 | 1–2 turbine level |
| 2–3 | 2–3 turbine level |
| >3 | >3 turbine level |

## A2.2 Erosion pin data

Table A2-1 Zone 1 erosion pin results 1/4. Exposed pin length recorded in mm

| **Zone** | **1** | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Site** | **A** | | | | | | | | | | | | | | | | | | | |
| **Pin number** | **1** | | **2** | | **3** | | **4** | | **5** | | **6** | | **7** | | **8** | | | | | **9** |
| a,b,c,.. | | | | | | | | | | | | | | | a | | b | | c | |
| Bank location | Col | | Col | | Col | | Col | | Col | | Col | | Col | | Col | | Col | | Col | | Col | |
| Top/Bot of pin | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot |
| 11 Dec 99 | 155 | | 165 | | 516 | | 158 | | 191 | | 544 | | 140 | | 112 | | 203 | | 136 | | 198 | |
| 18 Dec 99 | 157 | | 164 | | 514 | | 161 | | 191 | | 555 | | 140 | | 112 | | 204 | | 137 | | 196 | |
| 4 Mar 00 | 158 | | 164 | | 512 | | 161 | | 192 | | 560 | | 141 | | 122 | | 204 | | 137 | | 198 | |
| 25 Mar 00 | 165 | | 168 | | 515 | | 167 | | 170 | | 562 | | 142 | | 128 | | 200 | | 135 | | 192 | |
| 22 Jul 00 | 165 | | 160 | | 500 | | 158 | | 190 | | 560 | | 142 | | 125 | | 201 | | 139 | | 186 | |
| 2 Sep 00 | 160 | | 165 | | 510 | | 165 | | 170 | | 572 | | 125 | | 124 | | 210 | | 134 | | 188 | |
| 4 Aug 01 | 160 | | 165 | | 520 | | 160 | | 170 | | 590 | | | | 122 | | 168 | | 133 | | | |
| 23 Nov 01 | 167 | | 163 | | 510 | 525 | 165 | | 186 | | 612 | | 139 | | 121 | 129 | 172 | 169 | 125 | 135 | 190 | |
| 9 Dec 01 | | | | | | | | | | | | | | | | | | | | | | |
| 10 Feb 02 | 163 | 158 | 161 | 147 | 512 | 508 | 168 | 158 | 168 | 153 | 615 | | 119 | 130 | 120 | 130 | 165 | 163 | 120 | 140 | 188 | 178 |
| 9 Mar 02 | 163 | 155 | 161 | 141 | 512 | 505 | 175 | 162 | 173 | 155 | 610 | 530 | 124 | 130 | 121 | 128 | 162 | 154 | 131 | | | |
| 5 Oct 02 | 168 | 154 | 163 | 150 | 514 | 510 | 174 | 165 | 171 | 155 | 620 | | 134 | 139 | 129 | 134 | 163 | 154 | 118 | 142 | 185 | 179 |
| 16 Dec 02 | 172 | 154 | 163 | 151 | 515 | 509 | 216 | 167 | 188 | 155 | 620 | 525 | 138 | 140 | 125 | 138 | 161 | 163 | 121 | 147 | 191 | 180 |
| 29 Mar 03 | 170 | 160 | 164 | 150 | 515 | 518 | 218 | 170 | 177 | 156 | 613 | | 121 | 138 | 112 | 138 | 110 | 170 | 131 | 142 | 188 | 181 |

*Table A2-1 continued next page*

| Zone | 1 | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site | A | | | | | | | | | | | | | | | | | | | | | |
| Pin number | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | | | | | 9 | |
| a,b,c,.. | | | | | | | | | | | | | | | a | | b | | c | | | |
| Bank location | Col | | Col | | Col | | Col | | Col | | Col | | Col | | Col | | Col | | Col | | Col | |
| Top/Bot of pin | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot |
| 18 Oct 03 | 170 | 156 | 164 | 153 | 514 | 506 | 220 | 167 | 182 | 157 | 611 | 530 | 142 | 139 | 102 | 141 | 150 | 162 | 127 | 137 | 185 | 181 |
| 6 Mar 04 | 173 | 157 | 163 | 156 | 513 | 508 | 220 | 176 | 159 | 155 | 600 | 455 | 136 | 132 | 98 | 141 | 137 | 171 | 126 | 139 | 186 | 183 |
| 9 Oct 04 | 174 | 157 | 161 | 154 | 511 | 512 | 197 | 168 | 149 | 153 | 585 | 519 | 143 | 140 | 110 | 140 | 138 | 165 | 128 | 143 | 185 | 183 |
| 2 Apr 05 | 173 | 169 | 183 | 152 | 512 | 509 | 218 | 172 | 182 | 152 | 597 | 513 | 152 | 142 | 113 | 140 | 145 | 168 | 132 | 149 | 184 | 178 |
| 15 Oct 05 | 175 | 175 | 168 | 160 | 415 | 425 | 250 | 180 | 185 | 156 | 610 | 420 | 175 | 170 | 115 | 150 | 160 | 178 | 140 | 162 | 191 | 188 |
| 11 Mar 06 | 173 | 159 | 165 | 156 | 513 | 514 | 228 | 175 | 166 | 155 | 597 | 521 | 160 | 162 | 100 | 138 | 152 | 170 | 150 | 180 | 188 | 186 |
| 17 Oct 06 | 175 | 155 | 165 | 154 | 514 | 510 | 227 | 175 | 174 | 158 | 600 | 535 | 150 | 190 | 108 | 144 | 156 | 174 | 195 | 327 | 184 | 186 |
| 17 Mar 07 | 169 | 157 | 163 | 156 | 511 | 509 | 226 | 175 | 174 | 155 | 596 | 549 | 149 | 190 | 106 | 140 | 157 | 175 | 203 | 313 | 188 | 187 |
| 20 Oct 07 | 165 | 161 | 163 | 151 | 510 | 509 | 223 | 170 | 167 | 153 | 594 | 554 | 143 | 193 | 106 | 140 | 159 | 176 | 207 | 346 | 186 | 183 |
| 1 Mar 08 | 171 | 160 | 165 | 155 | 510 | 510 | 234 | 174 | 171 | 155 | 598 | 565 | 160 | 196 | 102 | 142 | 164 | 175 | 213 | 345 | 188 | 187 |
| 17 Oct 08 | 174 | 172 | 164 | 154 | 512 | 510 | 220 | 220 | 167 | 154 | 596 | 572 | 154 | 193 | 110 | 136 | 160 | 176 | 217 | 377 | 187 | 187 |
| 22 Mar 09 | 168 | 160 | 164 | 152 | 511 | 509 | 224 | 175 | 168 | 151 | 594 | 572 | 144 | 192 | 75 | 135 | 168 | 178 | 224 | 373 | 287 | 279 |
| 31 Oct 09 | 176 | 172 | 163 | 155 | 512 | 51 | 220 | 175 | 173 | 152 | 590 | 570 | 153 | 198 | 115 | 143 | 183 | 184 | 237 | 362 | 190 | 185 |
| 13 Mar 10 | 173 | 162 | 162 | 155 | 512 | 509 | 234 | 175 | 172 | 153 | 595 | 570 | 151 | 199 | 116 | 153 | 157 | 172 | 240 | 374 | 180 | 181 |
| 19 Oct 10 | 173 | 160 | 160 | 155 | 510 | 510 | 224 | 175 | 172 | 152 | 586 | 559 | 129 | 196 | 109 | 142 | 159 | 171 | 352 | 360 | 178 | 183 |
| 26 Feb 11 | 174 | 174 | 162 | 150 | 512 | 511 | 225 | 178 | 173 | 152 | 585 | 565 | 154 | 200 | 123 | 145 | 181 | 172 | 358 | 360 | 186 | 183 |

Table A2-1 continued

Table A2-2 Zone 1 erosion pin results 2/4. Exposed pin length recorded in mm

| **Zone** | **1** | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Site** | **B** | | | | | | | | | | **C** | | | | | | | | **D** | | | |
| **Pin Number** | **1** | | **2** | | **3** | | **4** | | **5** | | **1** | | **2** | | **3** | | **4** | | **1** | | **2** | |
| Bank Location | cavity | | cavity | | flow | | cavity | | toe | | toe | | toe | | toe | | toe | | cavity | | slope | |
| Top/Bot of Pin | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot |
| 11 Dec 99 | | | | | | | | | | | | | | | | | | | | | | |
| 18 Dec 99 | | | | | | | | | | | | | | | | | | | | | | |
| 4 Mar 00 | | | | | | | | | | | | | | | | | | | | | | |
| 25 Mar 00 | | | | | | | | | | | | | | | | | | | | | | |
| 22 Jul 00 | | | | | | | | | | | | | | | | | | | | | | |
| 2 Sep 00 | | | | | | | | | | | | | | | | | | | | | | |
| 4 Aug 01 | | | | | | | | | | | | | | | | | | | | | | |
| 23 Nov 01 | 815 | | 276 | | 744 | | 259 | | 503 | | 830 | | 936 | | 797 | | 902 | | 390 | | 286 | |
| 9 Dec 01 | 807 | 809 | 265 | | 738 | | 253 | | 505 | | 835 | 841 | 925 | 934 | 781 | | 893 | 893 | 428 | 424 | 282 | 280 |
| 10 Feb 02 | | | | | | | | | | | | | | | | | | | | | | |
| 9 Mar 02 | 800 | 828 | 271 | 259 | 739 | 748 | 265 | 251 | 504 | 510 | 829 | 836 | 923 | 932 | 780 | 793 | 893 | 892 | 433 | 448 | 297 | 294 |
| 5 Oct 02 | 806 | 806 | | | 735 | 745 | 250 | 230 | 527 | 532 | 834 | 846 | 928 | 940 | 778 | 788 | 892 | 894 | 455 | 459 | 311 | 303 |
| 16 Dec 02 | | | | | | | | | | | 835 | 841 | 931 | 939 | 779 | 791 | 894 | 900 | 416 | 466 | 321 | 314 |
| 29 Mar 03 | 796 | 822 | 267 | 206 | 722 | 740 | 260 | 248 | 536 | 550 | 844 | 850 | 923 | 936 | 776 | 794 | 884 | 892 | 449 | 466 | 292 | 294 |
| 18 Oct 03 | 923 | 941 | 236 | 227 | 720 | 737 | 222 | 214 | 562 | 579 | 843 | 860 | 934 | 939 | 780 | 797 | 889 | 893 | 446 | 463 | 319 | 318 |
| 6 Mar 04 | 826 | 859 | 227 | 210 | 720 | 737 | 252 | 230 | 565 | 583 | 854 | 862 | 934 | 938 | 780 | 796 | 887 | 893 | 469 | 460 | 310 | 306 |
| 9 Oct 04 | 924 | 932 | 210 | 198 | 710 | 730 | 199 | 215 | 114 | 110 | 832 | 845 | 933 | 937 | 785 | 800 | 890 | 895 | 481 | 468 | 319 | 322 |
| 2 Apr 05 | 858 | 880 | 190 | 153 | 717 | 738 | 243 | 256 | 121 | 112 | 829 | 840 | 932 | 937 | 780 | 801 | 884 | 893 | 468 | 476 | 286 | 285 |

*Table A2-2 continued next page*

| Zone | 1 | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site | B | | | | | | | | | | C | | | | | | | | D | | | |
| Pin Number | 1 | | 2 | | 3 | | 4 | | 5 | | 1 | | 2 | | 3 | | 4 | | 1 | | 2 | |
| Bank Location | cavity | | cavity | | flow | | cavity | | toe | | toe | | toe | | toe | | toe | | cavity | | slope | |
| Top/Bot of Pin | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot |
| 15 Oct 05 | 940 | 963 | 113 | 110 | 723 | 799 | 295 | 304 | 110 | 108 | 850 | 843 | 940 | 936 | 805 | 787 | 894 | 892 | 483 | 473 | 313 | 307 |
| 11 Mar 06 | 962 | 998 | 115 | 119 | 784 | 805 | 374 | 389 | 107 | 111 | 853 | 844 | 936 | 942 | 790 | 809 | 892 | 898 | 480 | 475 | 307 | 307 |
| 17 Oct 06 | 961 | 995 | 90 | 105 | 808 | 824 | 404 | 430 | 112 | 107 | 838 | 850 | 938 | 941 | 790 | 810 | 890 | 900 | 484 | 484 | 310 | 310 |
| 17 Mar 07 | 949 | 964 | 77 | 118 | 782 | 785 | 415 | 418 | 114 | 107 | 833 | 838 | 932 | 938 | 791 | 806 | 893 | 901 | 486 | 475 | 300 | 304 |
| 20 Oct 07 | 930 | 954 | 185 | 165 | 719 | 785 | 378 | 413 | 108 | 92 | 821 | 828 | 936 | 946 | 789 | 805 | 896 | 905 | 484 | 475 | 292 | 299 |
| 1 Mar 08 | 939 | 953 | Lost | | 719 | 783 | 379 | 438 | 110 | 103 | 824 | 831 | 932 | 941 | 791 | 805 | 899 | 907 | 487 | 480 | 330 | 354 |
| 17 Oct 08 | 1000 | 1007 | | | 718 | 781 | 335 | 425 | 109 | 103 | 822 | 836 | 932 | 941 | 787 | 810 | 901 | 907 | 487 | 482 | 324 | 328 |
| 22 Mar 09 | 1040 | 1044 | | | 720 | 776 | 163 | 163 | 93 | 100 | 821 | 829 | 930 | 939 | 787 | 810 | 898 | 906 | 487 | 476 | 321 | 326 |
| 31 Oct 09 | 1032 | 1049 | | | 726 | 786 | 400 | 400 | 107 | 105 | 828 | 848 | 931 | 940 | 788 | 805 | 903 | 910 | 486 | 478 | 325 | 330 |
| 13 Mar 10 | 1051 | 1058 | | | 726 | 780 | 381 | 385 | 106 | 108 | 827 | 847 | 922 | 931 | 788 | 780 | 902 | 908 | 484 | 481 | 323 | 339 |
| 19 Oct 10 | 1054 | 1059 | | | 730 | 784 | 384 | 435 | 85 | 97 | 832 | 846 | 932 | 939 | 787 | 807 | 900 | 910 | 486 | 477 | 317 | 334 |
| 26 Feb 11 | 1054 | 1060 | | | 735 | 787 | 410 | 438 | 102 | 98 | 846 | 832 | 937 | 922 | 802 | 786 | 907 | 902 | 480 | 482 | 323 | 320 |

Table A2-2 continued

Table A2-3 Zone 1 erosion pin results 3/4. Exposed pin length recorded in mm

| **Zone** | **1** | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Site** | **D** | | | **E** | | | | | | | | | | **F** | | | |
| **Pin Number** | **3** | | **4** | **1** | | **2** | | **3** | | **4** | | **5** | | **1** | **2** | **3** | **4** |
| Bank Location | wall | | cavity | wall | | wall | | slope | | slope | | toe | | cavity | cavity | cavity | cavity |
| Top/Bot of Pin | Top | Bot | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Bot | Bot | Bot | Bot |
| 11 Dec 99 | | | | | | | | | | | | | | | | | |
| 18 Dec 99 | | | | | | | | | | | | | | | | | |
| 4 Mar 00 | | | | | | | | | | | | | | | | | |
| 25 Mar 00 | | | | | | | | | | | | | | | | | |
| 22 Jul 00 | | | | | | | | | | | | | | | | | |
| 2 Sep 00 | | | | | | | | | | | | | | | | | |
| 4 Aug 01 | | | | | | | | | | | | | | | | | |
| 23 Nov 01 | 229 | | 410 | 324 | | 272 | | 265 | | 216 | | 181 | | 941 | 217 | 577 | 414 |
| 9 Dec 01 | 220 | | 414 | 328 | 326 | 279 | 279 | 264 | 267 | 215 | 217 | 183 | 181 | 975 | 228 | 561 | 410 |
| 10 Feb 02 | | | | | | | | | | | | | | | | | |
| 9 Mar 02 | 215 | 195 | 418 | 330 | 327 | 279 | 280 | 268 | 268 | 215 | 217 | 184 | 180 | 918 | 235 | 566 | 436 |
| 5 Oct 02 | 204 | 193 | 390 | 182 | 167 | 212 | 210 | 280 | 284 | 276 | 274 | 336 | 340 | 875 | 229 | 571 | 498 |
| 16 Dec 02 | 212 | 194 | 422 | 181 | 170 | 207 | 211 | 284 | 285 | 278 | 275 | 343 | 344 | 937 | 226 | 571 | 301 |
| 29 Mar 03 | 216 | 194 | 410 | 179 | 174 | 204 | 207 | 291 | 285 | 280 | 275 | 338 | 341 | 911 | 224 | 529 | 338 |
| 18 Oct 03 | 215 | 200 | 420 | 184 | 157 | 200 | 201 | 287 | 286 | 263 | 258 | 335 | 340 | 840 | 227 | 555 | 382 |
| 6 Mar 04 | 217 | 193 | 408 | 184 | 167 | 203 | 202 | 291 | 291 | 263 | 261 | 338 | 342 | 829 | 222 | 568 | 315 |
| 9 Oct 04 | 220 | 191 | 399 | 190 | 165 | 201 | 202 | 294 | 295 | 238 | 237 | 319 | 323 | 510 | 224 | 571 | 362 |
| 2 Apr 05 | 212 | 190 | 398 | 195 | 164 | 203 | 203 | 283 | 286 | 224 | 225 | 317 | 326 | 458 | 224 | 535 | 338 |
| 15 Oct 05 | 221 | 191 | 376 | 200 | 163 | 206 | 203 | 270 | 269 | 226 | 230 | 294 | 295 | 415 | 225 | 588 | 375 |

*Table A2-3 continued next page*

| Zone | 1 | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site | D | | | E | | | | | | | | | F | | | | |
| Pin Number | 3 | | 4 | 1 | | 2 | | 3 | | 4 | | 5 | | 1 | 2 | 3 | 4 |
| Bank Location | wall | | cavity | wall | | wall | | slope | | slope | | toe | | cavity | cavity | cavity | cavity |
| Top/Bot of Pin | Top | Bot | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Bot | Bot | Bot | Bot |
| 11 Mar 06 | 222 | 199 | 377 | 203 | 167 | 209 | 204 | 273 | 271 | 219 | 217 | 292 | 298 | 194 | 224 | 629 | 378 |
| 17 Oct 06 | 228 | 191 | 480 | 200 | 175 | 211 | 209 | 235 | 235 | 210 | 205 | 291 | 295 | 1085 | 230 | 555 | 405 |
| 17 Mar 07 | 216 | 194 | 472 | 200 | 186 | 214 | 212 | 247 | 254 | 210 | 211 | 300 | 301 | 1045 | 228 | 598 | 377 |
| 20 Oct 07 | 220 | 168 | 483 | 185 | 167 | 217 | 210 | 212 | 213 | 204 | 204 | 289 | 295 | 803 | 215 | 567 | 334 |
| 1 Mar 08 | 207 | 191 | 478 | 186 | 176 | 213 | 212 | 216 | 217 | 202 | 208 | 297 | 298 | 2360 | 217 | 619 | 379 |
| 17 Oct 08 | 206 | 161 | 484 | 182 | 156 | 217 | 213 | 210 | 207 | 195 | 193 | 287 | 290 | 293 | 67 | 634 | 379 |
| 22 Mar 09 | 214 | 154 | 514 | 179 | 149 | 217 | 214 | 209 | 203 | 190 | 196 | 278 | 289 | 835 | 209 | 620 | 378 |
| 31 Oct 09 | 215 | 184 | 516 | 170 | 148 | 223 | 224 | 205 | 206 | 183 | 187 | 286 | 291 | 1826 | 205 | 616 | 385 |
| 13 Mar 10 | 192 | 215 | 514 | 157 | 145 | 226 | 227 | 205 | 204 | 182 | 184 | 280 | 286 | 1026 | 71 | 602 | 361 |
| 19 Oct 10 | 212 | 185 | 514 | 156 | 134 | 234 | 239 | 194 | 188 | 155 | 174 | 261 | 267 | 1115 | 199 | 590 | 382 |
| 26 Feb 11 | 187 | 285 | 457 | 153 | 136 | 235 | 240 | 193 | 184 | 154 | 163 | 271 | 276 | 731 | 196 | 627 | 383 |

Table A2-3 continued

Table A2-4 Zone 1 erosion pin results 4/4. New Pins installed December 2004. Exposed pin length recorded in mm

| **Zone** | **1** | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Site** | **E** | | | | | | | | | | | | | | | |
| **Pin Number** | **6** | | **7** | | **8** | | **9** | | **10** | | **11** | | **12** | | **13** | |
| **a,b,c …** | | | | | **Dup 1E/2** | | **Dup 1E/3** | | **Dup 1E/4** | | **Dup 1E/5** | | **Dup 1E/4** | | **Dup 1E/5, 1E/11** | |
| Bank Location | 2–3 | | >3 | | 1–2 | | 1–2 | | <1 | | <1 | | <1 | | <1 | |
| Top/Bot of Pin | upslope | downslope | upslope | downslope | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot |
| 11 Dec 04 | 168 | 177 | 141 | 142 | | | | | | | | | | | | |
| 2 Apr 05 | 171 | 173 | 140 | 142 | | | | | | | | | | | | |
| 15 Oct 05 | 164 | 167 | 140 | 141 | | | | | | | | | | | | |
| 11 Mar 06 | 176 | 167 | 130 | 138 | | | | | | | | | | | | |
| 17 Oct 06 | 170 | 168 | 141 | 138 | | | | | | | | | | | | |
| 17 Mar 07 | 170 | 167 | 138 | 138 | | | | | | | | | | | | |
| 20 Oct 07 | 174 | 164 | 141 | 139 | | | | | | | | | | | | |
| 1 Mar 08 | 171 | 164 | 142 | 143 | | | | | | | | | | | | |
| 17 Oct 08 | 163 | 163 | 140 | 138 | | | | | | | | | | | | |
| 22 Mar 09 | 179 | 168 | 139 | 137 | | | | | | | | | | | | |
| 31 Oct 09 | 170 | 170 | 142 | 139 | | | | | | | | | | | | |
| 13 Mar 10 | 168 | 168 | 136 | 134 | 117 | 109 | 104 | 111 | 38 | 39 | 22 | 32 | 280 | 281 | 326 | 326 |
| 19 Oct 10 | 182 | 170 | 136 | 136 | 123 | 102 | 93 | 105 | 24 | 28 | 21 | 27 | 269 | 269 | 311 | 311 |
| 26 Feb 11 | 176 | 172 | 139 | 137 | 113 | 101 | 81 | 90 | 18 | 29 | 22 | 22 | 270 | 273 | 317 | 317 |

Table A2-5 Zone 2 erosion pin results 1/6. Exposed pin length recorded in mm

| **Zone** | **2** | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Site** | **A** | | | | | | | | | | | | | | **B** | | | | | | | |
| **Pin Number** | **1** | | **2** | | **3** | | **4** | | **5** | | **6** | | **7** | | **1** | | **2** | **3** | | **4** | **5** | |
| Bank Location | toe | | slope | | slope | | crest | | b/slope | | b/slope | | b/water | | flow | | cavity | flow | | cavity | flow | |
| Top/Bot of Pin | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Bot | Top | Bot | Bot | Top | Bot |
| 11 Dec 99 | | | | | | | | | | | | | | | | | | | | | | |
| 19 Dec 99 | | | | | | | | | | | | | | | | | | | | | | |
| 4 Mar 00 | | | | | | | | | | | | | | | | | | | | | | |
| 24 Mar 00 | | | | | | | | | | | | | | | | | | | | | | |
| 22 Jul 00 | | | | | | | | | | | | | | | | | | | | | | |
| 26 Sep 00 | | | | | | | | | | | | | | | | | | | | | | |
| 25 Nov 00 | | | | | | | | | | | | | | | | | | | | | | |
| 28 Jul 01 | | | | | | | | | | | | | | | | | | | | | | |
| 4 Aug 01 | | | | | | | | | | | | | | | | | | | | | | |
| 23 Nov 01 | 361 | | 338 | | 213 | | | | | | 301 | | 306 | | 604 | | 1024 | 866 | | 883 | 228 | |
| 9 Dec 01 | 368 | 369 | 344 | 346 | 218 | 226 | 500 | 500 | 397 | 403 | 295 | 298 | 311 | 311 | 594 | 598 | 1002 | 856 | 856 | 884 | 271 | 276 |
| 9 Feb 02 | 373 | 375 | 339 | 342 | 219 | 222 | 501 | 501 | 399 | 404 | 291 | 293 | 310 | 304 | 526 | 562 | 1002 | 852 | 853 | 887 | 257 | 260 |
| 9 Mar 02 | 370 | 379 | 340 | 341 | 216 | 225 | 500 | 502 | 399 | 404 | 294 | 294 | 306 | 303 | 535 | 565 | 1003 | 859 | 856 | 893 | 181 | 256 |
| 13 Apr 02 | 377 | 379 | 346 | 347 | 216 | 222 | 499 | 501 | 400 | 405 | 289 | 291 | 292 | 297 | 527 | 569 | 1001 | 849 | 844 | 890 | 201 | 237 |
| 5 Oct 02 | 363 | 371 | 337 | 340 | 206 | 220 | 500 | 500 | 396 | 405 | 290 | 295 | 301 | 300 | 562 | 603 | 1039 | 890 | 890 | 907 | 218 | 280 |
| 16 Dec 02 | 365 | 368 | 337 | 341 | 211 | 217 | 500 | 498 | 400 | 394 | 290 | 288 | 298 | 287 | 568 | 616 | 1058 | 874 | 888 | 928 | 213 | 214 |

*Table A2-5 continued next page*

| Zone | 2 | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site | A | | | | | | | | | | | | | | B | | | | | | | |
| Pin Number | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 1 | | 2 | 3 | | 4 | 5 | |
| Bank Location | toe | | slope | | slope | | crest | | b/slope | | b/slope | | b/water | | flow | | cavity | flow | | cavity | flow | |
| Top/Bot of Pin | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Bot | Top | Bot | Bot | Top | Bot |
| 29 Mar 03 | 370 | 371 | 336 | 339 | 208 | 218 | 500 | 500 | 395 | 399 | 280 | 279 | 300 | 298 | 502 | 575 | 1000 | 831 | 882 | 909 | 102 | 203 |
| 18 Oct 03 | 368 | 369 | 337 | 344 | 205 | 216 | 499 | 498 | 390 | 396 | 281 | 285 | 297 | 299 | 588 | 615 | 1001 | 879 | 916 | 879 | 145 | 270 |
| 6 Mar 04 | 364 | 362 | 335 | 337 | 203 | 217 | 500 | 499 | 391 | 398 | 277 | 284 | 296 | 300 | 577 | 599 | 1002 | 893 | 912 | 886 | 163 | 230 |
| 9 Oct 04 | 371 | 370 | 333 | 340 | 201 | 213 | 495 | 499 | 388 | 397 | 276 | 280 | 300 | 301 | 610 | 611 | 1001 | 913 | 929 | 874 | 197 | 266 |
| 9 Apr 05 | 361 | 369 | 335 | 340 | 200 | 213 | 495 | 495 | 390 | 401 | 277 | 277 | 298 | 300 | 564 | 609 | 1015 | 887 | 880 | 910 | 195 | 205 |
| 15 Oct 05 | 374 | 377 | 340 | 347 | 200 | 206 | 495 | 497 | 390 | 394 | 272 | 276 | 308 | 305 | 627 | 627 | 1001 | 941 | 943 | 872 | 257 | 260 |
| 11 Mar 06 | 371 | 373 | 341 | 350 | 199 | 210 | 496 | 492 | 390 | 394 | 272 | 273 | 314 | 308 | 631 | 633 | 1002 | 948 | 935 | 909 | 253 | 270 |
| 17 Oct 06 | 366 | 373 | 343 | 348 | 200 | 210 | 494 | 492 | 390 | 394 | 270 | 272 | 403 | 354 | 625 | 635 | 1001 | 966 | 958 | 1097 | 263 | 263 |
| 17 Mar 07 | 357 | 359 | 335 | 340 | 198 | 203 | 494 | 493 | 388 | 392 | 260 | 265 | 390 | 381 | 626 | 625 | 1001 | 952 | 954 | 958 | 264 | 266 |
| 20 Oct 07 | 364 | 369 | 242 | 342 | 193 | 194 | 494 | 494 | 386 | 388 | 251 | 251 | 351 | 344 | 644 | 650 | 1001 | 976 | 967 | | 261 | 263 |
| 1 Mar 08 | 365 | 366 | 341 | 346 | 195 | 201 | 494 | 198 | 385 | 394 | 253 | 255 | 348 | 345 | 660 | 653 | 1003 | 984 | 988 | | 266 | 267 |
| 17 Oct 08 | 364 | 361 | 338 | 344 | 195 | 205 | 491 | 493 | 382 | 386 | 256 | 255 | 346 | 340 | 668 | 600 | 1001 | 994 | 996 | | | 289 |
| 22 Mar 09 | 359 | 361 | 339 | 344 | 196 | 205 | 492 | 494 | 380 | 386 | 249 | 252 | 337 | 335 | 665 | 666 | 999 | 1026 | 1041 | | 155 | 290 |
| 31 Oct 09 | 361 | 362 | 339 | 345 | 196 | 209 | 495 | 491 | 382 | 381 | 252 | 256 | 333 | 339 | 671 | 671 | 1002 | 1046 | 1041 | | | |
| 13 Mar 10 | 357 | 360 | 338 | 345 | 196 | 206 | 492 | 495 | 380 | 378 | 253 | 253 | 340 | 340 | 682 | 673 | 1002 | 1044 | 1041 | | 292 | 292 |
| 19 Oct 10 | 362 | 364 | 333 | 346 | 207 | 196 | 493 | 494 | 383 | 383 | 251 | 252 | 339 | 335 | 685 | 684 | 999 | 1025 | 1028 | | 291 | 142 |
| 26 Feb 11 | 364 | 363 | 342 | 344 | 197 | 206 | 493 | 496 | 379 | 384 | 247 | 247 | 337 | 334 | 685 | 681 | 1001 | 1023 | 1026 | | 286 | 148 |

Table A2-5 continued

Table A2-6 Zone 2 erosion pin results 2/6. Exposed pin length recorded in mm

| **Zone** | **2** | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Site** | **B** | | | | | **C** | | | | | | | **D** | | | | | | | | **E** | | | | |
| **Pin Number** | **6** | **7** | | **8** | | **1** | | **2** | **3** | | **4** | | **1** | | **2** | | **3** | | **4** | | **1** | **2** | | **3** | |
| Bank Location | cavity | flow | | toe | | cavity | | cavity | slope | | toe | | top | | slope | | slope | | toe | | cavity | top | | slope | |
| Top/Bot of Pin | Bot | Top | Bot | Top | Bot | Top | Bot | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Bot | Top | Bot | Top | Bot |
| 11 Dec 99 | | | | | | | | | | | | | | | | | | | | | | 110 | | 155 | |
| 19 Dec 99 | | | | | | | | | | | | | 150 | | 159 | | 145 | | 950 | | | 123 | | 70 | |
| 4 Mar 00 | | | | | | | | | 295 | | | | 150 | | 98 | | 143 | | 934 | | | 118 | | 151 | |
| 24 Mar 00 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 22 Jul 00 | | | | | | | | | 390 | | | | 129 | | 140 | | 150 | | 985 | | | 111 | | 165 | |
| 26 Sep 00 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 25 Nov 00 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 28 Jul 01 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 Aug 01 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 23 Nov 01 | 961 | 289 | | | | | | | 450 | 333 | | | 154 | 165 | 112 | 156 | 120 | 138 | 783 | 821 | 572 | 112 | 130 | 151 | 215 |
| 9 Dec 01 | 947 | 390 | 389 | | | 1849 | | 822 | 434 | 481 | | | 154 | 168 | 109 | 128 | 129 | 146 | 835 | 862 | 572 | 112 | 130 | 155 | 213 |
| 9 Feb 02 | 956 | 311 | 313 | | | 1844 | | 792 | 348 | 464 | | | 155 | 169 | 115 | 125 | 137 | 147 | 858 | 880 | 582 | 113 | 128 | 154 | 220 |
| 9 Mar 02 | 946 | 308 | 321 | | | 1795 | 1799 | 784 | 358 | 476 | | | 155 | 169 | 109 | 116 | 143 | 156 | 878 | 886 | 582 | 117 | 143 | 180 | 218 |
| 13 Apr 02 | 920 | 295 | 307 | | | 1807 | 1790 | 783 | 290 | 481 | | | 155 | 165 | 88 | 90 | 151 | 165 | 862 | 867 | 583 | 123 | 145 | 151 | 218 |
| 5 Oct 02 | 510 | 241 | 327 | 241 | 327 | 1845 | 1813 | 794 | 393 | 542 | 250 | 248 | 151 | 153 | 131 | 152 | 140 | 160 | 853 | 866 | 586 | 130 | 154 | 150 | 220 |
| 16 Dec 02 | 505 | 245 | 329 | 428 | 438 | 1868 | 1811 | 783 | 410 | 519 | 264 | 266 | 150 | 150 | 152 | 167 | 145 | 160 | 850 | 870 | 594 | 129 | 152 | 145 | 223 |
| 29 Mar 03 | 430 | 243 | 325 | 493 | 500 | 1810 | 1850 | 782 | 473 | 538 | 260 | 266 | 154 | 160 | 116 | 120 | 223 | 227 | 840 | 840 | 597 | 134 | 161 | 144 | 233 |

*Table A2-6 continued next page*

| Zone | 2 | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site | B | | | | | C | | | | | | | D | | | | | | | | E | | | | |
| Pin Number | 6 | 7 | | 8 | | 1 | | 2 | 3 | | 4 | | 1 | | 2 | | 3 | | 4 | | 1 | 2 | | 3 | |
| Bank Location | cavity | flow | | toe | | cavity | | cavity | slope | | toe | | top | | slope | | slope | | toe | | cavity | top | | slope | |
| Top/Bot of Pin | Bot | Top | Bot | Top | Bot | Top | Bot | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Bot | Top | Bot | Top | Bot |
| 18 Oct 03 | 515 | 316 | 332 | 413 | 416 | 1779 | 1778 | 719 | 466 | 571 | 277 | 279 | 145 | 155 | 199 | 202 | 161 | 167 | 819 | 828 | 588 | 129 | 151 | 230 | 144 |
| 6 Mar 04 | 506 | | 282 | 422 | 431 | 1511 | 1625 | 727 | 470 | 575 | 272 | 276 | 144 | 155 | 169 | 180 | 170 | 180 | 828 | 831 | 597 | 129 | 153 | 134 | 234 |
| 9 Oct 04 | 502 | 317 | 344 | 423 | 425 | 1777 | 1663 | 716 | 488 | 582 | | | 148 | 159 | 172 | 190 | 188 | 203 | 786 | 804 | 594 | 154 | 136 | 188 | 387 |
| 9 Apr 05 | 517 | 310 | 325 | 430 | 435 | 1152 | 1178 | 730 | 500 | 570 | 280 | 285 | 165 | 210 | 175 | 191 | 214 | 216 | 830 | 852 | 605 | 136 | 140 | 209 | 315 |
| 15 Oct 05 | 521 | 346 | 345 | 405 | 410 | 1787 | 1838 | 754 | 514 | 577 | 284 | 287 | 215 | 240 | 213 | 217 | 185 | 196 | 860 | 854 | 595 | 141 | 165 | 247 | 362 |
| 11 Mar 06 | 390 | 326 | 338 | 399 | 404 | 1690 | 1690 | 754 | 523 | 583 | 281 | 286 | 216 | 296 | 217 | 219 | 196 | 209 | 769 | 802 | 609 | 138 | 164 | 238 | 365 |
| 17 Oct 06 | 939 | 341 | 346 | 369 | 374 | 1695 | 1695 | 777 | 466 | 532 | 288 | 292 | 179 | 150 | 202 | 201 | 194 | 207 | 807 | 821 | 600 | 174 | 149 | 249 | 272 |
| 17 Mar 07 | 908 | 347 | 346 | 378 | 380 | 1771 | 1776 | 829 | 468 | 522 | 288 | 282 | 171 | 157 | 183 | 184 | 177 | 186 | 792 | 806 | 615 | 196 | 176 | 256 | 340 |
| 20 Oct 07 | 971 | 360 | 363 | 410 | 415 | 513 | 513 | 750 | 449 | 555 | 290 | 296 | Use 2D6 as record | | 118 | 106 | 132 | 142 | 805 | 821 | 627 | 235 | 202 | 260 | 377 |
| 1 Mar 08 | 986 | 377 | 375 | 403 | 406 | 496 | 470 | 770 | 451 | 556 | 294 | 296 | | | 113 | 112 | 123 | 138 | 766 | 799 | 365 | 210 | 251 | 273 | 386 |
| 17 Oct 08 | 359 | 386 | 386 | 384 | 386 | 1916 | 1916 | 851 | 445 | 552 | 283 | 292 | | | 130 | 124 | 77 | 95 | 760 | 787 | 630 | 213 | 254 | 269 | 385 |
| 22 Mar 09 | 362 | 293 | 380 | 363 | 368 | 1885 | 1885 | 825 | 451 | 547 | 281 | 291 | | | 120 | 117 | 93 | 96 | 790 | 861 | 645 | 224 | 196 | 260 | 381 |
| 31 Oct 09 | 353 | 376 | 376 | 347 | 350 | 1877 | 1877 | 830 | 465 | 557 | 285 | 290 | | | 88 | 83 | 60 | 86 | 956 | 981 | 658 | 211 | 198 | 291 | 427 |
| 13 Mar 10 | 353 | 372 | 372 | 444 | 447 | 2115 | 2115 | 932 | 466 | 560 | 281 | 288 | | | 100 | 96 | 56 | 81 | 897 | 897 | 679 | 178 | 215 | 308 | 415 |
| 19 Oct 10 | 347 | 375 | 375 | 367 | 370 | 1910 | 1910 | 841 | 470 | 557 | 288 | 285 | | | 93 | 85 | 72 | 90 | 911 | 959 | 671 | 203 | 188 | 303 | 416 |
| 26 Feb 11 | 345 | 379 | 365 | 398 | 406 | 1831 | 1831 | 841 | 470 | 558 | 284 | 291 | | | 91 | 93 | 85 | 101 | 910 | 948 | 617 | 203 | 185 | 306 | 405 |

Table A2-6 continued

Table A2-7 Zone 2 erosion pin results 3/6. Exposed pin length recorded in mm

| **Zone** | **2** | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Site** | **E** | | | | **F** | | | | **G** | | | | | | | | **H** | | | | | | |
| **Pin Number** | **4** | | **5** | | **1** | | **2** | | **1** | **2** | | **3** | **4** | **5** | **6** | | **1** | | **2** | | **3** | | **4** |
| Bank Location | slope | | toe | | cob | | cob | | cavity | flow | | cavity | cavity | cavity | toe | | slope | | slope | | toe | | cavity |
| Top/Bot of Pin | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Bot | Top | Bot | Bot | Bot | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Bot |
| 11 Dec 99 | 135 | | 810 | | | | | | | | | | | | | | | | | | | | |
| 19 Dec 99 | 138 | | 827 | | | | | | | | | | | | | | | | | | | | |
| 4 Mar 00 | 139 | | 815 | | | | | | | | | | | | | | | | | | | | |
| 24 Mar 00 | | | | | | | | | | | | | | | | | | | | | | | |
| 22 Jul 00 | 140 | | 818 | | | | | | | | | | | | | | | | | | | | |
| 26 Sep 00 | | | | | | | | | | | | | | | | | | | | | | | |
| 25 Nov 00 | | | | | | | | | | | | | | | | | | | | | | | |
| 28 Jul 01 | | | | | | | | | | | | | | | | | | | | | | | |
| 4 Aug 01 | | | | | | | | | | | | | | | | | | | | | | | |
| 23 Nov 01 | 127 | 165 | 789 | 828 | 222 | | 194 | | 846 | 415 | | 696 | | 1000 | | | 301 | | 299 | | 322 | | 405 |
| 9 Dec 01 | 129 | 165 | 790 | 822 | 231 | 229 | 215 | 175 | 858 | 408 | | 693 | | 1015 | | | | | | | | | |
| 9 Feb 02 | 129 | 166 | 799 | 835 | 236 | 229 | 218 | 164 | 872 | 432 | 435 | 682 | 1423 | 1032 | | | 295 | 295 | 273 | 276 | 333 | 329 | 409 |
| 9 Mar 02 | 134 | 160 | 790 | 824 | 242 | 231 | 239 | 167 | 878 | 460 | 466 | 672 | 1531 | 1026 | | | 291 | 295 | 258 | 259 | 316 | 306 | 393 |
| 13 Apr 02 | 136 | 161 | 790 | 824 | 246 | 250 | 235 | 162 | | | | | | | | | | | | | | | |
| 5 Oct 02 | 126 | 128 | 762 | 773 | 249 | 246 | 239 | 194 | 875 | 486 | 498 | 673 | 1531 | 1036 | 173 | 172 | 261 | 258 | 256 | 261 | 332 | 328 | 392 |
| 16 Dec 02 | 133 | 131 | 765 | 809 | 246 | 252 | 235 | 208 | 885 | 489 | 504 | 673 | 1567 | 1094 | 181 | 190 | 263 | 271 | 241 | 245 | 310 | 320 | 400 |
| 29 Mar 03 | 142 | 150 | 782 | 670 | | | | | 888 | 432 | 500 | 676 | 1535 | 1109 | 142 | 143 | 264 | 267 | 263 | 266 | 342 | 336 | 391 |
| 18 Oct 03 | 133 | 174 | 767 | 778 | 244 | 248 | 246 | 203 | 1069 | 449 | 472 | 671 | 1136 | 1115 | 174 | 178 | 258 | 256 | 228 | 232 | 261 | 257 | 286 |

*Table A2-7 continued next page*

| Zone | 2 | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site | E | | | | F | | | | G | | | | | | | | H | | | | | | |
| Pin Number | 4 | | 5 | | 1 | | 2 | | 1 | 2 | | 3 | 4 | 5 | 6 | | 1 | | 2 | | 3 | | 4 |
| Bank Location | slope | | toe | | cob | | cob | | cavity | flow | | cavity | cavity | cavity | toe | | slope | | slope | | toe | | cavity |
| Top/Bot of Pin | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Bot | Top | Bot | Bot | Bot | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Bot |
| 6 Mar 04 | 138 | 194 | 765 | 777 | 248 | 232 | 216 | 207 | 1262 | 423 | 468 | 675 | 1533 | 1073 | 134 | 178 | 260 | 265 | 241 | 248 | 296 | 313 | 380 |
| 9 Oct 04 | 157 | 185 | 748 | 758 | | | | | 946 | 398 | 427 | 686 | 1636 | 1051 | 220 | 233 | 272 | 271 | 255 | 262 | 310 | 310 | 374 |
| 9 Apr 05 | 155 | 170 | 760 | 765 | 265 | 265 | 244 | 205 | 1175 | 390 | 440 | 680 | 1700 | 730 | 114 | 170 | 275 | 277 | 255 | 262 | 323 | 320 | 400 |
| 15 Oct 05 | 179 | 181 | 731 | 735 | | | | | 915 | 437 | 446 | 688 | 1649 | 651 | 144 | 164 | 275 | 275 | 257 | 260 | 298 | 300 | 225 |
| 11 Mar 06 | 208 | 210 | 749 | 783 | | | | | 1052 | 444 | 478 | 680 | 1536 | 838 | 131 | 193 | 277 | 276 | 253 | 258 | 297 | 300 | 223 |
| 17 Oct 06 | 162 | 167 | 724 | 725 | | | | | 1051 | 512 | 518 | 696 | 1590 | 1016 | 93 | 133 | 276 | 276 | 247 | 257 | 295 | 297 | 70 |
| 17 Mar 07 | 164 | 170 | 745 | 748 | | | | | 1062 | 507 | 521 | 694 | 1596 | 1038 | 76 | 95 | 273 | 276 | 241 | 250 | 289 | 288 | 80 |
| 20 Oct 07 | 126 | 135 | 674 | 684 | | | | | 924 | 494 | 496 | 704 | 1595 | 1036 | 66 | 69 | 270 | 272 | 233 | 236 | 272 | 273 | 35 |
| 1 Mar 08 | 152 | 186 | 707 | 720 | | | | | 1067 | 484 | 490 | 715 | 1541 | 1043 | 51 | 55 | 275 | 277 | 226 | 234 | 277 | 277 | 66 |
| 17 Oct 08 | 152 | 169 | 687 | 693 | | | | | 970 | 478 | 490 | 711 | 1603 | 1026 | 73 | 60 | 273 | 275 | 230 | 231 | 277 | 275 | 25 |
| 22 Mar 09 | 150 | 161 | 681 | 690 | | | | | 983 | 486 | 478 | 723 | 1611 | 1046 | 75 | 89 | 275 | 276 | 226 | 233 | 273 | 275 | Lost |
| 31 Oct 09 | 141 | 154 | 673 | 680 | | | | | 1090 | 478 | 477 | 754 | 1611 | 1061 | 115 | 153 | 274 | 276 | 230 | 237 | 252 | 265 | |
| 13 Mar 10 | 137 | 145 | 671 | 677 | | | | | 1102 | 500 | 501 | 758 | 1583 | 1143 | 185 | 186 | 275 | 276 | 233 | 235 | 249 | 255 | |
| 19 Oct 10 | 185 | 233 | 649 | 671 | | | | | 1111 | 490 | 498 | 736 | 1584 | 1038 | 260 | 268 | 276 | 275 | 234 | 237 | 255 | 261 | |
| 26 Feb 11 | 193 | 232 | 653 | 665 | | | | | 1045 | 532 | 535 | 732 | 1239 | 1176 | 170 | 185 | 277 | 275 | 236 | 240 | 255 | 265 | |

Table A2-7 continued

Table A2-8 Zone 2 erosion pin results 4/6. Exposed pin length recorded in mm

| **Zone** | **2** | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Site** | **H** | | | | **I** | | | | **J** | | | | | | **K** | | | | | | | |
| **Pin Number** | **5** | | **6** | | **1** | | **2** | | **1** | | **2** | | **3** | | **1** | **2** | **3** | | **4** | | **5** | |
| Bank Location | slope | | toe | | top | | toe | | top | | slope | | toe | | cavity | flow | top | | slope | | toe | |
| Top/Bot of Pin | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Bot | Bot | Top | Bot | Top | Bot | Top | Bot |
| 11 Dec 99 | | | | | | | | | 160 | | 120 | | 150 | | | | 115 | | 160 | | 980 | |
| 19 Dec 99 | | | | | | | | | | | | | | | | | 152 | | 133 | | 893 | |
| 4 Mar 00 | | | | | | | | | | | | | | | | | | | | | | |
| 24 Mar 00 | | | | | | | | | | | | | | | | | | | | | 1032 | |
| 22 Jul 00 | | | | | | | | | | | | | | | | | 185 | | 160 | | 900 | |
| 26 Sep 00 | | | | | | | | | | | | | | | | | | | | | 938 | |
| 25 Nov 00 | | | | | | | | | | | | | | | | | 104 | | 34 | | 954 | |
| 28 Jul 01 | | | | | | | | | | | | | | | | | | | | | | |
| 4 Aug 01 | | | | | | | | | | | | | | | | | | | | | | |
| 23 Nov 01 | 385 | | 275 | | 261 | | 291 | | 170 | | 244 | 260 | 223 | | 772 | 921 | 165 | | 158 | | 1020 | 1062 |
| 9 Dec 01 | | | | | | | | | | | | | | | | | | | | | | |
| 9 Feb 02 | 405 | 415 | 293 | 293 | 262 | 259 | 288 | 288 | 202 | | 245 | 258 | 218 | | 760 | 950 | 163 | 204 | 175 | 250 | 1042 | 1101 |
| 9 Mar 02 | 493 | 496 | 255 | 301 | 260 | 258 | 288 | 289 | 184 | 272 | 253 | 290 | 226 | | 762 | 1078 | 163 | 196 | 227 | 240 | 1086 | 1103 |
| 13 Apr 02 | | | | | | | | | | | | | | | | | | | | | | |
| 5 Oct 02 | 476 | 482 | 322 | 317 | 254 | 253 | 284 | 285 | 152 | 375 | 310 | 306 | 167 | 175 | 761 | 181 | 120 | 138 | 220 | 211 | 1062 | 1098 |
| 16 Dec 02 | 484 | 494 | 257 | 262 | | | | | | | | | | | | | | | | | | |
| 29 Mar 03 | 511 | 540 | 240 | 230 | 252 | 253 | 284 | 287 | 188 | 182 | 329 | 412 | 256 | 260 | 769 | 257 | 211 | 240 | 350 | 354 | 1229 | 1244 |
| 18 Oct 03 | 400 | 351 | 305 | 390 | 242 | 240 | 274 | 278 | 160 | 185 | 364 | 382 | 200 | 208 | 767 | 515 | 409 | 414 | 277 | 289 | 1141 | 1154 |
| 6 Mar 04 | 350 | 335 | 202 | 181 | 241 | 238 | 275 | 286 | 200 | 235 | 373 | 432 | 243 | 259 | 760 | 461 | 413 | 432 | 265 | 328 | 1199 | 1210 |

*Table A2-8 continued next page*

| Zone | 2 | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site | H | | | | I | | | | J | | | | | | K | | | | | | | |
| Pin Number | 5 | | 6 | | 1 | | 2 | | 1 | | 2 | | 3 | | 1 | 2 | 3 | | 4 | | 5 | |
| Bank Location | slope | | toe | | top | | toe | | top | | slope | | toe | | cavity | flow | top | | slope | | toe | |
| Top/Bot of Pin | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Bot | Bot | Top | Bot | Top | Bot | Top | Bot |
| 9 Oct 04 | 370 | 380 | 175 | 177 | 240 | 237 | 278 | 286 | 336 | 363 | 350 | 369 | 245 | 243 | 617 | 798 | 433 | 471 | 258 | 272 | 1160 | 1175 |
| 9 Apr 05 | 392 | 392 | 184 | 185 | 235 | 232 | 279 | 281 | 300 | 414 | 333 | 411 | 290 | 300 | 164 | 672 | 401 | 487 | 332 | 387 | 1123 | 1130 |
| 15 Oct 05 | 289 | 386 | 177 | 184 | 233 | 231 | 270 | 273 | 295 | 358 | 380 | 413 | 303 | 309 | | 662 | 441 | 479 | 380 | 392 | 1313 | 1354 |
| 11 Mar 06 | 370 | 394 | 175 | 174 | 235 | 230 | 267 | 278 | 303 | 360 | 380 | 437 | 290 | 293 | 458 | 663 | 440 | 483 | 369 | 396 | 1270 | 1288 |
| 17 Oct 06 | 391 | 395 | 173 | 173 | 233 | 229 | 275 | 289 | 398 | 450 | 389 | 424 | 275 | 280 | 407 | 225 | 305 | 444 | 269 | 317 | 1396 | 1321 |
| 17 Mar 07 | 354 | 338 | 143 | 146 | 221 | 227 | 280 | 289 | 386 | 470 | 322 | 430 | 349 | 347 | 386 | 154 | 302 | 307 | 156 | 297 | 1318 | 1340 |
| 20 Oct 07 | 297 | 278 | 105 | 114 | 224 | 222 | 299 | 305 | 455 | 454 | 371 | 474 | 391 | 390 | 470 | Lost | Lost | | Lost | | 1255 | 1307 |
| 1 Mar 08 | 261 | 254 | 110 | 122 | 221 | 213 | 300 | 304 | 379 | 449 | 374 | 393 | 355 | 363 | 523 | | | | | | 1217 | 1300 |
| 17 Oct 08 | 236 | 253 | 108 | 113 | 221 | 215 | 304 | 310 | 387 | 446 | 337 | 394 | 286 | 292 | 575 | | | | | | 1123 | 1260 |
| 22 Mar 09 | 229 | 244 | 123 | 126 | 221 | 216 | 302 | 308 | 400 | 453 | 385 | 392 | 295 | 303 | 626 | | | | | | 1104 | 1236 |
| 31 Oct 09 | 221 | 241 | 87 | 89 | 230 | 224 | 304 | 314 | 405 | 455 | 350 | 394 | 283 | 289 | 645 | | | | | | 1093 | 1235 |
| 13 Mar 10 | 221 | 220 | 97 | 96 | 231 | 236 | 308 | 317 | 443 | 445 | 405 | 480 | 284 | 288 | 673 | | | | | | 1150 | 1209 |
| 19 Oct 10 | 213 | 199 | 88 | 84 | 232 | 224 | 303 | 310 | 408 | 470 | 349 | 396 | 256 | 264 | 652 | | | | | | 1135 | 1196 |
| 26 Feb 11 | 211 | 199 | 86 | 81 | 234 | 228 | 301 | 306 | 405 | 450 | 333 | 395 | 264 | 270 | 658 | | | | | | 1016 | 1062 |

Table A2-8 continued

Table A2-9 Zone 2 erosion pin results 5/6. Exposed pin length recorded in mm

| **Zone** | **2** | | | | | | |
|---|---|---|---|---|---|---|---|
| **Site** | **L** | | | | | | |
| **Pin Number** | **1** | **2** | | **3** | | **4** | |
| Bank Location | cavity | top | | slope | | toe | |
| Top/Bot of Pin | Bot | Top | Bot | Top | Bot | Top | Bot |
| 11 Dec 99 | | 96 | | 175 | | 942 | |
| 19 Dec 99 | | | | | | | |
| 4 Mar 00 | | 92.5 | | 175 | | 980 | |
| 24 Mar 00 | | 100 | | 175 | | 1118 | |
| 22 Jul 00 | | 98 | | 160 | | 1130 | |
| 26 Sep 00 | | 97 | | 188 | | 1150 | |
| 25 Nov 00 | | 92 | | 190 | | 1166 | |
| 28 Jul 01 | | 100 | | 186 | | 1169 | |
| 4 Aug 01 | | 100 | | 187 | | 1169 | |
| 23 Nov 01 | 763 | 98 | 101 | 190 | 192 | 1167 | |
| 9 Dec 01 | | | | | | | |
| 9 Feb 02 | 769 | 97 | 100 | 174 | 180 | 1167 | 1175 |
| 9 Mar 02 | 765 | 96 | 100 | 184 | 188 | 1152 | 1182 |
| 13 Apr 02 | | | | | | | |
| 5 Oct 02 | 767 | 98 | 101 | 199 | 224 | 1149 | 1161 |
| 16 Dec 02 | | | | | | | |
| 29 Mar 03 | 769 | 98 | 104 | 211 | 220 | 1167 | 1165 |
| 18 Oct 03 | 757 | 103 | 106 | 259 | 276 | 1145 | 1154 |
| 6 Mar 04 | 771 | 102 | 108 | 269 | 286 | 1168 | 1179 |
| 9 Oct 04 | 776 | 121 | 209 | 345 | 350 | 1162 | 1165 |
| 9 Apr 05 | 772 | 191 | 216 | 320 | 342 | 1164 | 1184 |
| 15 Oct 05 | 768 | 243 | 261 | 321 | 334 | 1164 | 1180 |
| 11 Mar 06 | 763 | 237 | 266 | 357 | 354 | 1165 | 1180 |
| 17 Oct 06 | 766 | 250 | 291 | 258 | 254 | 1161 | 1176 |
| 17 Mar 07 | 757 | 276 | 282 | 249 | 252 | 1160 | 1173 |
| 20 Oct 07 | 770 | 277 | 286 | 224 | 223 | 1164 | 1184 |
| 1 Mar 08 | 764 | 285 | 288 | 221 | 225 | 1164 | 1182 |
| 17 Oct 08 | 760 | 266 | 352 | 259 | 264 | 1188 | 1165 |
| 22 Mar 09 | 749 | 276 | 333 | 283 | 283 | 1166 | 1183 |
| 31 Oct 09 | 848 | 315 | 317 | 281 | 287 | 1163 | 1176 |
| 13 Mar 10 | 841 | 278 | 314 | 303 | 304 | 1173 | 1184 |
| 19 Oct 10 | 747 | 278 | 275 | 317 | 315 | 1163 | 1185 |
| 26 Feb 11 | 747 | 281 | 314 | 305 | 305 | 1165 | 1177 |

Table A2-10 Zone 2 erosion pin results 6/6. New pins installed in December 2004 Exposed pin length recorded in mm

| **Zone** | **2** | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Site** | **D** | | **G** | | | | **L** | | | | **K** | | **L** | | **D** | | **I** | | **K** | | **D** | |
| **Pin Number** | **5** | | **7** | | **8** | | **5** | | **6** | | **2** | | **7** | | **6** | | **3** | | **6** | | **1** | |
| Bank Location | 2–3 | | 2–3 | | 2–3 | | 2–3 | | 2–3 | | 2–3 | | 2–3? | | 2–3 | | 1–2 | | dup 2K5 | | re-install | |
| Top/Bot of Pin | top | bot | top | bot | top | bot | top | bot | top | bot | top | bot | top | bot | top | bot | top | bot | top | bot | top | bot |
| 11 Dec 04 | 196 | 195 | 177 | 161 | 191 | 189 | 160 | 158 | 200 | 191 | | | | | | | | | | | | |
| 9 Apr 05 | 200 | 200 | 174 | 160 | 197 | 195 | 160 | 152 | 194 | 190 | | | | | | | | | | | | |
| 15 Oct 05 | 202 | 201 | 171 | 162 | 199 | 193 | 160 | 151 | 192 | 187 | | | | | | | | | | | | |
| 11 Mar 06 | 201 | 202 | 174 | 161 | 198 | 192 | 160 | 149 | 183 | 216 | 458 | 462 | | | | | | | | | | |
| 17 Oct 06 | 200 | 199 | 171 | 169 | 201 | 199 | 153 | 146 | 223 | 214 | 225 | 246 | 208 | 210 | 272 | 285 | 467 | 467 | | | | |
| 17 Mar 07 | 199 | 199 | 171 | 166 | 201 | 222 | 151 | 144 | 208 | 208 | 154 | 161 | 200 | 207 | 268 | 282 | 463 | 463 | 225 | 234 | | |
| 20 Oct 07 | 206 | 194 | 156 | 150 | 203 | 211 | 146 | 135 | 211 | 202 | Lost | | 187 | 196 | 279 | 289 | 455 | 454 | 224 | 250 | 202 | 193 |
| 1 Mar 08 | 208 | 202 | 150 | 144 | 201 | 220 | 149 | 136 | 214 | 217 | | | 185 | 193 | 295 | 312 | 451 | 453 | 185 | 222 | 192 | 205 |
| 17 Oct 08 | 207 | 206 | 147 | 140 | 200 | 214 | 135 | 131 | 212 | 213 | | | 177 | 187 | 313 | 361 | 447 | 448 | 172 | 192 | 220 | 217 |
| 22 Mar 09 | 207 | 198 | 146 | 137 | 201 | 221 | 136 | 132 | 216 | 215 | | | 170 | 186 | 293 | 308 | 443 | 445 | 165 | 171 | 201 | 205 |
| 31 Oct 09 | 217 | 193 | 144 | 139 | 205 | 220 | 140 | 132 | 217 | 218 | | | 173 | 186 | 314 | 330 | 443 | 441 | 160 | 189 | 224 | 227 |
| 13 Mar 10 | 210 | 197 | 141 | 135 | 207 | 221 | 138 | 128 | 217 | 219 | | | 174 | 187 | 329 | 335 | 443 | 445 | 104 | 172 | 222 | 225 |
| 19 Oct 10 | 205 | 197 | 140 | 132 | 209 | 221 | 129 | 127 | 213 | 215 | | | 176 | 182 | 340 | 345 | 443 | 441 | 104 | 143 | 276 | 268 |
| 26 Feb 11 | 206 | 197 | 138 | 128 | 209 | 223 | 140 | 125 | 211 | 214 | | | 178 | 187 | 340 | 342 | 442 | 439 | 86 | 93 | 271 | 255 |

*Table A2-10 continued next page*

| Zone | 2 | | | | | |
|---|---|---|---|---|---|---|
| Site | K | | | | G | |
| Pin Number | 7 | | 8 | | 9 | |
| a,b,c,.. | new 2k/2 | | new 2k/3 | | duplicate | |
| Bank Location | 2–3 | | | | toe | |
| Top/Bot of Pin | Top | Bot | Top | Bot | Top | Bot |
| 20 Oct 07 | 722 | 724 | 1353 | 1365 | | |
| 1 Mar 08 | 739 | 732 | 1367 | 1375 | | |
| 17 Oct 08 | 776 | 774 | 1356 | 1368 | | |
| 22 Mar 09 | 799 | 785 | 1345 | 1356 | | |
| 31 Oct 09 | 923 | 923 | 1348 | 1357 | 462 | 464 |
| 13 Mar 10 | 913 | 916 | 1287 | 1307 | 492 | 493 |
| 19 Oct 10 | 853 | 856 | 1327 | 1312 | 530 | 570 |
| 26 Feb 11 | 833 | 828 | 1322 | 1319 | 497 | 497 |

Table A2-10 continued

Table A2-11 Zone 3 erosion pin results 1/5 – exposed pin length recorded in mm

| **Zone** | **3** | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Site** | **A** | | | | | | | | **B** | | | | | | | | **C** | | | | |
| **Pin Number** | **1** | | **2** | | **3** | | **4** | | **1** | **2** | **3** | **4** | | | **5** | | **1** | **2** | | **3** | |
| Bank Location | toe | | slope | | slope | | toe | | slope | cavity | cavity | slope | | | slope | | cavity | top | | slope | |
| Top/Bot of Pin | Top | Bot | Top | Bot | top | bot | top | bot | Top | Bot | Bot | Top | Top | Bot | Top | Bot | Bot | Top | Bot | Top | Bot |
| 18 Dec 99 | 390 | | | | | | | | 175 | | | | 154 | | 325 | | | | | | |
| 6 Mar 00 | 510 | | | | | | | | | | | | | | | | | | | | |
| 26 Sep 00 | 540 | | | | | | | | | | | | | | | | | | | | |
| 23 Nov 01 | 674 | | | | | | | | 159 | | | | | | | | | | | | |
| 8 Dec 01 | 682 | | | | | | | | 135 | | 504 | 676 | 68 | | | | 1835 | 389 | | 268 | 281 |
| 10 Feb 02 | 730 | | | | | | | | 83 | 105 | 482 | 680 | 170 | 185 | | | 1770 | 404 | 407 | 264 | 279 |
| 9 Mar 02 | 765 | 773 | | | | | | | 142 | 274 | 465 | 686 | | | 191 | 237 | 1837 | 396 | 404 | 257 | 279 |
| 13 Apr 02 | | | | | | | | | | | | | | | | | | | | | |
| 5 Oct 02 | Lost | | 156 | 149 | 274 | 278 | 767 | 770 | 172 | 191 | 420 | 675 | Lost | Lost | 199 | 203 | 1686 | 390 | 395 | 248 | 287 |
| 16 Dec 02 | | | 152 | 160 | 283 | 283 | 769 | 769 | 174 | 195 | 415 | 677 | 114 | 69 | 202 | 211 | 1871 | 381 | 378 | 248 | 286 |
| 29 Mar 03 | | | 320 | 335 | 345 | 339 | 853 | 855 | 170 | 199 | 425 | 689 | 237 | 262 | 266 | 270 | 1888 | 380 | 395 | 250 | 284 |
| 18 Oct 03 | | | 444 | 446 | 378 | 380 | 951 | 948 | 180 | 198 | 425 | 698 | 275 | 291 | 204 | 270 | 1685 | 368 | 383 | 248 | 256 |
| 6 Mar 04 | | | 516 | 522 | 500 | 501 | 777 | 777 | 173 | 201 | 415 | 690 | 282 | 272 | 215 | 268 | 1874 | 365 | 386 | 245 | 256 |
| 9 Oct 04 | | | 523 | 522 | 420 | 416 | 733 | 735 | 195 | 221 | 418 | 713 | 307 | 308 | 190 | 236 | 1855 | 360 | 369 | 245 | 440 |
| 2 Apr 05 | | | 581 | 570 | 309 | 309 | 641 | 645 | 186 | 214 | 140 | 718 | 253 | 308 | 269 | 193 | 1795 | 359 | 370 | 431 | 439 |
| 15 Oct 05 | | | 533 | 530 | 200 | 194 | 714 | 714 | 243 | 231 | 132 | 721 | 301 | 317 | 256 | 256 | 1796 | 362 | 370 | 415 | 443 |
| 11 Mar 06 | | | 568 | 667 | 190 | 187 | 687 | 685 | 233 | 246 | 143 | 704 | 295 | 306 | 263 | 265 | 1682 | 361 | 366 | 416 | 430 |
| 17 Oct 06 | | | 510 | 504 | 115 | 108 | 652 | 656 | 214 | 255 | 130 | 715 | 276 | 282 | 227 | 248 | 1680 | 367 | 372 | 485 | 509 |

*Table A2-11 continued next page*

| Zone | 3 | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site | A | | | | | | | | B | | | | | | | | | C | | | |
| Pin Number | 1 | | 2 | | 3 | | 4 | | 1 | 2 | 3 | 4 | | 5 | | 1 | 2 | | 3 | | |
| Bank Location | toe | | slope | | slope | | toe | | slope | cavity | cavity | slope | | slope | | cavity | top | | slope | | |
| Top/Bot of Pin | Top | Bot | Top | Bot | top | bot | top | bot | Top | Bot | Bot | Top | Top | Bot | Top | Bot | Bot | Top | Bot | Top | Bot |
| 17 Mar 07 | Lost | | 495 | 491 | 171 | 177 | 699 | 699 | 190 | 232 | 78 | 740 | 280 | 296 | 230 | 285 | 1875 | 364 | 373 | 465 | 486 |
| 20 Oct 07 | | | 458 | 440 | 116 | 116 | 734 | 738 | 198 | 208 | 30 | 655 | Lost | | 211 | 223 | 1771 | 356 | 369 | 399 | 414 |
| 1 Mar 08 | | | 463 | 456 | 131 | 129 | 829 | 827 | 205 | 207 | 60 | 806 | | | 228 | 275 | 1785 | 356 | 363 | 499 | 410 |
| 17 Oct 08 | | | 272 | 221 | 94 | 92 | 777 | 776 | 210 | 207 | 55 | 664 | | | 234 | 271 | 1760 | 355 | 361 | 353 | 410 |
| 22 Mar 09 | | | 237 | 226 | 85 | 85 | 748 | 750 | 209 | 207 | 55 | 662 | | | 287 | 286 | 2043 | 362 | 363 | 369 | 387 |
| 17 Oct 09 | | | 176 | 185 | 57 | 57 | 676 | 674 | 212 | 250 | 50 | 641 | | | 228 | 245 | 2015 | 371 | 381 | 359 | 378 |
| 13 Mar 10 | | | 127 | 133 | 38 | 37 | 701 | 702 | 227 | 237 | 0 | 651 | | | 239 | 239 | 2044 | 375 | 381 | 361 | 372 |
| 19 Oct 10 | | | 69 | 76 | 58 | 44 | 683 | 684 | 236 | 238 | 9 | 660 | | | 259 | 261 | 855 | 333 | 386 | 348 | 360 |
| 26 Feb 11 | | | 89 | 95 | 45 | 45 | 837 | 837 | 235 | 246 | 0 | 665 | | | 290 | 291 | 2050 | 382 | 387 | 356 | 380 |

Table A2-11 continued

Table A2-12 Zone 3 erosion pin results 2/5 – exposed pin length recorded in mm

| **Zone** | **3** | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Site** | **C** | | | | **D** | | | | | | **Ea** | | | | | | | | | | | |
| **Pin Number** | **4** | | **5** | | **1** | | **2** | | **3** | | **1** | | **2** | | **3** | | **4** | | **5** | | **6** | |
| Bank Location | slope | | toe | | cavity | | slope | | toe | | top | | slope | | toe | | slope | | top | | HW | |
| Top/Bot of Pin | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot |
| 18 Dec 99 | | | | | | | | | | | | | | | | | | | | | | |
| 6 Mar 00 | | | | | | | | | | | | | | | | | | | | | | |
| 26 Sep 00 | | | | | | | | | | | | | | | | | | | | | | |
| 23 Nov 01 | | | | | | | | | | | 105 | | 244 | | 245 | | 119 | | 115 | | | |
| 8 Dec 01 | 261 | 280 | 434 | 434 | 600 | | 581 | 578 | 340 | 333 | 102 | 104 | 239 | 233 | 242 | 241 | 137 | 117 | 122 | 120 | | |
| 10 Feb 02 | 258 | 288 | 486 | 490 | 588 | 605 | 582 | 586 | 340 | 355 | 100 | 85 | 237 | 241 | 234 | 255 | 69 | 69 | 158 | 152 | | |
| 9 Mar 02 | 244 | 277 | 479 | 496 | 616 | 589 | 577 | 584 | 329 | 333 | 98 | 75 | 240 | 241 | 219 | 220 | 27 | 30 | 210 | 204 | | |
| 13 Apr 02 | | | | | | | | | | | 78 | 98 | 235 | 238 | 208 | 205 | 0 | | 221 | 213 | | |
| 5 Oct 02 | 395 | 395 | 390 | 395 | 615 | 396 | 580 | 582 | 310 | 321 | 97 | 80 | 300 | 306 | 260 | 329 | 122 | 123 | 190 | 184 | 417 | 394 |
| 16 Dec 02 | 366 | 395 | 408 | 414 | | 592 | 580 | 580 | 334 | 344 | 84 | 93 | 330 | 331 | 251 | 308 | 134 | 128 | 176 | 174 | 422 | 422 |
| 29 Mar 03 | 260 | 292 | 430 | 437 | 613 | 604 | 576 | 576 | 428 | 430 | 96 | 84 | 317 | 316 | 263 | 262 | 72 | 82 | 214 | 202 | 420 | 405 |
| 18 Oct 03 | 373 | 390 | 351 | 356 | 608 | 583 | 576 | 583 | 450 | 454 | 86 | 64 | 371 | 388 | 248 | 257 | 136 | 134 | 191 | 186 | 420 | 388 |
| 6 Mar 04 | 376 | 385 | 313 | 313 | 645 | 582 | 582 | 576 | 496 | 501 | 74 | 68 | 350 | 373 | 251 | 259 | 93 | 102 | 230 | 198 | 420 | 397 |
| 9 Oct 04 | 363 | 369 | 329 | 330 | 566 | 327 | 602 | 605 | 493 | 495 | 68 | 66 | 381 | 470 | 246 | 244 | 126 | 129 | 195 | 192 | 420 | 395 |
| 2 Apr 05 | 338 | 355 | 253 | 265 | 588 | 548 | 614 | 614 | 547 | 549 | 77 | 65 | 384 | 433 | 224 | 232 | 64 | 63 | 225 | 222 | 420 | 391 |
| 15 Oct 05 | 319 | 360 | 238 | 235 | 587 | 555 | 704 | 718 | 550 | 556 | 67 | 86 | 404 | 467 | 172 | 177 | 91 | 99 | 215 | 211 | 418 | 397 |
| 11 Mar 06 | 318 | 341 | 237 | 240 | 553 | 583 | 697 | 707 | 496 | 490 | 88 | 70 | 480 | 539 | 190 | 188 | 102 | 100 | 245 | 238 | 426 | 389 |
| 17 Oct 06 | 283 | 287 | 199 | 204 | 551 | 598 | 692 | 693 | 475 | 480 | 220 | 218 | 421 | 418 | 191 | 191 | 167 | 163 | 250 | 244 | 420 | 395 |
| 17 Mar 07 | 274 | 288 | 228 | 230 | 568 | 601 | 660 | 670 | 576 | 580 | 341 | 257 | 344 | 347 | 150 | 163 | 65 | 66 | 273 | 265 | 420 | 406 |

*Table A2-12 continued next page*

| Zone | 3 | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site | C | | | | D | | | | | | Ea | | | | | | | | | | | |
| Pin Number | 4 | | 5 | | 1 | | 2 | | 3 | | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | |
| Bank Location | slope | | toe | | cavity | | slope | | toe | | top | | slope | | toe | | slope | | top | | HW | |
| Top/Bot of Pin | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot |
| 20 Oct 07 | 290 | 292 | 203 | 199 | 577 | 606 | 717 | 728 | 448 | 455 | 255 | 261 | 310 | 309 | 204 | 228 | 26 | 25 | 211 | 207 | 404 | 415 |
| 1 Mar 08 | 280 | 284 | 196 | 197 | 57 | 588 | 726 | 739 | 483 | 490 | 266 | 253 | 321 | 313 | 210 | 210 | 17 | 18 | 252 | 245 | 421 | 405 |
| 17 Oct 08 | 293 | 301 | 167 | 168 | 537 | 576 | 815 | 832 | 477 | 477 | 310 | 255 | 420 | 430 | 220 | 221 | 119 | 122 | 210 | 224 | 321 | 329 |
| 22 Mar 09 | 292 | 294 | 147 | 151 | 558 | 585 | 811 | 809 | 464 | 465 | 297 | 253 | 438 | 434 | 219 | 218 | 122 | 123 | 225 | 216 | 414 | 398 |
| 17 Oct 09 | 261 | 262 | 117 | 118 | 562 | 600 | 791 | 792 | 440 | 446 | 267 | 255 | 426 | 420 | 186 | 186 | 115 | 128 | 230 | 228 | 415 | 390 |
| 13 Mar 10 | 280 | 286 | 156 | 158 | 562 | 603 | 928 | 932 | 477 | 477 | 271 | 254 | 423 | 422 | 175 | 177 | 122 | 133 | 267 | 262 | 413 | 390 |
| 19 Oct 10 | 272 | 279 | 69 | 70 | 558 | 591 | 806 | 807 | 530 | 438 | 278 | 256 | 423 | 418 | 177 | 174 | 121 | 124 | 222 | 254 | 414 | 394 |
| 26 Feb 11 | 266 | 273 | 100 | 96 | 561 | 600 | 829 | 832 | 485 | 491 | 255 | 261 | 410 | 411 | 268 | 283 | 126 | 128 | 241 | 241 | 415 | 401 |

Table A2-12 continued

Table A2-13 Zone 3 erosion pin results 3/5 – exposed pin length recorded in mm

| **Zone** | **3** | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Site** | **Eb** | | | | | | | | | | **F** | | | | | | | | | | **G** | | |
| **Pin Number** | **1** | | **2** | | **3** | | **4** | | **5** | | **1** | | **2** | | **3** | | **4** | | **5** | | **1** | **2** | |
| Bank Location | top | | slope | | slope | | slope | | toe | | cavity | | top | | slope | | toe | | HW | | cavity | top | |
| Top/Bot of Pin | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Bot | Top | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Top | Bot |
| 18 Dec 99 | | | | | | | | | | | | | | | | | | | | | | | |
| 6 Mar 00 | | | | | | | | | | | | | | | | | | | | | | | |
| 26 Sep 00 | | | | | | | | | | | | | | | | | | | | | | | |
| 23 Nov 01 | 163 | | 150 | | 210 | | 222 | | 170 | | | | | | | | | | | | | | |
| 8 Dec 01 | 161 | 161 | 142 | 151 | 207 | 208 | 227 | 229 | 186 | 185 | 1492 | | 125 | | 180 | | 212 | | | | 479 | 195 | 192 |
| 10 Feb 02 | 165 | 159 | 145 | 149 | 237 | 240 | 247 | 252 | 227 | 224 | 1245 | | 138 | | 179 | 178 | 230 | 227 | | | 478 | 196 | 191 |
| 9 Mar 02 | 161 | 161 | 145 | 150 | 246 | 255 | 286 | 286 | 254 | 253 | 1185 | | 133 | 133 | 175 | 174 | 236 | 234 | | | 484 | 194 | 195 |
| 13 Apr 02 | 156 | 160 | 234 | 243 | 273 | 291 | 303 | 300 | 268 | 269 | 1307 | | 133 | 134 | 177 | 177 | 240 | 242 | | | 482 | 181 | 182 |
| 5 Oct 02 | 160 | 164 | 133 | 140 | 452 | 455 | 332 | 334 | 245 | 240 | 1205 | 1250 | 132 | 133 | 169 | 170 | 218 | 220 | 738 | 680 | 484 | 191 | 186 |
| 16 Dec 02 | 159 | 164 | 131 | 136 | 448 | 450 | 351 | 350 | 229 | 233 | 1360 | | 145 | 145 | 173 | 173 | 226 | 230 | | | 489 | 190 | 188 |
| 29 Mar 03 | 161 | 163 | 137 | 139 | 496 | 501 | 328 | 326 | 220 | 218 | 1205 | 1373 | 139 | 138 | 174 | 173 | 226 | 225 | | | 490 | 183 | 180 |
| 18 Oct 03 | 155 | 156 | 127 | 131 | 542 | 556 | 352 | 352 | 215 | 223 | 1221 | 1210 | 136 | 133 | 169 | 169 | 223 | 220 | 730 | 696 | 476 | 193 | 190 |
| 6 Mar 03 | 156 | 160 | 124 | 131 | 555 | 658 | 371 | 372 | 270 | 270 | 1220 | 1200 | 138 | 138 | 171 | 169 | 244 | 240 | 735 | 698 | 475 | 186 | 187 |
| 9 Oct 04 | 151 | 162 | 121 | 121 | 601 | 606 | 390 | 385 | 270 | 271 | 2000 | 2002 | 143 | 143 | 168 | 168 | 209 | 209 | 732 | 699 | 475 | 202 | 189 |
| 2 Apr 05 | 154 | 163 | 118 | 122 | 587 | 592 | 374 | 373 | 270 | 269 | 2484 | | 141 | 140 | 191 | 188 | 227 | 224 | 739 | 706 | 482 | 195 | 193 |
| 15 Oct 05 | 152 | 164 | 120 | 120 | 586 | 603 | 358 | 354 | 253 | 248 | 1236 | | 152 | 152 | 182 | 184 | 196 | 195 | 700 | 731 | 472 | 207 | 200 |
| 11 Mar 06 | 153 | 164 | 120 | 117 | 573 | 604 | 376 | 374 | 256 | 256 | 1202 | 1245 | 151 | 152 | 186 | 192 | 203 | 203 | 735 | 700 | 476 | 217 | 216 |
| 17 Oct 06 | 152 | 161 | 120 | 114 | 559 | 563 | 365 | 363 | 242 | 240 | 1239 | 1246 | 150 | 149 | 200 | 201 | 201 | 197 | 733 | 690 | 475 | 233 | 232 |

Table A2-13 *continued next page*

| Zone | 3 | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site | Eb | | | | | | | | | | F | | | | | | | | | | G | | |
| Pin Number | 1 | | 2 | | 3 | | 4 | | 5 | | 1 | | 2 | | 3 | | 4 | | 5 | | 1 | 2 | |
| Bank Location | top | | slope | | slope | | slope | | toe | | cavity | | top | | slope | | toe | | HW | | cavity | top | |
| Top/Bot of Pin | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Bot | Top | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Top | Bot |
| 17 Mar 07 | 150 | 171 | 115 | 115 | 573 | 590 | 376 | 378 | 258 | 258 | 1260 | 1254 | 140 | 141 | 205 | 200 | 212 | 218 | 730 | 700 | 508 | 231 | 231 |
| 20 Oct 07 | 161 | 163 | 101 | 100 | 576 | 582 | 351 | 350 | 260 | 260 | 1200 | 1212 | 132 | 131 | 190 | 208 | 216 | 218 | 740 | 698 | 363 | 240 | 236 |
| 1 Mar 08 | 160 | 166 | 103 | 111 | 590 | 608 | 406 | 404 | 351 | 350 | 1234 | 1214 | 130 | 127 | 211 | 226 | 219 | 220 | 735 | 704 | 352 | 234 | 235 |
| 18 Oct 08 | 159 | 167 | 109 | 108 | 585 | 592 | 414 | 413 | 308 | 305 | 1212 | 1210 | 117 | 113 | 206 | 228 | 214 | 209 | 731 | 677 | 370 | 261 | 259 |
| 21 Mar 09 | 163 | 169 | 102 | 103 | 590 | 606 | 411 | 406 | 308 | 312 | 1240 | 786 | 140 | 135 | 224 | 230 | 205 | 203 | 734 | 673 | 435 | 273 | 271 |
| 17 Oct 09 | 165 | 171 | 103 | 103 | 620 | 619 | 399 | 398 | 293 | 295 | 1206 | | 126 | 124 | 214 | 229 | 197 | 195 | 744 | 685 | 452 | 285 | 283 |
| 13 Mar 10 | 163 | 162 | 98 | 98 | 619 | 632 | 378 | 380 | 271 | 276 | 1222 | 1220 | 140 | 136 | 209 | 226 | 198 | 198 | 734 | 678 | 444 | 276 | 276 |
| 19 Oct 10 | 168 | 163 | 98 | 96 | 636 | 639 | 376 | 373 | 262 | 258 | 1259 | | 131 | 128 | 208 | 219 | 210 | 208 | 728 | 681 | 446 | 279 | 286 |
| 26 Feb 11 | 166 | 170 | 98 | 106 | 642 | 643 | 408 | 408 | 302 | 303 | 1256 | | 121 | 125 | 211 | 221 | 215 | 213 | 733 | 681 | 436 | 289 | 300 |

Table A2-13 continued

Table A2-14 Zone 3 erosion pin results 4/5 – exposed pin length recorded in mm

| **Zone** | **3** | | | | | |
|---|---|---|---|---|---|---|
| **Site** | **G** | | | | | |
| **Pin Number** | **3** | | **4** | | **5** | |
| Bank Location | slope | | slope | | toe | |
| Top/Bot of Pin | Top | Bot | Top | Bot | Top | Bot |
| 18 Dec 99 | | | | | | |
| 6 Mar 00 | | | | | | |
| 26 Sep 00 | | | | | | |
| 23 Nov 01 | | | | | | |
| 8 Dec 01 | 134 | 134 | 230 | 235 | 129 | 131 |
| 10 Feb 02 | 138 | 140 | 237 | 238 | 142 | 165 |
| 9 Mar 02 | 135 | 138 | 232 | 237 | 145 | 160 |
| 13 Apr 02 | 130 | 131 | 231 | 233 | 217 | 235 |
| 5 Oct 02 | 111 | 113 | 230 | 228 | 265 | 300 |
| 16 Dec 02 | 106 | 109 | 213 | 215 | 230 | 263 |
| 29 Mar 03 | 105 | 108 | 200 | 215 | 237 | 241 |
| 18 Oct 03 | 98 | 104 | 207 | 210 | 95 | 98 |
| 6 Mar 04 | 97 | 105 | 225 | 230 | 181 | 200 |
| 9 Oct 04 | 119 | 121 | 222 | 232 | 167 | |
| 2 Apr 05 | 134 | 138 | 243 | 243 | 114 | 123 |
| 15 Oct 05 | 151 | 146 | 226 | 224 | 69 | 89 |
| 11 Mar 06 | 149 | 150 | 215 | 218 | 47 | 55 |
| 17 Oct 06 | 158 | 157 | 192 | 192 | 52 | 56 |
| 17 Mar 07 | 150 | 148 | 174 | 180 | 101 | 112 |
| 20 Oct 07 | 131 | 144 | 153 | 160 | | |
| 1 Mar 08 | 145 | 146 | 143 | 141 | 59 | 66 |
| 17 Oct 08 | 154 | 156 | 136 | 135 | -55 | -55 |
| 22 Mar 09 | 150 | 151 | 158 | 163 | | |
| 17 Oct 09 | 157 | 159 | 142 | 142 | | |
| 13 Mar 10 | 157 | 160 | 162 | 163 | | |
| 19 Oct 10 | 158 | 163 | 146 | 147 | | |
| 26 Feb 11 | 181 | 183 | 167 | 170 | | |

Table A2-15 Zone 3 erosion pin results 5/5 – new pins installed in December 2004. Exposed pin length recorded in mm

| **Zone** | **3** | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Site** | **A** | | | | | | **C** | | **D** | | | | **Eb** | | | | **Ea** | | **G** | |
| **Pin Number** | **55** | | **5** | | **6** | | **55** | | **55** | | **4** | | **55** | | **6** | | **6** | | **6** | |
| a,b,c, | | | | | | | | | | | | | | | | | dup Ea/4 | | dup 3G/5 | |
| Bank location | 55 $m^3 s^{-1}$ | | 2–3 | | 2–3 | | 55 $m^3 s^{-1}$ | | 55 $m^3 s^{-1}$ | | 2–3 | | 55 $m^3 s^{-1}$ | | 2–3 | | 1–2 | | <1 | |
| Top/Bot of Pin | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot |
| 11 Dec 04 | 159 | 175 | 185 | 173 | 168 | 170 | | | 130 | 137 | 169 | 149 | 102 | 111 | 108 | 101 | | | | |
| 2 Apr 05 | 173 | 188 | 180 | 174 | 189 | 188 | 107 | 134 | 114 | 125 | 166 | 148 | 75 | 77 | 123 | 133 | | | | |
| 15 Oct 05 | 180 | 188 | 214 | 214 | 200 | 199 | 105 | 171 | 105 | 123 | 167 | 144 | 63 | 68 | 151 | 156 | | | | |
| 11 Mar 06 | 266 | 284 | 210 | 217 | 205 | 203 | 158 | 184 | 110 | 127 | 170 | 150 | 71 | 71 | 159 | 245 | | | | |
| 17 Oct 06 | 270 | 296 | 211 | 270 | 207 | 210 | | | 216 | 199 | 166 | 149 | 57 | 59 | 403 | 478 | | | | |
| 17 Mar 07 | 276 | 295 | 215 | 271 | 208 | 205 | 130 | 163 | 150 | 173 | 167 | 150 | 81 | 82 | 340 | 410 | 297 | 298 | 420 | 420 |
| 20 Oct 07 | 269 | 282 | 256 | 259 | 235 | 227 | 105 | 152 | 157 | 184 | 167 | 170 | 59 | 63 | 333 | 267 | 240 | 242 | 437 | 434 |
| 1 Mar 08 | 279 | 289 | 256 | 260 | 235 | 232 | 109 | 147 | 190 | 205 | 175 | 163 | 96 | 101 | 207 | 281 | 225 | 235 | 375 | 392 |
| 17 Oct 08 | 272 | 288 | 256 | 257 | 241 | 231 | 101 | 144 | 229 | 250 | 172 | 149 | 104 | 106 | 200 | 270 | 321 | 329 | 285 | 290 |
| 22 Mar 09 | 265 | 296 | 258 | 257 | 242 | 234 | 103 | 133 | 238 | 273 | 175 | 155 | 105 | 107 | 295 | 336 | 414 | 398 | 278 | 284 |
| 31 Oct 09 | 270 | 288 | 258 | 260 | 237 | 233 | 91 | 123 | 272 | 290 | 174 | 177 | 92 | 93 | 348 | 378 | 348 | 378 | 268 | 282 |
| 13 Mar 10 | 272 | 287 | 256 | 257 | 240 | 232 | 101 | 130 | 272 | 281 | 175 | 167 | 89 | 97 | 306 | 377 | 314 | 328 | 252 | 258 |
| 19 Oct 10 | 269 | 269 | 262 | 260 | 244 | 234 | 121 | 154 | 266 | 295 | 160 | 161 | 79 | 79 | 340 | 298 | 308 | 315 | 240 | 247 |
| 26 Feb 11 | 270 | 272 | 268 | 267 | 249 | 238 | 100 | 96 | 264 | 290 | 162 | 163 | 109 | 120 | 367 | | 415 | 401 | 202 | 206 |

Table A2-16 Zone 4 erosion pin results 1/5 – exposed pin length recorded in mm

| **Zone** | **4** | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Site** | **A** | | | | | | **B** | | | | | | **C** | | **D** | | | | | |
| **Pin Number** | **1** | | **2** | | **3** | | **1** | | **2** | | **3** | | **1** | | **1** | | **2** | | **3** | |
| Bank Location | top | | slope | | toe | | top | | slope | | toe | | cob | | top | | slope | | toe | |
| Top/Bot of Pin | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Bot | Top | Top | Bot | Top | Bot | Top | Bot |
| 18 Dec 99 | | | | | | | | | | | | | | | | | | | | |
| 25 Sep 00 | | | | | | | | | | | | | | | | | | | | |
| 23 Nov 01 | | | | | | | | | | | | | | | | | | | | |
| 8 Dec 01 | 188 | 192 | 208 | 210 | 151 | 150 | 256 | 258 | 377 | 381 | 150 | 151 | 321 | 269 | 221 | 224 | 231 | 234 | 220 | 220 |
| 10 Feb 02 | 196 | 195 | 204 | 212 | 199 | 201 | 270 | 264 | 415 | 410 | 150 | 160 | 332 | 281 | 211 | 216 | 238 | 242 | 251 | 255 |
| 10 Mar 02 | 196 | 198 | 190 | 193 | 214 | 213 | 238 | 231 | 369 | 382 | 158 | 158 | 323 | 288 | 210 | 217 | 244 | 246 | 266 | 268 |
| 13 Apr 02 | 191 | 196 | 195 | 205 | 268 | 269 | 165 | 136 | 367 | 334 | 161 | 168 | 324 | 294 | 201 | 212 | 218 | 244 | 263 | 267 |
| 5 Oct 02 | 169 | 170 | 196 | 236 | 362 | 365 | Lost | Lost | 208 | 210 | 128 | | 341 | 298 | 175 | 181 | 240 | 248 | 243 | 247 |
| 16 Dec 02 | 170 | 173 | 195 | 220 | 357 | 357 | | | 228 | 205 | | | 324 | 298 | 185 | 190 | 252 | 267 | 250 | 250 |
| 29 Mar 03 | 166 | 171 | 193 | 240 | 410 | 405 | | | 229 | 225 | 225 | 270 | | | 185 | 196 | 238 | 240 | 245 | 247 |
| 18 Oct 03 | 131 | 135 | 211 | 217 | 395 | 393 | | | 218 | 214 | 238 | 238 | | | 157 | 167 | 263 | 265 | 237 | 242 |
| 6 Mar -4 | 124 | 135 | 178 | 183 | 396 | 393 | 840 | 846 | 252 | 244 | 133 | 138 | | | 159 | 166 | 246 | 251 | 233 | 235 |
| 9 Oct 04 | 106 | 110 | 208 | 218 | 339 | | 887 | 888 | | | 160 | 160 | 323 | 289 | 135 | 152 | 250 | 250 | 273 | 276 |
| 2 Apr 05 | 105 | 111 | 185 | 194 | 403 | 410 | 884 | 878 | 342 | 342 | 167 | 178 | | | 136 | 151 | 245 | 247 | 253 | 257 |
| 15 Oct 05 | 98 | 105 | 197 | 207 | 404 | 388 | 883 | 873 | | | 182 | 206 | 320 | 286 | 141 | 161 | 280 | 282 | 294 | 302 |
| 11 Mar 06 | 91 | 102 | 210 | 214 | 396 | 396 | 899 | 893 | 380 | | 232 | 232 | | | 147 | 161 | 300 | 301 | 308 | 311 |
| 17 Oct 06 | 113 | 123 | 249 | 253 | 455 | 450 | 934 | 915 | 360 | 360 | 215 | 233 | | | 164 | 181 | 275 | 277 | 285 | 287 |
| 17 Mar 07 | 100 | 108 | 168 | 174 | 485 | 475 | 905 | 850 | 392 | | 205 | 323 | 320 | 287 | 168 | 180 | 256 | 158 | 252 | 255 |

*Table A2-16 continued next page*

| Zone | 4 | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site | A | | | | | | B | | | | | | C | | D | | | | | |
| Pin Number | 1 | | 2 | | 3 | | 1 | | 2 | | 3 | | 1 | | 1 | | 2 | | 3 | |
| Bank Location | top | | slope | | toe | | top | | slope | | toe | | cob | | top | | slope | | toe | |
| Top/Bot of Pin | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Bot | Top | Top | Bot | Top | Bot | Top | Bot |
| 20 Oct 07 | 39 | 41 | 338 | 345 | 370 | 370 | 765 | 786 | Lost | Lost | 291 | 280 | | | 124 | 128 | 179 | 186 | 238 | 240 |
| 1 Mar 08 | 27 | 33 | 300 | 307 | 386 | | 831 | 832 | | | 306 | 315 | | | 136 | 140 | 256 | 258 | 245 | 247 |
| 17 Oct 08 | 56 | 71 | 320 | 326 | 255 | 253 | 943 | 931 | | | 316 | 334 | 321 | 279 | 121 | 139 | 268 | 274 | 258 | 261 |
| 22 Mar 09 | 58 | 75 | 322 | 336 | 265 | 265 | 910 | 905 | | | 285 | 287 | | | 126 | 160 | 274 | 279 | 270 | 272 |
| 17 Oct 09 | 55 | 75 | 174 | 179 | | | 882 | 868 | | | 295 | 310 | | | 133 | 138 | 286 | 285 | 273 | 274 |
| 13 Mar 10 | 59 | 91 | 158 | 164 | 95 | 80 | 945 | 909 | | | 296 | 301 | | | 121 | 130 | 312 | 316 | 285 | 287 |
| 19 Oct 10 | 112 | 160 | 124 | 138 | | | 779 | 797 | | | 308 | 314 | | | 112 | 114 | 339 | 349 | 291 | 290 |
| 26 Feb 11 | 132 | 168 | 117 | 129 | 20 | 20 | 772 | 746 | | | 303 | 306 | 328 | 282 | 116 | 120 | 292 | 297 | 279 | 279 |

Table A2-16 continued

Table A2-17 Zone 4 erosion pin results 2/5 – exposed pin length recorded in mm

| **Zone** | **4** | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Site** | **E** | | | | | | | | **F** | | | | | | | | | |
| **Pin Number** | **1** | | **2** | | **3** | | **4** | | **1** | | **2** | | **3** | | **4** | | **5** | |
| Bank Location | top | | slope | | slope | | toe | | top | | slope | | slope | | slope | | slope | |
| Top/Bot of Pin | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot |
| 18 Dec 99 | | | | | | | | | 195 | | 225 | | | | | | | |
| 25 Sep 00 | | | | | | | | | 191 | | 232 | | | | | | | |
| 23 Nov 01 | | | | | | | | | 194 | | 229 | | | | | | | |
| 8 Dec 01 | 236 | 261 | 305 | 305 | 228 | 229 | 210 | 215 | 184 | 193 | 215 | 225 | 217 | 224 | 151 | 161 | 391 | 398 |
| 10 Feb 02 | 251 | 255 | 327 | 330 | 237 | 241 | 145 | 201 | 169 | 191 | 209 | 216 | 220 | 227 | 187 | 191 | 408 | 407 |
| 10 Mar 02 | 247 | 266 | 330 | 335 | 230 | 240 | 280 | 285 | 171 | 184 | 184 | 196 | 232 | 240 | 193 | 201 | 413 | 409 |
| 13 Apr 02 | 255 | 267 | 330 | 337 | 241 | 249 | 240 | 254 | 199 | 199 | 224 | 215 | 230 | 242 | 185 | 192 | 416 | 418 |
| 5 Oct 02 | 243 | 268 | 322 | 331 | 230 | 268 | 300 | 320 | 190 | 203 | 224 | 241 | 175 | 185 | 131 | 134 | 428 | 425 |
| 16 Dec 02 | 246 | 269 | 329 | 336 | 231 | 270 | 302 | 320 | 202 | 203 | 234 | 245 | 206 | 212 | 175 | 185 | 443 | 440 |
| 29 Mar 03 | 236 | 251 | 320 | 322 | 245 | 284 | 326 | 333 | 201 | 206 | 236 | 240 | 201 | 210 | 216 | 219 | 412 | 416 |
| 18 Oct 03 | 240 | 270 | 323 | 330 | 267 | 268 | 313 | 324 | 188 | 192 | 230 | 240 | 195 | 205 | 240 | 245 | 440 | 445 |
| 6 Mar04 | 246 | 269 | 322 | 335 | 286 | 297 | 335 | 348 | 190 | 190 | 210 | 230 | 227 | 261 | 233 | 245 | 430 | 442 |
| 9 Oct 04 | 249 | 273 | 340 | 348 | 280 | 311 | 344 | | 195 | 197 | 219 | 232 | 184 | 250 | 94 | 115 | 450 | 454 |
| 2 Apr 05 | 256 | 287 | 491 | 511 | 345 | 351 | 385 | 402 | 180 | 206 | 220 | 232 | 246 | 262 | 261 | 275 | 450 | 460 |
| 15 Oct 05 | 267 | 298 | 620 | 600 | 363 | 367 | 350 | 360 | 201 | 208 | 242 | 259 | 254 | 268 | | | 479 | 478 |
| 11 Mar 06 | 269 | 303 | Lost | | 325 | 341 | 367 | 390 | 212 | 214 | 241 | 255 | 262 | 278 | 291 | | 477 | 477 |
| 17 Oct 06 | 722 | 698 | | | 303 | 304 | | | 206 | 211 | 239 | 259 | 266 | 286 | 308 | 311 | 480 | 480 |
| 17 Mar 07 | 738 | 770 | | | 310 | 313 | 322 | 330 | 200 | 215 | 255 | 250 | 271 | 310 | 310 | 320 | 450 | 455 |
| 20 Oct 07 | 586 | 582 | | | 201 | 205 | 73 | 81 | 182 | 219 | 265 | 279 | 190 | 197 | 106 | 123 | 488 | 489 |

*Table A2-17 continued next page*

| Zone | 4 | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site | E | | | | | | | | F | | | | | | | | | |
| Pin Number | 1 | | 2 | | 3 | | 4 | | 1 | | 2 | | 3 | | 4 | | 5 | |
| Bank Location | top | | slope | | slope | | toe | | top | | slope | | slope | | slope | | slope | |
| Top/Bot of Pin | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot |
| 1 Mar 08 | 587 | 598 | Lost | | 247 | 246 | 125 | 137 | 236 | 242 | 61 | 77 | 282 | 295 | 155 | 155 | 508 | 515 |
| 17 Oct 08 | 593 | 617 | | | 276 | 274 | 150 | 159 | 180 | 260 | 265 | 280 | 272 | 283 | 102 | 109 | 508 | 513 |
| 22 Mar 09 | 618 | 630 | | | 300 | 298 | 190 | 199 | 243 | 257 | 274 | 293 | 294 | 290 | 68 | 73 | 502 | 510 |
| 31 Oct 09 | 620 | 635 | | | 316 | 311 | 187 | 192 | 222 | 269 | 274 | 307 | 284 | 307 | 200 | 207 | 510 | 516 |
| 13 Mar 10 | 620 | 632 | | | 305 | 304 | 205 | 223 | 246 | 185 | 265 | 296 | 301 | 312 | 201 | 211 | 505 | 507 |
| 19 Oct 10 | 638 | 651 | | | 356 | 357 | 242 | 255 | 196 | 262 | 270 | 296 | 293 | 313 | 208 | 218 | 487 | 494 |
| 26 Feb 11 | 637 | 645 | | | 371 | 374 | 246 | 276 | 188 | 278 | 268 | 303 | 285 | 305 | 208 | 209 | 488 | 511 |

Table A2-17 continued

Table A2-18 Zone 4 erosion pin results 3/5 – exposed pin length recorded in mm

| **Zone** | **4** | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Site** | **Ga** | | | | | | | | **Gb** | | | | | | | | | |
| **Pin Number** | **1** | | **2** | | **3** | | **4** | | **1** | | **2** | | **3** | | **4** | | **5** | |
| Bank Location | top | | slope | | slope | | toe | | top | | slope | | slope | | slope | | toe | |
| Top/Bot of Pin | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot |
| 18 Dec 99 | | | | | | | | | | | | | | | | | | |
| 25 Sep 00 | | | | | | | | | | | | | | | | | | |
| 23 Nov 01 | | | | | | | | | | | | | | | | | | |
| 8 Dec 01 | 316 | 325 | 368 | 370 | 305 | 325 | 314 | 318 | 259 | 262 | 375 | 386 | 275 | 280 | 310 | 315 | 254 | 255 |
| 10 Feb 02 | | | | | | | | | | | | | | | | | | |
| 10 Mar 02 | 315 | 333 | 363 | 368 | 304 | 313 | 372 | 385 | 262 | 266 | 398 | 412 | 295 | 296 | 349 | 343 | 279 | 279 |
| 13 Apr 02 | 318 | 342 | 364 | 368 | 303 | 321 | 356 | 369 | 270 | 274 | 395 | 399 | 304 | 306 | 332 | 340 | 285 | 284 |
| 5 Oct 02 | 333 | 345 | 400 | 398 | 290 | 331 | 354 | 411 | 270 | 286 | 409 | 423 | 340 | 343 | 386 | 389 | 298 | 298 |
| 16 Dec 02 | 331 | 345 | 391 | 390 | 286 | 333 | | | 287 | 285 | 401 | 415 | 339 | 332 | 371 | 378 | 265 | 274 |
| 29 Mar 03 | 333 | 347 | 413 | 417 | 303 | 360 | 356 | 420 | 280 | 298 | 393 | 414 | 341 | 350 | 396 | 403 | 334 | 329 |
| 18 Oct 03 | 285 | 350 | 420 | 425 | 344 | 391 | 360 | 405 | 280 | 287 | 410 | 416 | 369 | 373 | 411 | 416 | 300 | 300 |
| 6 Mar 04 | 286 | 351 | 408 | 414 | 393 | 408 | 386 | 415 | 282 | 303 | 407 | 242 | 389 | 391 | 446 | 451 | 297 | 296 |
| 9 Oct 04 | 276 | 351 | 436 | 437 | 425 | 432 | | | 295 | 308 | 390 | 405 | 425 | 430 | 377 | 377 | | |
| 2 Apr 05 | 355 | 374 | 411 | 421 | 402 | 422 | 354 | 436 | 326 | 311 | 411 | 421 | 451 | 453 | 378 | 381 | 273 | 280 |
| 15 Oct 05 | 348 | 363 | 415 | 426 | 367 | 420 | 461 | 465 | 286 | 313 | 411 | 419 | 482 | 482 | 402 | 398 | | |
| 11 Mar 06 | 345 | 368 | 406 | 442 | 365 | 380 | 347 | 360 | 288 | 308 | 412 | 444 | 278 | 260 | 384 | 390 | 262 | 267 |
| 17 Oct 06 | 340 | 358 | 446 | 448 | 338 | 347 | 350 | 350 | 289 | 313 | 438 | 449 | 187 | 179 | 405 | 411 | 257 | 262 |
| 17 Mar 07 | 352 | 397 | 448 | 463 | 350 | 365 | 354 | 426 | 308 | 323 | 412 | 423 | 323 | 310 | 426 | 433 | 267 | 275 |
| 20 Oct 07 | 400 | 399 | 412 | 455 | 168 | 206 | 312 | 315 | 304 | 313 | 421 | 433 | 413 | 405 | 435 | 436 | 235 | 226 |

*Table A2-18 continued next page*

| Zone | 4 | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site | Ga | | | | | | | | Gb | | | | | | | | | |
| Pin Number | 1 | | 2 | | 3 | | 4 | | 1 | | 2 | | 3 | | 4 | | 5 | |
| Bank Location | top | | slope | | slope | | toe | | top | | slope | | slope | | slope | | toe | |
| Top/Bot of Pin | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot |
| 1 Mar 08 | 386 | 401 | 411 | 456 | 158 | 203 | 352 | 357 | 321 | 330 | 443 | 450 | 454 | 442 | 438 | 440 | 254 | 250 |
| 17 Oct 08 | 381 | 404 | 408 | 450 | 180 | 194 | 349 | 352 | 337 | 339 | 421 | 451 | 392 | 376 | 424 | 422 | 274 | 264 |
| 22 Mar 09 | 390 | 397 | 416 | 432 | 183 | 202 | 323 | 322 | 331 | 339 | 426 | 443 | 328 | 325 | 408 | 412 | 281 | 282 |
| 31 Oct 09 | 376 | 391 | 416 | 424 | 289 | 286 | 264 | 266 | 324 | 332 | 435 | 448 | 293 | 281 | 384 | 383 | 296 | 290 |
| 13 Mar 10 | 382 | 388 | 413 | 421 | 260 | 369 | 253 | 257 | 323 | 326 | 427 | 441 | 270 | 255 | 354 | 351 | 280 | 275 |
| 19 Oct 10 | 362 | 408 | 408 | 418 | 270 | 297 | 300 | 290 | 334 | 340 | 431 | 455 | 216 | 200 | 340 | 348 | 240 | 240 |
| 26 Feb 11 | 374 | 402 | 409 | 414 | 261 | 277 | 260 | 261 | 330 | 342 | 429 | 456 | 207 | 199 | 349 | 350 | 261 | 263 |

Table A2-18 continued

Table A2-19 Zone 4 erosion pin results 4/5 – exposed pin length recorded in mm

| **Zone** | **4** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Site** | **H** | | | | | | | | | |
| **Pin Number** | **1** | | **2** | | **3** | | **4** | | **5** | |
| Bank Location | top | | slope | | slope | | slope | | slope | |
| Top/Bot of Pin | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot |
| 18 Dec 99 | | | | | | | | | | |
| 25 Sep 00 | | | | | | | | | | |
| 23 Nov 01 | | | | | | | | | | |
| 8 Dec 01 | 473 | 473 | 370 | 374 | 287 | 288 | 318 | 320 | 338 | 341 |
| 10 Feb 02 | | | | | | | | | | |
| 10 Mar 02 | 485 | 490 | 384 | 381 | 304 | 307 | 327 | 329 | 266 | 266 |
| 13 Apr 02 | 485 | 487 | 379 | 380 | 300 | 304 | 327 | 331 | 565 | 564 |
| 5 Oct 02 | 481 | 480 | 377 | 378 | 282 | 285 | 310 | 325 | 363 | 360 |
| 16 Dec 02 | 481 | 487 | 379 | 375 | 285 | 288 | 319 | 327 | 361 | 357 |
| 29 Mar 03 | 481 | 491 | 374 | 375 | 286 | 291 | 318 | 325 | 355 | 351 |
| 18 Oct 03 | 499 | 488 | 368 | 366 | 271 | 278 | 321 | 328 | 366 | 365 |
| 6 Mar 04 | 483 | 487 | 357 | 352 | 275 | 283 | 319 | 326 | 375 | 371 |
| 9 Oct 04 | 484 | 489 | 357 | 359 | 258 | 262 | 316 | 323 | 387 | 389 |
| 2 Apr 05 | 482 | 490 | 345 | 344 | 264 | 272 | 313 | 320 | 387 | 395 |
| 15 Oct 05 | 479 | 489 | 338 | 337 | 250 | 258 | 317 | 318 | 398 | 403 |
| 11 Mar 06 | 478 | 486 | 330 | 331 | 241 | 247 | 312 | 317 | 378 | 378 |
| 17 Oct 06 | 474 | 484 | 324 | 323 | 241 | 246 | 314 | 317 | 369 | 411 |
| 17 Mar 07 | 471 | 478 | 311 | 312 | 237 | 242 | 307 | 309 | 401 | 411 |
| 20 Oct 07 | 462 | 475 | 324 | 322 | 272 | 270 | 330 | 333 | 515 | 507 |
| 1 Mar 08 | 462 | 472 | 325 | 335 | 267 | 277 | 326 | 333 | 501 | 500 |
| 17 Oct 08 | 456 | 465 | 322 | 333 | 266 | 270 | 319 | 328 | 511 | 515 |
| 22 Mar 09 | 449 | 459 | 320 | 324 | 264 | 274 | 323 | 328 | 461 | 457 |
| 31 Oct 09 | 440 | 445 | 321 | 316 | 276 | 275 | 330 | 336 | 489 | 490 |
| 13 Mar 10 | 438 | 443 | 312 | 315 | 262 | 273 | 326 | 327 | 470 | 465 |
| 19 Oct 10 | 423 | 421 | 300 | 299 | 252 | 260 | 312 | 323 | 460 | 458 |
| 26 Feb 11 | 426 | 430 | 301 | 298 | 256 | 268 | 286 | 325 | 462 | 456 |

Table A2-20 Zone 4 erosion pin results 5/5 – New pins installed December 2005, exposed pin length recorded in mm

| **Zone** | **4** | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Site** | **A** | | **B** | | **D** | | | | **F** | | **E** | | **A** | | **B** | | **A** | |
| **Pin Number** | **4** | | **4** | | **4** | | **5** | | **HW** | | **2** | | **5** | | **5** | | **6** | |
| a,b,c,.. | | | | | | | | | star picket | | E | | dup 4A/1 | | dup 4B/1 | | | |
| Bank Location | 2–3 | | 2–3 | | 2–3 | | 2–3 | | High water | | 2–3 | | | | | | | |
| Top/Bot of Pin | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | | | | | | |
| 2 Apr 05 | 209 | 209 | 180 | 182 | 139 | 140 | 346 | 340 | 945 | 995 | | | | | | | | |
| 15 Oct 05 | 208 | 209 | 163 | 193 | 142 | 160 | 343 | 337 | 945 | 1007 | | | | | | | | |
| 11 Mar 06 | 198 | 207 | 168 | 196 | 136 | 160 | 344 | 340 | 942 | 1015 | 330 | 340 | | | | | | |
| 17 Oct 06 | 197 | 208 | 225 | 225 | 118 | 152 | 336 | 338 | 937 | 1013 | 273 | 276 | | | | | | |
| 17 Mar 07 | 200 | 208 | 268 | 263 | 170 | 173 | 340 | 337 | 951 | 1010 | 290 | 310 | | | 250 | 260 | | |
| 20 Oct 07 | 186 | 202 | 276 | 270 | 148 | 158 | 345 | 352 | 940 | 1008 | 172 | 170 | 224 | 225 | 214 | 241 | | |
| 1 Mar 08 | 182 | 205 | 277 | 270 | 146 | 172 | 344 | 350 | | | 267 | 272 | 211 | 217 | 250 | 330 | 72 | 85 |
| 17 Oct 08 | 170 | 204 | 274 | 266 | 134 | 174 | 343 | 354 | 944 | 1011 | 309 | 317 | 241 | 243 | 351 | 381 | | |
| 22 Mar 09 | 182 | 198 | 273 | 267 | 132 | 161 | 345 | 355 | 942 | 1006 | 309 | 316 | 240 | 241 | 382 | 385 | | |
| 31 Oct 09 | 180 | 201 | 271 | 266 | 153 | 162 | 345 | 352 | 933 | 1011 | 325 | 322 | 255 | 271 | 373 | 382 | 19 | 25 |
| 13 Mar 10 | 171 | 201 | 274 | 268 | 150 | 163 | 348 | 353 | 942 | 1010 | 376 | 369 | 258 | 262 | 391 | 406 | Lost | |
| 19 Oct 10 | 166 | 201 | 273 | 263 | 116 | 162 | 298 | 299 | 927 | 999 | 399 | 394 | 272 | 314 | 385 | 386 | | |
| 26 Feb 11 | 180 | 258 | 272 | 262 | 126 | 164 | 345 | 351 | 930 | 991 | 425 | 422 | 283 | 292 | 410 | 437 | | |

Table A2-21 Zone 5 erosion pin results 1/6 – exposed pin length recorded in mm

| **Zone** | **5** | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Site** | **A** | | | | | | **B** | | | | | | | | **C** | | | | | |
| **Pin Number** | **1** | **2** | **3** | | **4** | | **1** | | **2** | | **3** | | **4** | | **1** | | **2** | | **3** | |
| Bank Location | cavity | cavity | slope | | toe | | top | | slope | | slope | | toe | | top | | slope | | toe | |
| Top/Bot of Pin | Bot | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot |
| 20 Dec 99 | | | | | | | | | | | | | | | | | | | | |
| 26 Sep 00 | | | | | | | | | | | | | | | | | | | | |
| 23 Nov 01 | | | | | | | | | | | | | | | | | | | | |
| 9 Dec 01 | 700 | 233 | 496 | 499 | 517 | 525 | 209 | 217 | 222 | 226 | 202 | 208 | 292 | 294 | 195 | 195 | 125 | 122 | 426 | 427 |
| 10 Feb 02 | | | | | | | | | | | | | | | | | | | | |
| 10 Mar 02 | 700 | 230 | 506 | 507 | 584 | 595 | 208 | 218 | 219 | 226 | 205 | 208 | 304 | 307 | 200 | 202 | 126 | 126 | 435 | 439 |
| 13 Apr 02 | 701 | 230 | 495 | 499 | 623 | 660 | 212 | 221 | 218 | 224 | 205 | 208 | 309 | 312 | | | | | | |
| 5 Oct 02 | 890 | 221 | 519 | 519 | 491 | 489 | 210 | 231 | 185 | 187 | 126 | 127 | 363 | 370 | 203 | 200 | 105 | 100 | 435 | 436 |
| 16 Dec 02 | 973 | 234 | 550 | 547 | 541 | 546 | 210 | 231 | 194 | 196 | 111 | 114 | 350 | 366 | 198 | 208 | 143 | 173 | 405 | 405 |
| 29 Mar 03 | 979 | 224 | 508 | 504 | 620 | 623 | 212 | 233 | 192 | 194 | 118 | 122 | 374 | 390 | 186 | 199 | 117 | 114 | 420 | 420 |
| 18 Oct 03 | 985 | 226 | 532 | 530 | 481 | 474 | 218 | 228 | 189 | 190 | 100 | 107 | 376 | 395 | 191 | 202 | 98 | 96 | 411 | 409 |
| 6 Mar 04 | 884 | 224 | 505 | 506 | 604 | 597 | 216 | 226 | 177 | 179 | 95 | 112 | 416 | 440 | 196 | 200 | 104 | 102 | 409 | 414 |
| 9 Oct 04 | | | 391 | 390 | 480 | 461 | 197 | 228 | 149 | 148 | 65 | 74 | 574 | 576 | 196 | 205 | 98 | 99 | 428 | 460 |
| 2 Apr 05 | new pin 293 | new pin 276 | 362 | 363 | 529 | 520 | 195 | 219 | 149 | 151 | 60 | 64 | 560 | 563 | 203 | 205 | 99 | 98 | 411 | 415 |
| 15 Oct 05 | 292 | 317 | 412 | 407 | 570 | 562 | 184 | 220 | 148 | 143 | 28 | 34 | Lost | | 282 | 285 | 109 | 106 | 441 | 439 |
| 11 Mar 06 | 291 | 319 | 464 | 457 | 558 | 550 | 195 | 217 | 144 | 150 | 43 | 50 | | | 201 | 203 | 123 | 127 | 467 | 465 |
| 17 Oct 06 | 291 | 447 | 460 | 458 | 520 | 513 | 173 | 215 | 138 | 141 | 38 | 51 | | | 193 | 208 | 180 | 180 | 453 | 455 |
| 17 Mar 07 | 291 | 405 | 595 | 584 | 652 | 626 | 198 | 224 | 124 | 130 | 41 | 54 | | | 201 | 209 | 180 | 191 | 452 | 454 |

*Table A2-21 continued next page*

| Zone | 5 | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site | A | | | | | | B | | | | | | | | C | | | | | |
| Pin Number | 1 | 2 | 3 | | 4 | | 1 | | 2 | | 3 | | 4 | | 1 | | 2 | | 3 | |
| Bank Location | cavity | cavity | slope | | toe | | top | | slope | | slope | | toe | | top | | slope | | toe | |
| Top/Bot of Pin | Bot | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot |
| 20 Oct 07 | 300 | 323 | | | | | 142 | 218 | 38 | 39 | 406 | 411 | Lost | | 236 | 239 | 125 | 110 | 490 | 505 |
| 1 Mar 08 | 365 | 78 | 678 | 700 | 375 | 320 | 145 | 211 | 39 | 40 | 355 | 390 | | | 263 | 275 | 124 | 117 | 513 | 517 |
| 17 Oct 08 | 360 | | | | | | 200 | 205 | 43 | 54 | 376 | 386 | | | 262 | 254 | 322 | 321 | 513 | 506 |
| 22 Mar 09 | 509 | 481 | 703 | 715 | | | 204 | 204 | 41 | 53 | 141 | 214 | | | 259 | 269 | 193 | 192 | 468 | 470 |
| 31 Oct 09 | 567 | 448 | 792 | 724 | 235 | 248 | 106 | 142 | -50 | -50 | 248 | 339 | | | 260 | 267 | 209 | 201 | 500 | 502 |
| 13 Mar 10 | 637 | 468 | 728 | 770 | 336 | 346 | 104 | 167 | Buried | | 337 | 342 | | | 255 | 262 | 164 | 132 | 523 | 525 |
| 19 Oct 10 | 621 | 300 | | | 355 | 358 | 123 | 157 | 3 | 6 | 335 | 342 | 157 | 125 | 252 | 260 | 227 | 209 | 488 | 497 |
| 26 Feb 11 | 320 | 301 | 805 | 795 | 379 | 389 | Lost | | Buried | | 314 | 349 | | | 246 | 262 | 233 | 212 | 437 | 439 |

Table A2-21 continued

Table A2-22 Zone 5 erosion pin results 2/6 – exposed pin length recorded in mm

| **Zone** | **5** | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Site** | **D** | | | | | | **E** | | | | | | | | **F** | | | | | |
| **Pin Number** | **1** | | **2** | | **3** | | **1** | | **2** | | **3** | | **4** | | **1** | | **2** | | **3** | |
| Bank Location | top | | slope | | toe | | cavity | | slope | | slope | | toe | | wall | | slope | | toe | |
| Top/Bot of Pin | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot |
| 20 Dec 99 | | | | | | | | | | | | | | | | | | | | |
| 26 Sep 00 | | | | | | | | | | | | | | | | | | | | |
| 23 Nov 01 | | | | | | | | | | | | | | | | | | | | |
| 9 Dec 01 | 116 | 135 | 186 | 186 | 318 | 325 | 807 | | 224 | 224 | 171 | 176 | 145 | 145 | 246 | 249 | 207 | 211 | 243 | 245 |
| 10 Feb 02 | | | | | | | | | | | | | | | | | | | | |
| 10 Mar 02 | 125 | 161 | 185 | 196 | 310 | 322 | 853 | 777 | 162 | 172 | 163 | 167 | 168 | 170 | 249 | 247 | 221 | 228 | 258 | 260 |
| 13 Apr 02 | 148 | 169 | 184 | 185 | 299 | 309 | 859 | 715 | 160 | 166 | 163 | 166 | 175 | 179 | 248 | 249 | 225 | 230 | 263 | 265 |
| 5 Oct 02 | 115 | 155 | 190 | 195 | 280 | 282 | 780 | 720 | 169 | 169 | 191 | 190 | 210 | 210 | 240 | 245 | 196 | 200 | 94 | 72 |
| 16 Dec 02 | 116 | 175 | 207 | 206 | 296 | 303 | 650 | 625 | 162 | 164 | 191 | 199 | 193 | 195 | 80 | | 216 | 216 | 243 | 245 |
| 29 Mar 03 | 119 | 165 | 206 | 207 | 306 | 313 | 203 | 1160 | 133 | 137 | 194 | 189 | 203 | 205 | 91 | 66 | 222 | 228 | 242 | 248 |
| 18 Oct 03 | 88 | 142 | 199 | 202 | 223 | 235 | | | 144 | 134 | 150 | 151 | 202 | 209 | 247 | 250 | 198 | 202 | 296 | 307 |
| 6 Mar 04 | 81 | 124 | 203 | 206 | 224 | 232 | 980 | 980 | 130 | 129 | 166 | 165 | 209 | 213 | 245 | 249 | 201 | 205 | 275 | 277 |
| 9 Oct 04 | 89 | 163 | 206 | 210 | | | 970 | 984 | 127 | 124 | 123 | 121 | | | 245 | 248 | 165 | 172 | 311 | 304 |
| 2 Apr 05 | 95 | 127 | 245 | 245 | 168 | 174 | 988 | 988 | 115 | 114 | 126 | 124 | 202 | 202 | 254 | 250 | 154 | 156 | 289 | 288 |
| 15 Oct 05 | 87 | 125 | 233 | 234 | 162 | 168 | 812 | 760 | 95 | 84 | 75 | 94 | 185 | 176 | 244 | 245 | 188 | 193 | 289 | 295 |
| 11 Mar 06 | 83 | 173 | 226 | 234 | 181 | 187 | 1010 | 1028 | 94 | 88 | 68 | 85 | 71 | 73 | 243 | 245 | 208 | 212 | 218 | 218 |
| 17 Oct 06 | 83 | 263 | 222 | 225 | 151 | 157 | 32 | 32 | 78 | 78 | 30 | 96 | 185 | 195 | 241 | 241 | 190 | 195 | 248 | 245 |
| 17 Mar 07 | 77 | 163 | 220 | 220 | 185 | 192 | 30 | 30 | 68 | 64 | 41 | 99 | 174 | 170 | 249 | 244 | 202 | 200 | 260 | 265 |
| 20 Oct 07 | 76 | 177 | 206 | 224 | 213 | 215 | | | 62 | 64 | 197 | 190 | 238 | 231 | 249 | 245 | 294 | 307 | 300 | |

*Table A2-22 continued next page*

| Zone | 5 | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site | D | | | | | | E | | | | | | | | F | | | | | |
| Pin Number | 1 | | 2 | | 3 | | 1 | | 2 | | 3 | | 4 | | 1 | | 2 | | 3 | |
| Bank Location | top | | slope | | toe | | cavity | | slope | | slope | | toe | | wall | | slope | | toe | |
| Top/Bot of Pin | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot |
| 1 Mar 08 | 74 | 179 | 214 | 230 | 210 | 215 | 156 | 162 | 59 | 64 | 178 | 180 | 227 | 232 | 243 | 245 | 224 | 224 | 192 | 205 |
| 17 Oct 08 | 65 | 176 | 222 | 234 | 146 | 151 | 112 | 118 | 32 | 50 | 152 | 168 | 223 | 219 | 236 | 240 | 250 | 252 | 113 | 126 |
| 22 Mar 09 | 45 | 165 | 203 | 214 | 154 | 165 | 111 | 125 | 64 | 60 | 135 | 144 | 199 | 195 | 218 | 239 | 269 | 274 | 85 | 102 |
| 31 Oct 09 | 38 | 158 | 186 | 180 | 178 | 184 | Lost | | 57 | 58 | 118 | 125 | 179 | 180 | 213 | 238 | 253 | 258 | 73 | 75 |
| 13 Mar 10 | 10 | 153 | 212 | 220 | 156 | 160 | | | 55 | 46 | 129 | 132 | 154 | 152 | 235 | 240 | 271 | 270 | 61 | 66 |
| 19 Oct 10 | 14 | 147 | 303 | 304 | 155 | 177 | | | 54 | 45 | 164 | 161 | 110 | 130 | 225 | 223 | 275 | 277 | 43 | 50 |
| 26 Feb 11 | 14 | 180 | 264 | 253 | 171 | 178 | | | 54 | 31 | 238 | 207 | 71 | 68 | 221 | 220 | 192 | 167 | 53 | 57 |

Table A2-22 continued

Table A2-23 Zone 5 erosion pin results 3/6 – exposed pin length recorded in mm

| **Zone** | **5** | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Site** | **G** | | | | | | | | | | | | **H** | | | | | | | |
| **Pin Number** | **1** | | **2** | | **3** | | **4** | | **5** | | **6** | | **1** | | **2** | | **3** | | **4** | |
| Bank Location | cavity | | slope | | slope | | slope | | bench | | toe | | top | | slope | | slope | | toe | |
| Top/Bot of Pin | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot |
| 20 Dec 99 | 128 | | 170 | | 173 | | 522 | | 469 | | 398 | | | | | | | | | |
| 26 Sep 00 | 122 | | 161 | | 143 | | 465 | | 456 | | 409 | | | | | | | | | |
| 23 Nov 01 | 134 | | 149 | | 119 | | 450 | | 490 | | 422 | | | | | | | | | |
| 9 Dec 01 | 135 | 120 | 150 | 150 | 113 | 114 | 416 | 426 | 492 | 492 | | | 240 | 242 | 137 | 137 | 346 | 353 | 466 | 480 |
| 10 Feb 02 | | | | | | | | | | | | | | | | | | | | |
| 10 Mar 02 | 138 | 121 | 150 | 150 | 106 | 116 | 451 | 452 | 479 | 480 | 432 | 444 | 240 | | 135 | 136 | 347 | 357 | 488 | 525 |
| 13 Apr 02 | 137 | 122 | 147 | 147 | 106 | 110 | 449 | 448 | 473 | 475 | 434 | 459 | | | | | | | | |
| 5 Oct 02 | 140 | 123 | 140 | 140 | 101 | 102 | 441 | 442 | 500 | 502 | 410 | 430 | 241 | 245 | 114 | 119 | 330 | 338 | 510 | 570 |
| 16 Dec 02 | 140 | 125 | 146 | 146 | 106 | 110 | 435 | 444 | 517 | 518 | 410 | 418 | 245 | 241 | 120 | 125 | 360 | 362 | 520 | 533 |
| 29 Mar 03 | 149 | 136 | 141 | 143 | 103 | 112 | 438 | 443 | 494 | 495 | 440 | 453 | 249 | 265 | 113 | 125 | 344 | 361 | 540 | 548 |
| 18 Oct 03 | 151 | 140 | 143 | 142 | 106 | 107 | 446 | 448 | 516 | 517 | 404 | 423 | 260 | 278 | 101 | 102 | 366 | 368 | 488 | 500 |
| 6 Mar 04 | 154 | 143 | 136 | 137 | 79 | 84 | 441 | 443 | 482 | 493 | 458 | 475 | 293 | 311 | 93 | 92 | 347 | 358 | 496 | 505 |
| 9 Oct 04 | 161 | 146 | 137 | 143 | 82 | 86 | 483 | 490 | 515 | 515 | 422 | 428 | 300 | 321 | 66 | 59 | 345 | 356 | 511 | 532 |
| 2 Apr 05 | 159 | 149 | 132 | 136 | 110 | 116 | 482 | 479 | 503 | 506 | 439 | 453 | 314 | 340 | 49 | 50 | 351 | 361 | 513 | 525 |
| 15 Oct 05 | 163 | 387 | 148 | 149 | 77 | 75 | 489 | 489 | 510 | 516 | 438 | 438 | 342 | 348 | 6 | 12 | 448 | 453 | | |
| 11 Mar 06 | 163 | 357 | 154 | 153 | 114 | 115 | 500 | 500 | 536 | 537 | 399 | 411 | 348 | 341 | 12 | 14 | 333 | 350 | 492 | 519 |
| 17 Oct 06 | 160 | 358 | 165 | 158 | 82 | 83 | 520 | 520 | 509 | 511 | 354 | 353 | 323 | 303 | 0 | 0 | 350 | 355 | 477 | 520 |
| 17 Mar 07 | 190 | 360 | 56 | 59 | 49 | 55 | 538 | 538 | 495 | 494 | 488 | 500 | 336 | 330 | -5 | -5 | 344 | 353 | 491 | 534 |
| 20 Oct 07 | 200 | 361 | 134 | 134 | 46 | 42 | 525 | 522 | 488 | 488 | 512 | 525 | 372 | 350 | -10 | -10 | 326 | 325 | 445 | 490 |

*Table A2-23 continued next page*

| Zone | 5 | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site | G | | | | | | | | | | | | H | | | | | | | |
| Pin Number | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 1 | | 2 | | 3 | | 4 | |
| Bank Location | cavity | | slope | | slope | | slope | | bench | | toe | | top | | slope | | slope | | toe | |
| Top/Bot of Pin | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot |
| 1 Mar 08 | 292 | 374 | 127 | 134 | 120 | 123 | 527 | 526 | 512 | 519 | 373 | 372 | 393 | 393 | -15 | -15 | 320 | 325 | 490 | 498 |
| 17 Oct 08 | 370 | 372 | 140 | 143 | 175 | 175 | 562 | 562 | 528 | 527 | 474 | 474 | 390 | 360 | -25 | -25 | 307 | 311 | 503 | 505 |
| 22 Mar 09 | 376 | 382 | 150 | 154 | 199 | 199 | 578 | 578 | 540 | 542 | 412 | 408 | 341 | 341 | -10 | -10 | 300 | 304 | 467 | 538 |
| 31 Oct 09 | 464 | 390 | 153 | 150 | 210 | 210 | 589 | 591 | 546 | 547 | 425 | 427 | 230 | 230 | Buried | | 286 | 287 | 485 | 491 |
| 13 Mar 10 | 382 | 388 | 154 | 155 | 238 | 242 | 596 | 596 | 557 | 556 | 461 | 457 | 355 | | | | 280 | 282 | 468 | 640 |
| 19 Oct 10 | 465 | 389 | 159 | 161 | 265 | 265 | 610 | 610 | 546 | 547 | 490 | 485 | Buried | | | | 266 | 276 | 540 | 535 |
| 26 Feb 11 | 442 | 388 | 154 | 162 | 274 | 293 | 638 | 636 | 550 | 550 | 496 | 488 | Reset as new 5H1 | | | | 265 | 279 | 548 | 548 |

Table A2-23 continued

Table A2-24 Zone 5 erosion pin results 4/6 – exposed pin length recorded in mm

| **Zone** | **5** | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Site** | **I** | | | | | | | | **J** | | | | | | | | **K** | | | | | |
| **Pin Number** | **1** | | **2** | | **3** | | **4** | | **1** | | **2** | | **3** | | **4** | | **1** | | **2** | | **3** | |
| Bank Location | wall | | slope | | slope | | toe | | top | | slope | | slope | | toe | | slope | | slope | | toe | |
| Top/Bot of Pin | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot |
| 20 Dec 99 | | | | | | | | | | | | | | | | | | | | | | |
| 26 Sep 00 | | | | | | | | | | | | | | | | | | | | | | |
| 23 Nov 01 | | | | | | | | | | | | | | | | | | | | | | |
| 9 Dec 01 | 231 | 231 | 228 | 227 | 296 | 299 | 288 | 290 | | | | | | | | | | | | | | |
| 10 Feb 02 | 231 | 232 | 240 | 240 | 307 | 316 | 296 | 298 | 167 | 174 | 191 | 196 | 319 | 321 | 201 | 204 | 151 | 157 | 229 | 229 | 317 | 310 |
| 10 Mar 02 | 230 | 237 | 234 | 236 | 309 | 315 | 298 | 306 | 167 | 169 | 190 | 193 | 313 | 316 | 209 | 210 | 150 | 156 | 225 | 231 | 331 | 345 |
| 13 Apr 02 | 232 | 234 | 212 | 218 | 311 | 316 | 308 | 310 | | | | | | | | | | | | | | |
| 5 Oct 02 | 256 | 260 | 178 | 180 | 376 | 384 | 288 | 290 | 111 | 124 | 163 | 166 | 359 | 360 | 246 | 244 | 104 | 116 | 113 | 124 | 203 | 209 |
| 16 Dec 02 | 251 | 266 | 230 | 230 | 361 | 370 | 270 | 273 | 140 | 143 | 177 | 176 | 364 | 361 | 245 | 240 | 100 | 112 | 102 | 104 | 210 | 218 |
| 29 Mar 03 | 253 | 266 | 216 | 218 | 344 | 354 | 343 | 348 | 136 | 141 | 176 | 179 | 350 | 349 | 242 | 242 | | | | | | |
| 18 Oct 03 | 243 | 268 | 168 | 168 | 295 | 307 | 307 | 314 | 122 | 126 | 180 | 184 | 362 | 365 | 263 | 268 | | | 118 | 127 | 249 | 262 |
| 6 Mar 04 | 243 | 255 | 89 | 91 | 375 | 373 | 282 | 286 | 111 | 116 | 189 | 191 | 380 | 386 | 297 | 296 | 15 | 28 | 163 | 170 | 242 | 255 |
| 9 Oct 04 | 244 | 263 | 163 | 171 | 381 | 378 | 263 | 263 | 51 | 56 | 272 | 276 | 388 | 387 | 338 | 336 | 0 | 0 | 17 | 29 | 244 | 256 |
| 2 Apr 05 | 248 | 265 | 220 | 221 | 339 | 348 | 272 | 280 | 125 | 128 | 300 | 309 | 394 | 387 | 335 | 330 | 497 | 506 | 60 | 65 | 241 | 260 |
| 15 Oct 05 | 241 | 250 | 234 | 232 | 323 | 318 | 347 | 352 | 135 | 144 | 304 | 311 | 420 | 406 | 355 | 357 | Lost | | 118 | 128 | 226 | 225 |
| 11 Mar 06 | 240 | 255 | 221 | 227 | 325 | 325 | 333 | 340 | 174 | 178 | 357 | 359 | 391 | 387 | 338 | 340 | | | 108 | 125 | 215 | 246 |
| 17 Oct 06 | 226 | 240 | 250 | 256 | 318 | 320 | 315 | 311 | 188 | 190 | 340 | 345 | 370 | 351 | 305 | 298 | | | 100 | 110 | 211 | 221 |
| 17 Mar 07 | 218 | 226 | 204 | 209 | 287 | 294 | 339 | 340 | 194 | 198 | 332 | 332 | 350 | 337 | 283 | 275 | | | 144 | 178 | 241 | 269 |
| 20 Oct 07 | 202 | 212 | 179 | 185 | 350 | 356 | 255 | 256 | 68 | 74 | 102 | 144 | 448 | 438 | Lost | | | | 10 | 14 | 226 | 244 |

*Table A2-24 continued next page*

| Zone | 5 | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site | I | | | | | | | | J | | | | | | | | K | | | | | |
| Pin Number | 1 | | 2 | | 3 | | 4 | | 1 | | 2 | | 3 | | 4 | | 1 | | 2 | | 3 | |
| Bank Location | wall | | slope | | slope | | toe | | top | | slope | | slope | | toe | | slope | | slope | | toe | |
| Top/Bot of Pin | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot |
| 1 Mar 08 | 197 | 210 | 234 | 230 | 238 | 241 | 232 | 233 | 142 | 153 | 215 | 227 | 470 | 470 | Lost | | Lost | | 49 | 73 | 168 | 185 |
| 17 Oct 08 | 188 | 202 | 233 | 230 | 330 | 330 | 225 | 233 | 194 | 198 | 337 | 353 | 506 | 492 | | | | | 30 | 46 | 252 | 260 |
| 22 Mar 09 | 189 | 194 | 219 | 271 | 346 | 349 | 266 | 275 | 195 | 203 | 354 | 370 | 451 | 450 | | | | | 22 | 43 | 203 | 219 |
| 31 Oct 09 | 180 | 186 | 193 | 195 | 410 | 411 | 259 | 263 | 190 | 196 | 443 | 456 | Lost | | | | | | 30 | 58 | 235 | 258 |
| 13 Mar 10 | 180 | 180 | 185 | 213 | 422 | 420 | 238 | 236 | 206 | 213 | 486 | 506 | | | | | | | 38 | 52 | 201 | 222 |
| 19 Oct 10 | 170 | 167 | 176 | 247 | 377 | 378 | 212 | 212 | 209 | 213 | 490 | 510 | | | | | | | 72 | 79 | 201 | 209 |
| 26 Feb 11 | 149 | 159 | 178 | 212 | 399 | 400 | 222 | 227 | 212 | 223 | 524 | 546 | | | | | | | 55 | 122 | 207 | 262 |

Table A2-24 continued

Table A2-25. Zone 5 erosion pin results 5/6 – exposed pin length recorded in mm

| **Zone** | **5** | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Site** | **L** | | | | | | | | **M** | | | | | | **K** | |
| **Pin Number** | **1** | | **2** | | **3** | | **4** | | **1** | | **2** | | **3** | | **0** | |
| Bank Location | wall | | slope | | slope | | toe | | top | | slope | | toe | | 2–3 | |
| Top/Bot of Pin | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot |
| 20 Dec 99 | | | | | | | | | | | | | | | | |
| 26 Sep 00 | | | | | | | | | | | | | | | | |
| 23 Nov 01 | | | | | | | | | | | | | | | | |
| 9 Dec 01 | | | | | | | | | | | | | | | | |
| 10 Feb 02 | 194 | 195 | 178 | 178 | 133 | 141 | 136 | 144 | 411 | 431 | 216 | 210 | 167 | 166 | | |
| 10 Mar 02 | 189 | 193 | 162 | 168 | 135 | 145 | 165 | 178 | 413 | 430 | 207 | 210 | 165 | 167 | | |
| 13 Apr 02 | | | | | | | | | | | | | | | | |
| 5 Oct 02 | 170 | 175 | 191 | 193 | 154 | 180 | 161 | 162 | 311 | 330 | 208 | 214 | 203 | 215 | | |
| 16 Dec 02 | 170 | 175 | 182 | 192 | 170 | 188 | 152 | 152 | 317 | 328 | 181 | 194 | 206 | 215 | | |
| 29 Mar 03 | 181 | 192 | 166 | 186 | 179 | 193 | 176 | 192 | 335 | 346 | 180 | 213 | 174 | 222 | | |
| 18 Oct 03 | 186 | 194 | 189 | 205 | 186 | 192 | 169 | 170 | 352 | 395 | 132 | 141 | 209 | 210 | | |
| 6 Mar 04 | 185 | 191 | 207 | 217 | 212 | 216 | 184 | 199 | 352 | 371 | 71 | 141 | 161 | 181 | 577 | 585 |
| 9 Oct 04 | 200 | 212 | 234 | 240 | 231 | 226 | 149 | 149 | 295 | 308 | 57 | 92 | 45 | 45 | 319 | 324 |
| 2 Apr 05 | 234 | 235 | 223 | 233 | 236 | 237 | 210 | 217 | 280 | 320 | 96 | 122 | 124 | 130 | 497 | 506 |
| 15 Oct 05 | 220 | 226 | 241 | 250 | 248 | 246 | 210 | 212 | 247 | 273 | 55 | 81 | 165 | 158 | 387 | 382 |
| 11 Mar 06 | 225 | 232 | 255 | 266 | 250 | 256 | 205 | 215 | 251 | 282 | 76 | 90 | 100 | 176 | 360 | 365 |
| 17 Oct 06 | 230 | 244 | 290 | 310 | 294 | 295 | 215 | 221 | 245 | 260 | 45 | 118 | 244 | 242 | 365 | 360 |
| 17 Mar 07 | 275 | 280 | 304 | 306 | 314 | 319 | 243 | 249 | 263 | 276 | 125 | 150 | 85 | 88 | 479 | 475 |
| 20 Oct 07 | 226 | 242 | 328 | 330 | 312 | 313 | 94 | 97 | 268 | 284 | 268 | 277 | 436 | 436 | 266 | 281 |

*Table A2-25 continued next page*

| Zone | 5 | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site | L | | | | | | | | M | | | | | | K | |
| Pin Number | 1 | | 2 | | 3 | | 4 | | 1 | | 2 | | 3 | | 0 | |
| Bank Location | wall | | slope | | slope | | toe | | top | | slope | | toe | | 2–3 | |
| Top/Bot of Pin | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot |
| 1 Mar 08 | 234 | 251 | 309 | 314 | 277 | 281 | 258 | 274 | 267 | 294 | 278 | 291 | 428 | 577 | 336 | 353 |
| 17 Oct 08 | 224 | 237 | 277 | 276 | 249 | 248 | 221 | 224 | 255 | 271 | 251 | 297 | 347 | 354 | 467 | 456 |
| 22 Mar 09 | 149 | 304 | 237 | 253 | 238 | 245 | 103 | 124 | 270 | 276 | 301 | 313 | 406 | 426 | 214 | 318 |
| 31 Oct 09 | 215 | 237 | 208 | 219 | 270 | 274 | 49 | 50 | 260 | 270 | 278 | 281 | 450 | 475 | 280 | 280 |
| 13 Mar 10 | 221 | 289 | 197 | 202 | 256 | 259 | 39 | 40 | 266 | 284 | 254 | 295 | 462 | 461 | 292 | 308 |
| 19 Oct 10 | 134 | 178 | 85 | 92 | 190 | 232 | 30 | 30 | 254 | 280 | 256 | 274 | Not found | | 323 | 315 |
| | 129 | 165 | 71 | 79 | 173 | 199 | 77 | 93 | 250 | 276 | 236 | 250 | 264 | 326 | 430 | 579 |

Table A2-25 continued

Table A2-26 Zone 5 erosion pin results 5/6 – New Pins December 2004. Sites B, C, D, I and J. Exposed pin length recorded in mm

| **Zone** | **5** | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Site** | **B** | | | | **C** | | **D** | | **I** | | | | **J** | | | |
| **Pin Number** | **5** | | **6** | | **4** | | **HW** | | **5** | | **6** | | **5** | | **6** | |
| Bank Location | 1–2 | | 1–2 | | 2–3 | | 2–3 | | 2–3 | | 1–2 | | 2–3 | | 2–3 | |
| Top/Bot of Pin | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot | Top | Bot |
| 2 Apr 05 | 231 | 246 | 164 | 171 | 280 | 286 | 341 | 500 | 301 | 304 | 201 | 206 | 320 | 322 | 205 | 210 |
| 15 Oct 05 | 226 | 230 | 197 | 201 | 210 | 203 | 351 | 482 | 167 | 169 | 226 | 231 | 306 | 314 | 222 | 222 |
| 11 Mar 06 | 245 | 246 | 195 | 201 | 282 | 285 | 348 | 463 | 126 | 145 | 253 | 272 | 301 | 311 | 220 | 222 |
| 17 Oct 06 | 233 | 247 | 189 | 189 | 300 | 301 | 350 | 455 | 185 | 170 | 234 | 241 | 301 | 310 | 221 | 225 |
| 17 Mar 07 | 229 | 250 | 172 | 178 | 277 | 282 | 327 | 378 | 249 | 243 | 233 | 241 | 301 | 309 | 231 | 234 |
| 20 Oct 07 | 204 | | 98 | 104 | 261 | 261 | 337 | 409 | 22 | 32 | 151 | 195 | 294 | 309 | 202 | 212 |
| 1 Mar 08 | 354 | 394 | 89 | 97 | 270 | 279 | 339 | 479 | 235 | 230 | 174 | 226 | 296 | 306 | 226 | 228 |
| 17 Oct 08 | 180 | 205 | 87 | 94 | 282 | 288 | 333 | 472 | 136 | 137 | 235 | 234 | 297 | 303 | 228 | 232 |
| 22 Mar 09 | 78 | 116 | 95 | 109 | 282 | 285 | 324 | 466 | 183 | 203 | 188 | 238 | 296 | 304 | 231 | 235 |
| 31 Oct 09 | 128 | 147 | 56 | 78 | 287 | 284 | 306 | 410 | 87 | 91 | 239 | 242 | 293 | 298 | 232 | 236 |
| 13 Mar 10 | 195 | 279 | 72 | 90 | 275 | 280 | 306 | 409 | 210 | 205 | 206 | 226 | 292 | 298 | 242 | 250 |
| 19 Oct 10 | 157 | 125 | Not found | | 282 | 283 | 304 | 410 | 130 | 152 | 250 | 448 | 291 | 293 | 242 | 266 |
| 26 Feb 11 | 69 | 129 | 88 | 92 | 277 | 283 | 295 | 410 | 275 | 270 | 264 | 230 | 286 | 290 | 692 | 696 |

Table A2-27 Zone 5 erosion pin results 5/6 – New Pins December 2004. Sites K, G, H, J, K, A and E. Exposed pin length recorded in mm

| **Zone** | **5** | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Site** | **K** | | **G** | | **H** | | | | **J** | | **K** | | **A** | | **E** | |
| **Pin Number** | **4** | | **7** | | **5** | | **6** | | **7** | | **5** | | **5** | | **1 new** | |
| a,b,c,.. | | | dup 5G/3 | | dup 5H/1 | | dup 5H/2 | | dup 5J/4 | | dup 5k/2 | | 0–1 | | 2–3 | |
| Bank Location | 1–2 | | | | | | | | | | | | dup 5A/4 | | | |
| Top/Bot of Pin | Top | Bot | | | | | | | | | | | | | | |
| 2 Apr 05 | 270 | 278 | | | | | | | | | | | | | | |
| 15 Oct 05 | 155 | 172 | | | | | | | | | | | | | | |
| 11 Mar 06 | 73 | 99 | | | | | | | | | | | | | | |
| 17 Oct 06 | 100 | 120 | | | | | | | | | | | | | | |
| 17 Mar 07 | 181 | 195 | 315 | 315 | 447 | 440 | 401 | 401 | 292 | 292 | | | | | | |
| 20 Oct 07 | 152 | 170 | 350 | 353 | 458 | 443 | 396 | 400 | 394 | 389 | 184 | 192 | | | | |
| 1 Mar 08 | 187 | 197 | 395 | 399 | 490 | 454 | 398 | 403 | 394 | 388 | 234 | 258 | 377 | 404 | 156 | 162 |
| 17 Oct 08 | 180 | 189 | 437 | 436 | 484 | 463 | 397 | 397 | 397 | 380 | 220 | 242 | 401 | 400 | 112 | 118 |
| 22 Mar 09 | 99 | 117 | 476 | 476 | 475 | 437 | 398 | 398 | 385 | 373 | 203 | 229 | 445 | 456 | 111 | 125 |
| 31 Oct 09 | 35 | 70 | 485 | 485 | 473 | 451 | 391 | 393 | 315 | 312 | 235 | 245 | 488 | 493 | 74 | 82 |
| 13 Mar 10 | 36 | 68 | 517 | 526 | 470 | 432 | 390 | 392 | 341 | 344 | 245 | 262 | 520 | 526 | 70 | 87 |
| 19 Oct 10 | 243 | 256 | 536 | 541 | 452 | 415 | 394 | 393 | 286 | 289 | 265 | 277 | 582 | 590 | 76 | 86 |
| 26 Feb 11 | 236 | 278 | 551 | 556 | 448 | 403 | 394 | 390 | 256 | 246 | 305 | 306 | 609 | 611 | 60 | 81 |

Table A2-28 Zone 5 erosion pin results, new pins established since 2008. Exposed pin length recorded in mm

| **Zone** | **5** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Site** | **M** | | **G** | | **J** | | | | **B** | | **H** | |
| **Pin Number** | **4new** | | **8** | | **3** | | **4** | | **7** | | **1** | |
| **a,b,c,…** | **toe** | | **HW starpicket** | | **reset** | | | | **dup 5B2** | | **Reset in same spot** | |
| **Bank Location** | **dup 5M/3** | | | | | | | | | | | |
| 1 Mar 08 | 625 | 635 | | | | | | | | | | |
| 17 Oct 08 | 555 | 569 | | | | | | | | | | |
| 22 Mar 09 | 625 | 631 | | | | | | | | | | |
| 31 Oct 09 | 618 | 628 | 1077 | 1083 | 550 | 558 | 146 | 145 | 400 | 408 | | |
| 13 Mar 10 | 630 | 636 | | | 571 | 572 | 188 | 176 | 420 | 428 | | |
| 19 Oct 10 | 560 | 590 | 1079 | 1085 | 598 | 596 | 150 | 163 | 423 | 435 | | |
| 26 Feb 11 | 481 | 504 | 1076 | 1085 | 604 | 606 | 146 | 144 | 420 | 428 | 310 | 282 |

## A2.3 Scour chain results

Note, results only shown for December 2001 – present. Previous results available in previous reports.

Table A2-29 Scour chain results zone 1/2

| **Zone** | **1** | | | | | | | | | **2** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Site** | **A** | | | | | | **E** | | | **A** | | | **D** | |
| **Scour Chain #** | **1a** | | | **4a** | | | **1e** | | | **2a** | | | **2d** | |
| Bank Location | Col | | | Col | | | Col | | | slope | | | slope | |
| mm/links/depo | mm | links | deposition | mm | links | deposition | mm | links | deposition | mm | links | deposition | mm | links |
| 9 Dec 01 | | | | | | | | | | | | | 350 | 13 |
| 9 Feb 02 | | | | | | | | | | 3200 | 33 | 0 | 380 | 14 |
| 10 Feb 02 | 715 | 27 | 0 | 540 | 20.5 | 0 | | | | | | | | |
| 9 Mar 02 | 720 | 27 | 0 | 545 | 21 | 0 | 933 | 35 | 0 | | | | 360 | 13 |
| 13 Apr 02 | | | | | | | | | | 892 | 33 | 0 | 285 | 11 |
| 5 Oct 02 | 715 | 27 | 0 | 560 | 21 | 0 | 900 | 34 | 1 | 855 | 32 | 1 | 395 | 15 |
| 16 Dec 02 | 710 | 27 | 0 | 560 | 21 | 0 | 910 | 35 | 2 | 853 | 32 | 0 | 374 | 14 |
| 29 Mar 03 | 735 | 28 | 0 | 576 | 22 | 0 | 875 | 33 | 10 | 860 | 33 | 0 | 460 | 15 |
| 18 Oct 03 | 719 | 27 | 0 | 571 | 21 | 0 | 903 | 34 | 12 | 870 | 33 | 6 | 349 | 13 |
| 6 Mar 04 | 736 | 27 | 0 | 555 | 21 | 0 | 890 | 33.5 | 6 | 857 | 33 | 1 | 350 | 13 |
| 9 Oct 04 | 734 | 28 | 0 | 555 | 21 | 0 | 902 | 34.5 | 25 | 835 | 33 | 0 | 390 | 15 |
| 2 Apr 05 | 734 | 28 | 0 | 600 | 23 | 0 | 890 | 34 | 0 | 845 | 33 | 5 | 393 | 15 |
| 15 Oct 05 | 735 | 28 | 0 | 830 | 29 | 0 | 890 | 33 | 20 | 845 | 33 | 0 | 380 | 14 |

*Table A2-29 continued next page*

| Zone | 1 | | | | | | | | | 2 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site | A | | | | | | E | | | A | | | D | |
| Scour Chain # | 1a | | | 4a | | | 1e | | | 2a | | | 2d | |
| Bank Location | Col | | | Col | | | Col | | | slope | | | slope | |
| mm/links/depo | mm | links | deposition | mm | links | deposition | mm | links | deposition | mm | links | deposition | mm | links |
| 11 Mar 06 | 735 | 28 | 0 | 780 | 29 | 0 | 870 | 33 | 10 | 860 | 33 | 0 | | |
| 17 Oct 06 | 735 | 28 | 0 | 780 | 29 | 0 | 874 | 33 | 10 | 820 | 32 | 0 | 420 | 16 |
| 17 Mar 07 | 715 | 28 | 0 | 775 | 29 | 0 | 875 | 33 | 0 | 840 | 33 | 0 | 375 | 14 |
| 20 Oct 07 | 735 | 28 | 0 | 775 | 30 | 0 | 830 | 32 | 15 | 840 | 32 | 0 | 330 | 12 |
| 1 Mar 08 | 715 | 28 | 0 | 800 | 31 | 0 | 850 | 32 | 0 | 830 | 33 | 0 | 310 | 11 |
| 17 Oct 08 | 710 | 28 | 0 | 795 | 31 | 0 | 870 | 33 | 10 | 850 | 33 | 0 | 300 | 11 |
| 22 Mar 09 | 710 | 28 | 0 | 810 | 31 | 0 | 860 | 33 | 20 | 850 | 33 | 0 | 325 | 12 |
| 17 Oct 09 | 720 | 28.5 | 0 | 800 | 31 | 0 | 900 | 32 | 10 | 840 | 33.5 | 0 | 320 | 12 |
| 13 Mar 10 | 720 | 28.5 | 0 | 900 | 31 | 0 | 900 | 31 | 10 | 850 | 33 | 0 | 320 | 13 |
| 19 Oct 10 | 850 | 29 | 0 | 820 | 31 | 0 | Chain buried and not disturbed | | | 835 | 33.5 | 0 | Chain buried and not disturbed | |
| 27 Feb 11 | 720 | 28 | 0 | 790 | 30 | 0 | Chain buried and not disturbed | | | 810 | 33.5 | 0 | Chain partially buried & not disturbed | |

Table A2-29 continued

Table A2-30 Scour chain results zone 2/3

| **Zone** | **2** | | | | | | | | | | **3** | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Site** | **D** | **H** | | | **K** | | | **L** | | | **A** | | | **B** |
| **Scour Chain #** | **2d** | **2h** | | | **2k** | | | **2l** | | | **3a** | | | **3b** |
| Bank Location | slope | slope | | | slope | | | slope | | | slope | | | slope |
| mm/links/depo | deposition | mm | links | deposition | mm | links | deposition | mm | links | deposition | mm | links | deposition | mm |
| 9 Dec 01 | 10 | | | | 727 | 27 | 100 | | | | 760 | 28 | 1 | 683 |
| 9 Feb 02 | 20 | | | | | | | | | | | | | |
| 10 Feb 02 | | | | | 840 | 31 | 55 | 590 | 22 | 0 | 745 | 28 | 0 | 550 |
| 9 Mar 02 | 20 | | | | 690 | 26 | 80 | 580 | 22 | 0 | 770 | 28 | 0 | 510 |
| 13 Apr 02 | 5 | | | | | | | | | | | | | |
| 5 Oct 02 | 45 | 780 | 29.5 | 10 | 798 | 29 | 145 | 585 | 22 | 0 | | | | 685 |
| 16 Dec 02 | 25 | 755 | 29 | 17 | | | | | | | | | | 676 |
| 29 Mar 03 | 50 | 770 | 29 | 0 | 950 | 35 | 5 | 620 | 23 | 22 | 935 | 35 | 30 | 670 |
| 18 Oct 03 | 45 | 755 | 29 | 15 | | 26 | 150 | 711 | 26 | 14 | 975 | 37 | 45 | 680 |
| 6 Mar 04 | 15 | 759 | 29 | 5 | 794 | 29 | 33 | 685 | 26 | 15 | 1050 | 39 | 90 | 680 |
| 9 Oct 04 | 25 | 752 | 29.5 | 0 | 830 | 31 | 170 | 700 | 26 | 20 | 780 | 30 | 170 | 680 |
| 2 Apr 05 | 40 | 752 | 29 | 5 | 850 | 32 | 35 | 700 | 25 | 30 | | | | 690 |
| 15 Oct 05 | 10 | 750 | 29 | 10 | 910 | 33 | 125 | 710 | 27 | 0 | 685 | 26 | 135 | 690 |
| 11 Mar 06 | | 720 | 29 | 0 | 900 | 33 | 75 | 720 | 27 | 30 | | | | 640 |
| 17 Oct 06 | 65 | 730 | 29 | 0 | 1080 | 38 | 180 | 710 | 27 | 25 | 520 | 21 | 190 | 670 |
| 17 Mar 07 | 45 | 720 | 28 | 0 | 860 | 32 | 0 | 700 | 27 | 25 | 545 | 22 | 40 | 675 |
| 20 Oct 07 | 35 | 710 | 27 | 3 | | | | 720 | 27 | 10 | | | | 645 |

*Table A2-30 continued next page*

| Zone | 2 | | | | | | | | | | 3 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Site** | **D** | **H** | | | **K** | | | **L** | | | **A** | | | **B** |
| **Scour Chain #** | **2d** | **2h** | | | **2k** | | | **2l** | | | **3a** | | | **3b** |
| Bank Location | slope | slope | | | slope | | | slope | | | slope | | | slope |
| mm/links/depo | deposition | mm | links | deposition | mm | links | deposition | mm | links | deposition | mm | links | deposition | mm |
| 1 Mar 08 | 35 | 710 | 27 | 10 | | | | 720 | 27 | 10 | | | | 680 |
| 17 Oct 08 | 30 | 700 | 27 | 0 | | | | 720 | 27 | 0 | 653 | 25 | 100 | 684 |
| 22 Mar 09 | 0 | 710 | 27 | 3 | | | | 720 | 27 | 20 | 580 | 22 | 30 | 680 |
| 17 Oct 09 | 10 | 700 | 27 | 0 | end of chain found but not extracted as it would damage the bank | | 250 | 770 | 28 | 0 | 560 | 21 | 30 | 700 |
| 13 Mar 10 | 20 | 720 | 27 | 0 | Chain buried and not disturbed | | | 730 | 28 | 0 | 480 | 18 | 80 | 700 |
| 19 Oct 10 | | 700 | 27.5 | 0 | Chain buried and not disturbed | | | 720 | 28 | 0 | 460 | 19 | 5 | 690 |
| 26 Feb 11 | 100+ | 690 | 27.5 | 0 | Chain buried and not disturbed | | | Chain buried and not disturbed | | | 570 | 23 | 0 | 660 |

Table A2-30 continued

Table A2-31 Scour chain results zone 3/4

| **Zone** | **3** | | | | | | | | **4** | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Site** | **B** | | **Eb** | | | **G** | | | **A** | | | **D** | | |
| **Scour Chain #** | **3b** | | **3Eb** | | | **3g** | | | **4a** | | | **4d** | | |
| Bank Location | slope | | slope | | | slope | | | slope | | | slope | | |
| mm/links/depo | links | deposition | mm | links | deposition | mm | links | deposition | mm | links | deposition | mm | links | deposition |
| 9 Dec 01 | 25.5 | 0 | | | | | | | | | | | | |
| 9 Feb 02 | | | | | | | | | | | | | | |
| 10 Feb 02 | 21 | | | | | 965 | 36 | 0 | 830 | 31 | 0 | 800 | 30 | 0 |
| 9 Mar 02 | 19 | 30 | 815 | 31 | 13 | 927 | 35 | 22 | 840 | 31 | 25 | 805 | 31 | 10 |
| 13 Apr 02 | | | 812 | 33 | 6 | 955 | 36 | 6 | 817 | 31 | 25 | 775 | 30 | 35 |
| 5 Oct 02 | 26 | 10 | | | | 955 | 36 | 0 | 880 | 34 | 25 | 805 | 31.5 | 15 |
| 16 Dec 02 | 24 | 13 | 925 | 35 | 40 | 953 | 36 | 25 | 875 | 33 | 20 | 780 | 31 | 20 |
| 29 Mar 03 | 25 | 10 | 920 | 35 | 55 | 932 | 36 | 25 | 890 | 34 | 13 | 840 | 32 | 70 |
| 18 Oct 03 | 26 | 0 | 960 | 36 | 1 | 910 | 36 | 20 | 850 | 33 | 40 | 790 | 31 | 50 |
| 6 Mar 04 | 26 | 0 | 930 | 36 | 5 | 900 | 36 | 0 | 860 | 33 | 35 | 835 | 32 | 65 |
| 9 Oct 04 | 26 | 0 | 930 | 36 | 5 | 900 | 36 | 0 | 868 | 33 | 60 | 798 | 31 | 12 |
| 2 Apr 05 | 26 | 45 | | | | 965 | 37 | 0 | 860 | 34 | 95 | 815 | 32 | 40 |
| 15 Oct 05 | 25 | 0 | 960 | 37 | 65-85 | Inundated | | | 860 | 33 | 50 | 800 | 31 | 0 |
| 11 Mar 06 | 24 | 25 | 880 | 35 | 10 | 930 | 36 | 20 | 860 | 33 | 40 | 800 | 32 | 0 |
| 17 Oct 06 | 25 | 20 | 920 | 36 | 35 | 910 | 34 | 40 | 880 | 34 | 50 | 820 | 32 | 55 |
| 17 Mar 07 | 26 | 20 | 880 | 36 | 0 | 830 | 32 | 30 | 890 | 34 | 130 | 815 | 32 | 90 |
| 20 Oct 07 | 25 | 80 | 880 | 35 | 30 | 900 | 34 | 50 | 930 | 36 | | 780 | 31 | 65 |

*Table A2-31 continued next page*

| Zone | 3 | | | | | | | | 4 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Site** | **B** | | **Eb** | | | **G** | | | **A** | | | **D** | | |
| **Scour Chain #** | **3b** | | **3Eb** | | | **3g** | | | **4a** | | | **4d** | | |
| Bank Location | slope | | slope | | | slope | | | slope | | | slope | | |
| mm/links/depo | links | deposition | mm | links | deposition | mm | links | deposition | mm | links | deposition | mm | links | deposition |
| 1 Mar 08 | 26 | 10 | 950 | 37 | 0 | 910 | 34 | 30 | 920 | 36 | 25 | 730 | 29 | 10 |
| 17 Oct 08 | 26 | 30 | 955 | 39 | 30 | 850 | 33 | 40 | 900 | 36 | 0 | 750 | 30 | 20 |
| 22 Mar 09 | 26 | 0 | 950 | 38 | 30 | 850 | 33 | 0 | 930 | 36 | 50 | 740 | 30 | 10 |
| 17 Oct 09 | 26 | 0 | 920 | 37 | 35 | 870 | 33 | 20 | 990 | 38 | 0 | 750 | 30 | 35 |
| 13 Mar 10 | 26 | 0 | chain buried and not disturbed | | | 850 | 33 | 0 | 960 | 37 | 55 | 750 | 31 | 0 |
| 19 Oct 10 | 27 | 25 | 910 | 37 | 20 | 880 | 33 | 22 | 910 | 36 | 28 | 760 | 31 | 10 |
| 28 Feb 11 | 27 | 10 | 940 | 35 | 10 | chain buried and not disturbed | | | 990 | 35 | 10 | 759 | 31 | 30 |

Table A2-31 continued

Table A2-32 Scour chain results zone 4/5

| **Zone** | **4** | | | | | | | | | | | | **5** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Site** | **E** | | | **F** | | | **Gb** | | | **H** | | | **B** | | |
| **Scour Chain #** | **4e** | | | **4f** | | | **4Gb** | | | **4h** | | | **5b** | | |
| Bank Location | slope | | | slope | | | slope | | | slope | | | slope | | |
| mm/links/depo | mm | links | deposition | mm | links | deposition | mm | links | deposition | mm | links | deposition | mm | links | deposition |
| 9 Dec 01 | | | | 760 | 29 | 20 | | | | | | | | | |
| 9 Feb 02 | | | | | | | | | | | | | | | |
| 10 Feb 02 | 870 | 33 | 0 | 760 | 29 | 40 | | | | | | | | | |
| 9 Mar 02 | 830 | 32 | 0 | 765 | 29 | 55 | 920 | 35 | 0 | 935 | 35 | 0 | 790 | 30 | 0 |
| 13 Apr 02 | 842 | 32 | 20 | 742 | 27 | 40 | 902 | 35 | 6 | 935 | 36 | 6 | 790 | 30 | 12 |
| 5 Oct 02 | 890 | 33.5 | 45 | 740 | 27 | 12 | 960 | 37 | 0 | 960 | 36.5 | 10 | | | |
| 16 Dec 02 | 865 | 33 | 20 | 790 | 29 | 5 | 940 | 36 | 10 | 960 | 37 | 0 | | | |
| 29 Mar 03 | 900 | 34 | 15 | 790 | 29 | 20 | 940 | 36 | 13 | 920 | 36 | 0 | 800 | 31 | 70 |
| 18 Oct 03 | 830 | 31 | 55 | 770 | 29 | 30 | 960 | 37 | 58 | 940 | 36 | 0 | 730 | 28 | 90 |
| 6 Mar 04 | 835 | 32 | 15 | 780 | 29 | 35 | 960 | 37 | 15 | 940 | 36.5 | 0 | 690 | 26.5 | 5 |
| 9 Oct 04 | 860 | 33 | 45 | 796 | 29 | 40 | | | | 950 | 37 | 4 | 660 | 25 | 25 |
| 2 Apr 05 | 900 | 35 | 0 | 750 | 30 | 40 | 980 | 38 | 80 | 950 | 37 | 0 | 675 | 26 | 25 |
| 15 Oct 05 | 950 | 37 | 10 | 830 | 30 | 0 | underwater | | | 950 | 38 | 0 | 705 | 28 | 35 |
| 11 Mar 06 | 910 | 36 | 25 | 760 | 30 | 15 | 945 | 37 | 30 | 960 | 38 | 5 | 690 | 27 | 10 |
| 17 Oct 06 | 940 | 36 | 110 | 790 | 30 | 10 | 940 | 36 | 70 | 960 | 38 | 0 | 665 | 27 | 40 |
| 17 Mar 07 | 890 | 35 | 5 | 780 | 30 | 35 | 945 | 38 | 10 | 945 | 39 | 5 | 675 | 28 | 2 |
| 20 Oct 07 | | | | 780 | 30 | 15 | 930 | 37 | 30 | 1070 | 42 | 5 | | | |

*Table A2-32 continued next page*

| **Zone** | **4** | | | | | | | | | | | | **5** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Site** | **E** | | | **F** | | | **Gb** | | | **H** | | | **B** | | |
| **Scour Chain #** | **4e** | | | **4f** | | | **4Gb** | | | **4h** | | | **5b** | | |
| Bank Location | slope | | | slope | | | slope | | | slope | | | slope | | |
| mm/links/depo | mm | links | deposition | mm | links | deposition | mm | links | deposition | mm | links | deposition | mm | links | deposition |
| 1 Mar 08 | 925 | 36 | 110 | 770 | 31 | 40 | 1005 | 39 | 0 | 1050 | 42 | 0 | | | |
| 17 Oct 08 | 800 | 34 | 60 | | | | 910 | 37 | 55 | 1006 | 41 | 0 | | | |
| 22 Mar 09 | 860 | 34 | 45 | 780 | 30 | 10 | 920 | 36 | 30 | 1015 | 40 | 25 | | | |
| 17 Oct 09 | 860 | 34 | 40 | 790 | 31 | 10 | 930 | 36 | 5 | 1040 | 42 | 0 | chain buried and not disturbed | | |
| 13 Mar 10 | 920 | 33 | | chain buried and not disturbed | | | 920 | 34 | 0 | 1050 | 41 | 0 | chain buried and not disturbed | | |
| 19 Oct 10 | 905 | 37 | 20 | 810 | 31 | 28 | 950 | | 20 | 1030 | 41 | 20 | chain buried and not disturbed | | |
| 28 Feb 11 | 972 | 39 | 0 | 815 | 31 | 10 | chain buried and not disturbed | | | 957+ | 41 | 10 | chain buried and not disturbed | | |

Table A2-32 continued

Table A2-33 Scour chain results zone 5

| **Zone** | **5** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Site** | **C** | | | **F** | | | **G** | | | **I** | | |
| **Scour Chain #** | **5c** | | | **5f** | | | **5g** | | | **5i** | | |
| Bank Location | slope | | | slope | | | slope | | | slope | | |
| mm/links/depo | mm | links | deposition | mm | links | deposition | mm | links | deposition | mm | links | deposition |
| 9 Dec 01 | | | | | | | 540 | 19.5 | 0 | | | |
| 9 Feb 02 | | | | | | | | | | | | |
| 10 Feb 02 | | | | | | | | | | 960 | 33 | 0 |
| 9 Mar 02 | 855 | 33 | 0 | 915 | 35 | 0 | 505 | 19 | 10 | 868 | 33 | 19 |
| 13 Apr 02 | | | | 920 | 35 | 10 | 525 | 19 | 8 | 867 | 33 | 12 |
| 5 Oct 02 | 793 | 31 | 35 | 1010 | 39 | 30 | 510 | 19 | 5 | 140 | 35 | 10 |
| 16 Dec 02 | 815 | 32 | 30 | 975 | 38 | 50 | 520 | 20 | 0 | 870 | 34 | 40 |
| 29 Mar 03 | 820 | 31 | 5 | 1000 | 38 | 50 | 525 | 19 | 5 | 870 | 33 | 0 |
| 18 Oct 03 | 790 | 31 | 47 | 890 | 34 | 40 | 520 | 20 | 0 | 873 | 33 | 22 |
| 6 Mar 04 | 805 | 31 | 20 | 875 | 34 | 22 | 525 | 19.5 | 5 | 880 | 34 | 0 |
| 9 Oct 04 | 790 | 32 | 40 | 950 | 36 | 25 | 530 | 20 | 0 | | | |
| 2 Apr 05 | 815 | 32 | 25 | 940 | 36 | 65 | 544 | 20 | 27 | 870 | 34 | 25 |
| 15 Oct 05 | Underwater | | | 890 | 33 | 35 | 520 | 20 | 0 | 880 | 34 | 40 |
| 11 Mar 06 | 850 | 33 | 50 | 870 | 33 | 50 | 565 | 21 | 0 | 868 | 33 | not recorded |
| 17 Oct 06 | 850 | 32 | 20 | 830 | 32 | 30 | 545 | 20 | 20 | 920 | 33 | 80 |
| 17 Mar 07 | 885 | 34 | 50 | 840 | 32 | 20 | 565 | 21 | 30 | 900 | 35 | 40 |
| 20 Oct 07 | 960 | 35 | 65 | 1225 | 46 | 100 | 550 | 20 | 30 | 860 | 33 | |

*Table A2-33 continued next page*

| **Zone** | **5** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Site** | **C** | | | **F** | | | **G** | | | **I** | | |
| **Scour Chain #** | **5c** | | | **5f** | | | **5g** | | | **5i** | | |
| Bank Location | slope | | | slope | | | slope | | | slope | | |
| mm/links/depo | mm | links | deposition | mm | links | deposition | mm | links | deposition | mm | links | deposition |
| 1 Mar 08 | 910 | 36 | 15 | 1177 | 45 | 35 | 530 | 20 | 0 | | 33 | 30 |
| 17 Oct 08 | 800 | 34 | 50 | | | | 550 | 21 | 0 | 820 | 32 | 15 |
| 22 Mar 09 | 860 | 33 | 5 | | | | 585 | 22 | 2 | 850 | 34 | 15 |
| 17 Oct 09 | 895 | 34 | 20 | chain buried and not disturbed | | | 587 | 22 | 0 | 840 | 32 | 30 |
| 13 Mar 10 | 922 | 35 | 15 | chain buried and not disturbed | | | 602 | 23 | 10 | 822 | 33 | 15 |
| 19 Oct 10 | 912 | 34 | 15 | chain buried and not disturbed | | | 612 | 23 | 5 | 790 | 31 | 0 |
| 27 Feb 11 | 925 | 36 | 50 | chain buried and not disturbed | | | 610 | 23 | 4 | 815 | 33 | 15 |

Table A2-33 continued

Table A2-34 Scour chain results zone 5 continued

| **Zone** | **5** | | | | | |
|---|---|---|---|---|---|---|
| **Site** | **J** | | | **L** | | |
| **Scour Chain #** | **5j** | | | **5l** | | |
| Bank Location | slope | | | slope | | |
| mm/links/depo | mm | links | deposition | mm | links | deposition |
| 9 Dec 01 | | | | | | |
| 9 Feb 02 | | | | | | |
| 10 Feb 02 | 1150 | 43 | 0 | | | |
| 9 Mar 02 | 1107 | 42 | 30 | 830 | 32 | 0 |
| 13 Apr 02 | | | | | | |
| 5 Oct 02 | 1120 | 42.5 | 0 | 845 | 33 | 0 |
| 16 Dec 02 | 1120 | 43 | 40 | 840 | 33 | 0 |
| 29 Mar 03 | 1110 | 43 | 15 | 845 | 32 | 0 |
| 18 Oct 03 | 1149 | 43 | 27 | 847 | 33 | 0 |
| 6 Mar 04 | 1130 | 45 | 0 | 840 | 33 | 0 |
| 9 Oct 04 | 1245 | 47 | 0 | 870 | 33 | 0 |
| 2 Apr 05 | 1210 | 47 | 30 | 895 | 34 | 20 |
| 15 Oct 05 | Underwater | | | 900 | 35 | 10 |
| 11 Mar 06 | 1265 | 47 | 50 | 905 | 36 | 10 |
| 17 Oct 06 | 1190 | 46 | 40 | 945 | 31 | 10 |
| 17 Mar 07 | 1190 | 45 | 20 | 975 | 37 | 20 |
| 20 Oct 07 | 1300 | 50 | 40 | 1010 | 38 | 20 |
| 1 Mar 08 | | 51 | 20 | 940 | 36 | 50 |
| 17 Oct 08 | 1320 | 52 | 0 | 920 | 36 | 20 |
| 22 Mar 09 | 1300 | 53 | 5 | 900 | 35 | 40 |
| 17 Oct 09 | 1350 | 54 | 5 | 960 | 36 | 80 |
| 13 Mar 10 | 1340 | 56 | 5 | chain buried and not disturbed | | |
| 19 Oct 10 | Buried underwater | | | 970 | 36 | 70 |
| 27 Feb 11 | Chain broken | | | 840 | 33 | 75 |

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# A3 Fluvial geomorphology erosion pin descriptions and graphed data

## A3.1 Abbreviations used in graphs

b/slope – back slope; slope behind crest of bank

b/water – back water

cave – bank cavity

cob – vertical cobble bank

col – vertical colluvial bank

crest – crest of bank

flow – sediment flow

HW – power station controlled high water marker

pipe – casing for piezometer measured as erosion pin

slope – sandy bank slope

toe – sandy bank toe

top – top of bank

Table A3-1 Description of erosion pin monitoring sites

| Zone | Turbine Level | Bank Material- Colluvial | Bank Material - Alluvial | Bank Material – Alluvial over cobbles or bedrock | Location -Inside bend | Location- Outside bend | Location- Straight reach | No. of pins per turbine level |
|---|---|---|---|---|---|---|---|---|
| Zone 1 | <1 | | 1C/1-4, 1E/4, 1E/5 | | 1C/1-4, 1E/4, 1E/5 | | | 6 |
| | 1-2 | 1A/1-7,1A/9 | 1E/2, 1E/3 | 1B/1, 1B/3, 1B/4, 1D/2, 1D/3 | 1B/1, 1B/3, 1B/4, | 1D/2, 1D/3, 1E/2, 1E/3 | 1A/1-7,1A/9 | 15 |
| | 2-3 | 1A/8C | 1E/1, 1E/6, 1E/7 | 1B/2, 1B/5, 1D/1, 1D/4 | 1B/2, 1B/5, | 1D/1, 1D/4, 1E/1, 1E/6, 1E/7 | 1A/8C | 8 |
| | >3 | 1A/8a, 1A/8b | | 1F/1-4 | | | 1A/8a, 1A/8b, 1F/1-4 | 6 |
| **Bank type, location totals** | | **11** | **11** | **13** | **9** | **9** | **15** | |
| Zone 2 | <1 | | 2B/8, 2C/4, 2D/4, 2E/5, 2H/3, 2H/6, 2J/3, 2K/5, 2L/4 | 2G/6 | 2D/4, 2J/3, 2K/5 | 2C/4, 2E/5 | 2B/8, 2G/6, 2H/3, 2H/6, 2L/4 | 10 |
| | 1-2 | | 2B/1, 2B,3, 2B/5, 2B/7, 2C/3, 2D/3, 2E/3, 2E/4, 2H/2, 2H/5, 2I/1, 2I/2, 2J/2, 2K/4, 2K/3, 2L/2, 2L/3 | 2A/1, 2A/2, 2G/2 | 2D/3, 2E/3, 2I/1, 2I/2, 2J/2, 2K/4, 2K/3 | 2C/3, 2E/4 | 2A/1, 2A/2, 2B/1, 2B,3, 2B/5, 2B/7, 2G/2, 2H/2, 2H/5, 2L/2, 2L/3 | 20 |
| | 2-3 | | 2B/2, 2B/4, 2B/6, 2C/1, 2C/2, 2D/1, 2D/2, 2E/1, 2E/2, 2H/1, 2H/4, 2J/1, 2K/1, 2K/2, 2L/1, 2L/5, 2L/6 | 2A/3, 2A/5, 2A/6, 2A/7, 2G/1, 2G/3, 2G/4, 2G/5 | 2D/1, 2D/2, 2J/1, 2K/1, 2K/2 | 2C/1, 2C/2, 2E/1, 2E/2 | 2A/3, 2A/5, 2A/6, 2A/7, 2B/2, 2B/4, 2B/6, 2G/1, 2G/3, 2G/4, 2G/5, 2H/1, 2H/4, 2L/1, 2L/5, 2L/6 | 25 |
| | >3 | | | 2A/4 | | | 2A/4 | 1 |
| **Bank type, location totals** | | **0** | **43** | **13** | **15** | **8** | **33** | |
| Zone 3 | <1 | | 32A/1, 3A/4, 3A/5, 3C/5, 3D/3, 3Ea/3, 3Eb/5, 3F/4, 3G/5 | 3B/5 | 3C/5 | 3D/3 | 32A/1, 3A/4, 3A/5, 3B/5, 3Ea/3, 3Eb/5, 3F/4, 3G/5 | 10 |
| | 1-2 | | 3A/2, 3A/3, 3C/2, 3C/3, 3C/4, 3D/2, 3Ea/4, 3Eb/3, 3Eb/4, 3G/2, 3G/3, 3G/4 | 3B/1, 3B/4, 3F/2, 3F/3, | 3C/2, 3C/3, 3C/4 | 3D/2 | 3A/2, 3A/3, 3B/1, 3B/4, 3Ea/4, 3Eb/3, 3Eb/4, 3F/2, 3F/3, 3G/2, 3G/3, 3G/4 | 16 |

| Zone | Turbine Level | Bank Material-Colluvial | Bank Material - Alluvial | Bank Material – Alluvial over cobbles or bedrock | Location -Inside bend | Location-Outside bend | Location-Straight reach | No. of pins per turbine level |
|---|---|---|---|---|---|---|---|---|
| Zone 3 (cont) | 2-3 | | 3A/5, 3A/6, 3C/1, 3D/1, 3D/4, 3Ea/2, 3Ea/5, 3Eb/2, 3Eb/6, 3G/1 | 3B/2, 3B/3, 3F/1 | 3C/1 | 3D/1, 3D/4 | 3A/5, 3A/6, 3B/2, 3B/3, 3Ea/2 3Ea/5, 3Eb/2, 3Eb/6, 3F/1, 3G/1 | 13 |
| | >3 | | 3Ea/1, 3Ea/6, 3Eb/1 | | | | 3Ea/1, 3Ea/6, 3Eb/1 | 3 |
| **Bank type, location totals** | | | **34** | **8** | **5** | **4** | **33** | |
| Zone 4 | <1 | | 4A/3, 4B/3, 4E/4, 4Ga/3, 4Ga/4, 4Gb/3, 4Gb/4, 4Gb/5, 4H/4, 4H/5 | | 4E/4 | 4H/4, 4H/5 | 4A/3, 4B/3, 4Ga/3, 4Ga/4, 4Gb/3, 4Gb/4, 4Gb/5 | 10 |
| | 1-2 | | 4A/2, 4B/2, 4E/3, 4Ga/2, 4Gb/2, 4H/3 | 4D/2, 4D/3, 4F/3, 4F/4, 4F/5 | 4E/3, 4F/3, 4F/4, 4F/5 | 4D/2, 4D/3, 4H/3 | 4A/2, 4B/2, 4Ga/2, 4Gb/2 | 11 |
| | 2-3 | | 4A/1, 4A/4, 4B/1, 4/B/4, 4E/1, 4E/2, 4Ga/1, 4Gb/1, 4H/1, 4H/2 | 4D/1, 4D/4, 4F/1, 4F/2, | 4E/1, 4E/2, 4F/1, 4F/2, | 4D/1, 4D/4, 4H/1, 4H/2 | 4A/1, 4A/4, 4B/1, 4/B/4, 4Ga/1, 4Gb/1 | 14 |
| | >3 | | | 4F/HW | 4F/HW | | | 1 |
| **Bank type, location totals** | | | **26** | **10** | **10** | **9** | **17** | |
| Zone 5 | <1 | | 5A/4, 5B/4, 5C/3, 5D/3, 5E/3, 5E/4, 5F/3, 5G/6, 5H/4, 5I/4, 5J/4, 5K/3, 5L/4, 5M/3 | | 5B/4, 5C/3, 5F/3, 5J/4, 5K/3 | 5H/4, 5I/4, 5M/3 | 5A/4, 5D/3, 5E/3, 5E/4, 5G/6, 5L/4 | 14 |
| | 1-2 | | 5A/3, 5B/2, 5B/3, 5B/5, 5B/6, 5C/2, 5D/2, 5E/2, 5F/2, 5G/2, 5G/3, 5G/4, 5G/5, 5H/2, 5H/3, 5I/2, 5I/3, 5I/6, 5J/3, 5J/2, 5K/2, 5L/2, 5L/3, 5M/2 | | 5B/2, 5B/3, 5B/5, 5B/6, 5C/2, 5F/, 5J/3, 5J/2, 5K/2 | 5H/2, 5H/3, 5I/2, 5I/3, 5I/6 | 5A/3, 5D/2, 5E/2, 5G/2, 5G/3, 5G/4, 5G/5, 5L/2, 5L/3, 5M/2 | 24 |

Table A3-1 *continued next page*

| Zone | Turbine Level | Bank Material-Colluvial | Bank Material - Alluvial | Bank Material – Alluvial over cobbles or bedrock | Location -Inside bend | Location-Outside bend | Location-Straight reach | No. of pins per turbine level |
|---|---|---|---|---|---|---|---|---|
| Zone 5 (cont) | 2-3 | | 5A/1, 5A/2, 5B/1, 5C/1, 5C/4, 5D/1, 5E/1, 5F/1, 5G/1, 5H/1, 5I/1, 5I/5, 5J/1, 5J/5, 5J/6, 5K/0, 5K/1, 5L/1, 5M/1 | | 5B/1, 5C/1, 5C/4, 5F/1, 5J/1, 5J/5, 5J/6, 5K/0, 5K/1 | 5H/1, 5I/1, 5I/5 | 5A/1, 5A/2, 5D/1, 5E/1, 5G/1, 5L/1, 5M/1 | 19 |
| | >3 | | | | | | | |
| **Bank type, location totals** | | | **57** | **0** | **23** | **11** | **23** | |

Table A3-1 continued

# A3.2 Graphs of erosion pin results at each site

## A3.2.1 Zone 1

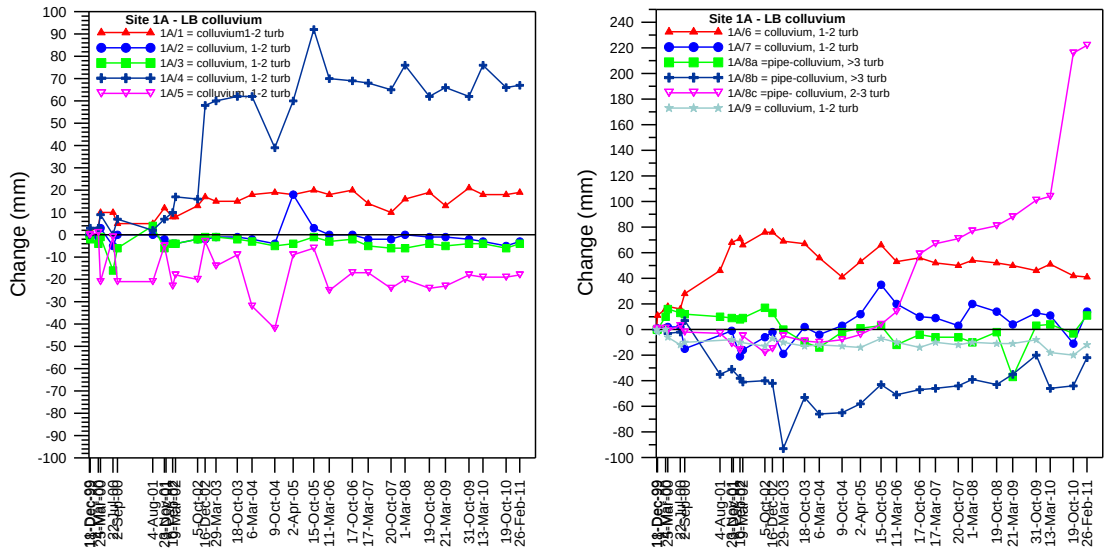


Figure A3-1 Erosion pin graphs, site 1A (left), and 1A continued (right)

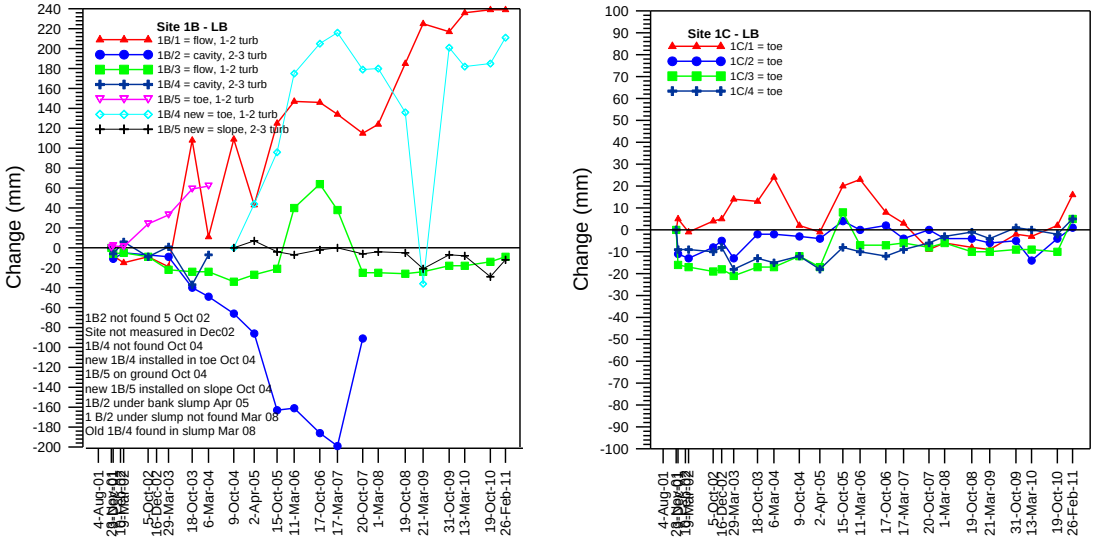


Figure A3-2 Erosion pin graphs, site 1B (left) and 1C (right)

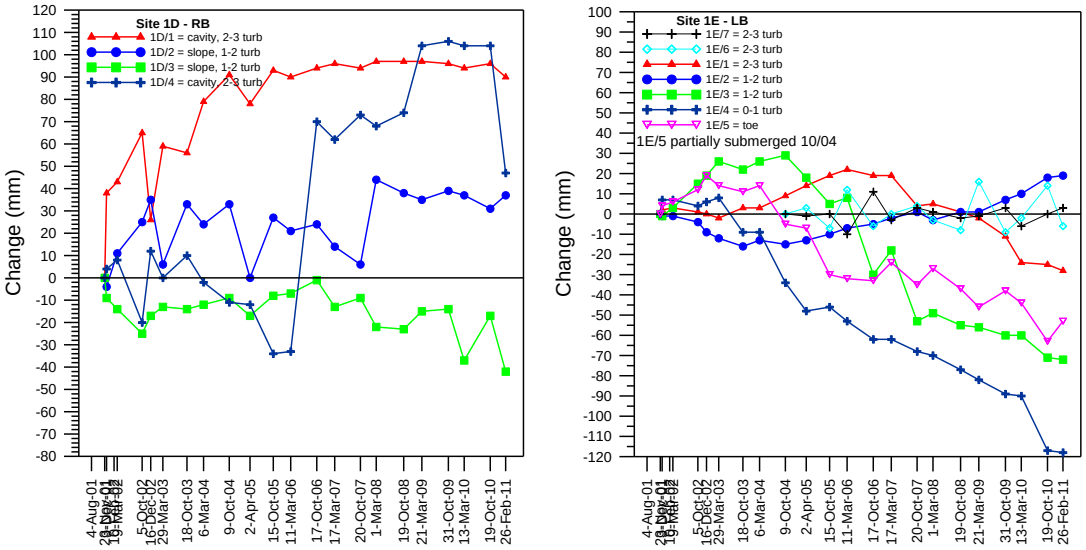


Figure A3-3 Erosion pin graphs, site 1D (left) and 1E (right)

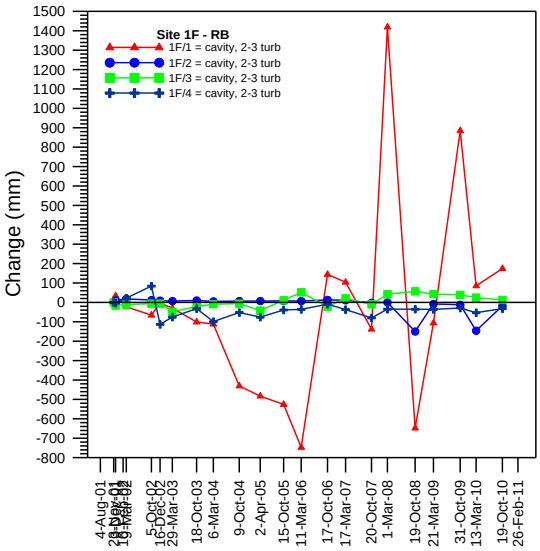


Figure A3-4 Erosion pin graph, site 1F

## A3.2.2 Zone 2

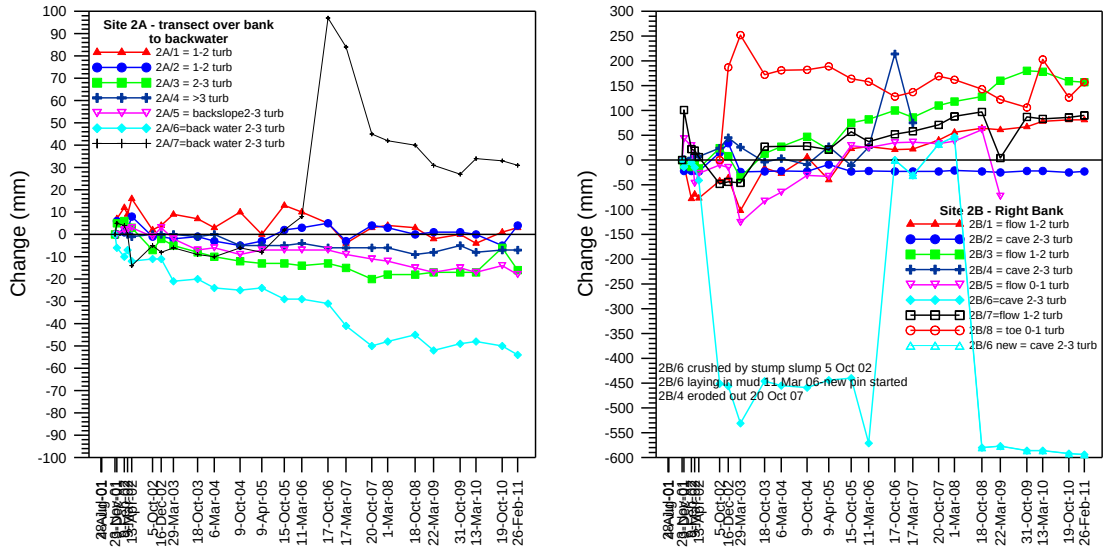


Figure A3-5 Erosion pin graphs, site 2A (left) and 2B (right)

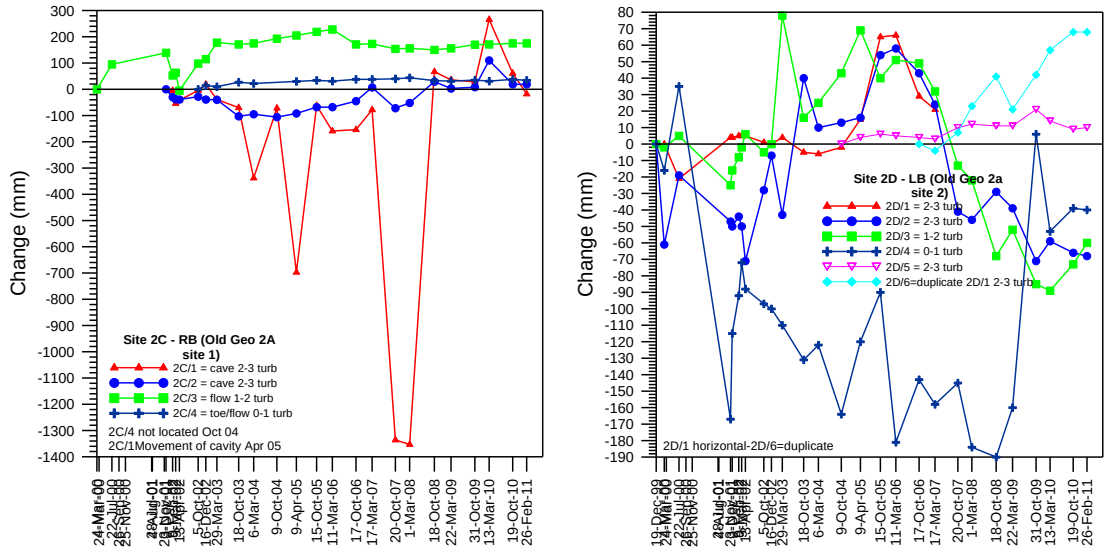


Figure A3-6 Erosion pin graphs, site 2C (left) and 2D (right)

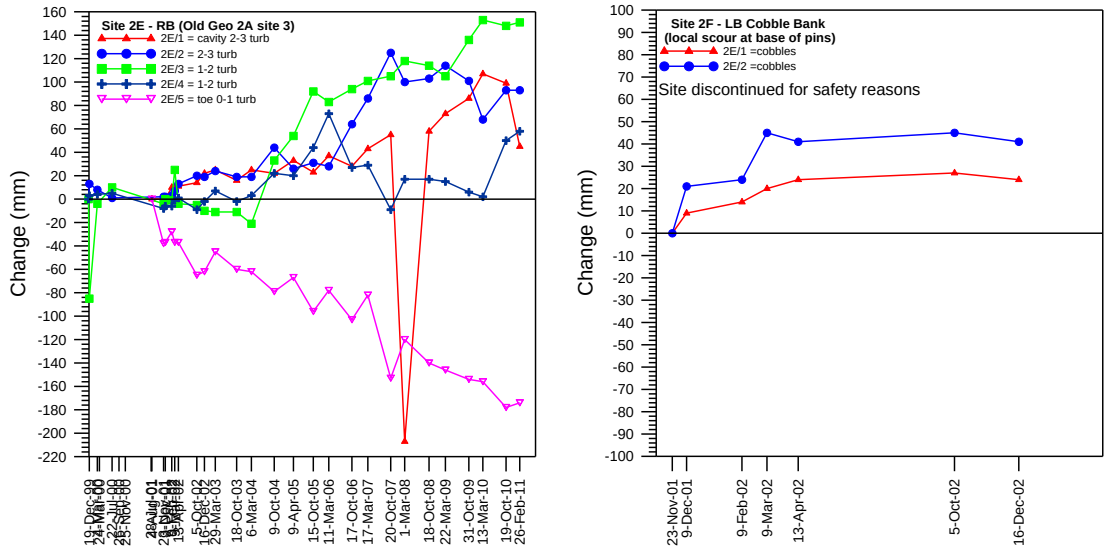


Figure A3-7 Erosion pin graphs, site 2E (left) and 2F (right)

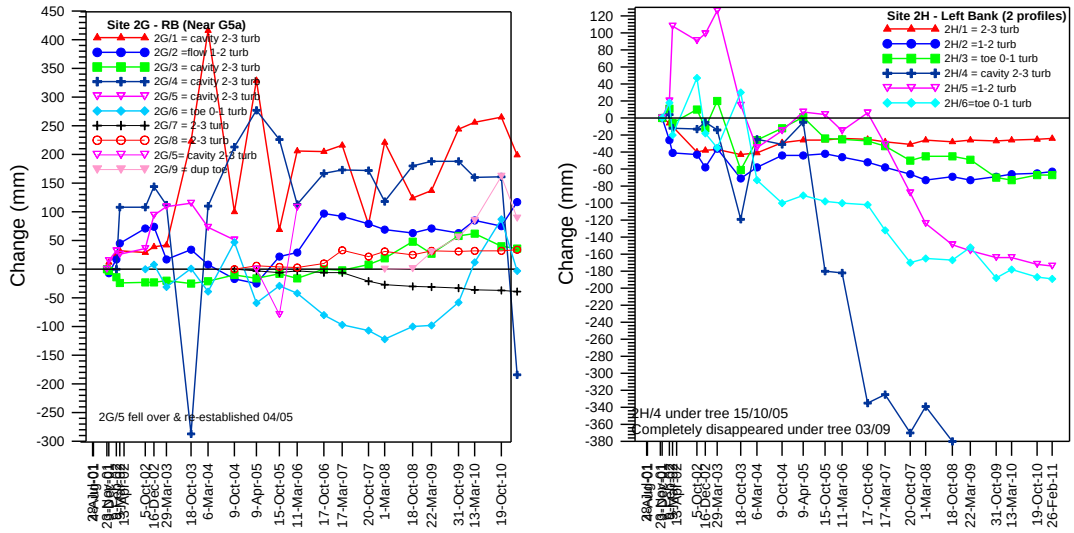


Figure A3-8 Erosion pin graphs, site 2G (left) and 2H (right)

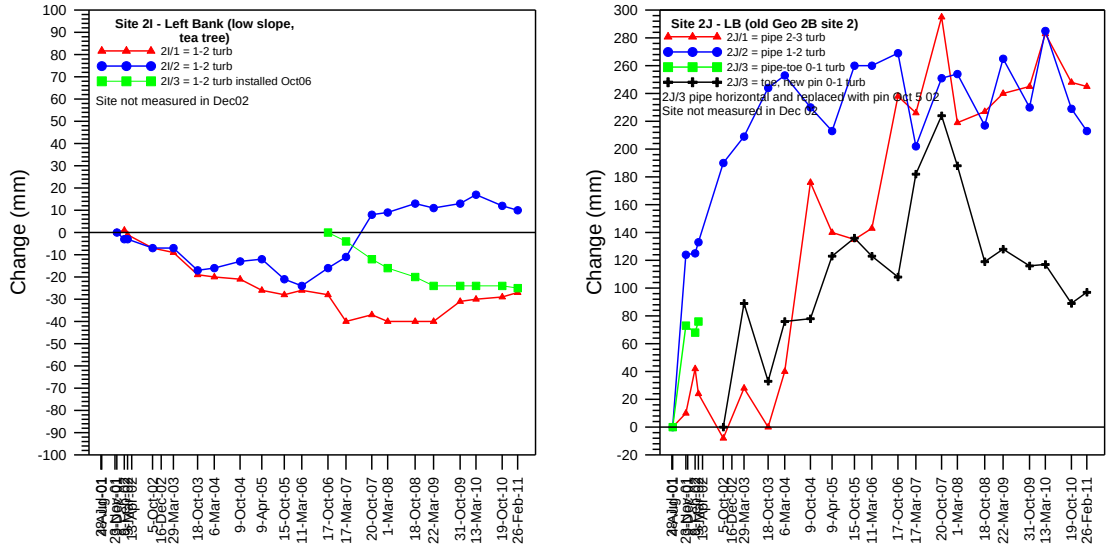


Figure A3-9 Erosion pin graphs, site 2I (left) and 2J (right)

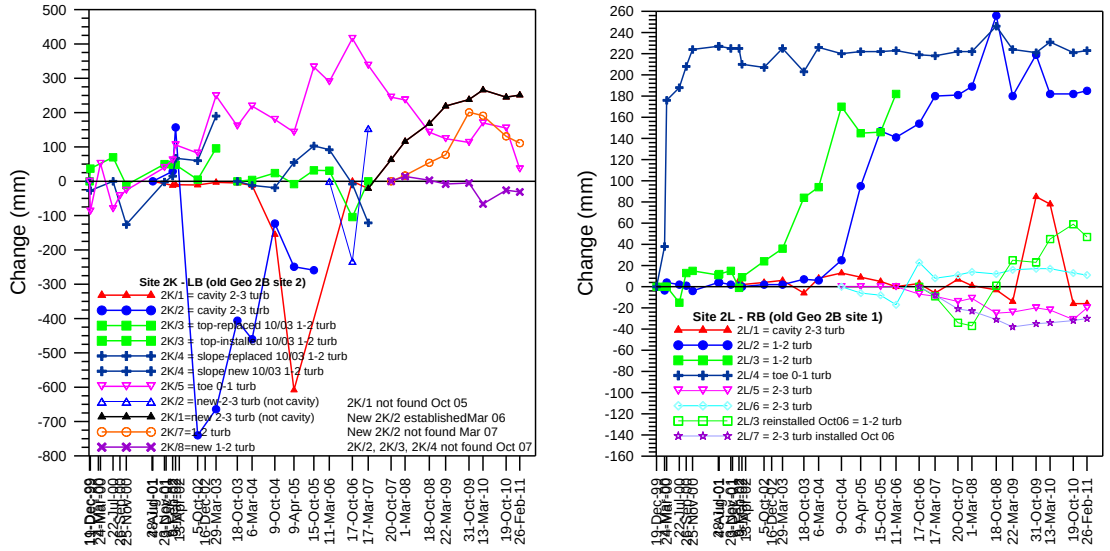


Figure A3-10 Erosion pin graphs, site 2K (left) and 2L (right)

## A3.2.3 Zone 3

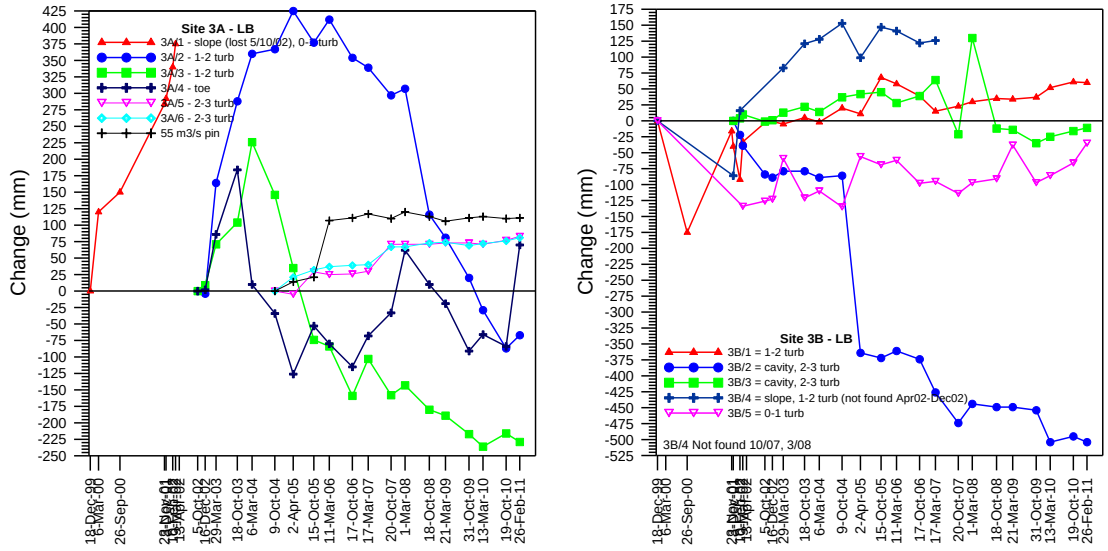


Figure A3-11 Erosion pin graph, sites 3A (left) and 3B (right)

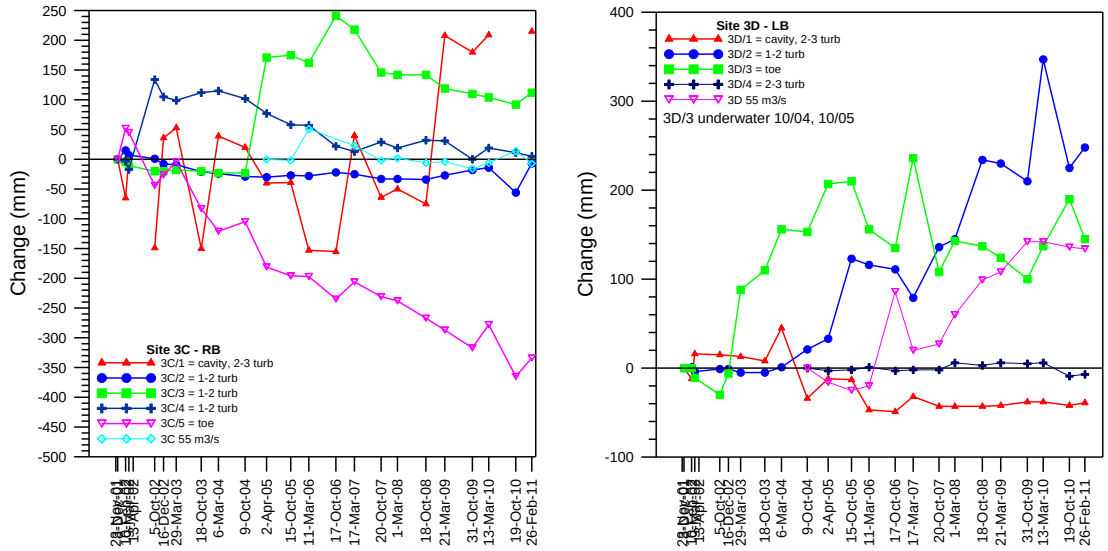


Figure A3-12 Erosion pin graphs, site 3C (left) and 3D (right)

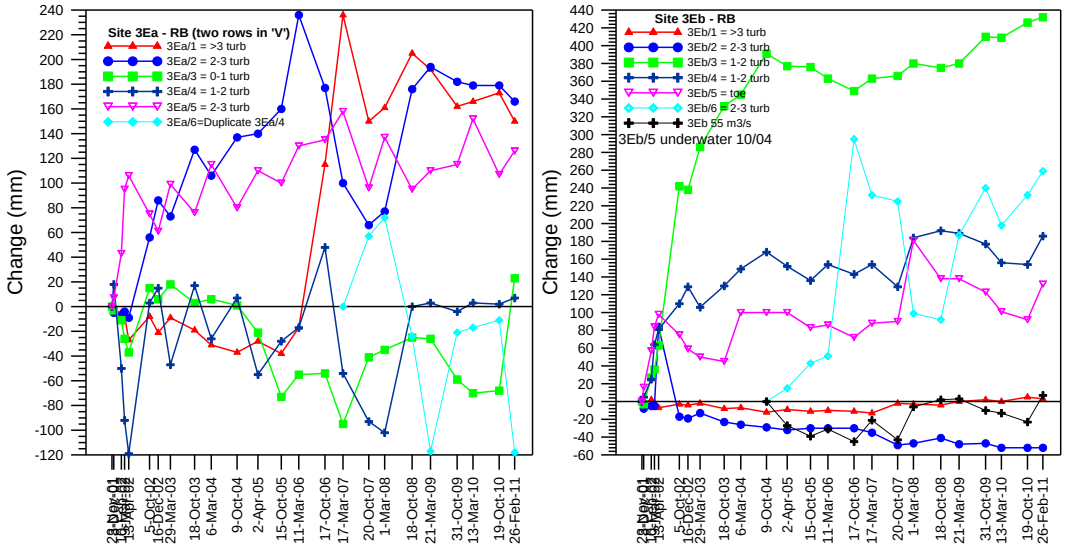


Figure A3-13 Erosion pin graphs, site 3Ea (left) and 3Eb (right)

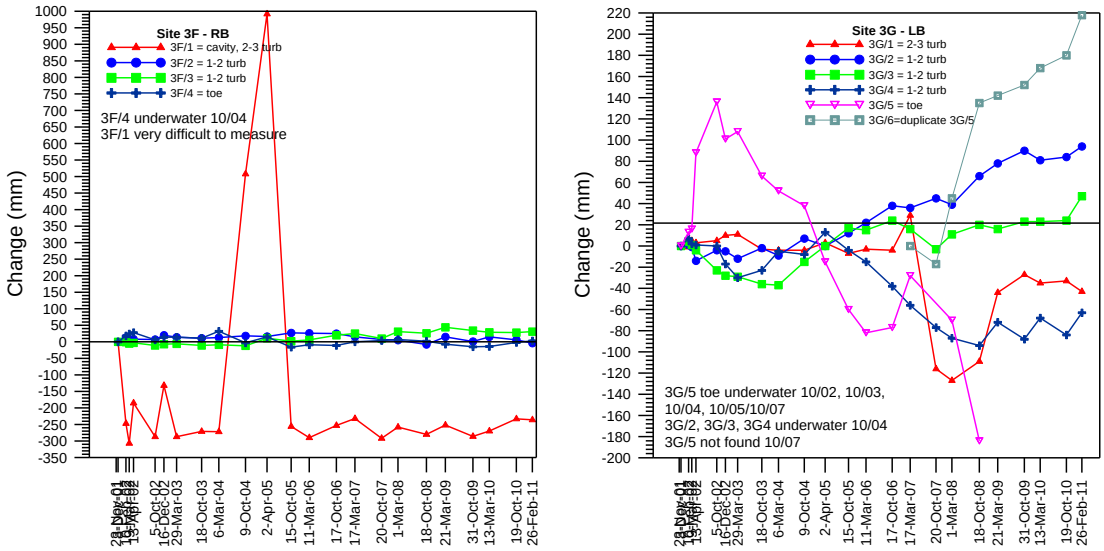


Figure A3-14 Erosion pin graphs, site 3F (left) and 3G (right)

## A3.2.4 Zone 4

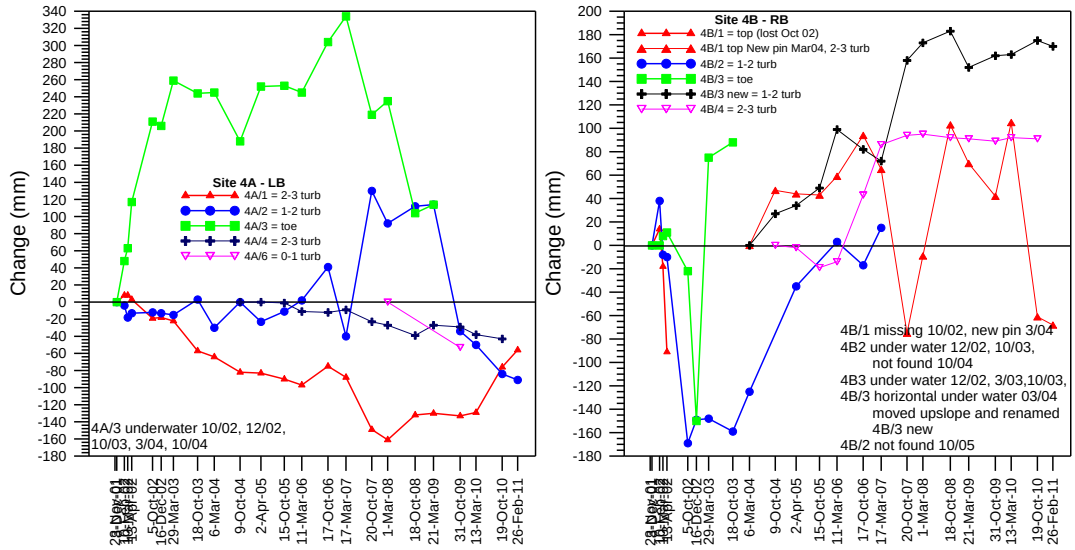


Figure A3-15 Erosion pin graphs, site 4A (left) and 4B (right)

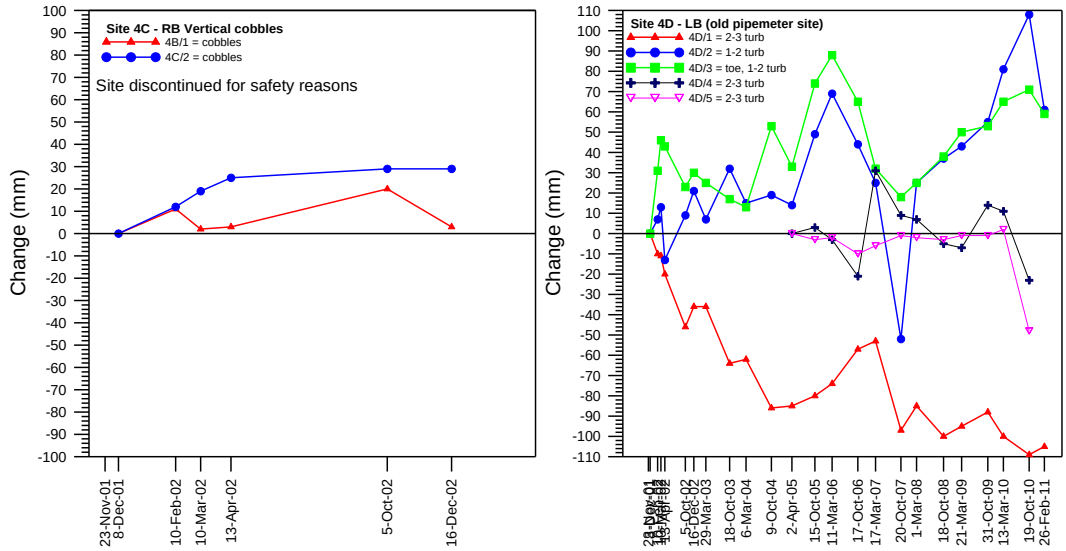


Figure A3-16 Erosion pin graphs, site 4C (left) and 4D (right)

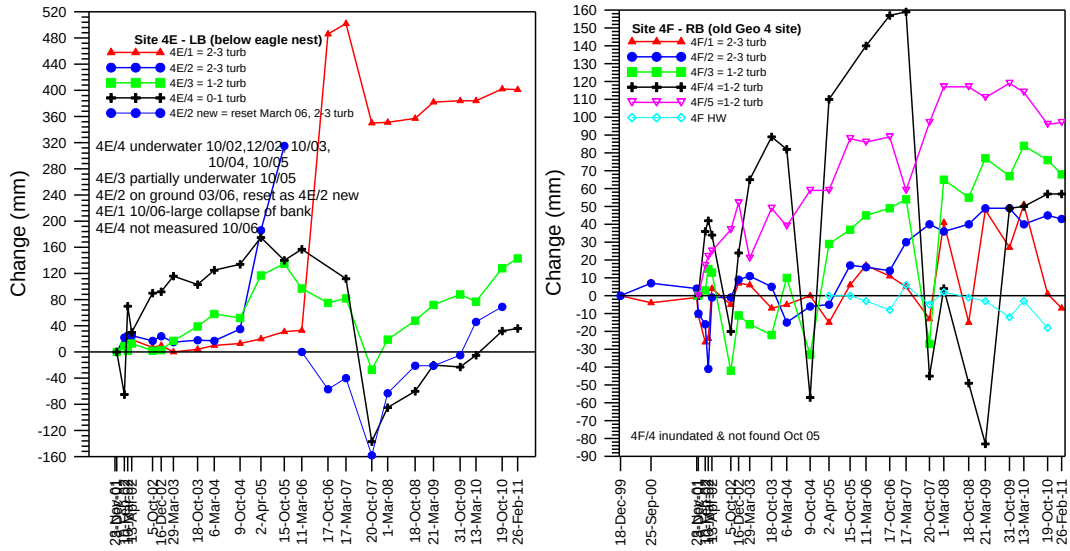


Figure A3-17 Erosion pin graphs, site 4E (left) and 4F (right)

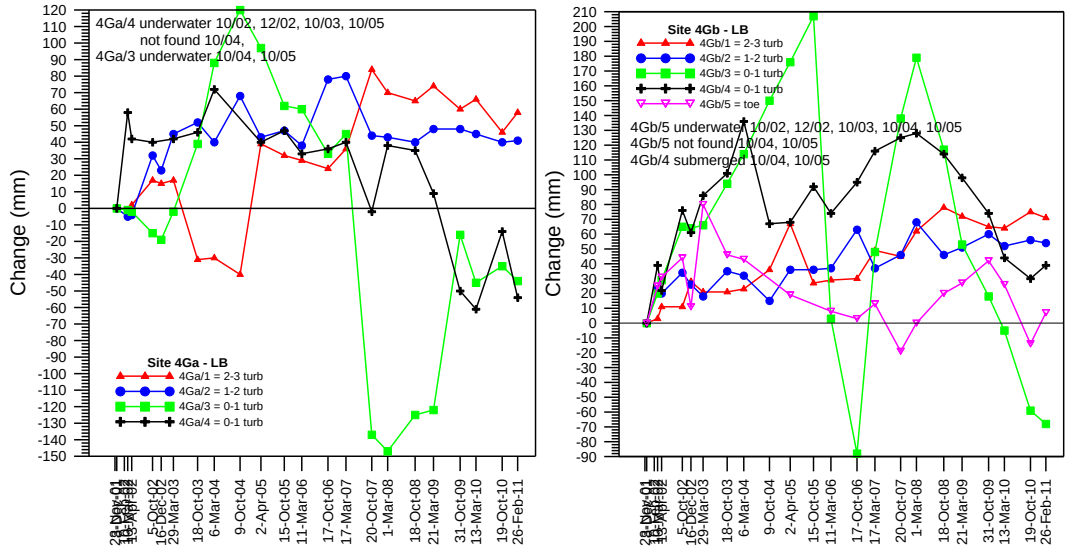


Figure A3-18 Erosion pin graphs, site 4Ga (left) and 4Gb (right)

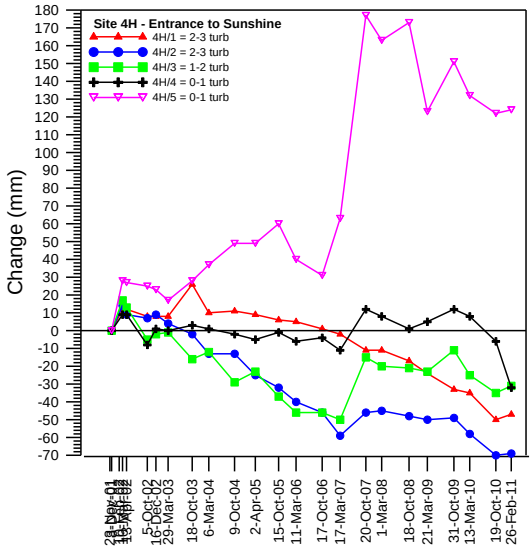


Figure A3-19 Erosion pin graph, site 4H

## A3.2.5 Zone 5

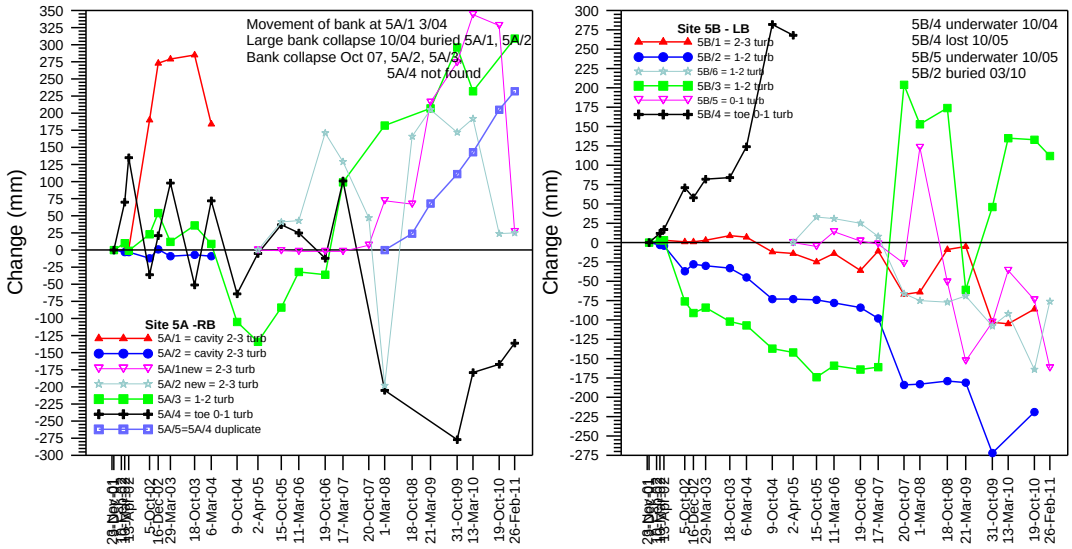


Figure A3-20 Erosion pin graphs, site 5A (left) and 5B (right)

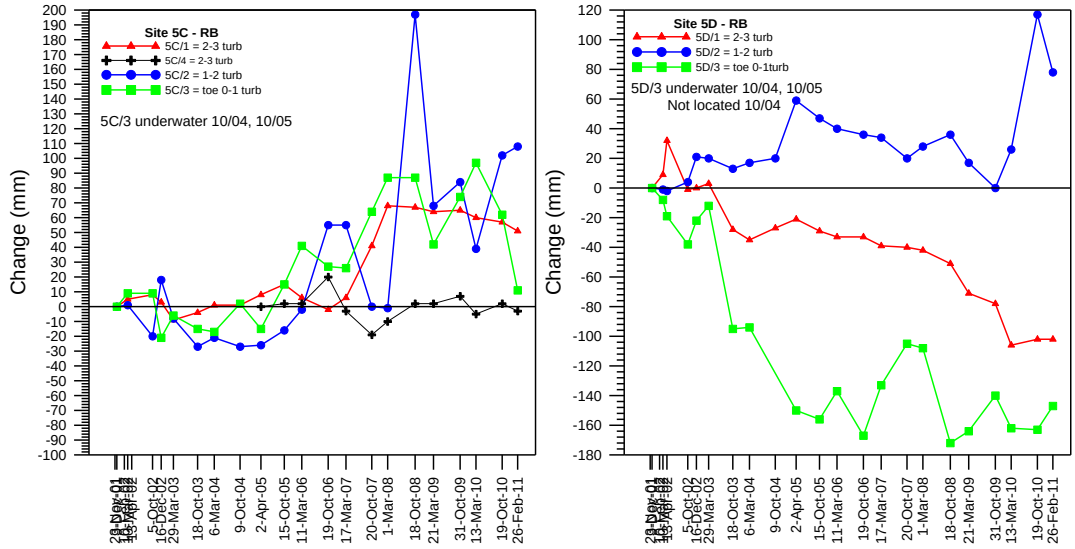


Figure A3-21 Erosion pin graphs, site 5C (left) and 5D (right)

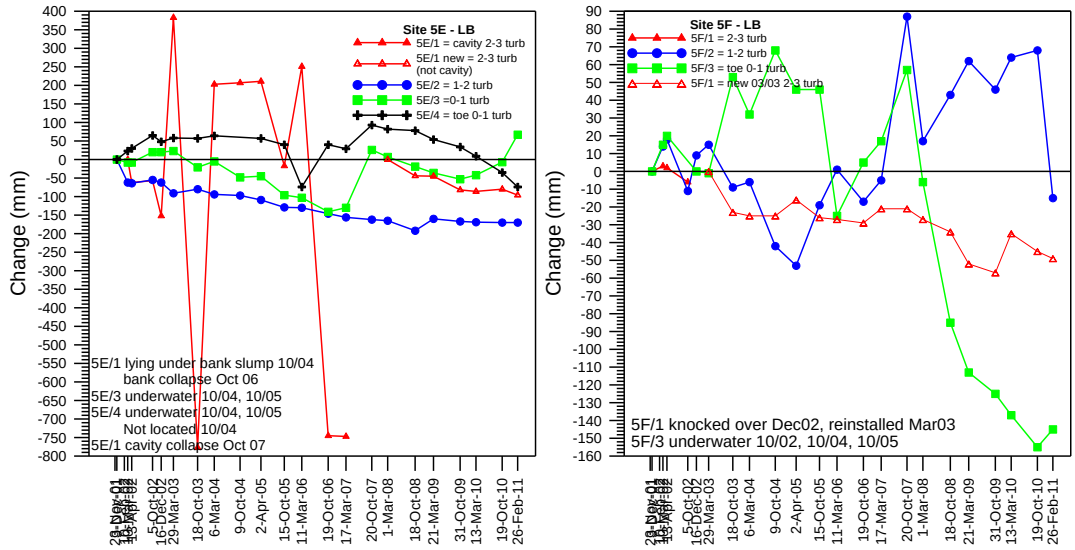


Figure A3-22 Erosion pin graphs, site 5E (left) and 5F (right)

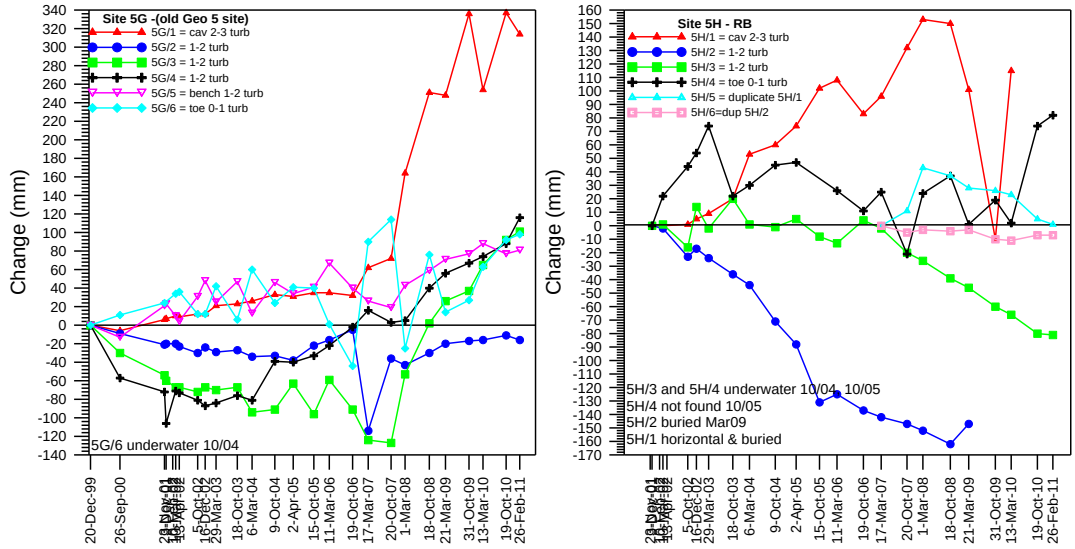


Figure A3-23 Erosion pin graphs, site 5G (left) and 5H (right)

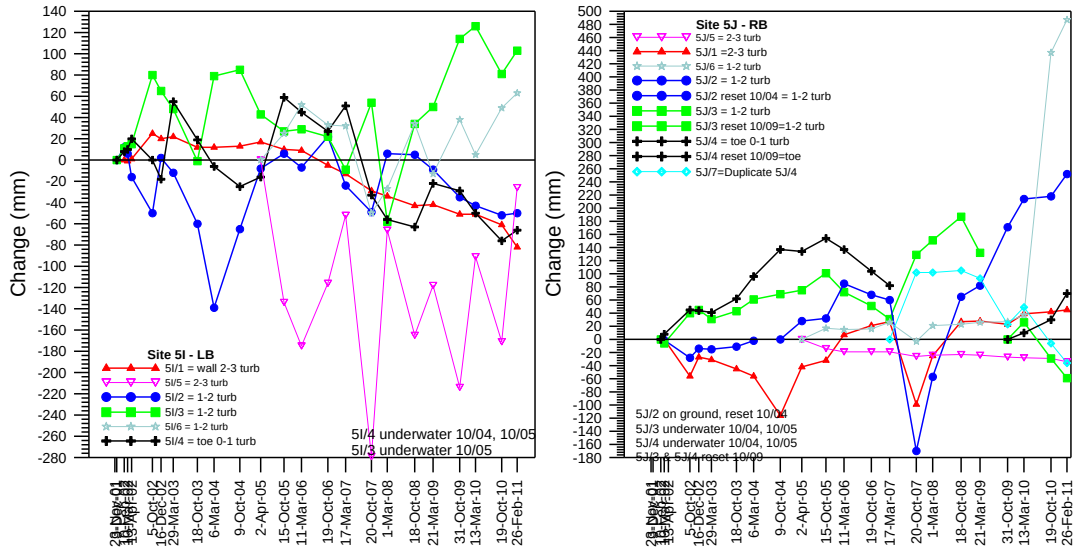


Figure A3-24 Erosion pin graphs, site 5I (left) and 5J (right)

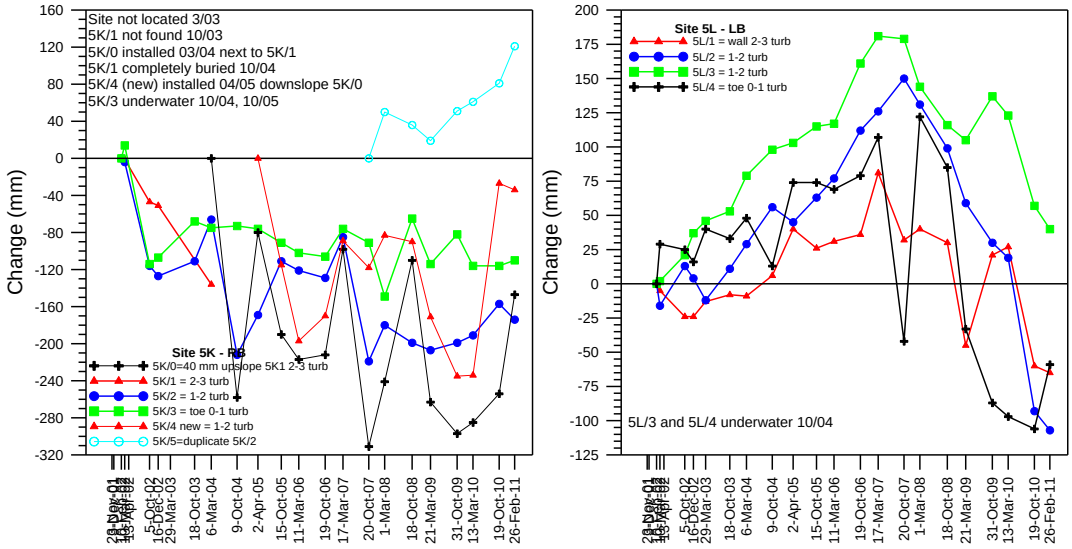


Figure A3-25 Erosion pin graphs, site 5K (left) and 5L (right)

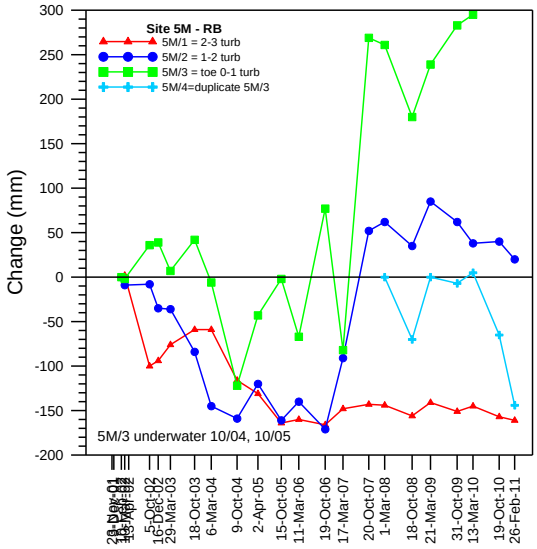


Figure A3-26 Erosion pin graph, site 5M

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# A4 Fluvial geomorphology photo-monitoring and site descriptions

Table A4-1 Summary of photo-monitoring in March 2011. Evaluation of changes based on comparison of photos taken in March 2010

FI = Flood impact, Mvmt = movement, WD = woody debris, WL = water level, Turb = turbine level

| Site | No apparent change | Slip/ tree fall upslope of HW level | Removal of veg at base of slip | Increased veg on slip upslope of HW level | Poor photo – no apparent change | Poor photo – apparent change | No photo taken | Other |
|---|---|---|---|---|---|---|---|---|
| P1-1 | 03, 04, 05, 06, 07, 08, 09, 10, 11 | | | | | | | |
| P1-2 | 03, 04, 06, 07, 08, 09, 10, 11 | | | | 05 | | | |
| P1-3 | 03, 04, 05, 06, 07, 08, 09, 10, 11 | | | | | | | |
| P1-4a | 03, 04, 05, 07, 08, 10, 11 | | 06 | | | | 09 | |
| P1-4b | 0, 05, 07, 08, 09, 10, 11 | 03 | 03, 06 | | | | | |
| P1-5 | 03, 04, 06, 07, 08, 09, 10, 11 | | | | 05 | | | |
| P2-1a | 03, 04, 05, 07, 08, 09, 10, 11 | | | | | | | 06 Inc in veg bel HW level |
| P2-1b | 03, 04, 05, 09 | | | | | | 08 | 06 Inc in veg bel HW level, 07 less sand on bank toe, 11 sand dep on toe |
| P2-2new 1 | 08 | 09 | | | | | | 10 eros. of slumped root mat, 11 Inc veg, mvmt of WD on toe |
| P2-2new 2 | 06, 07, 08, 10 | 09 | 05 | | | | | 11 mvmt of WD on toe |
| P2-2a | 07, 09, 10 | 04, 08 | | 03, 05 | 06 | | | |
| P2-2b | 03, 04, 07 | 08, 10, 11 | | 06, 09, 11 | | | 05 | 06, Inc in veg bel HW level, |
| P2-3 | 07, 11 | 04, 08 | 05 | 03 | 06, 10 | | | |
| P2-4 | 11 | 03 | | 03, 04, 05, 06, 08, 09, 10 | | | | 07 loss of leaves from tree fall on bank crest; 09 shifting of wd on toe |
| P2-5 | 04, 07, 08 | 03, 11 | 06 | | | 03, 04 | | 04 inc tree fall?, 05 small tree fall or accum of debris on toe; 07 inc sand dep on bank?, 09 mvmt of wd on toe, 10 mvmt of wd on toe |

| Site | No apparent change | Slip/ tree fall upslope of HW level | Removal of veg at base of slip | Increased veg on slip upslope of HW level | Poor photo – no apparent change | Poor photo – apparent change | No photo taken | Other |
|---|---|---|---|---|---|---|---|---|
| P2-6 | 04, 05, 08 | | | | | | | 03 inc. coating on cobbles; 06 loss of cobbles, 09 loss of cobbles, 10 scour of cobbles, 11 scour of cobbles |
| P2-new3 | 07, 08, 09, 10, 11 | | | | | | | |
| P2-7 | 03, 04, 05, 06, 07, 08, 09, 10, 11 | | | | | | | |
| P2-8 | 03, 04, 05, 06, 07, 08, 09, 10 | | | | | | | |
| P2-9 | 04, 05, 08, 09, | | | 03, 06, 07, 10, 11 | | 03 | | 07 maybe inc erosion on face, 10 & 11 mvmt wd on toe |
| P2-10 | 03, 04, 05, 06, 07, 08, 09, 11 | | | | | | | |
| P2-11 | 04, 05, 06, 07, 08 | | | | 09, 11 | | 03, 10 poor light | |
| P3-1 | 04, 05, 06, 07, 08, 09, 10 | | 03 | | | | | 11 change to WD on toe |
| P3-2 | 03, 04, 05, 07, 08, 09, 11 | | | | | | 06 | 10 mvmt wd on toe |
| P3-3 | 03, 04, 05, 09, 11 | | | 07 | | | | 06 flood debris 08 loss of small veg in 2-3 turb, 10 mvmt wd on toe |
| P3-4 | 04, 05, 06, 07, 08, 09 | 10, 11 | | | | 03 | | 03 may not be same site |
| P3-5 | 03, 04, 05, 06, 07, 10, 11 | 09 | | | | | | 08 removal of WD & veg (FI) |
| P4-new1 | 07, 11 | 09, 10 | | | | | | 08 new wd on toe (FI) |
| P4-new2 | 07 | | | | 09 | | | 08 new wd on toe (FI);09 poor light conditions, 10, 11 mvmt wd on toe |
| P4-1 | 03, 04, 05, 06, 07, 08, 09, 10 | | | | | | 11 | |
| P4-new3 | 07, 09, 10, 11 | | | | | | | 08 loss of WD from toe (FI) |
| P4-2 | 04, 08, 09, 11 | 07 | | | 03 | | | 06 inc veg 2-3 turb level, 10 mvmt WD on toe |
| P4-3 | 05, 06 | 10 | 03, 04, 09 | | | | | 07 overhanging veg may be lower<br>08 inc WD on toe (FI); 09 loss of fine branches on toe wd, 11 mvmt of WD on toe |

| Site | No apparent change | Slip/ tree fall upslope of HW level | Removal of veg at base of slip | Increased veg on slip upslope of HW level | Poor photo – no apparent change | Poor photo – apparent change | No photo taken | Other |
|---|---|---|---|---|---|---|---|---|
| P4-4a | 03, 04, 05, 07, 08, 09, 10, 11 | | 06 | | | | | |
| P4-4b | 03, 04, 05, 09, 10, 11 | | 06 | | | | | 07 movmt of WD<br>08change to WD (FI) |
| P4-4c | 07, 08, 09, 10, 11 | | | | | | | 04, change to dist'n of sand on cobble bar; 06 loss of flood debris |
| P4-5 | 03, 04, 05, 06, 07, 08, 09, 10,11 | | | | | | | |
| P4-6 | 03, 04, 07, 08, 09, 11 | | | | 05, 06 | | 10 | |
| P4-7 | 04, 06, 08, 09 | | | 05 | 03 | | 10 (bad light), 11 | 07 movmt of submerged wd |
| P4-8 | 04, 05, 06, 07, 09, 10 | | | | 03 | | | 08 movmt of WD (FI), 11 mvmt of WD on toe |
| P5-1 | 04, 05, 06, 07, 08, 09, 10, 11 | | | | | 03 | | 03 extra slip? |
| P5-2 | 03, 04, 06, 07, 08, 09, 10, 11 | | 05 | | | | | |
| P5-3 | 04, 06, 08, 09, 11 | | | 05 | 03, 07 | | 10 | |
| P5-4 | 03, 04, 05, 06, 07, 09, 10, 11 | | | | | | 08 | |
| P5-5 | 05, 08, 09 | | | | | 04 | 11 | 04, additional small tree fell, 06 movement of veg d/slope, 07 loss of branches, 10 mvmt wd on toe |
| P5-6 | 04, 07, 09, 10, 11 | | | 05, 06 | 03, | | | 06 inc veg 2-3 turb<br>08 movmt of WD on toe (FI) |
| P5-7 | 04, 07, 08, 09, 10 | | 05 | 06 | 03 | | | 06 inc veg 2-3 turb, 11 mvmt WD on toe |
| P5-8 | 04, 06, 07, 08, 09, 10, 11 | | | 05 | 03 | | | |
| P5-9 | 03, 04, 05, 06, 07 | | | | | | 11 | 08 inc WD on toe (FI), 09 mvmt wd on toe |
| P5-10 | 04, 05, 07, 08, 09, 10, 11 | | 03 | | | | | 06 inc WD at base |
| P5-11 | 03, 04, 07, 08, 09, 10, 11 | | 06 | 05 | | | | 05 inc veg below high WL |
| P5-12 | 04, 05, 07, 09, 10, 11 | | 03 | | | | | 06 inc WD at base<br>08inc SWD on toe |

| Site | No apparent change | Slip/ tree fall upslope of HW level | Removal of veg at base of slip | Increased veg on slip upslope of HW level | Poor photo – no apparent change | Poor photo – apparent change | No photo taken | Other |
|---|---|---|---|---|---|---|---|---|
| P5-13 | 03, 04, 05, 06, 07, 08, 11 | 10 | | | | | 09 | |
| P5-14 | 03, 04, 07 | 10 | | 06 | 11 | | 09 | 08 inc WD on toe (FI) |
| P5-15 | 04, 05, 06, 07, 08, 09, 10, 11 | | | 03 inc. in veg on bar | | 03 | | |
| P5-16 | 06, 07, 08, 09, 10, 11 | | 03 | 04, 05 | | | | 03 movement of branch downslope |
| P5-17 | 03, 04, 06, 08, 09 | | 05 | 07 | | | | 06 maybe inc veg in 2-3 turb, 10&11 mvmt wd on bank |
| P5-18 | 04, 05, 06, 08, 09, 10 | | | | | | | 03 may not be same site;07 new dead tree fall, 11 mvmt WD on toe |
| P5-19 | 06, 07, 09 | | | 04, 05, 10, 11 | 03 | | | 08 Erosion of slip face-major change |
| P5-20 | 04, 05, 06, 07, 08, 09, 10, 11 | | | | 03 | | | |
| P5-21 | 04, 07, 10 | | | 09 | 11 | | 03, 05 | 06 inc veg 2-3 turb<br>08 loss of veg 2-3 turb (may not be same site) |
| **2011 Total** | **36** | **3** | **0** | **3** | **3** | **0** | **4** | **12** |

Table A4-1 continued

## A4.1 Zone 1


Photo A4-1 Zone 1, site 1 – 9 March 2002 (left), 29 March 2003 (right)

No data available for 6 March 2004


Photo A4-2 Zone 1, site 1 – 2 April 2005 (left), 11 March 2006 (right)


Photo A4-3 Zone 1, site 1 – 17 March 2007 (left), 1 March 2008 (right)


Photo A4-4 Zone 1, site 1 – 21 March 2009 (left), 13 March 2010 (right)

Photo A4-5 Zone 1, site 1 – 26 February 2011


Photo A4-6 Zone 1, site 2 – 9 March 2002 (left), 29 March 2003 (right)


Photo A4-7 Zone 1, site 2 – 6 March 2004 (left), 3 April 2005 (right)


Photo A4-8 Zone 1, site 2 – 11 March 2006 (left), 17 March 2007 (right)


Photo A4-9 Zone 1, site 2 – 1 March 2008 (left), 21 March 2009 (right)


Photo A4-10 Zone 1, site 2 – 13 March 2010 (left), 26 February 2011 (right)


Photo A4-11 Zone 1, site 3 – 9 March 2002 (left), 29 March 2003 (right)


Photo A4-12 Zone 1, site 3 – 6 March 2004 (left), 3 April 2005 (right)


Photo A4-13 Zone 1, site 3 – 11 March 2006 (left), 17 March 2007 (right)


Photo A4-14 Zone 1, site 3 – 1 March 2008 (left), 21 March 2009 (right)


Photo A4-15 Zone 1, site 3 – 13 March 2010 (left), 26 February 2011 (right)


Photo A4-16 Zone 1, site 4 – 9 March 2002 (left), 29 March 2003 (right)


Photo A4-17 Zone 1, site 4 – 6 March 2004 (left), 3 April 2005 (right)


Photo A4-18 Zone 1, site 4 – 11 March 2006 (left), 17 March 2007 (right)


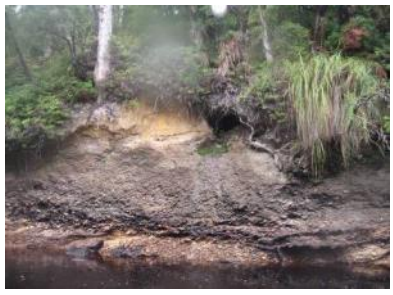

Photo A4-19 Zone 1, site 4 – 1 March 2008 (left), 21 March 2009 (right – wrong site, slightly upstream)


Photo A4-20 Zone 1, site 4 – 13 March 2010 (left), 26 February 2011 (right)

Photo A4-21 Zone 1, site 4b – 9 March 2002 (left), October 2002 (middle). Note vegetation at base which is absent on 29 March 2003 (right)

Photo A4-22 Zone 1, site 4b – 6 March 2004 (left), 3 April 2005 (right)

Photo A4-23 Zone 1, site 4b – 11 March 2006 (left), 17 March 2007 (right)

Photo A4-24 Zone 1, site 4b – 1 March 2008 (left), 21 March 2009 (right)

Photo A4-25 Zone 1, site 4b – 13 March 2010 (left), 26 February 2011 (right)


Photo A4-26 Zone 1, site 5 – 9 March 2002 (left), 29 March 2003 (right)


Photo A4-27 Zone 1, site 5 – 6 March 2004 (left), 3 April 2005 (right)


Photo A4-28 Zone 1, site 5 – 11 March 2006 (left), 17 March 2007 (right)


Photo A4-29 Zone 1, site 5 – 1 March 2008 (left), 21 March 2009 (right)


Photo A4-30 Zone 1, site 5 – 13 March 2010 (left), 26 February 2011 (right)

## A4.2 Zone 2


Photo A4-31 Zone 2, site 1a – 9 March 2002 (left), 29 March 2003 (right)


Photo A4-32 Zone 2, site 1a – 6 March 2004 (left), 3 April 2005 (right)


Photo A4-33 Zone 2, site 1a – March 2006 (left), 17 March 2007 (right)


Photo A4-34 Zone 2, site 1a – 1 March 2008 (left), 21 March 2009 (right)


Photo A4-35 Zone 2, site 1a – 13 March 2010 (left), 26 February 2011 (right)


Photo A4-36 Zone 2, site 1b – 9 March 2002 (left), 29 March 2003 (right)


Photo A4-37 Zone 2, site 1b – 6 March 2004 (left), 3 April 2005 (right)


Photo A4-38 Zone 2, site 1b – 11 March 2006 (left), 17 March 2007 (right)

Photo not taken 1 March 2008 (field error) – no changes noted in field notes.


Photo A4-39 Zone 2, site 1b – 21 March 2009 (left), 13 March 2010 (right)

Photo A4-40 Zone 2, site 1b – 26 February 2011


Photo A4-41 Zone 2, site new 1 – 11 March 2006 (left), 17 March 2007 (right)


Photo A4-42 Zone 2, site new 1 – 1 March 2008 (left), 21 March 2009 (right)


Photo A4-43 Zone 2, site new 1 – 13 March 2010 (left), 26 February 2011 (right)


Photo A4-44 Zone 2, site new 2 – 6 March 2004 (left), 9 April 2005 (right)


Photo A4-45 Zone 2, site new 2 – 11 March 2006 (left), 17 March 2007 (right)


Photo A4-46 Zone 2, site new 2 – 1 March 2008 (left), 21 March 2009 (right)


Photo A4-47 Zone 2, site new 2 – 13 March 2010 (left), 26 February 2011 (right)


Photo A4-48 Zone 2, site 2a – 9 March 2002 (left), 29 March 2003 (right)


Photo A4-49 Zone 2, site 2a – 6 March 2004 {downstream end} (left), 9 April 2005 (right)


Photo A4-50 Zone 2, site 2a – 11 March 2006 (left), 17 March 2007 (right)


Photo A4-51 Zone 2, site 2a – 1 March 2008 (left), 21 March 2009 (right)

Photo not taken in 2011

Photo A4-52 Zone 2, site 2a – 13 March 2010

Photo A4-53 Zone 2, site 2b – 9 March 2002 (left), 29 March 2003 (middle), 6 March 2004 (right)

Photo not taken April 2005

Photo A4-54 Zone 2, site 2b – 11 March 2006 (left), 17 March 2007 (right)

Photo A4-55 Zone 2, site 2b – 1 March 2008 (left), 21 March 2009 (right)

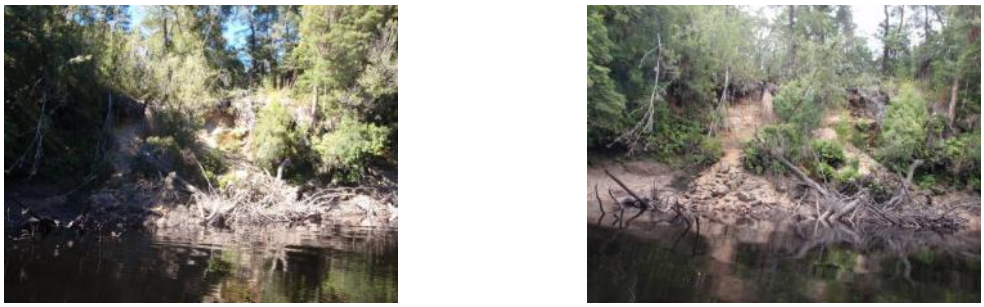

Photo A4-56 Zone 2, site 2b – 13 March 2010 (left), 26 February 2011 (right)

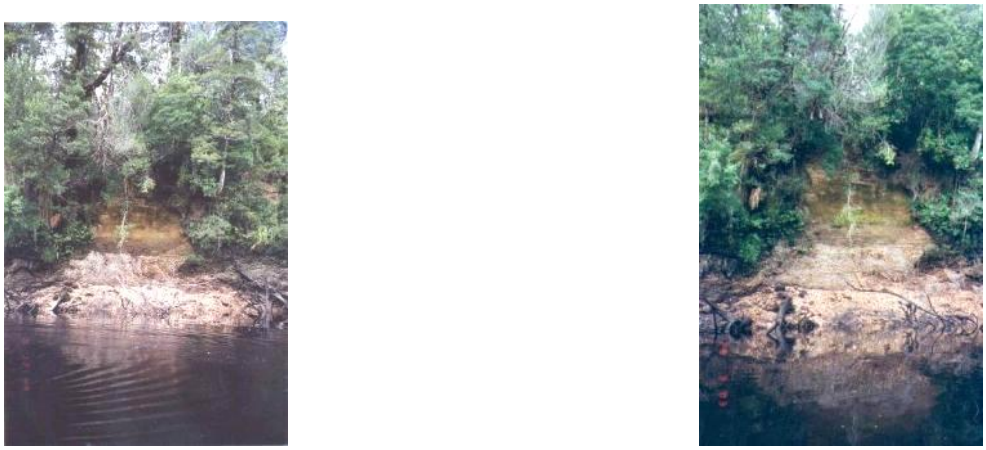

Photo A4-57 Zone 2, site 3 – 9 March 2002 (left), 29 March 2003 (right)

Photo A4-58 Zone 2, site 3 – 11 March 2006 (left), 17 March 2007 (right)

Photo A4-59 Zone 2, site 3 – 1 March 2008 (left), 21 March 2009 (right)

Photo A4-60 Zone 2, site 3 – 13 March 2010 (left), 26 February 2011 (right)


Photo A4-61 Zone 2, site 4 – 9 March 2002 (left), 29 March 2003 (right)


Photo A4-62 Zone 2, site 4 – 6 March 2004 (left), 9 April 2005 (right)


Photo A4-63 Zone 2, site 4 – 11 March 2006 (left), 17 March 2007 (right)


Photo A4-64 Zone 2, site 4 – 1 March 2008 (left), 21 March 2009 (right)


Photo A4-65 Zone 2, site 4 – 13 March 2010 (left), 26 February 2011 (right)


Photo A4-66 Zone 2, site 5 – 9 March 2002 (left), 29 March 2003 (right)


Photo A4-67 Zone 2, site 5 – 6 March 2004 (left), 9 April 2005 (right)


Photo A4-68 Zone 2, site 5 – 11 March 2006 (left), 17 March 2007 (right)


Photo A4-69 Zone 2, site 5 – 1 March 2008 (left), 21 March 2009 (right)


Photo A4-70 Zone 2, site 5 – 13 March 2010 (left), 26 February 2011 (right)

Photo A4-71 Zone 2, site 6 – 9 March 2002 (left), 29 March 2003 (right)

Photo A4-72 Zone 2, site 6 – 6 March 2004 (left), 9 April 2005 (right)

Photo A4-73 Zone 2, site 6 – 11 March 2006 (left), 17 March 2007 (right)

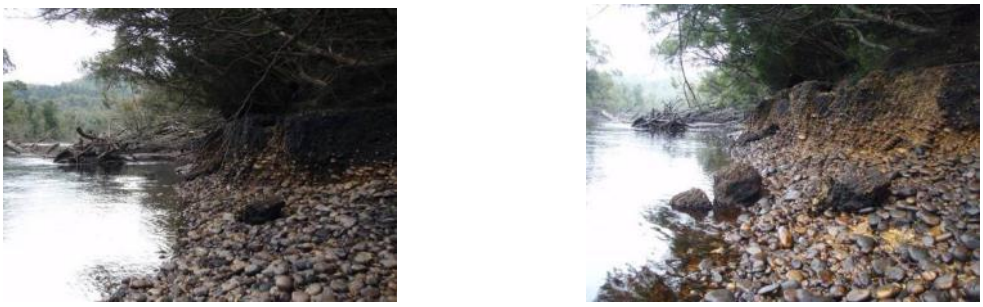

Photo A4-74 Zone 2, site 6 – 1 March 2008 (left), 21 March 2009 (right)

Photo A4-75 Zone 2, site 6 – 13 March 2010 (left), 26 February 2011 (right)


Photo A4-76 Zone 2, site new 3 – 17 October 2006 (left), 17 March 2007 (right)


Photo A4-77 Zone 2, site new 3 – 1 March 2008 (left), 21 March 2009 (right)


Photo A4-78 Zone 2, site new 3 – 13 March 2010 (left), 26 February 2011 (right)

Photo A4-79 Zone 2, site 7 – 9 March 2002 (left), 29 March 2003 (right)

Photo A4-80 Zone 2, site 7 – 6 March 2004 (left), 9 April 2005 (right)

Photo A4-81 Zone 2, site 7 – 11 March 2006 (left), 17 March 2007 (right)

Photo A4-82 Zone 2, site 7 – 1 March 2008 (left), 21 March 2009 (right)

Photo A4-83 Zone 2, site 7 – 13 March 2010 (left), 26 February 2011 (right)

Photo A4-84 Zone 2, site 8 – 9 March 2002 (left), 29 March 2003 (right)

Photo A4-85 Zone 2, site 8 – 6 March 2004 (left), 9 April 2005 (right)

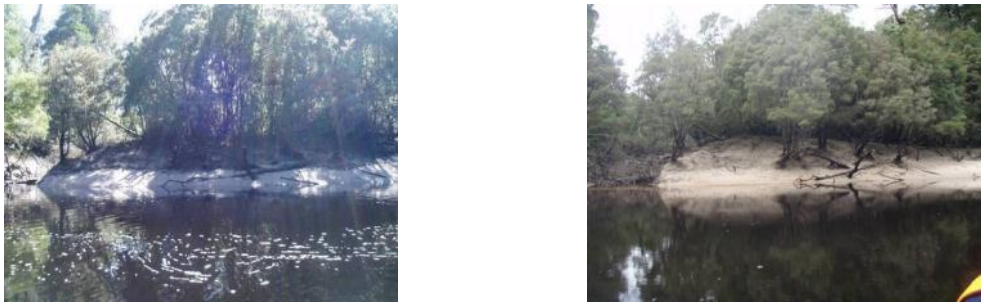

Photo A4-86 Zone 2, site 8 – 11 March 2006 (left), 17 March 2007 (right)

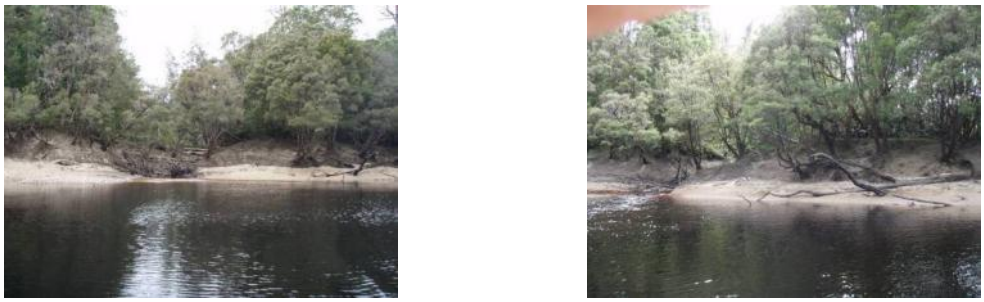

Photo A4-87 Zone 2, site 8 – 1 March 2008 (left), 21 March 2009 (right)

Photo A4-88 Zone 2, site 8 – 13 March 2010 (left), 26 February 2011 (right)


Photo A4-89 Zone 2, site 9 – 9 March 2002 (left), 29 March 2003 (right)


Photo A4-90 Zone 2, site 9 – 6 March 2004 (left), 9 April 2005 (right)


Photo A4-91 Zone 2, site 9 – 11 March 2006 (left), 17 March 2007 (right)


Photo A4-92 Zone 2, site 9 – 1 March 2008 (left), 21 March 2009 (right)


Photo A4-93 Zone 2, site 9 – 13 March 2010 (left), 26 February 2011 (right)

Photo A4-94 Zone 2, site 10 – 9 March 2002 (left), 29 March 2003 (middle), 9 April 2005 (right)

Photo not obtained in March 2004

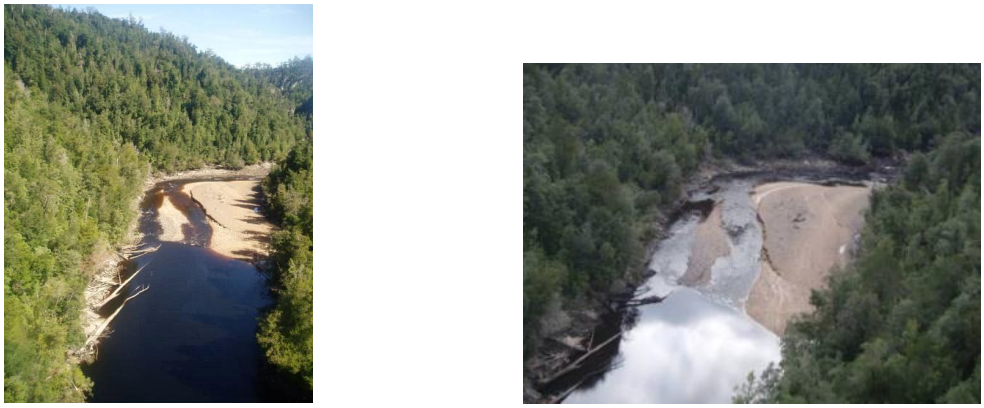

Photo A4-95 Zone 2, site 10 – 11 March 2006 (left), 17 March 2007 (right)

Photo A4-96 Zone 2, site 10 – 1 March 2008 (left), 21 March 2009 (right)

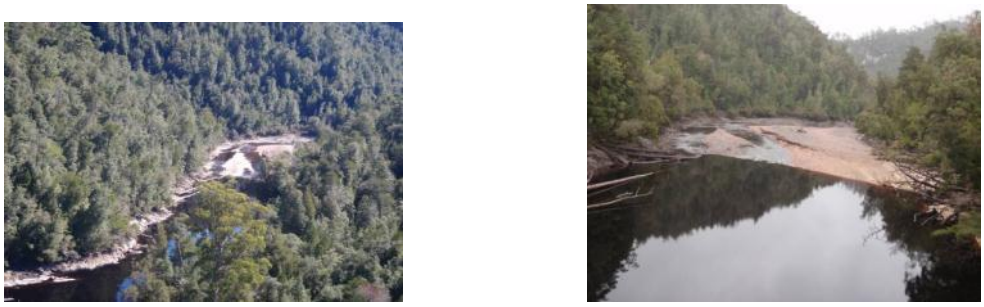

Photo A4-97 Zone 2, site 10 – 13 March 2010 (left), 26 February 2011 (right)

Photo A4-98 Zone 2, site 11 – 9 March 2002 (left), 9 April 2005 (right)

No suitable photo obtained March 2003 or March 2004

Photo A4-99 Zone 2, site 11 – 11 March 2006 (left), 17 March 2007 (right)

Photo A4-100 Zone 2, site 11 – 1 March 2008 (left), 21 March 2009 (right)

No photo obtained March 2010

Photo A4-101 Zone 2, site 11 – 26 February 2011

## A4.3 Zone 3


Photo A4-102 Zone 3, site 1 – 9 March 2002 (left), 29 March 2003 (right)


Photo A4-103 Zone 3, site 1 – 6 March 2004 (left), 2 April 2005 (right)


Photo A4-104 Zone 3, site 1 – 11 March 2006 (left), 17 March 2007 (right)


Photo A4-105 Zone 3, site 1 – 1 March 2008 (left), 21 March 2009 (right)


Photo A4-106 Zone 3, site 1 – 13 March 2010 (left), 26 February 2011 (right)


Photo A4-107 Zone 3, site 2 – 9 March 2002 (left), 29 March 2003 (right)


Photo A4-108 Zone 3, site 2 – 6 March 2004 (left), 2 April 2005 (right). Photo not taken 11 March 2006


Photo A4-109 Zone 3, site 2 – 17 March 2007 (left), 1 March 2008 (right)


Photo A4-110 Zone 3, site 2 – 21 March 2009 (left), 13 March 2010 (right)

Photo A4-111 Zone 3, site 2 – 26 February 2011


Photo A4-112 Zone 3, site 3 – 9 March 2002 (left), 29 March 2003 (right)


Photo A4-113 Zone 3, site 3 – 6 March 2004 (left), 2 April 2005 (right). Wrong site photographed in 2006


Photo A4-114 Zone 3, site 3 – 17 March 2007 (left), 1 March 2008 (right)


Photo A4-115 Zone 3, site 3 – 21 March 2009 (left), 13 March 2010 (right)

Photo A4-116 Zone 3, site 3 – 26 February 2011


Photo A4-117 Zone 3, site 4 – 9 March 2002 (left), 29 March 2003 (right)


Photo A4-118 Zone 3, site 4 – 6 March 2004 (left), 2 April 2005 (right)


Photo A4-119 Zone 3, site 4 – 11 March 2006 (left), 17 March 2007 (right)


Photo A4-120 Zone 3, site 4 – 1 March 2008 (left), 21 March 2009 (right)


Photo A4-121 Zone 3, site 4 – 13 March 2010 (left), 26 February 2011 (right)


Photo A4-122 Zone 3, site 5 – 9 March 2002 (left), 29 March 2003 (right)


Photo A4-123 Zone 3, site 5 – 6 March 2004 (left), 2 April 2005 (right)


Photo A4-124 Zone 3, site 5 – 11 March 2006 (left), 17 March 2007 (right)


Photo A4-125 Zone 3, site 5 – 1 March 2008 (left), 21 March 2009 (different site (right))


Photo A4-126 Zone 3, site 5 – 13 March 2010 (different site (left)), 26 February 2011 (correct site (right))

## A4.4 Zone 4

Photo A4-127 Zone 4, site new 1 – October 2006 (left), 17 March 2007 (right)

Photo A4-128 Zone 4, site new 1 – 1 March 2008 (left), 21 March 2009 (right)

Photo A4-129 Zone 4, site new 1 – 13 March 2010 (left), 26 February 2011 (right)

Photo A4-130 Zone 4, site new 2 – October 2006 (left), 17 March 2007 (right)

Photo A4-131 Zone 4, site new 2 – 1 March 2008 (left), 21 March 2009 (right)

Photo A4-132 Zone 4, site new 2 – 13 March 2010 (left), 26 February 2011 (right)


Photo A4-133 Zone 4, site 1 – 10 March 2002 (left), 29 March 2003 (right)


Photo A4-134 Zone 4, site 1 – 6 March 2004 (left), 2 April 2005 (right)


Photo A4-135 Zone 4, site 1 – 11 March 2006 (left), 17 March 2007 (right)


Photo A4-136 Zone 4, site 1 – 1 March 2008 (left), 21 March 2009 (right)

Site not photographed in February 2011

Photo A4-137 Zone 4, site 1 – 13 March 2010


Photo A4-138 Zone 4, site new 3 – October 2006 (left), 17 March 2007 (right)


Photo A4-139 Zone 4, site new 3 – 1 March 2008 (left), 21 March 2009 (right)


Photo A4-140 Zone 4, site new 3 – 13 March 2010 (left), 26 February 2011 (right)


Photo A4-141 Zone 4, site 2 – 10 March 2002 (left), 29 March 2003 (right)


Photo A4-142 Zone 4, site 2 – 6 March 2004 (left), 2 April 2005 (right)


Photo A4-143 Zone 4, site 2 – 11 March 2006 (left), 17 March 2007 (right)


Photo A4-144 Zone 4, site 2 – 1 March 2008 (left), 21 March 2009 (right)


Photo A4-145 Zone 4, site 2 – 13 March 2010 (left), 26 February 2011 (right)


Photo A4-146 Zone 4, site 3 – 10 March 2002 (left), 29 March 2003 (right)


Photo A4-147 Zone 4, site 3 – 6 March 2004 (left), 2 April 2005 (right)


Photo A4-148 Zone 4, site 3 – 11 March 2006 (left), 17 March 2007 (right)


Photo A4-149 Zone 4, site 3 – 1 March 2008 (left), 21 March 2009 (right)


Photo A4-150 Zone 4, site 3 – 13 March 2010 (left), 26 February 2011 (right)


Photo A4-151 Zone 4, site 4a – 10 March 2002 (left), 29 March 2003 (right)


Photo A4-152 Zone 4, site 4a – 6 March 2004 (left), 2 April 2005 (right)


Photo A4-153 Zone 4, site 4a – 11 March 2006 (left), 17 March 2007 (right)


Photo A4-154 Zone 4, site 4a – 1 March 2008 (left), 21 March 2009 (right)


Photo A4-155 Zone 4, site 4a – 13 March 2010 (left), 26 February 2011 (right)


Photo A4-156 Zone 4, site 4b – 10 March 2002 (left), 29 March 2003 (right)


Photo A4-157 Zone 4, site 4b – 6 March 2004 (left), 2 April 2005 (right)


Photo A4-158 Zone 4, site 4b – 11 March 2006 (left), 17 March 2007 (right)


Photo A4-159 Zone 4, site 4b – 1 March 2008 (left), 21 March 2009 (right)


Photo A4-160 Zone 4, site 4b – 13 March 2010 (left), 26 February 2011 (right)

Photo A4-161 Zone 4, site $4c_{1,2,3}$ – 10 March 2002

Photo A4-162 Zone 4, site $4c_{1,2,3}$ – 29 March 2003

Photo A4-163 Zone 4, site $4c_{1,2,3}$ – 6 March 2004

Photo A4-164 Zone 4, site $4c_{1,2,3}$ – 2 April 2005

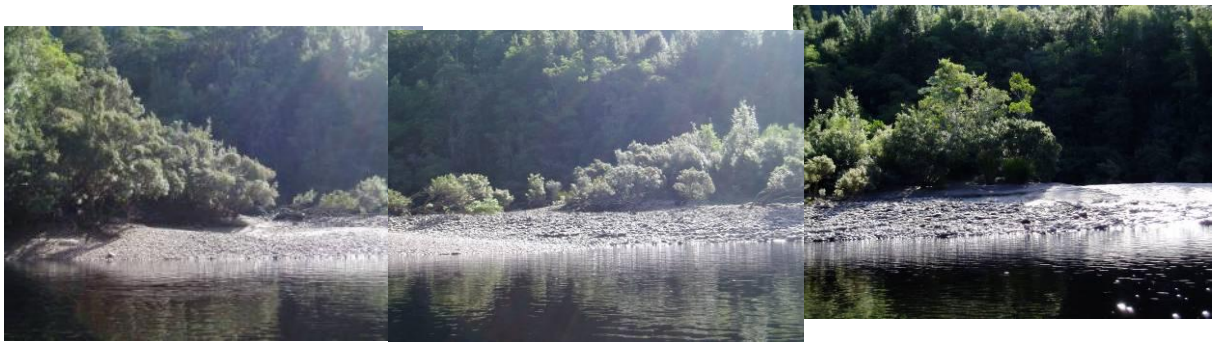

Photo A4-165 Zone 4, site $4c_{1,2,3}$ – 11 March 2006

Photo A4-166 Zone 4, site $4c_{1,2,3}$ – 17 March 2007

Photo A4-167 Zone 4, site $4c_{1,2,3}$ – 1 March 2008

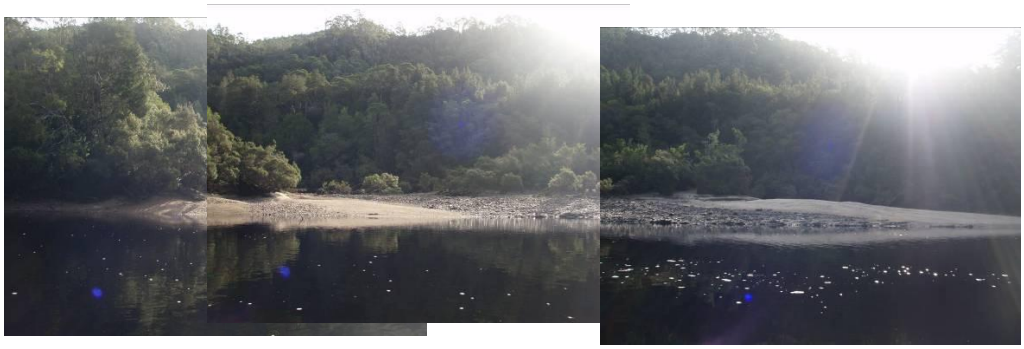

Photo A4-168 Zone 4, site $4c_{1,2,3}$ – 21 March 2009

Photo A4-169 Zone 4, site 4c – 13 March 2010

Photo A4-170 Zone 4, site 4c – 26 February 2011

Photo A4-171 Zone 4, site 5a,b – 10 March 2002 (left), 29 March 2003 (right)

Photo A4-172 Zone 4, site 5 – 29 6 March 2004 (left), 2 April 2005 (right)

Photo A4-173 Zone 4, site 5 – 11 March 2006 (left), 17 March 2007 (right)

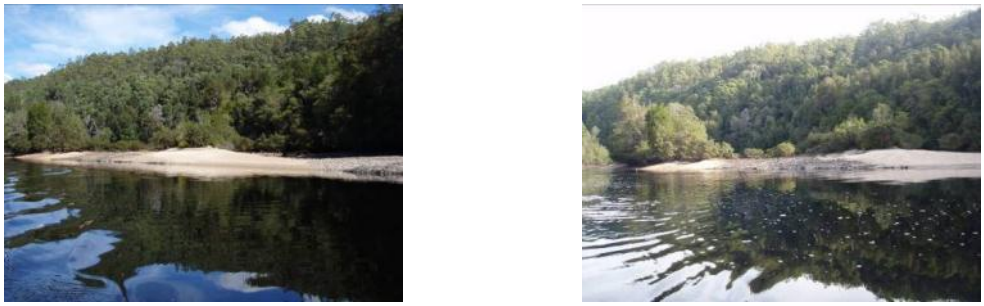

Photo A4-174 Zone 4, site 5 – 1 March 2008 (left), 21 March 2009 (right)

Photo A4-175 Zone 4, site 5 – 13 March 2010 (left), 26 February 2011 (right)

Photo A4-176 Zone 4, site 6 – 10 March 2002 (left), 29 March 2003 (middle), 6 March 2004 (right)

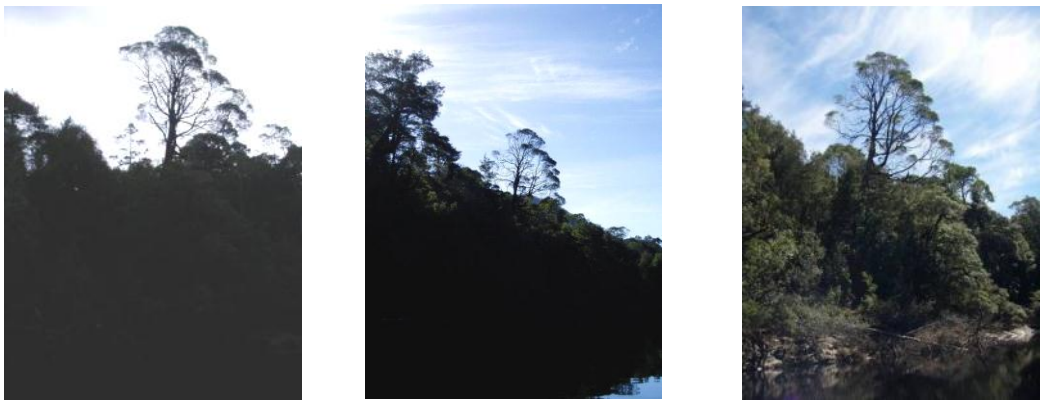

Photo A4-177 Zone 4, site 6 – 2 April 2005 (left), 11 March 2006 (middle), 17 March 2007 (right)

Photo A4-178 Zone 4, site 6 – 1 March 2008 (left), 21 March 2009 (right)

Photo not obtained March 2010

Photo A4-179 Zone 4, site 6 – 26 February 2011


Photo A4-180 Zone 4, site 7 – 10 March 2002 (left), 29 March 2003 (right)


Photo A4-181 Zone 4, site 7 – 6 March 2004 (left), 2 April 2005 (right)


Photo A4-182 Zone 4, site 7 – 11 March 2006 (left), 17 March 2007 (right)


Photo A4-183 Zone 4, site 7 – 1 March 2008 (left), 21 March 2009 (right)

Photo not obtained in March 2010 or February 2011


Photo A4-184 Zone 4, site 8 – 10 March 2002 (left), 29 March 2003 (right)


Photo A4-185 Zone 4, site 8 – 6 March 2004 (left), 2 April 2005 (right)


Photo A4-186 Zone 4, site 8 – 11 March 2006 (left), 17 March 2007 (right)


Photo A4-187. Zone 4, site 8 – 1 March 2008 (left), 21 March 2009 (right)


Photo A4-188 Zone 4, site 8 – 13 March 2010 (left), 26 February 2011 (right)

## A4.5 Zone 5


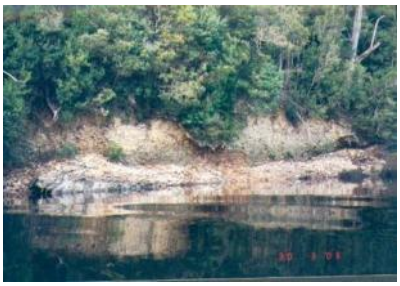

Photo A4-189 Zone 5, site 1 – 10 March 2002 (left), 30 March 2003 (right)


Photo A4-190 Zone 5, site 1 – 6 March 2004 (left), 2 April 2005 (right)


Photo A4-191 Zone 5, site 1 – 11 March 2006 (left), 17 March 2007 (right)


Photo A4-192 Zone 5, site 1 – 1 March 2008 (left), 21 March 2009 (right)


Photo A4-193 Zone 5, site 1 – 13 March 2010 (left), 26 February 2011 (right)

Photo A4-194 Zone 5, site 2 – 10 March 2002 (left), 30 March 2003 (middle), 6 March 2004 (right)

Photo A4-195 Zone 5, site 2 – 2 April 2005 (left), 11 March 2006 (middle), 17 March 2007 (right)

Photo A4-196 Zone 5, site 2 – 1 March 2008 (left), 21 March 2009 (right)

Photo A4-197 Zone 5, site 2 – 13 March 2010 (left), 26 February 2011 (right)

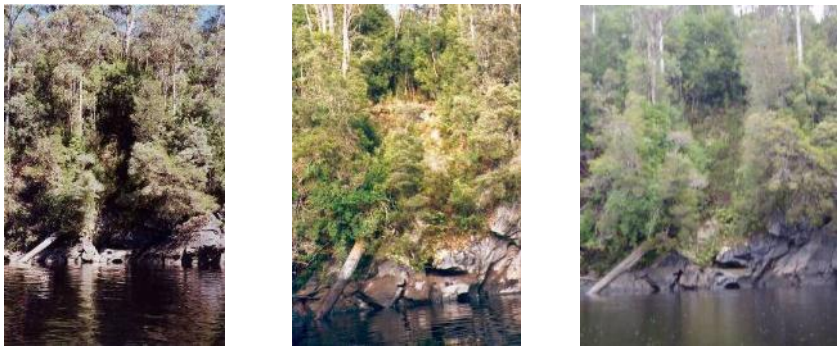

Photo A4-198 Zone 5, site 3 – 10 March 2002 (left), 30 March 2003 (middle), 6 March 2004 (right)

Photo A4-199 Zone 5, site 3 – 2 April 2005 (left), 11 March 2006 (middle), 17 March 2007 (right)

Photo A4-200 Zone 5, site 3 – 1 March 2008 (left), 21 March 2009 (right)

Photo not obtained March 2010

Photo A4-201 Zone 5, site 3 – 26 February 2011


Photo A4-202 Zone 5, site 4 – 10 March 2002 (left), 30 March 2003 (right)


Photo A4-203 Zone 5, site 4 – 6 March 2004 (left), 2 April 2005 (right)


Photo A4-204 Zone 5, site 4 – 11 March 2006 (left), 17 March 2007 (right). Photo not taken in March 2008 (error)


Photo A4-205 Zone 5, site 4 – 21 March 2009 (left), 13 March 2010 (right)

Photo A4-206 Zone 5, site 4 – 26 February 2011


Photo A4-207 Zone 5, site 5 – 10 March 2002 (left), 30 March 2003 (right)


Photo A4-208 Zone 5, site 5 – 6 March 2004 (left), 2 April 2005 (right)


Photo A4-209 Zone 5, site 5 – 11 March 2006 (left), 17 March 2007 (right)


Photo A4-210 Zone 5, site 5 – 1 March 2008 (left), 21 March 2009 (right)

Not photographed in February 2011

Photo A4-211 Zone 5, site 5 – 13 March 2010

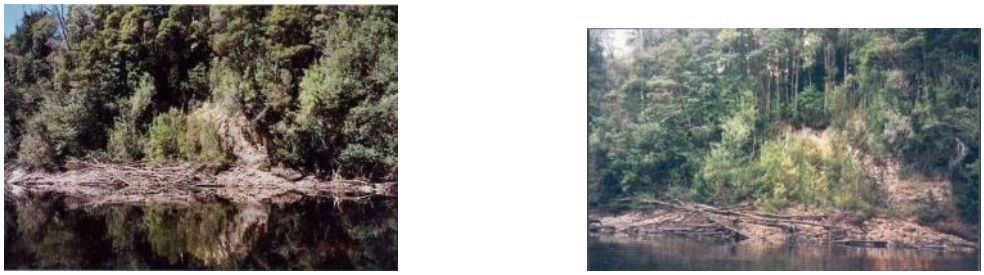

Photo A4-212 Zone 5, site 6 – 10 March 2002 (left), 30 March 2003 (right)

Photo A4-213 Zone 5, site 6 – 6 March 2004 (left), 2 April 2005 (right)

Photo A4-214 Zone 5, site 6 – 11 March 2006 (left), 17 March 2007 (right)

Photo A4-215 Zone 5, site 6 – 1 March 2008 (left), 21 March 2009 (right)

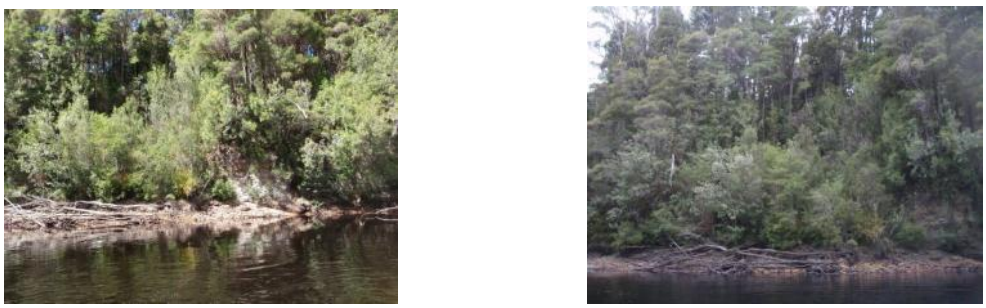

Photo A4-216 Zone 5, site 6 – 13 March 2010 (left), 26 February 2011 (right)

Photo A4-217 Zone 5, site 7 – 10 March 2002 (left), 30 March 2003 (middle), 10 March 2004 (right)

Photo A4-218 Zone 5, site 7 – 2 April 2005 (left), 11 March 2006 (middle), 17 March 2007 (right)

Photo A4-219 Zone 5, site 7 – 1 March 2008 (left), 21 March 2009 (right)

Photo A4-220 Zone 5, site 7 – 13 March 2010 (left), 26 February 2011 (right)


Photo A4-221 Zone 5, site 8 – 10 March 2002 (left), 30 March 2003 (right)


Photo A4-222 Zone 5, site 8 – 6 March 2004 (left), 2 April 2005 (right)


Photo A4-223 Zone 5, site 8 – 11 March 2006 (left), 17 March 2007 (right)


Photo A4-224 Zone 5, site 8 – 1 March 2008 (left), 21 March 2009 (right)


Photo A4-225 Zone 5, site 8 – 13 March 2010 (left), 26 February 2011 (right)


Photo A4-226 Zone 5, site 9 – 10 March 2002 (left), 30 March 2003 (right)


Photo A4-227 Zone 5, site 9 – 6 March 2004 (left), 2 April 2005 (right)


Photo A4-228 Zone 5, site 9 – 11 March 2006 (left), 17 March 2007 (right)


Photo A4-229 Zone 5, site 9 – 1 March 2008 (left), 21 March 2009 (right)

Not photographed in February 2011

Photo A4-230 Zone 5, site 9 – 13 March 2010

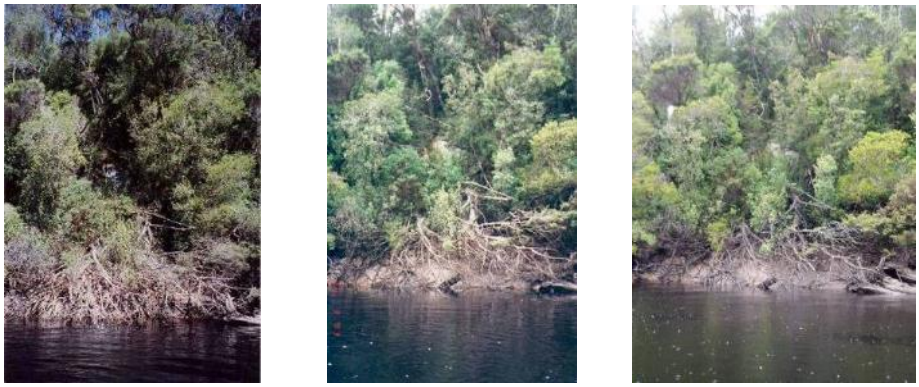

Photo A4-231 Zone 5, site 10 – 10 March 2002 (left), 30 March 2003 (middle), 6 March 2004 (right)

Photo A4-232 Zone 5, site 10 2 April 2005 (left), 11 March 2006 (middle), 17 March 2007 (right)

Photo A4-233 Zone 5, site 10 – 1 March 2008 (left), 21 March 2009 (right)

Photo A4-234 Zone 5, site 10 – 13 March 2010 (left), 26 February 2011 (right)

Photo A4-235 Zone 5, site 11 – 10 March 2002 (left), 30 March 2003 (middle), 6 March 2004 (right)

Photo A4-236 Zone 5, site 11 – 2 April 2005 (left), 11 March 2006 (middle), 17 March 2007 (right)

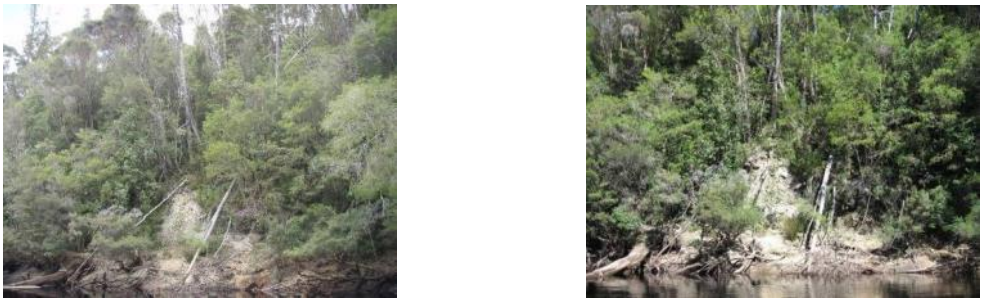

Photo A4-237 Zone 5, site 11 – 1 March 2008 (left), 21 March 2009 (right)

Photo A4-238 Zone 5, site 11 – 13 March 2010 (left), 26 February 2011 (right)

Photo A4-239 Zone 5, site 12 – 10 March 2002 (left), 30 March 2003 (middle), 6 March 2004 (right)

Photo A4-240 Zone 5, site 12 – 2 April 2005 (left), 11 March 2006 (middle), 17 March 2007 (right)

Photo A4-241 Zone 5, site 12 – 1 March 2008 (left), 21 March 2009 (right)

Photo A4-242 Zone 5, site 12 – 13 March 2010 (right), 26 February 2011 (right)


Photo A4-243 Zone 5, site 13 – 10 March 2002 (left), 30 March 2003 (right)


Photo A4-244 Zone 5, site 13 – 6 March 2002 (left), 2 April 2005 (right)


Photo A4-245 Zone 5, site 13 – 11 March 2006 (left), 17 March 2007 (right)

Photo not taken March 2009

Photo A4-246 Zone 5, site 13 – 1 March 2008


Photo A4-247 Zone 5, site 13 – 13 March 2010 (left – wrong site), 26 February 2011 (right – correct site)


Photo A4-248 Zone 5, site 14 – 10 March 2002 (left), and March 2003 (right)

Not taken in March 2004 – missed it and went down rapids (too late to return). Same thing happened in April 2005 – very tricky site.


Photo A4-249 Zone 5, site 14 – 11 March 2006 (left), 17 March 2007 (right)

Photo not taken in March 2009

Photo A4-250 Zone 5, site 14 – 1 March 2008


Photo A4-251 Zone 5, site 14 – 13 March 2010 (left), 26 February 2011 (right)


Photo A4-252 Zone 5, site 15 – 10 March 2002 (left), 30 March 2003 (right)


Photo A4-253 Zone 5, site 15 – 6 March 2004 (left), 2 April 2005 (right)


Photo A4-254 Zone 5, site 15 – 11 March 2006 (left), 11 March 2007 (right)


Photo A4-255 Zone 5, site 15 – 1 March 2008 (left), 21 March 2009 (right)


Photo A4-256 Zone 5, site 15 – 13 March 2010 (left), 26 February 2011 (right)

Photo A4-257 Zone 5, site 16 – 10 March 2002 (left), 30 March 2003 (right)

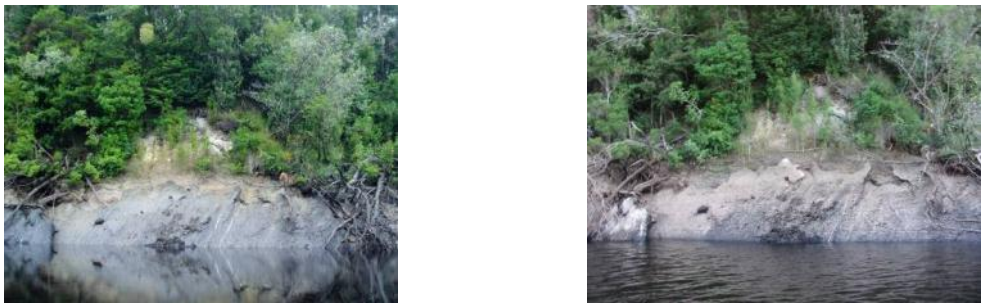

Photo A4-258 Zone 5, site 16 – 6 March 2004 (left), 2 April 2005 (right)

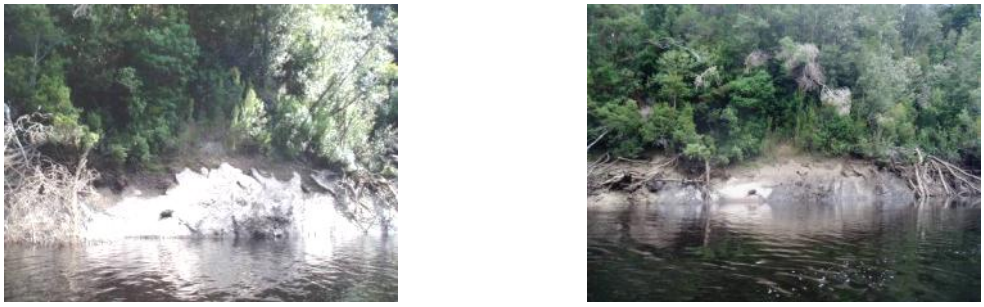

Photo A4-259 Zone 5, site 16 – 11 March 2006 (left), 17 March 2007 (right)

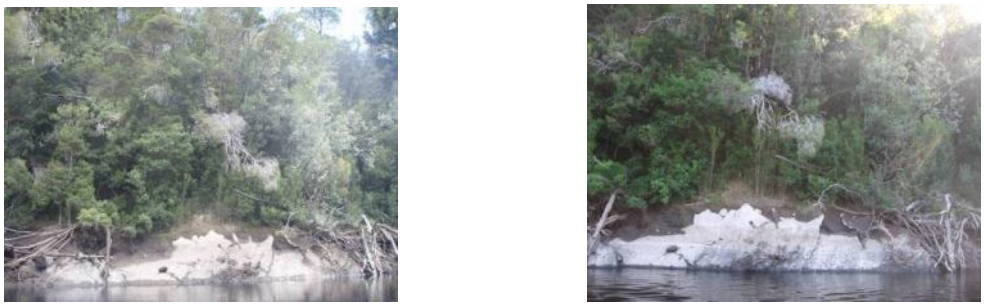

Photo A4-260 Zone 5, site 16 – 1 March 2008 (left), 21 March 2009 (right)

Photo A4-261 Zone 5, site 16 – 13 March 2010 (left), 26 February 2011 (right)


Photo A4-262 Zone 5, site 17 – 9 March 2002 (left), 30 March 2003 (right)


Photo A4-263 Zone 5, site 17 – 6 March 2004 (left), 2 April 2005 (right)


Photo A4-264 Zone 5, site 17 – 11 March 2006 (left), 17 March 2007 (right)


Photo A4-265 Zone 5, site 17 – 1 March 2008 (left), 21 March 2009 (right)


Photo A4-266 Zone 5, site 17 – 13 March 2010 (left), 26 February 2011 (right)


Photo A4-267 Zone 5, site 18 – 9 March 2002 (left), 30 March 2003 (right)


Photo A4-268 Zone 5, site 18 – 6 March 2004 (left), 2 April 2005 (right)


Photo A4-269 Zone 5, site 18 – 11 March 2006 (left), 17 March 2007 (right)


Photo A4-270 Zone 5, site 18 – 1 March 2008 (left), 21 March 2009 (right)


Photo A4-271 Zone 5, site 18 – 13 March 2010 (left), 26 February 2011 (right)


Photo A4-272 Zone 5, site 19 – 9 March 2002 (left), 30 March 2003 (right)


Photo A4-273 Zone 5, site 19 – 6 March 2004 (left), 2 April 2005 (right)


Photo A4-274 Zone 5, site 19 – 11 March 2006 (left), 17 March 2007 (right)


Photo A4-275 Zone 5, site 19 – 1 March 2008 (left), 21 March 2009 (right)


Photo A4-276 Zone 5, site 19 – 13 March 2010 (left), 26 February 2011 (right)


Photo A4-277 Zone 5, site 20 – 9 March 2002 (left), 30 March 2003 (right)


Photo A4-278 Zone 5, site 20 – 6 March 2004 (left), 2 April 2005 (right)


Photo A4-279 Zone 5, site 20 – 11 March 2006 (left), 17 March 2007 (right)


Photo A4-280 Zone 5, site 20 – 1 March 2008 (left), 21 March 2009 (right)


Photo A4-281 Zone 5, site 20 – 13 March 2010 (left), 26 February 2011 (right)

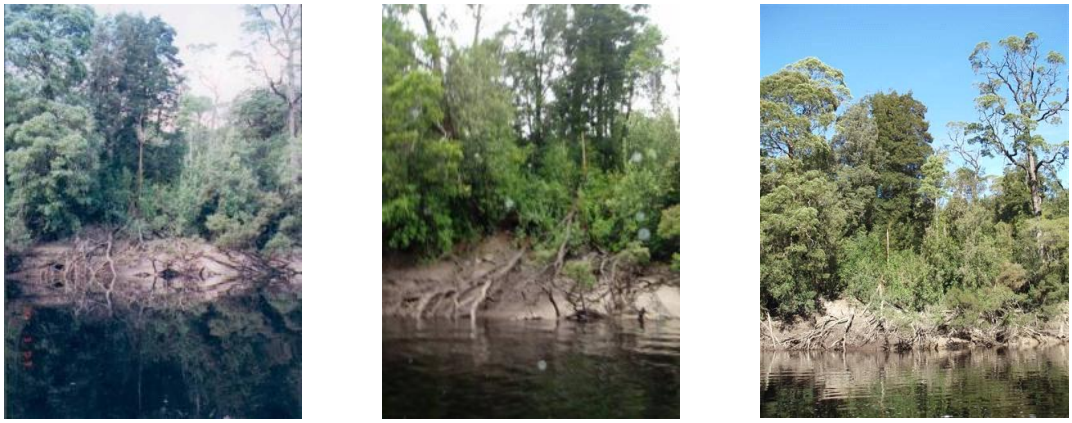

Photo A4-282 Zone 5, site 21 – 30 March 2003 (left), 6 March 2004 (middle), 11 March 2006 (right)

Photo not obtained in March 2002, or in April 2005

Photo A4-283 Zone 5, site 21 – 17 March 2007 (left), 1 March 2008 (right (may not be same site))

Photo A4-284 Zone 5, site 21 – 21 March 2009 (left), 13 March 2010 (middle), 26 February 2011 (right). Correct site each yea

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# A5 Ramp-down trials January – March 2011

DR LOIS KOEHNKEN
TECHNICAL ADVICE ON WATER
MAY 2011

*This report presents results of work commissioned as part of a review of the ramp-down rule and falls outside the normal Water Licence reporting requirements. It is included for completeness and to ensure the results of the trial are placed on record.*

## A5.1 Report summary

Sediment flows, a form of seepage erosion, occur in the 3-turbine bank level of the middle Gordon River when power station-induced river drawdown is rapid and banks are saturated. A ramp-rule has been in place since the commissioning of Basslink which controls power station operating patterns to reduce the impact of drawdown on the banks. Hydro Tasmania is reviewing the rule with the aim of enhancing environmental outcomes and aligning operational and environmental goals.

Field observations of ramped and un-ramped power station drawdowns following three turbine operation were completed in the Gordon River in January through March 2011 under a range of bank saturation conditions. The aims of the investigations were to compare the environmental effectiveness of a 45 $m^3 s^{-1}$ per hour ramping rate with a 30 $m^3 s^{-1}$ per hour rate, to better define the level of bank saturation at which ramping flows at the Gordon Power Station is warranted to protect the third turbine bank level, and to observe bank response during un-ramped drawdowns under conditions of low bank saturation. During the drawdown trials, power station discharge levels, river level and bank saturation levels were monitored. The work focussed on geomorphology zone 2, which is the most susceptible to seepage processes due to the widespread occurrence of sandy alluvial banks and large water level fluctuations (up to 4 m) associated with power station discharge (up to 4 m).

Results found that:

- ramping is an effective means of reducing sediment flows in the 3-turbine bank level;
- there is little difference in the rate of water level decrease between a 30 $m^3 s^{-1}$ per hour and 45 $m^3 s^{-1}$ per hour ramp during the first one to two hours, with the hydraulics of the river controlling initial recession rates due to the storage of water in banks and backwaters;
- the 45 $m^3 s^{-1}$ per hour ramp prevented sediment flows in the 3-turbine bank level, but exposed the lower bank (<2-turbine level) more rapidly, which may promote additional rilling of the lower bank face as compared to the 30 $m^3 s^{-1}$ per hour ramp;

- a bank saturation level of 2.75 m at piezometer 2 (10 m inland) at the zone 2 piezometer site is a good indicator of the limit between the 2- and 3-turbine bank levels;
- under conditions of low bank saturation (piezometer 2 <2.75 m) no sediment flows occurred in the 2–3 turbine bank level following uncontrolled flow reduction (no ramping);
- under these low saturation bank conditions, ramping of the power station flows can lead to an increase in bank saturation levels;
- small scale sediment flows were observed at some (but not all) of the observed sites when bank saturation exceeded 2.75 m and power station flows were not ramped; and
- all drawdowns, whether ramped or not, resulted in rilling of the bank face in the <2-turbine level due to the difference in level between where water was draining from the bank and the river level.

Analysis of the piezometer and hydrograph results indicates that during ramping, river recession rates are similar to the rate at which water can move through the banks, which allows bank draining to occur without increasing in-bank water surface slopes. The results also show that ground water slopes between piezometer 2 and the river level do not exceed those expected to induce mass failure. The observed small scale sediment flows indicate that near bank face water levels are likely to be much higher than these calculated slopes.

Overall, the results suggest that compared to the present rule, a better environmental outcome could be achieved by ramping all flow reduction >180 $m^3 s^{-1}$ at a rate of 45 $m^3 s^{-1}$ per hour or less when bank saturation exceeds 2.75 m, with no ramping required if bank saturation levels are below 2.75 m.

## A5.2 Introduction

The Basslink IIAS investigations identified an increase in seepage erosion in the 2–3 turbine bank level of the river as a potential impact of the altered operation of Gordon Power Station as a result of the commissioning of the Basslink power cable. Seepage erosion occurs when the water level in the river drops following power station shutdown, at a rate which greatly exceeds the rate at which water can drain from the bank. The elevated water table in the bank, combined with the denuded nature of the river banks, can lead to bank instability and failure through seepage processes. Of specific concern in the Gordon is the generation of seepage flows in the 2–3 turbine bank level (i.e. bank levels equivalent to flows >150 $m^3 s^{-1}$). Seepage occurs when the ground water slope in the bank exceeds a critical angle which causes saturated sediments to 'flow' downslope. The Joint Advisory Panel (JAP) decision, based on the Basslink IIAS, mandated that a ramp-rule be developed which reduced the risk of these sediment flows occurring under Basslink power station operations.

The ramp-rule, which has been implemented since the initiation of Basslink, has been found to be ineffective in that it allows unramped partial drawdowns under saturated bank conditions, and it encourages ongoing 3-turbine power station operation for prolonged periods under certain conditions. The ramp rate required in the rule, 30 $m^3$ $s^{-1}$ per hour, is also inconsistent with the requirement of the National Electricity Market (NEM) as the ramp rate equates to less than 1MW per minute which is the minimum hourly energy reduction allowed by the NEM. In effect, the environmental objectives of the present rule are not aligned with the operational reality of the Gordon Power Station under Basslink.

Hydro Tasmania is reviewing the ramp-rule with the intention of proposing a revised rule to the Regulator for inclusion in the water licence. The aim of the review is to identify a rule which will align environmental and operational objectives, and be consistent with the operating requirements of the NEM. Initial modelling investigations into the ramp rule were completed by Entura (2010). This report summarises field investigations associated with reviewing the rule.

## A5.3 Objectives of field investigations

The field investigations had three objectives:

- compare a 30 $m^3$ $s^{-1}$ per hour ramp with a 45 $m^3$ $s^{-1}$ per hour ramp under saturated bank conditions to determine if a revised rule could adopt this higher ramping rate. A 45 $m^3$ $s^{-1}$ per hour ramp equates to a reduction of approximately 1MW of energy per minute at the Gordon Power Station so would be consistent with NEM requirements;
- determine the critical level of bank saturation associated with sediment flows in the 2–3 turbine bank level. During the IIAS investigations, a level of 2.75 m at the zone 2 piezometer site (Photo A5-1) equated to the base of the 3-turbine operating level, and was used the basis for defining high bank saturation (if the water level at the piezometer located approximately 10 m inland registered 2.75 m, then the bank was considered saturated). As only three observations of drawdowns were completed in 2001, and none since then, additional bank observations were required to evaluate whether this level is adequate for determining saturation; and
- observe the impact to the banks during drawdowns when the bank is unsaturated (e.g. saturation is <2.75 m at piezometer 2). The piezometer results have shown that when the bank is not saturated, ramping of the power station increases saturation as water continues to flow from the river into the bank during the ramping period. Observations of unsaturated banks during drawdowns were completed to assess whether ramping may not be required under low saturation scenarios.

## A5.4 Methods

Field investigations were completed over seven field days in January, February and March 2011 as summarised in Table A5-1. During each field excursion, a field team consisting of L. Koehnken

and a coxswain were deployed via helicopter to the zone 2 helipad site. A boat had previously been 'slung' into the site using a helicopter, providing access to the river under high flow conditions (>200 $m^3 s^{-1}$). Prior to each field deployment, the power station had been operated under a prescribed pattern to produce the required bank saturation and river levels. Once on the river, the team contacted the operators at Hydro Tasmania, and the power station shutdown trial was initiated.

An exception occurred during the 30 $m^3 s^{-1}$ per hour ramp on 22 January under saturated conditions where the ramp-down was initiated prior to the team being able to access the river due to fog. To accommodate the delay, the ramp was stalled for 30 minutes, resulting in a slightly longer ramping period than usually occurs or was planned.

Field observations were completed between the piezometer site and the Albert River as indicated in Photo A5-1. Historically, this section of the river has been most prone to seepage erosion processes. During the period when river level was lowering through from the third turbine bank level into the 2-turbine bank level, a circuit was made between known seepage sites, as indicated in Photo A5-1. These same sites were observed during the initial ramp-down investigation in 2001.

Field observations for the five non-ramped drawdowns were augmented by the placement of fixed, time-lapse cameras at several known seepage areas. Photos were collected at 30 second to five minute intervals providing additional 'observations'.

During the field observations, water level was recorded at the tailrace of the power station and at the zone 2 piezometer site, where there is an array of six piezometers spaced at 10 m intervals extending from the toe of the bank (at power station off) to 50 m inland.


Photo A5-1 Map of Gordon River showing extent of field observations during ramping field investigations. Blue line denotes range of boat-based observations, orange dots indicate sites prone to seepage processes which were observed on a regular basis during the trials. Red dot indicates piezometer site

Table A5-1 Summary of ramp-down trials. Maximum river and piezometer 2 (P2) water levels are shown along with a description of the ramp-down trial

| ID | Date | Max River Level (m) | Max P2 Level (m) | Trial |
|---|---|---|---|---|
| 30 | 22 Jan 11 | 3.55 | 3.21 | 30 $m^3 s^{-1}$ per hour ramp – present ramping requirement. High bank saturation |
| 45 | 23 Jan 11 | 3.59 | 3.28 | Compare 45 $m^3 s^{-1}$ per hour ramp with 30 $m^3 s^{-1}$ per hour ramp. High bank saturation |
| 1 | 23 Feb 11 | 3.61 | 2.65 | Medium bank saturation no ramp |
| 2 | 24 Feb 11 | 3.72 | 2.94 | High bank saturation no ramp |
| 3 | 25 Feb 11 | 3.53 | 2.97 | High bank saturation no ramp |
| 4 | 7 Mar 11 | 3.65 | 2.24 | Low bank saturation no ramp |
| 5 | 8 Mar 11 | 3.95 | 2.69 | Medium bank saturation no ramp |

## A5.5 Results and discussion

### A5.5.1 Hydrology

Data from the river recorders and from piezometer 2, located 10 m inland are graphed in Figure A5-1 for each of the drawdown observations. The graphs show that there is a lag between power

station shutdown and river response in zone 2. The lag varies under different scenarios, but is typically between 45 minutes and 1.5 hours.

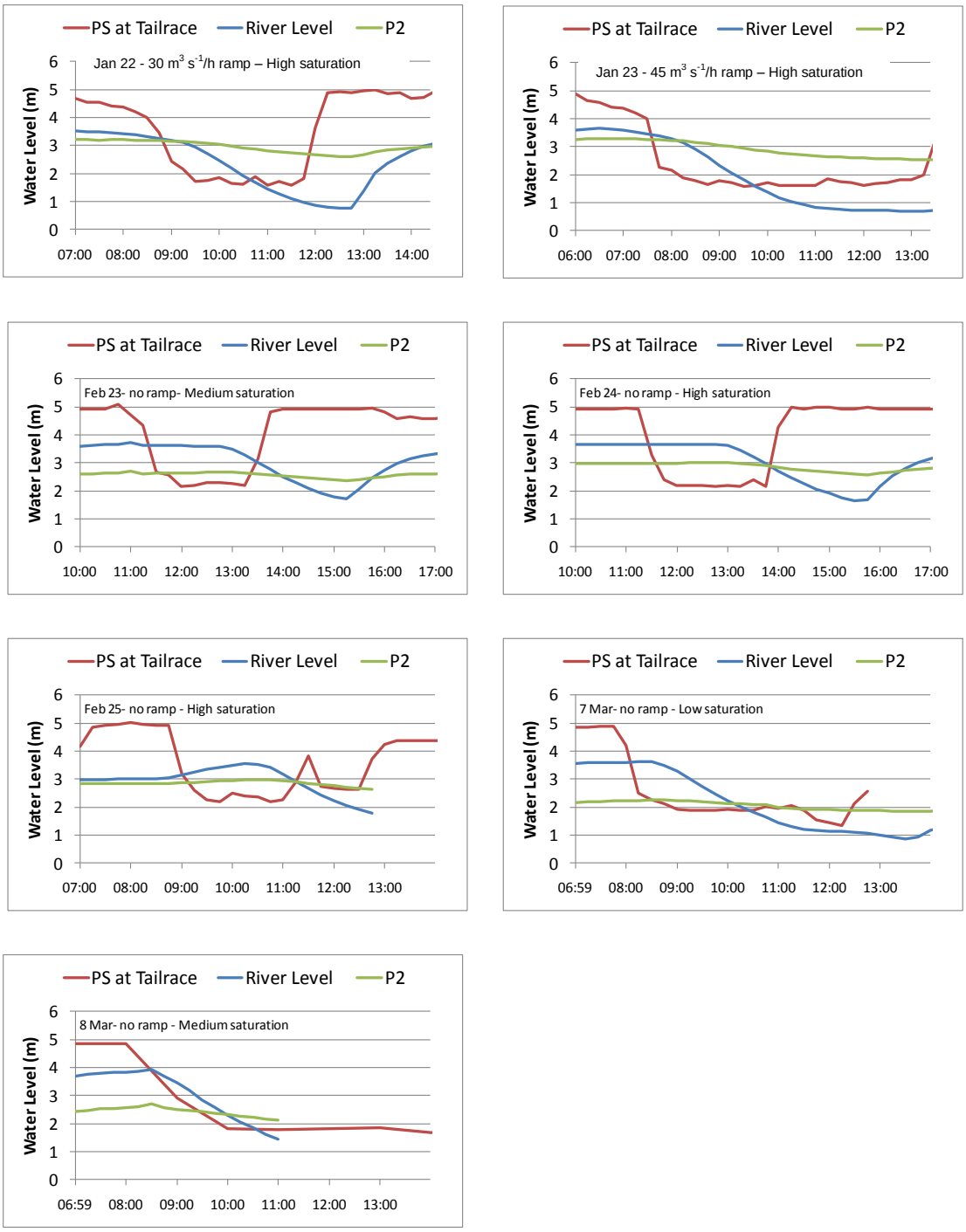


Figure A5-1 Water level at power station tailrace, in river at zone 2 piezometer site, and in piezometer 2 (10 m inland) during each ramp-down observation trial. Details of each scenario provided in Table A5-1. Note: power tailrace water level for 8 March is based on hourly data rather than 15 minutes

The river level and piezometer 2 results for each drawdown were used to calculate the ground water slope during each drawdown event at 15 minute intervals. These results are shown in Figure A5-2 compared with the actual water level at probe 2. These slopes are estimates, as the

draining of the bank does not produce a uniform slope over the distance between the river and the piezometer. The ground water slope is likely to be higher near the toe of the bank as the drawdown proceeds (note – it is because of this non-linearity that a groundwater slope of 0.1 has previously been used to identify periods with a high risk of seepage erosion. The assumption is that if the overall slope is 0.1, the near surface bank slope could be much higher, and in the absence of observations, this was adopted as a conservative measure). The figure also includes literature values for slope failure (Chu-Agor *et al*, 2009) which are discussed in a later section of the report.

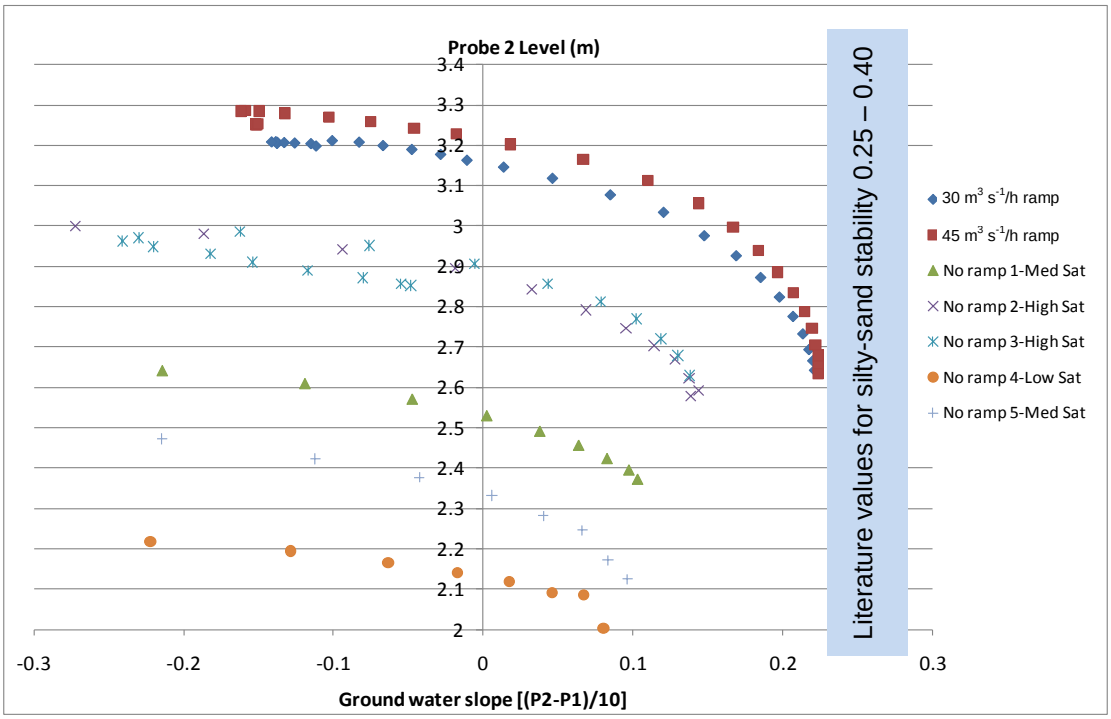


Figure A5-2 Ground water slopes at piezometer site [(P2 - $P1_{river\ level}$)/10 m] compared to river level during ramp-downs and drawdowns. Literature values from Bowles (1996) and Chu-Agor *et al.* 2009

## A5.6 Field observations

Field observations focussed on the response of the 2–3 turbine bank level under the differing drawdown conditions. As shown in Photo A5-2, this bank level is characterised by a steeper slope as indicated by arrows in the region between red and green lines, with the sandy bank frequently overlain by a degraded root mat supporting sparse vegetation. Because of this, observations focussed on banks on which the root mat has been previously removed, exposing the underlying sands, and which were previously identified as sites prone to seepage processes (Photo A5-3).

All ramp-downs or drawdowns were characterised by three distinct stages which varied in duration between the trials. The first stage consisted of a period during which river level decreased, but no water drained from the bank. This was consistent with the piezometer results which indicated that the river level continued to exceed ground water level at P2 during this period for all of the trials, so effectively the bank was continuing to fill.

The second stage of drawdown occurred when the river level fell to near or just below the ground water level in the bank. During this period, water began to drain from the bank, and contained low concentrations of sediment, except for the two high-saturation trials, when small scale seepage was observed during this stage (Photo A5-4).

The final stage of bank draining grades from the second, and is characterised by bank rilling. As the river level decreased at a rapid rate, the distance between the level of water in the bank and the river increased, resulting in the increased exposure of sandy bank toes. As water flowed down the sandy, denuded toes, rilling occurred (Photo A5-5), and the concentrations of sediments being carried by the surface flows increased (Photo A5-6). Differences between the ramped and unramped flow reductions are discussed in the next section.

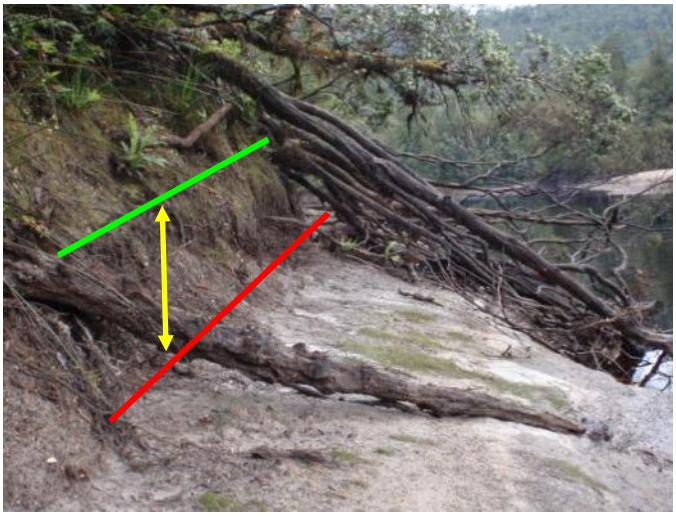

Photo A5-2 Bank profile in zone 2 showing break in slope at top of 2-turbine water level (marked by red line), degraded root mat and sparse vegetation in 3-turbine level, and sandy, denuded lower bank and bank toe

Photo A5-3 Exposed sands in 3-turbine bank level

Photo A5-4 Initial, diffuse draining of bank during drawdowns and ramp-downs

Photo A5-5 Rilling of bank toes during drawdowns

Photo A5-6 Photo showing increase in sediment content of water as it flows down sandy bank toes. Water on left collected near top of bank, water on right collected where water entering river. Vertical distance between ground water level and river level estimated to be 1 m. Distance over bank ~ 2.5 m

### A5.6.1 30 $m^3$ $s^{-1}$ per hour and 45 $m^3$ $s^{-1}$ per hour high saturation ramp-downs

The 30 $m^3$ $s^{-1}$ per hour and 45 $m^3$ $s^{-1}$ per hour ramp-down trials had the highest level of bank saturation, with water levels at P2 of 3.2 m and 3.3 m, respectively. Hydrographs of the ramps are contained in Figure A5-3, and hourly ground water levels for the two ramps are shown in Figure A5-4, though it needs to be emphasised that water level was continually dropping and the hourly levels are only 'snapshots' showing relative changes. The profiles show that the duration of the 45 $m^3$ $h^{-1}$ ramp was approximately one hour shorter than the 30 $m^3$ $s^{-1}$ per hour ramp, with water levels of 1.5 m occurring approximately four hours and three hours after initiation of the ramps, respectively. The profiles also show that during the first two hours of the 30 $m^3$ $s^{-1}$ per hour ramp and the first two hours of the 45 $m^3$ $s^{-1}$ per hour ramp river level continued to exceed the ground water level as recorded at P2, with the banks continuing to 'fill'. This is also evident in Figure A5-2 which shows that during the early stage of each ramp-down, water slope was into the bank. The next step in each ramp resulted in similar river levels of about 2.5 m.

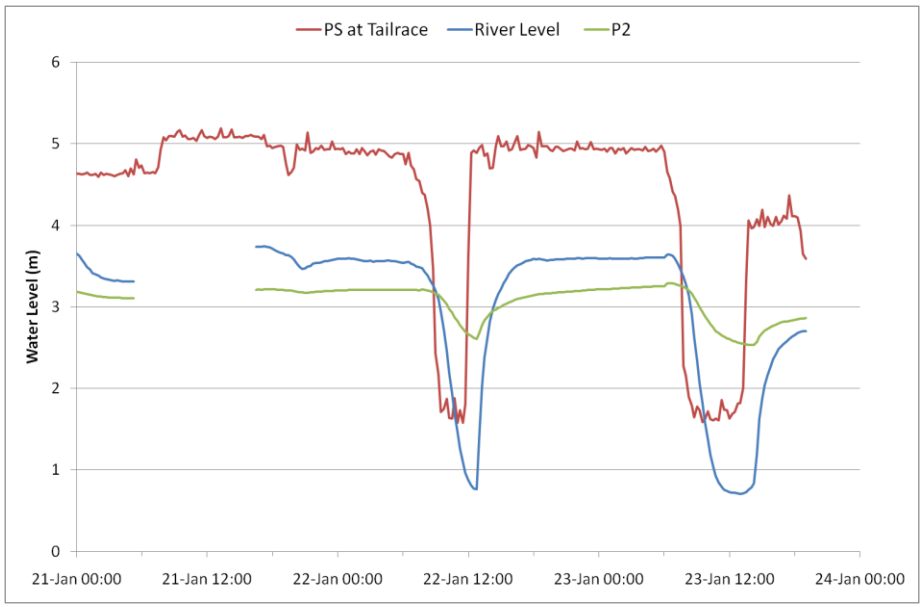


Figure A5-3 Hydrograph of power station, river level at piezometer site and water level at piezometer 2 during the ramp-down observations

The pattern of ground water slopes for the two ramp-downs was very similar (Figure A5-2). The curve for the 45 $m^3$ $h^{-1}$ ramp is slightly higher with respect to the water level at P2 due to the river level being higher when the ramp-down commenced as compared to the 30 $m^3$ $s^{-1}$ per hour ramp.

For both ramps, the initial power station flow reduction led to very little decrease in river level. It is likely that during this period, water draining from the Albert River, the 'pool' downstream of the Albert River, and other backwater areas maintain elevated flows as these 'storage' areas drained. This hypothesis was supported by foam lines observed on banks which were similar in the early stages of the ramped and unramped drawdowns, suggesting that the hydraulics of the river affect

the initial rate of water level drop in combination with the rate of decrease in discharge at the power station. The river level response to decreases at the power station become more rapid following this initial period. It is believed that this increase in the rate of river level reduction occurs once water levels decrease to the point that flow is completely contained within the main channel of the Gordon River.

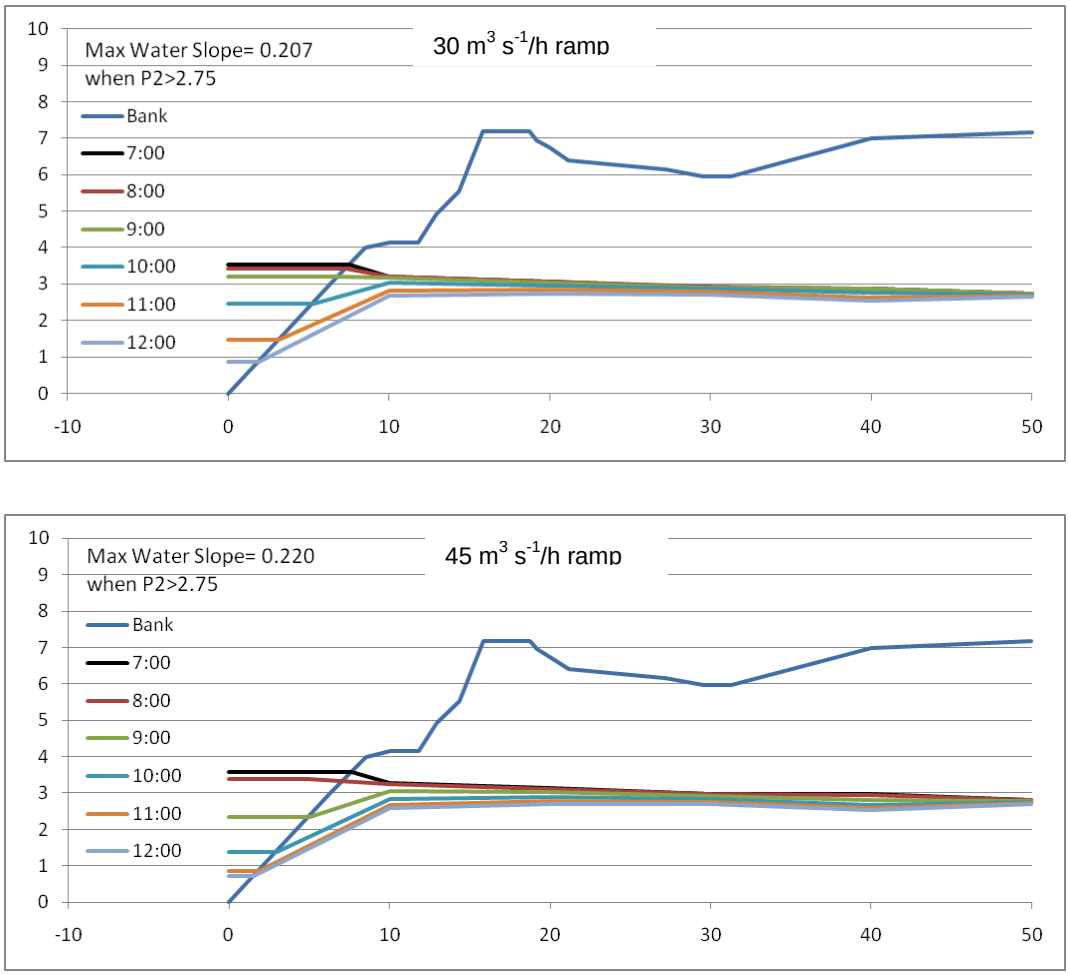


Figure A5-4 Ground water levels during the 30 and 45 $m^3 s^{-1}$ per hour ramping trials. Blue line shows bank profile. X-axis indicates distance from the bank toe. Note vertical exaggeration

Photo A5-7 Foam lines on bedrock bank during 45 $m^3$ $s^{-1}$ per hour ramp (left) and during high-saturation, non-ramped drawdown (right)

Observations of the ramp-downs included:

- a prolonged 'stage one' (as described above) corresponding to the first one to two hours of the 30 $m^3$ $s^{-1}$ per hour ramp and the first hour of the 45 $m^3$ $s^{-1}$ per hour ramp with no water draining from the banks. This corresponded to the period when water was continuing to enter the bank;
- during the 30 $m^3$ $s^{-1}$ per hour ramp, a prolonged stage two period (one to two hours), when water was draining from the bank, but no rilling occurred due to the relatively short distance between the level at which water was draining from the bank and river level. This occurred when the river level was in the lower portion of the 2–3 turbine bank level;
- the 45 $m^3$ $s^{-1}$ per hour ramp was characterised by a shorter stage two period. This was because the river level decreased more rapidly, leading to a longer distance over the ground the water had to travel before entering the river, which led to rilling (stage three);
- during the 45 $m^3$ $s^{-1}$ per hour ramp there was a longer period of bank draining accompanied by rilling in the 0–2 turbine bank level as compared to the 30 $m^3$ $s^{-1}$ per hour ramp;
- during both ramp-downs, there was extensive draining of water through the degraded root mat, leading to water dripping off the vegetation and the root mat;
- during both ramp-downs the 2–3 turbine bank level was saturated and 'spongy' when prodded with a boat oar; and
- no sediment flows were observed in the 2–3 turbine bank level during either the 30 $m^3$ $s^{-1}$ per hour or 45 $m^3$ $s^{-1}$ per hour ramp-down.

## A5.6.2 Un-ramped drawdowns

Five un-ramped drawdowns were observed with varying levels of initial bank saturation as summarised in Table A5-1.

### *A5.6.2.1 Low bank saturation*

The lowest bank saturation conditions were observed on 7 March when water level at P2 registered a maximum level of 2.24 m prior to the shutdown. River level was considerably higher, at 3.65 m. Not unexpectedly, this drawdown had a prolonged 'stage one' period, when no water was observed draining from the bank. There was also very little water draining from or dripping off the root mat or vegetation. The river level was well below the 2–3 turbine bank level before water began draining from the bank. Rilling of the bank in the <2 turbine bank level occurred, although the volume of water observed exiting the bank appeared to be substantially less than in the other ramp-downs or drawdowns, consistent with less water being present in the bank. No rilling or sediment flows were observed in the 2–3 turbine bank level.

### *A5.6.2.2 Medium bank saturation*

Two drawdowns were observed when ground water levels were about 2.6 m at P2 (23 February and 8 March). The starting river level for the two events was quite different, being 3.61 m and 3.95 m respectively. Although initial river level was higher for the 8 March drawdown, water level at P2 fell more rapidly during this trial as compared to the 23 February event (Figure A5-2). This is likely due to low discharge from the power station in the days preceding 8 March, as compared to the 23 February scenario. This demonstrates that a variety of operating scenarios can result in similar levels of bank saturation as gauged at P2, and that the rate of water level reduction in bank will defer depending on the flow history.

Observations made during these un-ramped drawdowns included:

- the 'stage one' period was shorter than the low bank saturation scenario, but longer than the high saturation scenarios (discussed below) consistent with the bank saturation level, consistent with the relative differences between river level and bank saturation level;
- a relatively short 'stage two' period due to the rapidly dropping river levels;
- an extended 'stage three' period with rilling occurring in the <2 turbine bank level; and
- no sediment flows were observed in the 2–3 turbine bank level or any other bank level during the trials.

### *A5.6.2.3 High bank saturation*

Two observations were completed when bank saturation levels exceeded the 2.75 m (2-turbine) level. Water level at P2 during the 24 and 25 February drawdowns was 2.94 m and 2.97 m, respectively. Initial river levels varied by about 20 cm between the two events, but the water slope graphs (Figure A5-2) show the events were very similar.

Observations of these events included:

- a relatively short 'stage one', with water beginning to drain from the bank whilst the river level was still above the 2-turbine bank level;
- a relatively short 'stage two' period which occurred while river level was still above the 2-turbine bank level;
- an extended 'stage three' period with relatively larger volumes of water draining from the bank as compared to the low- and medium-saturation trials; and
- small-scale sediment flows were observed at the break in slope between the 2- and 3-turbine bank level. Unlike the 2001 observations (full-gate to off, no ramp) when large volumes of sand moved downslope, the sediment flows observed during these events were small and localised. The mass movement of saturated sediments was observed for a period of several minutes at two different sites, and appeared to occur where several rills converged at the break in slope. The flowing water pushed newly exposed saturated sediments down slope.

## A5.7 Comparison of groundwater slopes during drawdowns

Comparing the in-bank water slopes recorded during the ramp-downs and unramped flow reductions with literature values for bank failure due to seepage processes (Figure A5-2) shows that maximum slopes associated with the trials were all less than those associated with seepage failure. Based on the slopes of the exposed sandy banks in the Gordon River, generally 17–21°, the estimated water slope required to induce failure is about 0.3–0.4. The observation of small-scale sediment flows during the high bank saturation trials suggests that the water slopes within the banks are not uniform, with slopes closer to the bank face being higher than that calculated.

The results from Figure A5-2 are compared to similar results for a full-gate (>240 $m^3 s^{-1}$) to off event under conditions of high bank saturation and no ramping in March 2000 (Figure A5-5). In March 2000, ground water levels were approximately 800 mm higher as compared to the recent high saturation ramp events. The reason for this is the power station had been run at 3-turbine discharge for the majority of time over previous months due to dry conditions in the state. The results show very large and rapid decreases in ground water levels at the piezometer site and increases in ground water slopes at the beginning of the drawdown. Maximum ground water slopes occurred when water levels in the bank were about 3 m. River observations made after events such as this recorded wide spread sediment flows in the 3-turbine bank level, consistent with the high water slopes.

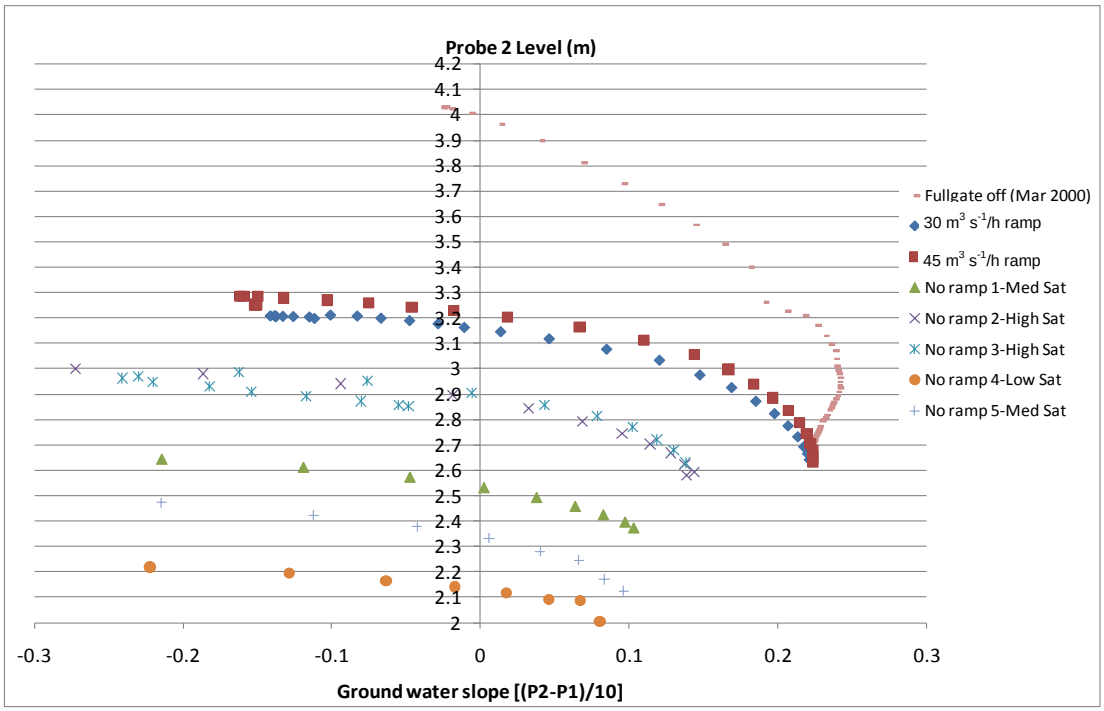


Figure A5-5 Ground water slopes and water level at probe 2 for recent trials compared with full-gate to off shutdown in March 2000. For the March 2000 event water slopes are based on a probe situated 11 m inland

### A5.7.1 Water movement and rates of slope change

Comparing the estimated permeability of the banks with the rate of water level drop in the river for the recent trials (Figure A5-6) shows that during the first part of the drawdowns, the rate at which the river is decreasing is similar to the permeability of the banks. During this time, water movement out of the bank can (almost) keep pace with the river recession and ground water slopes remain low. Because water is draining from the banks near river level, only a limited area of the bank face is exposed to rilling. This corresponds to 'stage two' of the drawdown. As the drawdown proceeds, the rate at which the river level drops increases, leading to higher water slopes and exposing a larger area of the bank face to rilling.

The benefit of ramping is that it extends this 'stage two' period and allows the 2–3 turbine bank level to drain under conditions of low water slope. Ramping reduces the recession rate of the river to rates similar to the permeability of the bank (Figure A5-6), thus allowing the bank to drain at a rate similar to that at which the river level is decreasing, resulting in low water slopes within the bank. In the ramped events, the river level decreased by up to 0.5 m under these conditions. In comparison, during the unramped event, river level is still in excess of 3.5 m when recession rate increases. This leads to high water slopes in the 2–3 turbine bank level, increasing the risk of seepage failure.

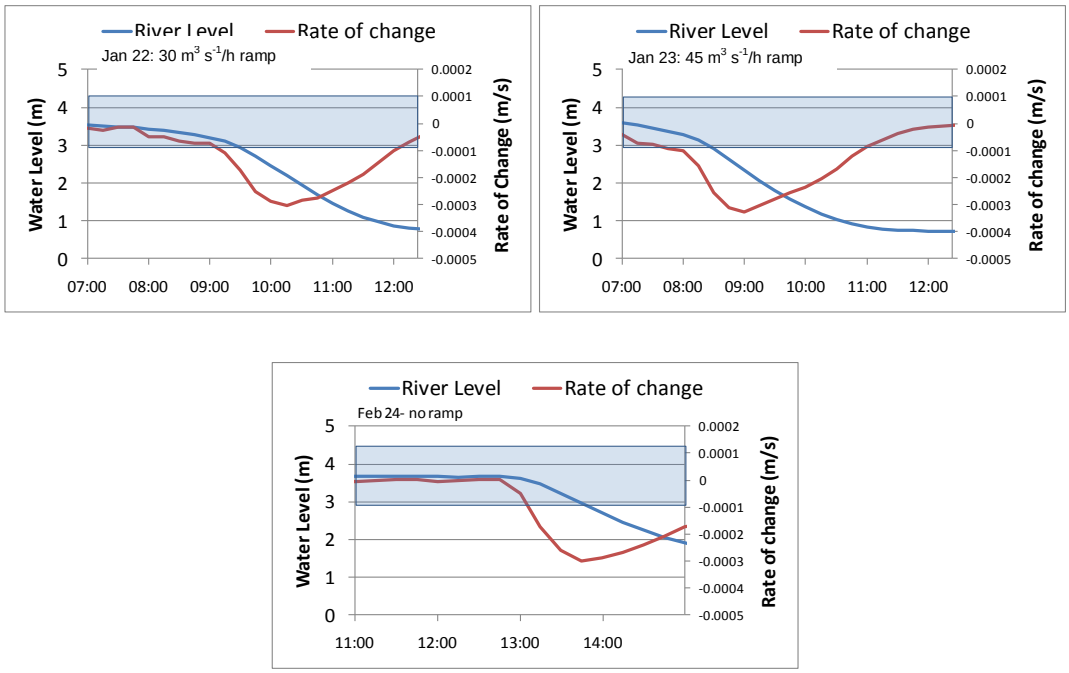


Figure A5-6 River level (m) compared to rate of river level change during the ramped and unramped drawdown under conditions of high bank saturation. The blue shaded area shows range of permeability for unconsolidated medium sands

Variations in the rate of ground water slope change at P2 during the trials is summarised in Figure A5-7 where this rate is compared to the water level at P2. The relevance of this comparison is that the higher the calculated rate of slope change between P2 and the river, the higher the actual slope near the bank face (likely well in excess of the calculated slope), because bank drainage cannot maintain pace with river recession.

The ramped trials show lower rates of ground water slope change. Interestingly, the graph also shows that the lower the initial bank saturation level, the more rapidly the water slope changes when the power station shuts down. This is most likely reflecting the relative amount of water stored within the catchment upstream of the piezometer site. When banks are saturated, the banks, backwaters, the lower Albert River and the 'pool' downstream of the Albert are all storing large amounts of water which buffers the initial rate of river recession. Under conditions of low saturation, river flow is contained within the channel and there is considerably less stored water, resulting in higher recession rates when the power station shuts down. These results suggest that seepage processes were probably very active during the early years of power station operation when only one or two turbines were operational and flow was contained within the channel.

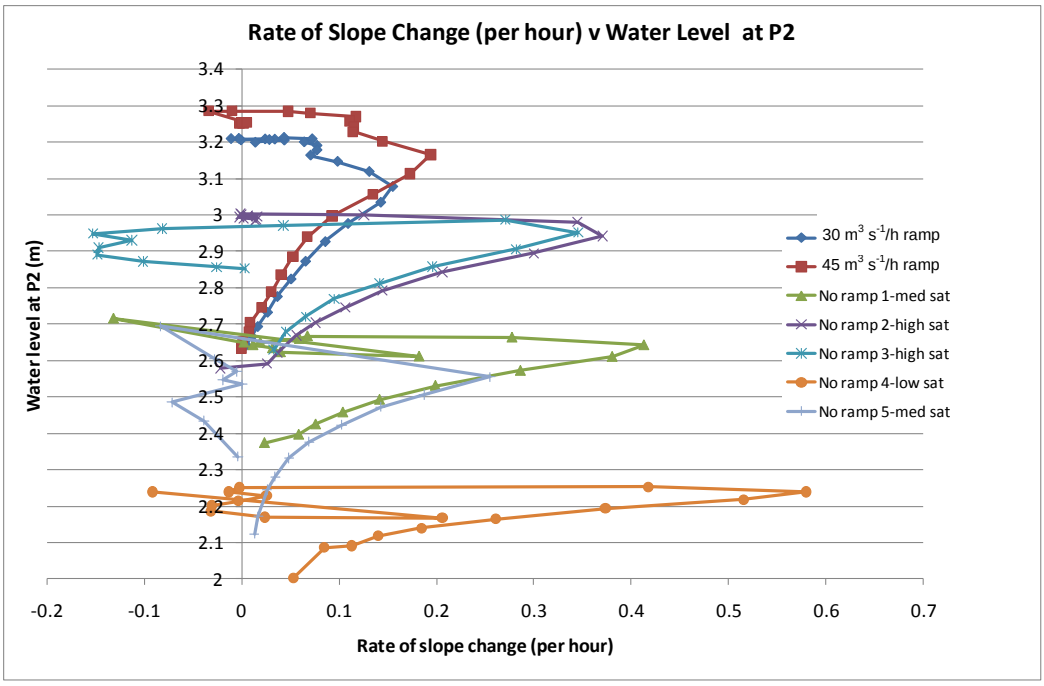


Figure A5-7 Rate of groundwater slope change at P2 (per hour) compared to the water level at P2. Data points are at 15 minute intervals over the duration of the drawdown

## A5.8 Summary of main findings

The main findings of the ramp-down trials were:

- ramping is an effective means of reducing sediment flows in the 3-turbine bank level;
- there is little difference in the rate of water level decrease between a 30 $m^3$ $s^{-1}$ per hour and 45 $m^3$ $s^{-1}$ per hour ramp during the first one to two hours, with the hydraulics of the river controlling initial recession rates due to the storage of water in banks and backwaters;
- the 45 $m^3$ $s^{-1}$ per hour ramp prevented sediment flows in the 3-turbine bank level, but exposed the lower bank (<2-turbine level) more rapidly, which may promote additional rilling of the lower bank face as compared to the 30 $m^3$ $s^{-1}$ per hour ramp;
- a bank saturation level of 2.75 m at piezometer 2 (10 m inland) at the zone 2 piezometer site is a good indicator of the limit between the 2- and 3-turbine bank levels;
- under conditions of low bank saturation (piezometer 2 <2.75 m) no sediment flows occurred in the 2–3 turbine bank level following uncontrolled flow reduction (no ramping);
- under these low saturation bank conditions, ramping of the power station flows can lead to an increase in bank saturation levels;

- small scale sediment flows were observed at some (but not all) of the observed sites when bank saturation exceeded 2.75 m and power station flows were not ramped; and
- all drawdowns, whether ramped or not, resulted in rilling of the bank face in the <2-turbine level due to the difference in level between where water was draining from the bank and the river level.

Overall, the results suggest that compared to the present rule, a better environmental outcome could be achieved by ramping all flow reduction >180 $m^3 s^{-1}$ at a rate of 45 $m^3 s^{-1}$ per hour or less when bank saturation exceeds 2.75 m, with no ramping required if bank saturation levels are below 2.75 m.

# References

Bowles, J.E., 1996, *Foundation Analysis and Design* (5th Edition), McGraw Hill

Chu-Agor, ML, Fox, GA, and Wilson, GV, 2009. *Empirical sediment transport function predicting seepage erosion undercutting for cohesive bank failure prediction*. Journal of Hydrology, v377, p.155-164.

Entura 2010, *Seepage modelling of the Gordon River bank – minimising erosion from power station operation*. Report for Hydro Tasmania

# A6 Karst erosion pin data

Table A6-1 All erosion pin data Spring 2001 to Autumn 2011

| Site no. | Site name | Pin no. | Erosion pin lengths (mm) | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | S01 | A02 | S02 | A03 | S03 | A04 | S04 | A05 | S05 | A06 | S06 | A07 | S07 | A08 | S08 | A09 | S09 | A10 | S10 | A11 |
| 1 | Channel Cam | 1 | 322 | 318 | 318 | 316 | 318 | 322 | 314 | 323 | 320 | 322 | 322 | 316 | 316 | 317 | 321 | 322 | 320 | 323 | 321 | 324 |
| | | 28 | n/a | n/a | 245 | 245 | 248 | 248 | 243 | 256 | 245 | 248 | 247 | 246 | 245 | 250 | 244 | 249 | 248 | 250 | 246 | 259 |
| 2 | GA-X1 cave | 2 | 250 | 239 | 238 | 244 | 242 | 245 | 248 | 251 | 250 | 251 | 253 | 251 | 254 | 255 | 255 | 256 | 259 | 263 | 264 | 270 |
| | | 3 | 190 | 189 | 193 | 195 | 196 | 194 | 194 | 194 | 195 | 193 | 194 | 194 | 195 | 195 | 196 | 195 | 196 | 197 | 196 | 198 |
| | | 4 | 154 | 161 | 160 | 163 | 159 | 165 | 168 | 168 | 176 | 178 | 173 | 177 | 181 | 175 | 173 | 177 | 182 | 168 | 178 | 181 |
| | Doline at cave entrance | 9 | 214 | 213 | 220 | 217 | 219 | 224 | 201 | 215 | 213 | 215 | 181 | 182 | 111 | 115 | 119 | 120 | 120 | 120 | 121 | 121 |
| | | 10 | 278 | 278 | 293 | 290 | 291 | 290 | 283 | 286 | 286 | 288 | 284 | 283 | 284 | 289 | 284 | 284 | 280 | 280 | 276 | 280 |
| | | 34 | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | 385 | 381 | 381 | 383 | 383 | 381 | 381 |
| 3 | Doline adjacent to GA-X1 | 5 | 259 | 287 | 294 | 297 | 284 | 283 | 291 | 290 | 292 | 290 | 283 | 290 | 269 | 278 | 270 | 267 | 255 | 263 | 265 | 270 |
| | | 6 | 300 | 300 | 294 | 306 | 297 | 290 | 296 | 296 | 295 | 297 | 300 | 301 | 298 | 301 | 300 | 300 | 301 | 305 | 307 | 307 |
| | | 7 | 254 | 252 | 258 | 261 | 257 | 252 | 250 | 248 | 261 | 260 | 261 | 254 | 249 | 252 | 254 | 251 | 252 | 254 | 254 | 254 |
| | | 8 | 195 | 196 | 192 | 200 | 194 | 192 | 195 | 194 | 192 | 189 | 188 | 186 | 190 | 190 | 189 | 189 | 188 | 190 | 188 | 187 |
| 4 | Small doline | 12 | 192 | 171 | 170 | 172 | 152 | 155 | 156 | 145 | 151 | 150 | 131 | 147 | 160 | 164 | 155 | 142 | 138 | 135 | 124 | 125 |
| | | 13 | 234 | 238 | 231 | 231 | 245 | 241 | 240 | 225 | 236 | 232 | 230 | 235 | 220 | 222 | 223 | 226 | 230 | 229 | 225 | 229 |
| | | 14 | 253 | 256 | 244 | 262 | 257 | 257 | 250 | 257 | 249 | 255 | 253 | 260 | 250 | 251 | 250 | 249 | 253 | 251 | 262 | 260 |
| | | 31 | n/a | n/a | n/a | n/a | n/a | n/a | 570 | 564 | 568 | 568 | 556 | 561 | 554 | 567 | 540 | n/a | n/a | n/a | n/a | n/a |
| | | 32 | n/a | n/a | n/a | n/a | n/a | n/a | 776 | 770 | 750 | 768 | 750 | 765 | 742 | 762 | 754 | 761 | 740 | 755 | 731 | 740 |

Table A6-1 *continued next page*

| Site no. | Site name | Pin no. | Erosion pin lengths (mm) | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | S01 | A02 | S02 | A03 | S03 | A04 | S04 | A05 | S05 | A06 | S06 | A07 | S07 | A08 | S08 | A09 | S09 | A10 | S10 | A11 |
| 5 | Kayak Kavern | 1 | 309 | 308 | 319 | 359 | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| | | 17 | 293 | 291 | 284 | 288 | 339 | 384 | 349 | 320 | 366 | 302 | 315 | 287 | 261 | 269 | 261 | 255 | 237 | 238 | 221 | 222 |
| | | 18 | 267 | 266 | 255 | 263 | 258 | 252 | 256 | 271 | 269 | 272 | 281 | 284 | 284 | 278 | 269 | 280 | 280 | 259 | 263 | 250 |
| | | 19 | 249 | 245 | 271 | 267 | 225 | 220 | 222 | 232 | 215 | 115 | 95 | 125 | 188 | 180 | 154 | 188 | 230 | 207 | 170 | 175 |
| | | 29 | n/a | n/a | n/a | n/a | n/a | 273 | ? | 272 | ? | 233 | 216 | 220 | 175 | 195 | 164 | 162 | 160 | 165 | 163 | 172 |
| | | 30 | n/a | n/a | n/a | n/a | n/a | 259 | ? | 241 | 243 | 245 | 243 | 224 | 200 | 200 | 184 | 172 | 169 | 168 | 88 | 88 |
| | | 33 | n/a | n/a | n/a | n/a | n/a | n/a | n/a | 275 | 266 | 283 | 293 | 256 | 279 | 262 | 273 | 288 | 263 | 186 | 191 | 189 |
| 6 | Bill Neilson Cave 6A at entrance | 20 | 483 | 480 | 499 | 495 | 501 | 493 | 502 | 497 | 497 | 495 | 498 | 499 | 495 | 498 | 510 | 509 | 494 | 495 | 498 | 499 |
| | | 21 | 300 | 299 | 302 | 301 | 304 | 305 | 301 | 300 | 304 | 306 | 310 | 310 | 304 | 312 | 314 | 312 | 313 | 313 | 314 | 312 |
| | | 22 | 272 | 272 | 269 | 272 | 271 | 271 | 270 | 271 | 270 | 270 | 267 | 268 | 266 | 265 | 265 | 261 | 264 | 267 | 265 | 266 |
| | Bill Neilson Cave 6B Sed bank II | 25 | 194 | 195 | 195 | 195 | 198 | 198 | 205 | 203 | 204 | 204 | 207 | 208 | 211 | 211 | 213 | 211 | 208 | 207 | 209 | 208 |
| | | 26 | 203 | 203 | 202 | 202 | 202 | 204 | 206 | 204 | 204 | 205 | 205 | 205 | 204 | 205 | 205 | 206 | 207 | 208 | 208 | 206 |
| | | 27 | 215 | 216 | 214 | 213 | 212 | 208 | 210 | 210 | 209 | 210 | 210 | 213 | 211 | 211 | 213 | 213 | 214 | 214 | 213 | 213 |
| | Bill Neilson Cave 6C Dry bank | 23 | 297 | 297 | 295 | 298 | 298 | 297 | 297 | 297 | 296 | 297 | 297 | 297 | 296 | 296 | 296 | 296 | 296 | 296 | 297 | 296 |
| | | 24 | 227 | 226 | 202 | 203 | 203 | 203 | 203 | 203 | 203 | 203 | 202 | 202 | 202 | 202 | 202 | 202 | 202 | 202 | 203 | 202 |

Table A6-1 continued

Table A6-2. Erosion pin survey data for Sites 3 and 4

| Site No. | Pins measured | Distance between pins (m) | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **S02** | **A03** | **S03** | **A04** | **S04** | **A05** | **S05** | **A06** | **S06** | **A07** | **S07** | **A08** | **S08** | **A09** | **S09** | **A10** | **S10** | **A11** |
| 3 | PMP* to pin 5 | 3.280 | 3.295 | 3.295 | 3.295 | 3.298 | 3.300 | 3.290 | 3.290 | 3.293 | 3.305 | 3.298 | 3.307 | 3.305 | 3.306 | 3.308 | 3.318 | 3.314 | 3.325 |
| | Pin 5 to pin 6 | 1.055 | 1.055 | 1.050 | 1.055 | 1.050 | 1.050 | 1.049 | 1.053 | 1.049 | 1.044 | 1.047 | 1.043 | 1.044 | 1.042 | 1.043 | 1.034 | 1.037 | 1.029 |
| | Pin 6 to pin 7 | 1.350 | 1.345 | 1.345 | 1.355 | 1.359 | 1.356 | 1.359 | 1.355 | 1.357 | 1.354 | 1.358 | 1.360 | 1.358 | 1.360 | 1.359 | 1.359 | 1.360 | 1.362 |
| | Pin 7 to pin 8 | 1.850 | 1.850 | 1.850 | 1.845 | 1.852 | 1.850 | 1.854 | 1.851 | 1.850 | 1.849 | 1.849 | 1.848 | 1.849 | 1.849 | 1.850 | 1.851 | 1.854 | 1.854 |
| | **Sum pins 5 to 8** | **4.255** | **4.250** | **4.245** | **4.255** | **4.261** | **4.256** | **4.262** | **4.259** | **4.256** | **4.247** | **4.254** | **4.251** | **4.251** | **4.251** | **4.252** | **4.244** | **4.251** | **4.245** |
| 4 | PMP* to pin 12 | 2.620 | 2.620 | 2.630 | 2.625 | 2.628 | 2.630 | 2.626 | 2.630 | 2.629 | 2.628 | 2.625 | 2.626 | 2.626 | 2.620 | 2.625 | 2.621 | 2.620 | 2.623 |
| | Pin 12 to pin 13 | 1.515 | 1.515 | 1.515 | 1.515 | 1.522 | 1.517 | 1.517 | 1.520 | 1.519 | 1.518 | 1.517 | 1.516 | 1.520 | 1.520 | 1.518 | 1.520 | 1.520 | 1.520 |
| | Pin 13 to pin 14 | 1.435 | 1.435 | 1.435 | 1.435 | 1.440 | 1.435 | 1.438 | 1.435 | 1.436 | 1.436 | 1.435 | 1.436 | 1.439 | 1.435 | 1.437 | 1.436 | 1.437 | 1.438 |
| | Pin 13 to stick (31) | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| | Pin 12 to pin 31 | n/a | n/a | n/a | n/a | 0.530 | 0.530 | 0.524 | 0.525 | 0.520 | n/a | 0.514 | 0.512 | 0.508 | n/a | n/a | n/a | n/a | n/a |
| | Pin 12 to pin 32 | n/a | n/a | n/a | n/a | 0.722 | 0.720 | 0.720 | 0.720 | 0.720 | n/a | 0.721 | 0.718 | 0.720 | 0.720 | 0.720 | 0.719 | 0.724 | 0.740 |
| | **Sum pins 12 to 14** | **2.950** | **2.950** | **2.950** | **2.950** | **2.962** | **2.952** | **2.955** | **2.955** | **2.955** | **2.954** | **2.952** | **2.952** | **2.959** | **2.955** | **2.955** | **2.956** | **2.957** | **2.958** |
| *PMP is photo-monitoring peg | | | | | | | | | | | | | | | | | | | |

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# A7 Riparian vegetation photo-monitoring

## A7.1 Zone 2

### A7.1.1 Site 1


Photo A7-1 Zone 2-1, November 2004 (left), December 2005 (right)


Photo A7-2 Zone 2-1, December 2006 (left), December 2007 (right)


Photo A7-3 Zone 2-1, December 2008 (left), December 2009 (right)

Photo A7-4 Zone 2-1, December 2010

## A7.1.2 Site 2


Photo A7-5 Zone 2-2, November 2004 (left), December 2005 (right)


Photo A7-6 Zone 2-2, December 2006 (left), December 2007 (right)


Photo A7-7 Zone 2-2, December 2008 (left), December 2009 (right)

Photo A7-8 Zone 2-2, December 2010

## A7.1.3 Site 3

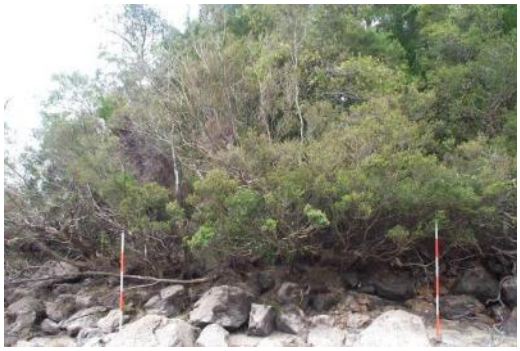



Photo A7-9 Zone 2-3, November 2004 (left), December 2005 (right)


Photo A7-10 Zone 2-3, December 2006 (left), December 2007 (right)


Photo A7-11 Zone 2-3, December 2008 (left), December 2009 (right)

Photo A7-12 Zone 2-3, December 2010

## A7.1.4 Site 4


Photo A7-13 Zone 2-4, November 2004 (left), December 2005 (right)


Photo A7-14 Zone 2-4, December 2006 (left), December 2007 (right)


Photo A7-15 Zone 2-4, December 2008 (left), December 2009 (right)

Photo A7-16 Zone 2-4, December 2010

## A7.1.5 Site 5

Photo A7-17 Zone 2-5, November 2004 (left), December 2005 (right)

Photo A7-18 Zone 2-5, December 2006 (left), December 2007 (right)

Photo A7-19 Zone 2-5, December 2008 (left), December 2009 (right)

Photo A7-20 Zone 2-5, December 2010

## A7.1.6 Site 6

No photo taken December 2005

Photo A7-21 Zone 2-6, November 2004

Photo A7-22 Zone 2-6, December 2006 (left), December 2007 (right)

Photo A7-23 Zone 2-6, December 2008 (left), December 2009 (right)

No photo taken December 2010

## A7.1.7 Site 7


Photo A7-24 Zone 2-7, November 2004 (left), December 2005 (right)


Photo A7-25 Zone 2-7, December 2006 (left), December 2007 (right)


Photo A7-26 Zone 2-7, December 2008 (left), December 2009 (right)

Photo A7-27 Zone 2-7, December 2010

### A7.1.8 Site 8


Photo A7-28 Zone 2-8, November 2004 (left), December 2005 (right)


Photo A7-29 Zone 2-8, December 2006 (left), December 2007 (right)

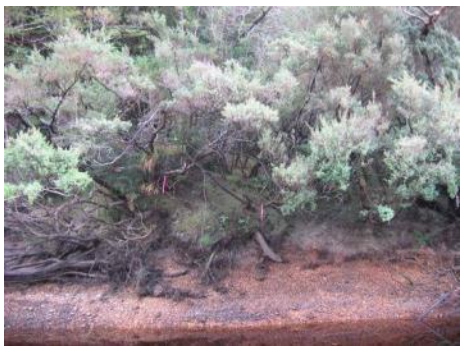



Photo A7-30 Zone 2-8, December 2008 (left), December 2009 (right)

Photo A7-31 Zone 2-8, December 2010

## A7.1.9 Site 9

Photo A7-32 Zone 2-9, November 2004 (left), December 2005 (right)

Photo A7-33 Zone 2-9, December 2006 (left), December 2007 (right)

Photo A7-34 Zone 2-9, December 2008 (left), December 2009 (right)

Photo A7-35 Zone 2-9, December 2010

## A7.1.10 Site 10

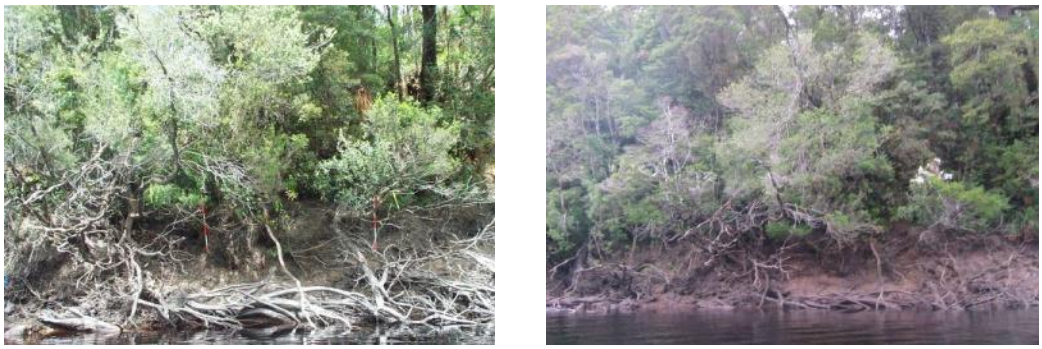


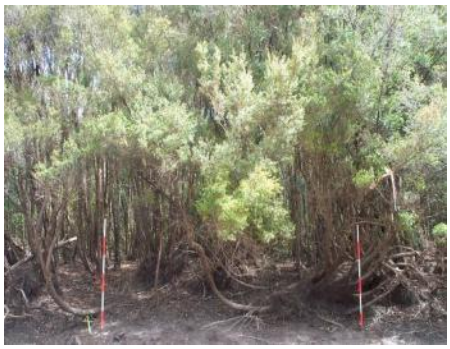
Photo A7-36 Zone 2-10, November 2004 (left), December 2005 (right)

Photo A7-37 Zone 2-10, December 2006 (left), December 2007 (right)

Photo A7-38 Zone 2-10, December 2008 (left), December 2009 (right)

Photo A7-39 Zone 2-10, December 2010

## A7.1.11 Site 11



No photo taken December 2005

Photo A7-40 Zone 2-11, November 2004

Photo A7-41 Zone 2-11, December 2006 (left), December 2007 (right)

Photo A7-42 Zone 2-11, December 2008 (left), December 2009 (right)

Photo A7-43 Zone 2-11, December 2010

## A7.1.12 Site 12

No photo taken December 2005

Photo A7-44 Zone 2-12, November 2004

Photo A7-45 Zone 2-12, December 2006 (left), December 2007 (right)

Photo A7-46 Zone 2-12, December 2008 (left), December 2009 (right)

Photo A7-47 Zone 2-12, December 2010

## A7.2 Zone 3

### A7.2.1 Site 1

Photo A7-48 Zone 3-1, November 2004 (left), December 2005 (right)

Photo A7-49 Zone 3-1, December 2006 (left), December 2007 (right)

Photo A7-50 Zone 3-1, December 2008 (left), December 2009 (right)

Photo A7-51 Zone 3-1, December 2010

### A7.2.2 Site 2


Photo A7-52 Zone 3-2, November 2004 (left), December 2005 (right)


Photo A7-53 Zone 3-2, December 2006 (left), December 2007 (right)


Photo A7-54 Zone 3-2, December 2008 (left), December 2009 (right)

Photo A7-55 Zone 3-2, December 2010

### A7.2.3 Site 3

Photo A7-56 Zone 3-3, November 2004 (left), December 2005 (right)

Photo A7-57 Zone 3-3, December 2006 (left), December 2007 (right)

Photo A7-58 Zone 3-3, December 2008 (left), December 2009 (right)

Photo A7-59 Zone 3-3, December 2010

### A7.2.4 Site 4

Photo A7-60 Zone 3-4, November 2004 (left), December 2005 (right)

Photo A7-61 Zone 3-4, December 2006 (left), December 2007 (right)

Photo A7-62 Zone 3-4, December 2008 (left), December 2009 (right)

Photo A7-63 Zone 3-4, December 2010

## A7.2.5 Site 5

Photo A7-64 Zone 3-5, November 2004 (left), December 2005 (right)

Photo A7-65 Zone 3-5, December 2006 (left), December 2007 (right)

Photo A7-66 Zone 3-5, December 2008 (left), December 2009 (right)

Photo A7-67 Zone 3-5, December 2010

## A7.2.6 Site 6


Photo A7-68 Zone 3-6, November 2004 (left), December 2005 (right)


Photo A7-69 Zone 3-6, December 2006 (left), December 2007 (right)


Photo A7-70 Zone 3-6, December 2008 (left), December 2009 (right)

Photo A7-71 Zone 3-6, December 2010

## A7.2.7 Site 7

Photo A7-72 Zone 3-7, November 2004 (left), December 2005 (right)

Photo A7-73 Zone 3-7, December 2006 (left), December 2007 (right)

Photo A7-74 Zone 3-7, December 2008 (left), December 2009 (right)

Photo A7-75 Zone 3-7, December 2010

## A7.2.8 Site 8


Photo A7-76 Zone 3-8, November 2004 (left), December 2005 (right)


Photo A7-77 Zone 3-8, December 2006 (left), December 2007 (right)

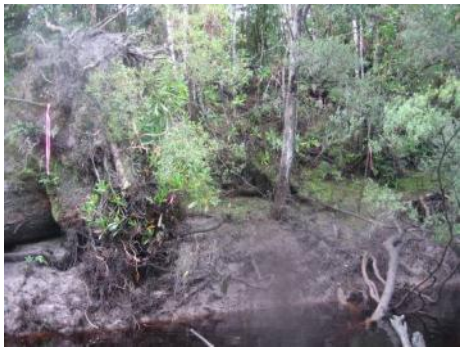



Photo A7-78 Zone 3-8, December 2008 (left), December 2009 (right)

Photo A7-79 Zone 3-8, December 2010

## A7.3 Zone 4

### A7.3.1 Site 1


Photo A7-80 Zone 4-1, November 2004 (left), December 2005 (right)


Photo A7-81 Zone 4-1, December 2006 (left), December 2007 (right)


Photo A7-82 Zone 4-1, December 2008 (left), December 2009 (right)

No photo taken December 2010

### A7.3.2 Site 2


Photo A7-83 Zone 4-2, November 2004 (left), December 2005 (right)


Photo A7-84 Zone 4-2, December 2006 (left), December 2007 (right)


Photo A7-85 Zone 4-2, December 2008 (left), December 2009 (right)

Photo A7-86 Zone 4-2, December 2010

## A7.3.3 Site 3


Photo A7-87 Zone 4-3, November 2004 (left), December 2005 (right)


Photo A7-88 Zone 4-3, December 2006 (left), December 2007 (right)


Photo A7-89 Zone 4-3, December 2008 (left), December 2009 (right)

Photo A7-90 Zone 4-3, December 2010

## A7.3.4 Site 4


Photo A7-91 Zone 4-4, November 2004 (left), December 2005 (right)


Photo A7-92 Zone 4-4, December 2006 (left), December 2007 (right)


Photo A7-93 Zone 4-4, December 2008 (left), December 2009 (right)

Photo A7-94 Zone 4-4, December 2010

### A7.3.5 Site 5


Photo A7-95 Zone 4-5, November 2004 (left), December 2005 (right)


Photo A7-96 Zone 4-5, December 2006 (left), December 2007 (right)


Photo A7-97 Zone 4-5, December 2008 (left), December 2009 (right)

Photo A7-98 Zone 4-5, December 2010

## A7.3.6 Site 6


Photo A7-99 Zone 4-6, November 2004 (left), December 2005 (right)


Photo A7-100 Zone 4-6, December 2006 (left), December 2007 (right)


Photo A7-101 Zone 4-6, December 2008 (left), December 2009 (right)

Photo A7-102 Zone 4-6, December 2010

## A7.3.7 Site 7


Photo A7-103 Zone 4-7, November 2004 (left), December 2005 (right)


Photo A7-104 Zone 4-7, December 2006 (left), December 2007 (right)


Photo A7-105 Zone 4-7, December 2008 (left), December 2009 (right)

No photo taken December 2010

## A7.4 Zone 5

### A7.4.1 Site 1


Photo A7-106 Zone 5-1, November 2004 (left), April 2009 (right)

No data available for 2005, 2006, 2007 or 2008. No photos taken December 2009 or December 2010 due to flooding

### A7.4.2 Site 2


Photo A7-107 Zone 5-2, November 2004 (left), December 2007 (right)

No data available for 2005 or 2006


Photo A7-108 Zone 5-2, November 2008 (left), December 2010 (right)

No photo taken December 2009 due to flooding

## A7.4.3 Site 3

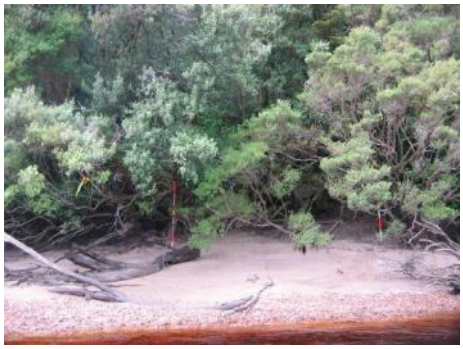


Photo A7-109 Zone 5-3, November 2004 (left), December 2005 (right)

Photo A7-110 Zone 5-3, December 2006 (left), December 2007 (right)

Photo A7-111 Zone 5-3, December 2008

No photo taken December 2009 due to flooding. No photo taken December 2010

### A7.4.4 Site 4


Photo A7-112 Zone 5-4, November 2004 (left), December 2005 (right)


Photo A7-113 Zone 5-4, December 2006 (left), December 2007 (right)


Photo A7-114 Zone 5-4, December 2008 (left), December 2009 (right)

Photo A7-115 Zone 5-4, December 2010

## A7.4.5 Site 5

Photo A7-116 Zone 5-5, November 2004 (left), December 2005 (right)

Photo A7-117 Zone 5-5, December 2006 (left), December 2007 (right)

Photo A7-118 Zone 5-5, December 2008 (left), December 2009 (right)

Photo A7-119 Zone 5-5, December 2010

## A7.4.6 Site 6


Photo A7-120 Zone 5-6, November 2004 (left), December 2005 (right)


Photo A7-121 Zone 5-6, December 2006 (left), December 2007 (right)


Photo A7-122 Zone 5-6, December 2008 (left), December 2009 (right)

Photo A7-123 Zone 5-6, December 2010

## A7.4.7 Site 7


Photo A7-124 Zone 5-7, November 2004 (left), December 2005 (right)


Photo A7-125 Zone 5-7, December 2006 (left), December 2007 (right)


Photo A7-126 Zone 5-7, December 2008 (left), December 2009 (right)

Photo A7-127 Zone 5-7, December 2010

## A7.4.8 Site 8

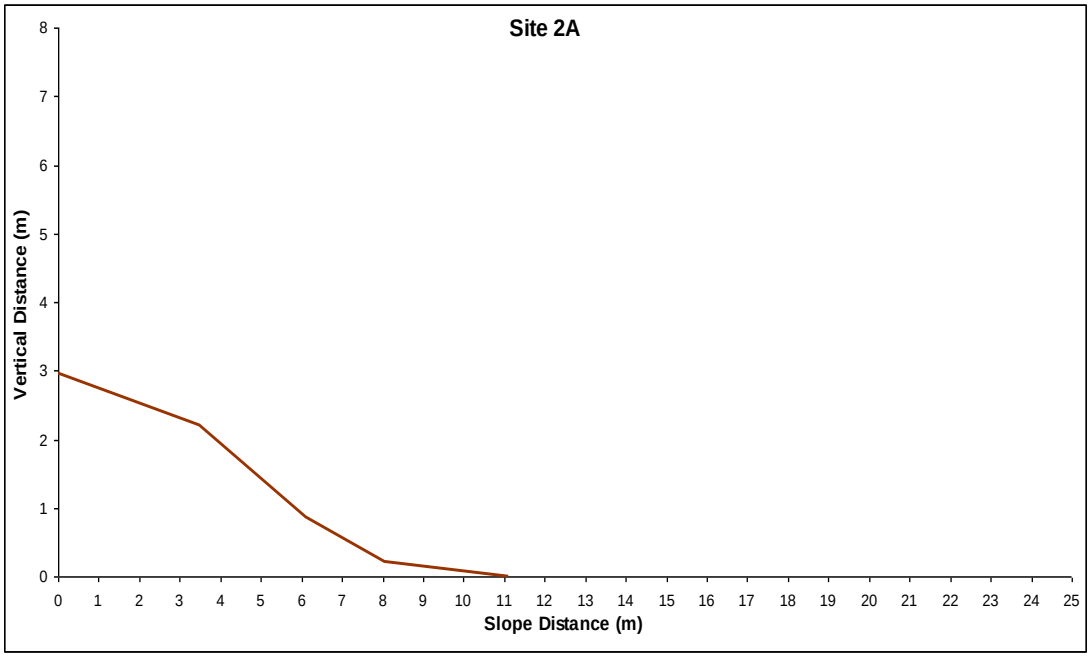

Photo A7-128 Zone 5-8, November 2004 (left), December 2005 (right)


Photo A7-129 Zone 5-8, December 2006 (left), December 2007 (right)


Photo A7-130 Zone 5-7, December 2008 (left), December 2009 (right)

Photo A7-131 Zone 5-7, December 2010

# A8 Bank profiles and ground cover variables



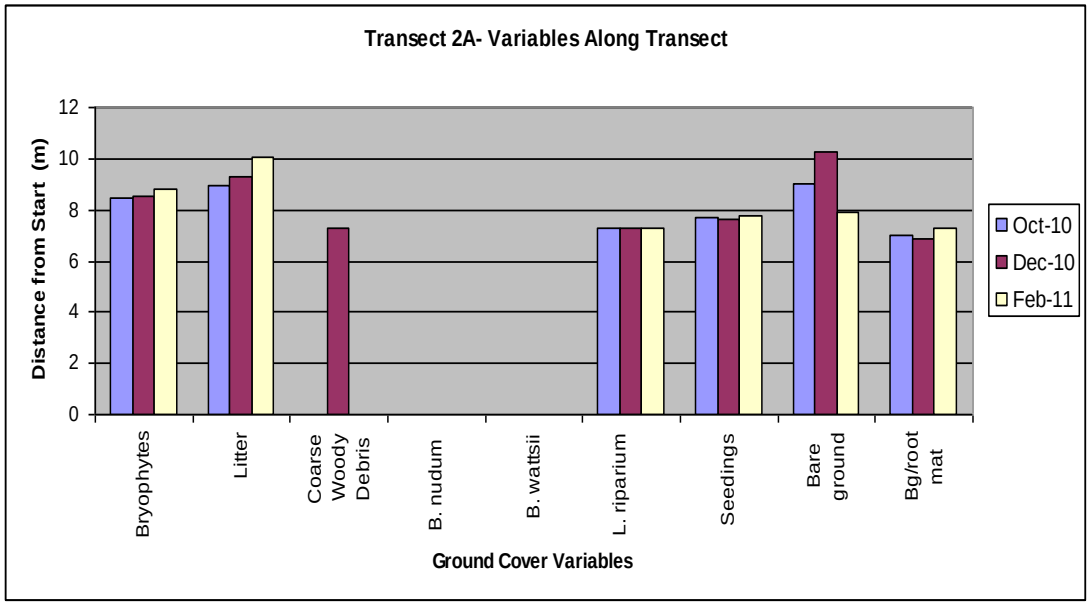
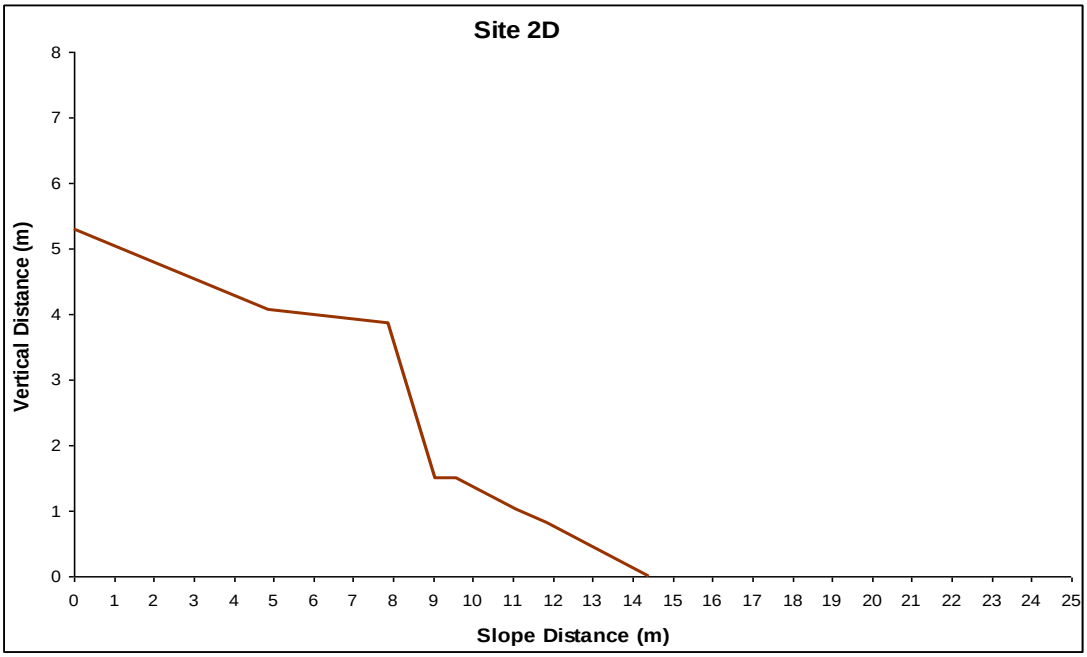




Figure A8-1 Bank profile and ground cover variables for site 2A



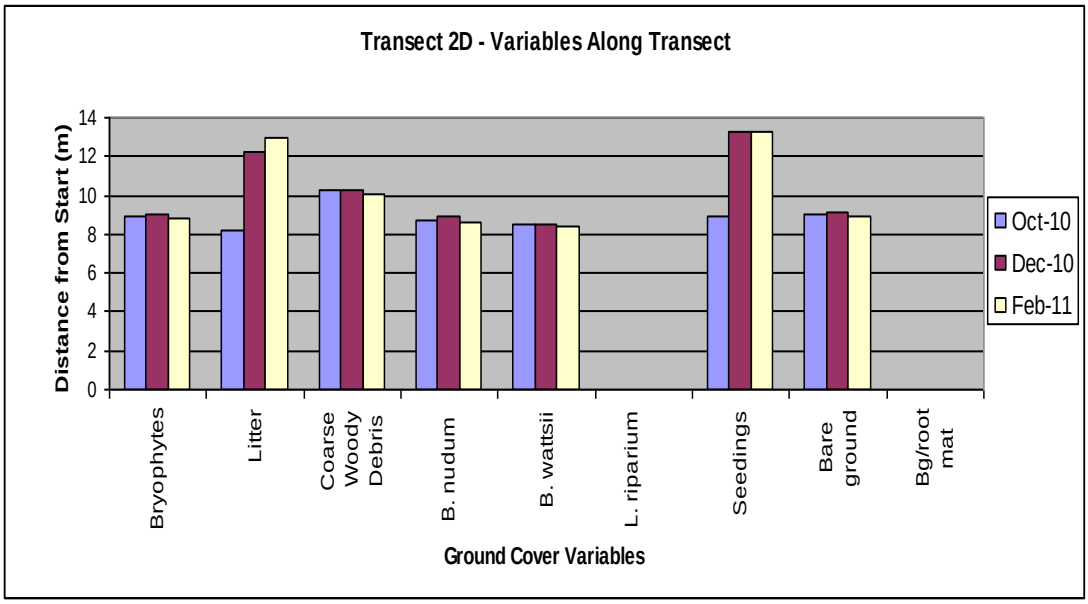
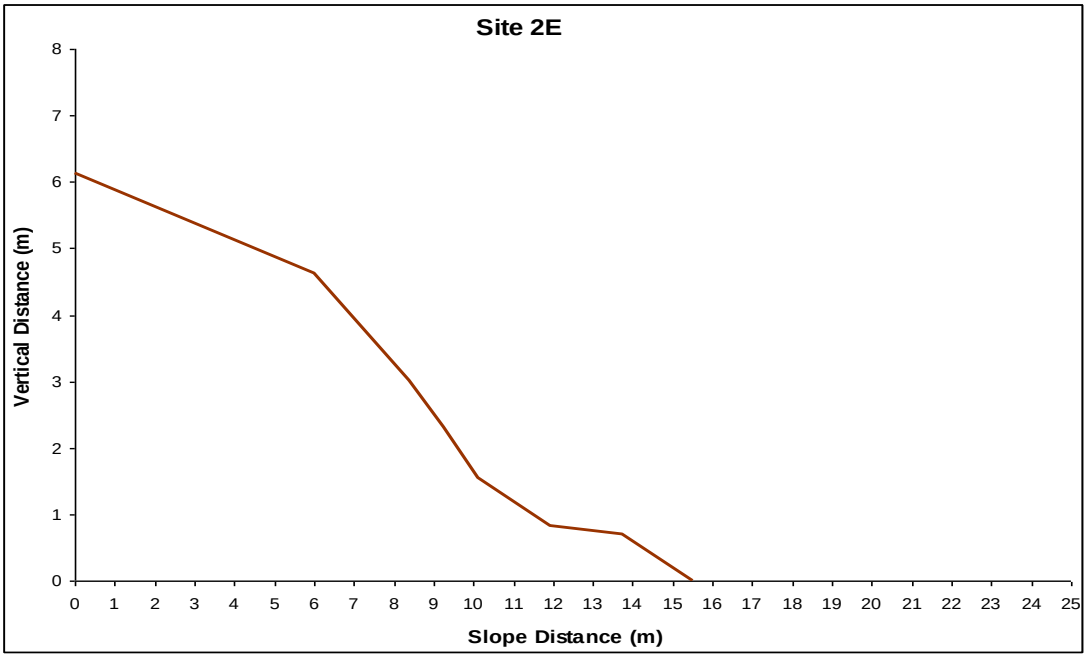




Figure A8-2 Bank profile and ground cover variables for site 2D



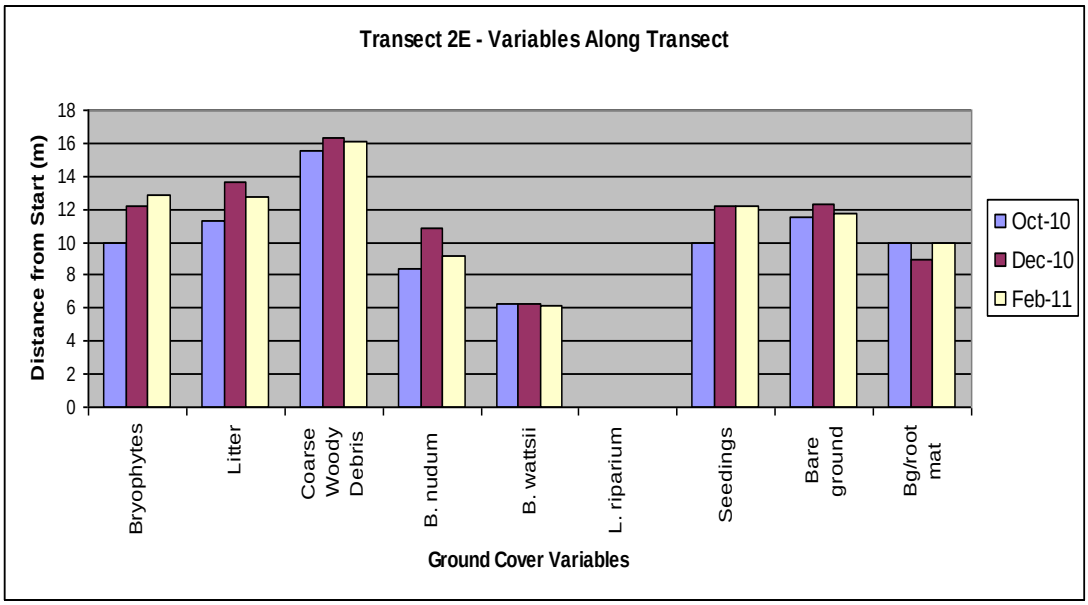
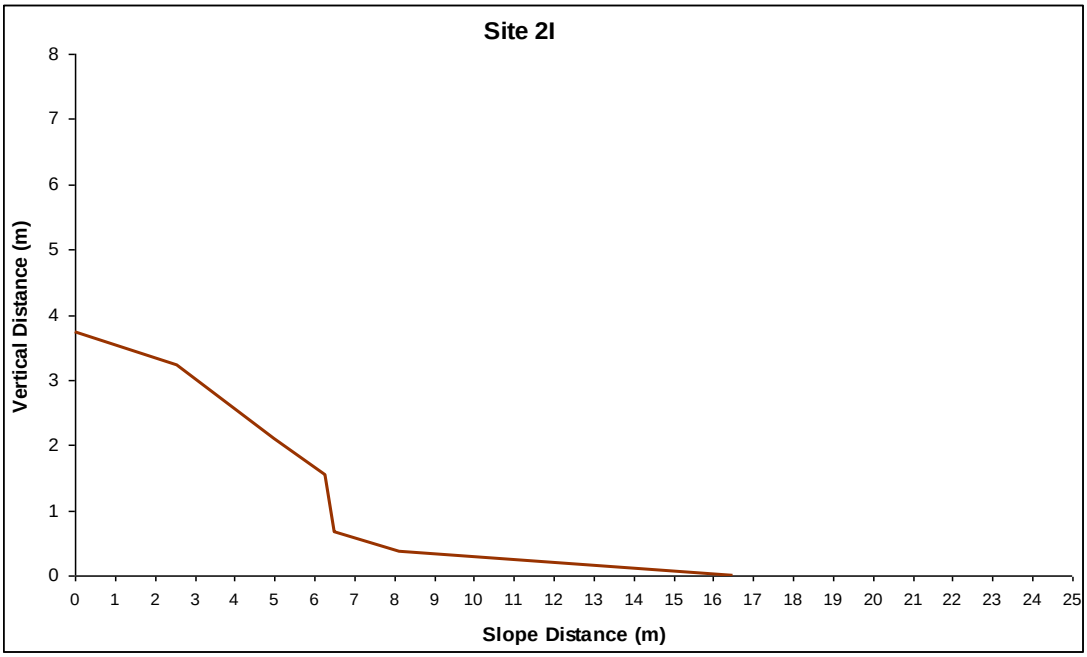




Figure A8-3 Bank profile and ground cover variables for site 2E



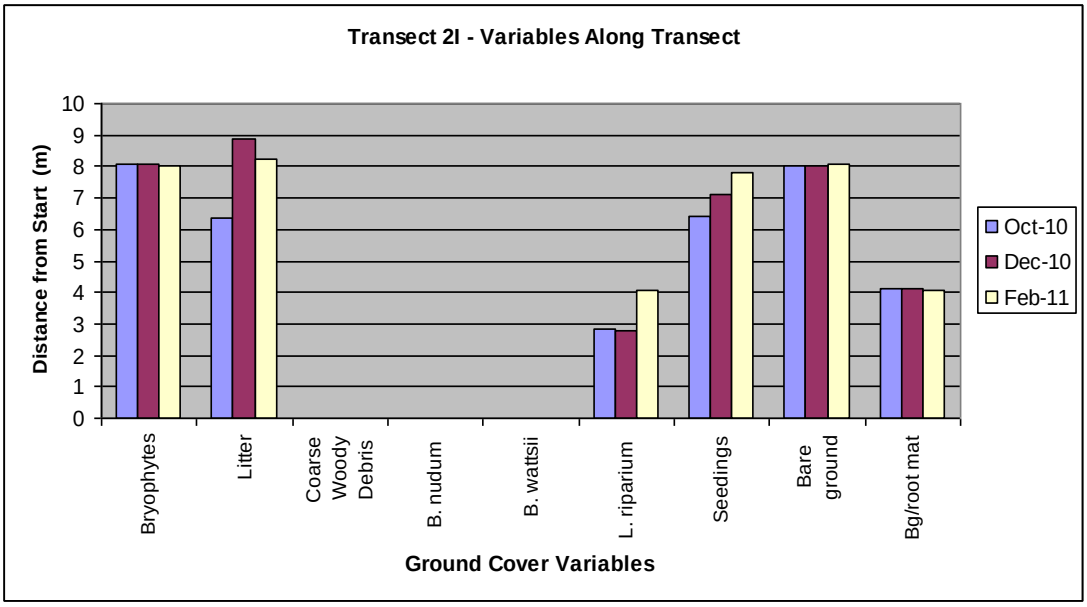
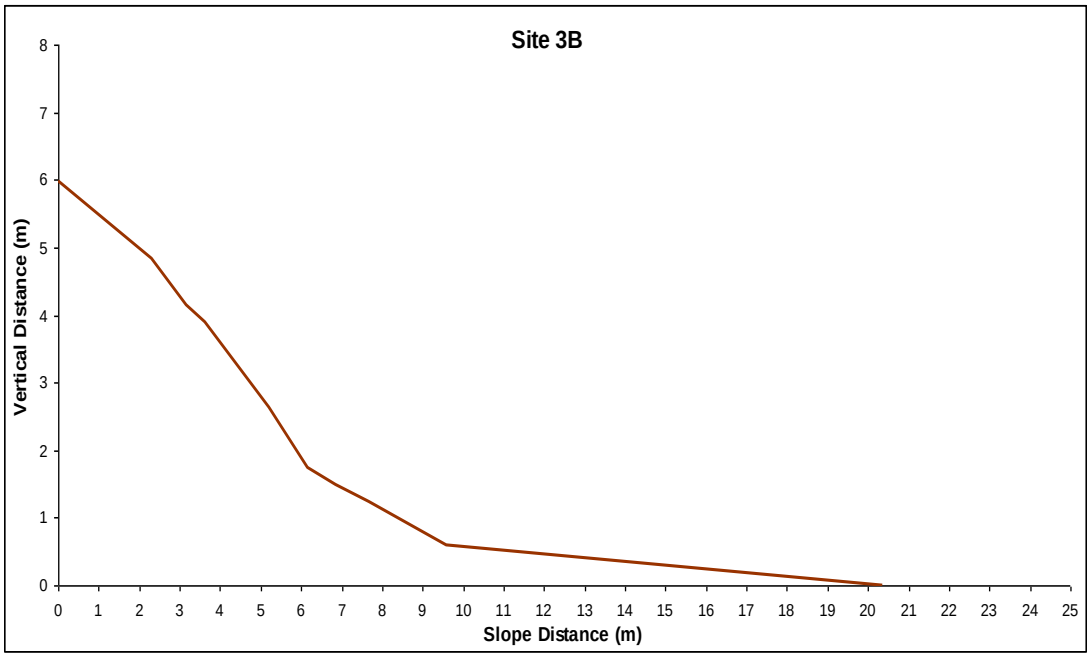




Figure A8-4 Bank profile and ground cover variables for site 2I



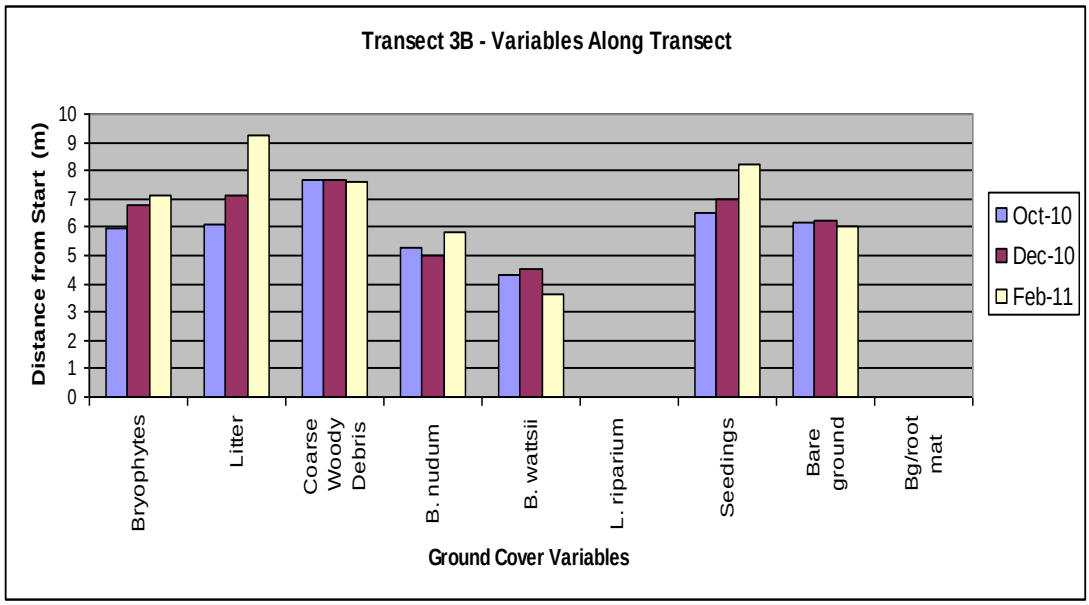
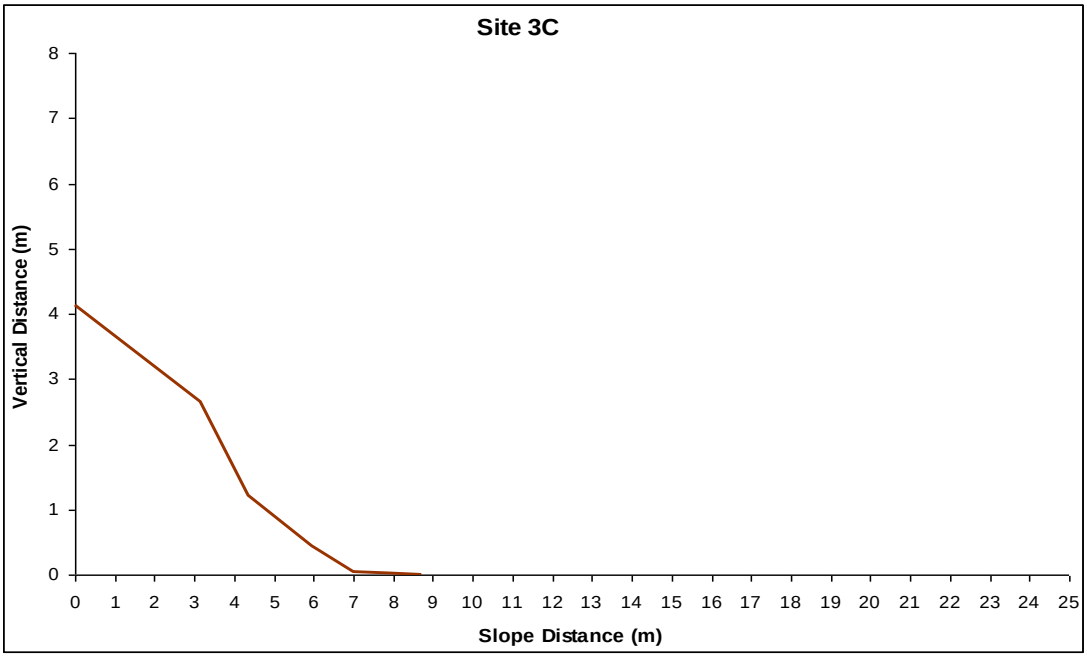




Figure A8-5 Bank profile and ground cover variables for site 3B



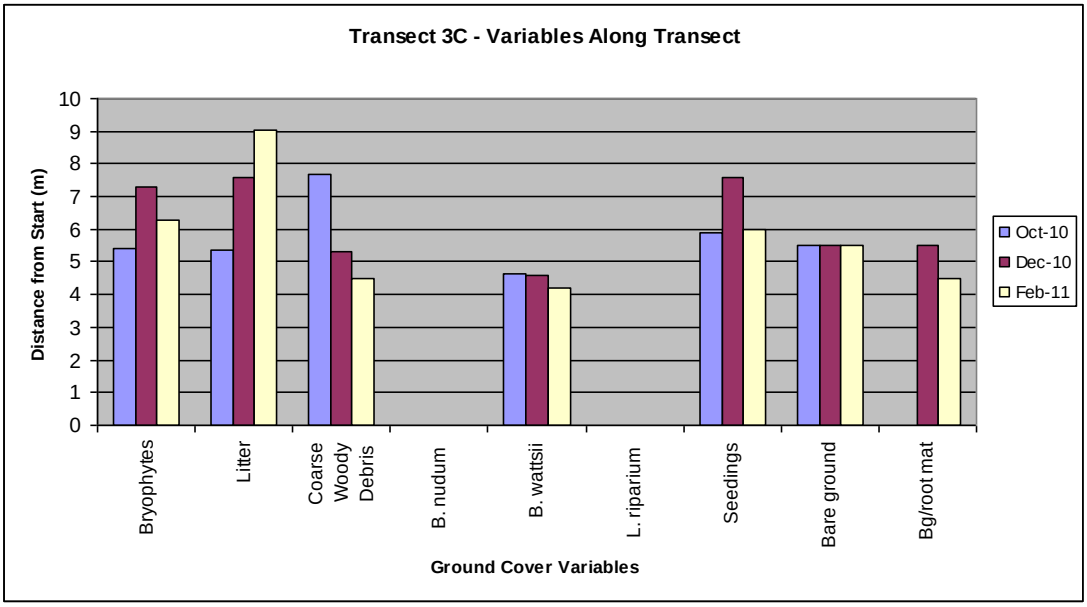
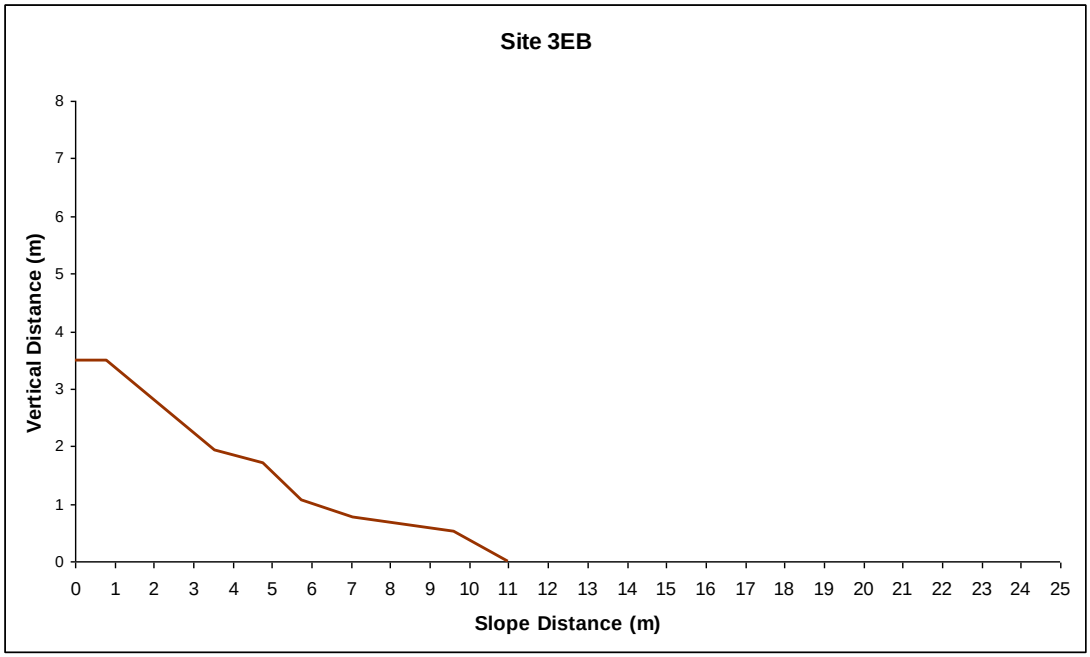




Figure A8-6 Bank profile and ground cover variables for site 3C



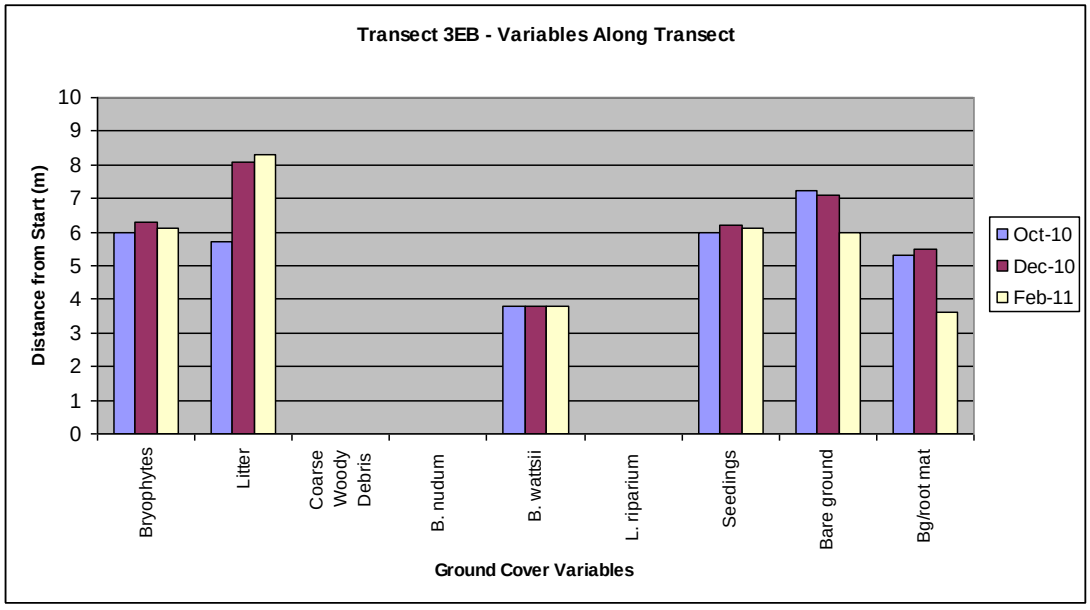
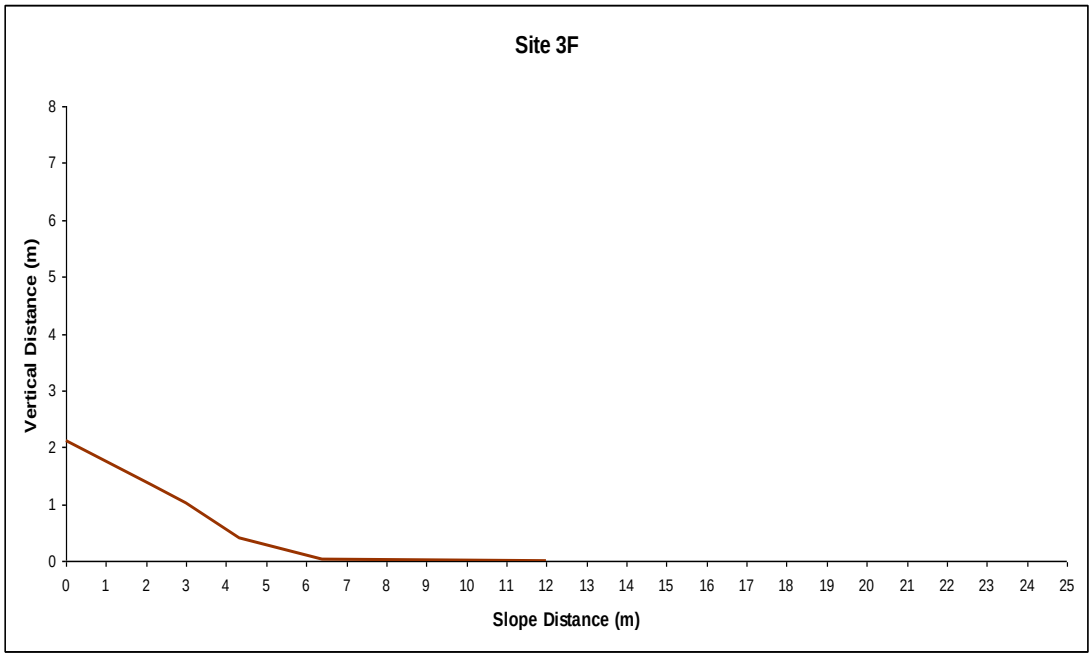




Figure A8-7 Bank profile and ground cover variables for site 3EB



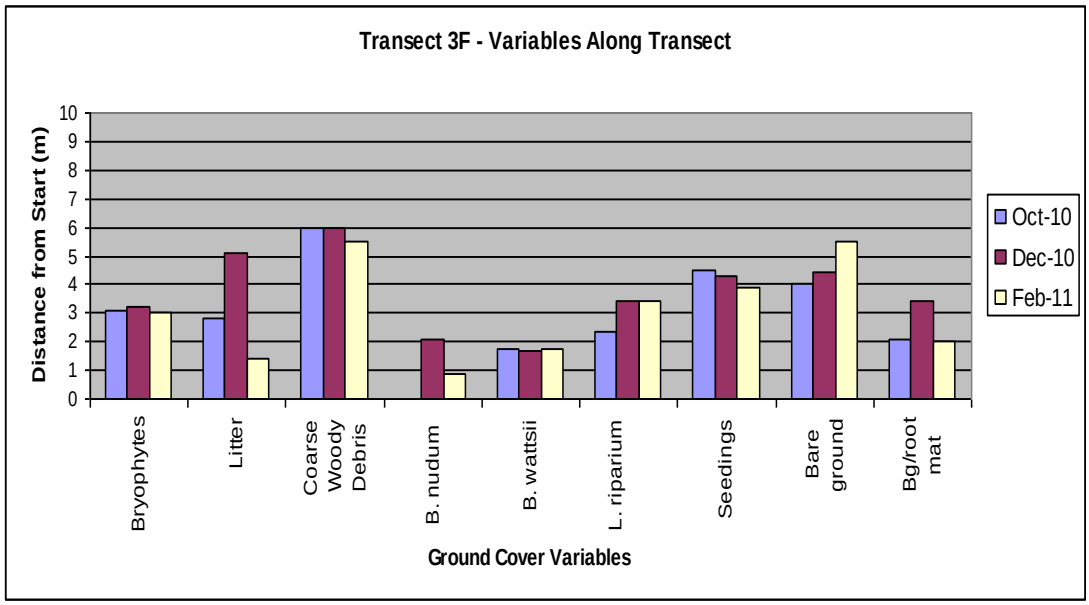
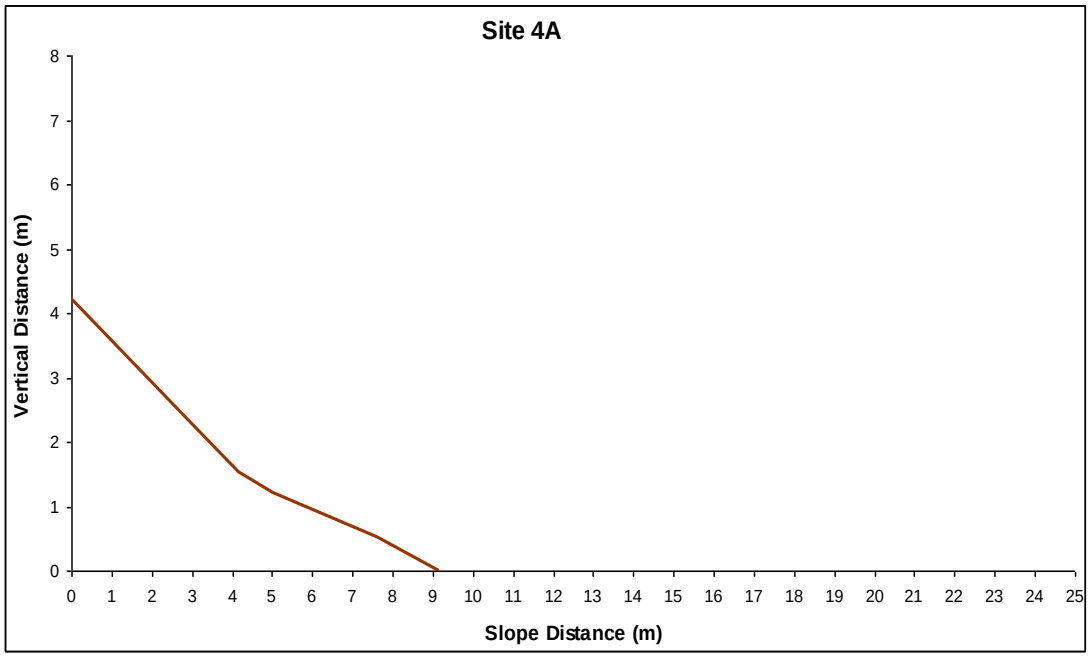




Figure A8-8 Bank profile and ground cover variables for site 3F



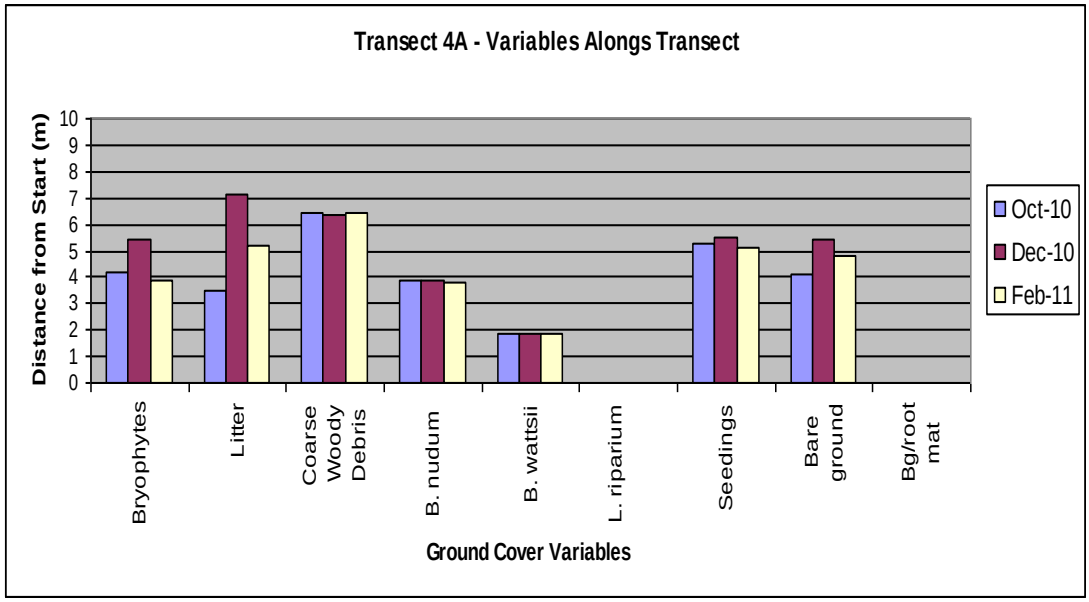
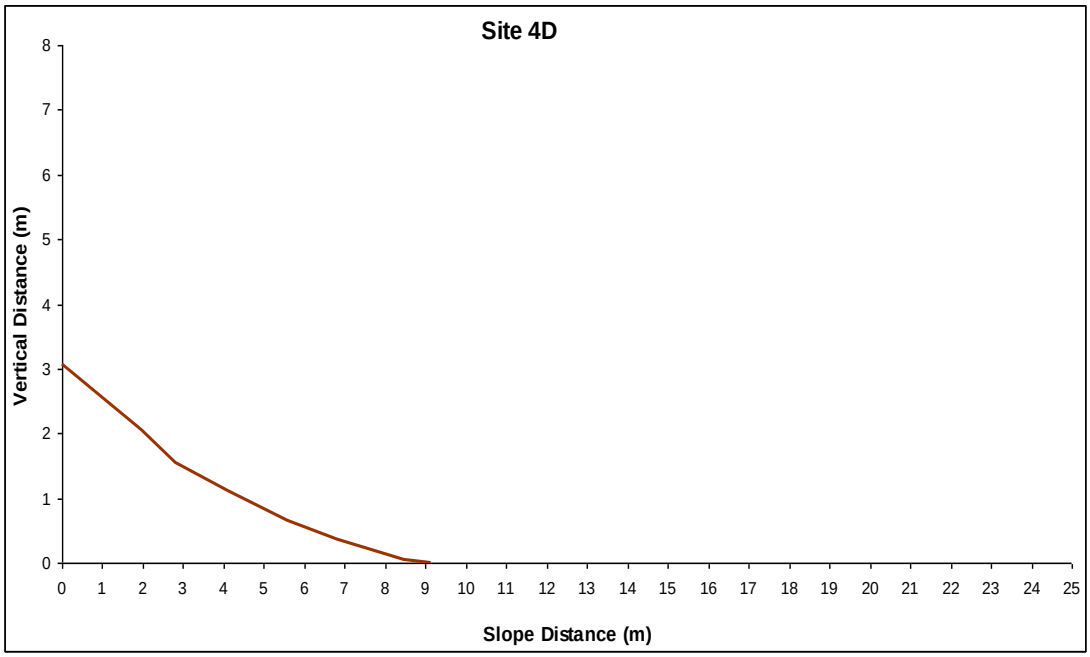




Figure A8-9 Bank profile and ground cover variables for site 4A



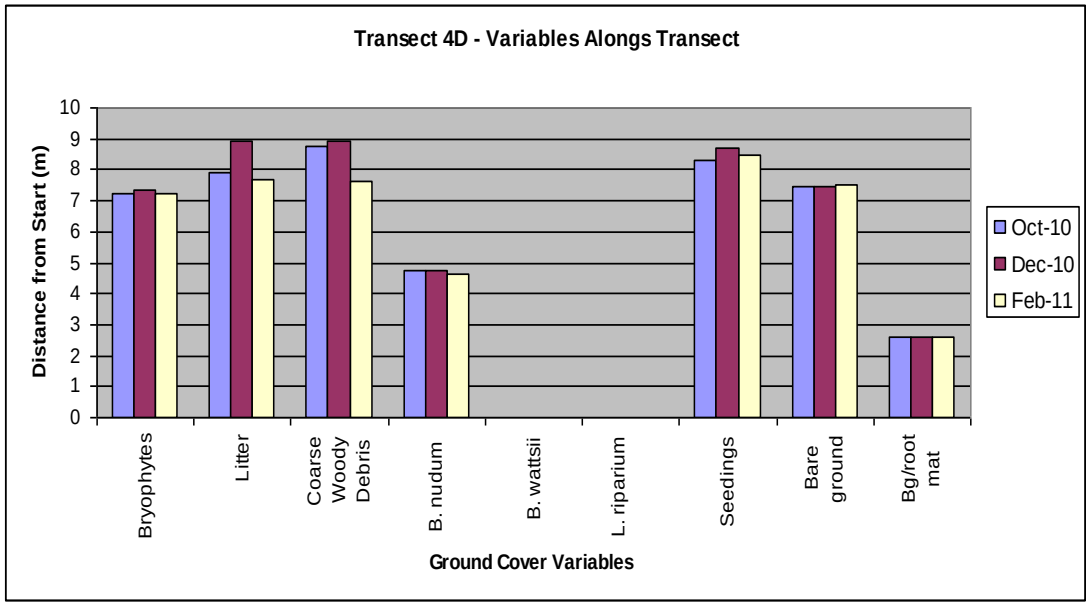
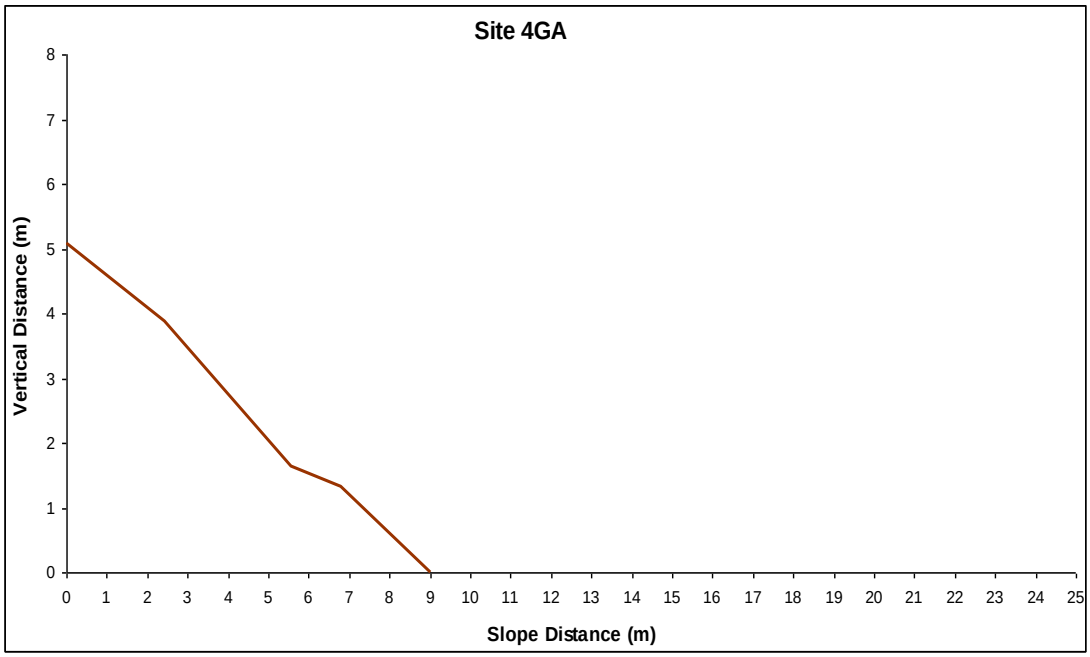




Figure A8-10 Bank profile and ground cover variables for site 4D



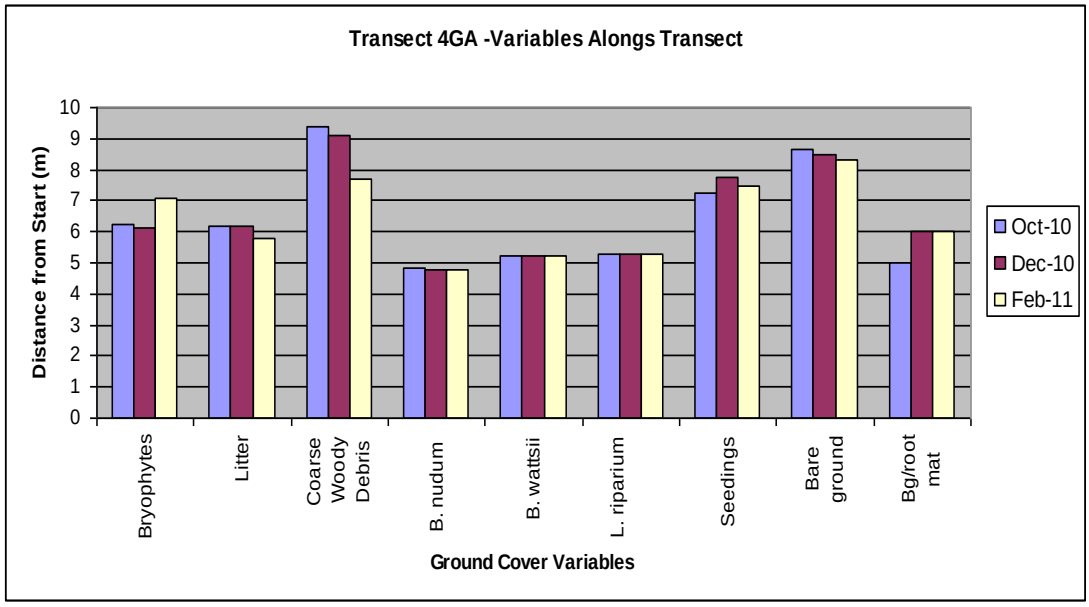




Figure A8-11 Bank profile and ground cover variables for site 4GA

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# A9 Fish monitoring data

Table A9-1 Fish monitoring relative abundance data (CPUE, fish per 1200 seconds) December 2010

| Zone | Type | Total effort (seconds) | *A. australis* | *A. tricornis* | *G. australis* | *G. brevipinnis* | *G. cleaveri* | *G. maculatus* | *G. truttaceus* | Nil | *P. urvillii* | *S. trutta* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | River | 4983.00 | 0.00 | 0.24 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.24 | 0.00 | 3.85 |
| | Tributary | 3792.00 | 0.00 | 0.32 | 0.00 | 1.90 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.27 |
| 2 | River | 5007.00 | 0.00 | 0.24 | 0.48 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 6.23 |
| | Tributary | 3233.00 | 0.00 | 0.37 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 7.05 |
| 3 | River | 3640.00 | 5.60 | 0.33 | 0.33 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.33 | 3.30 |
| | Tributary | 6336.00 | 0.76 | 0.38 | 0.19 | 0.00 | 0.00 | 0.00 | 0.19 | 0.00 | 0.19 | 11.36 |
| 4 | River | 3408.00 | 2.46 | 0.00 | 0.00 | 0.35 | 0.00 | 0.00 | 14.08 | 0.00 | 0.70 | 0.70 |
| | Tributary | 6246.00 | 1.54 | 0.58 | 0.38 | 0.19 | 0.00 | 0.00 | 6.92 | 0.00 | 0.58 | 2.50 |
| 5 | River | 6103.00 | 4.13 | 0.79 | 0.39 | 0.59 | 0.00 | 1.57 | 19.86 | 0.00 | 1.77 | 0.79 |
| 7 | River | 1170.00 | 0.00 | 0.00 | 0.00 | 5.13 | 0.00 | 0.00 | 6.15 | 0.00 | 4.10 | 0.00 |
| 8 | River | 3790.00 | 2.22 | 0.00 | 0.63 | 0.95 | 0.00 | 0.00 | 0.95 | 0.00 | 0.63 | 5.07 |
| | Tributary | 3761.00 | 0.32 | 0.00 | 0.00 | 4.79 | 0.00 | 0.00 | 7.98 | 0.00 | 0.00 | 3.51 |
| 9 | River | 2527.00 | 2.37 | 0.95 | 0.00 | 0.00 | 0.00 | 2.85 | 18.05 | 0.00 | 9.02 | 0.95 |
| 13–14 | River | 3894.00 | 0.31 | 0.62 | 0.62 | 0.31 | 0.31 | 0.00 | 7.70 | 0.00 | 2.47 | 3.08 |

Table A9-2 Fish monitoring relative abundance data (CPUE, fish per 1200 seconds) March 2011

| Zone | Type | Total effort (seconds) | *A. australis* | *A. tricornis* | *G. australis* | *G. brevipinnis* | *G. maculatus* | *G. truttaceus* | *M. mordax* | Nil | *P. urvillii* | *S. trutta* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | River | 4983.00 | 0.00 | 0.24 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.24 | 0.00 | 3.85 |
| | Tributary | 3792.00 | 0.00 | 0.32 | 0.00 | 1.90 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.27 |
| 2 | River | 5007.00 | 0.00 | 0.24 | 0.48 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 6.23 |
| | Tributary | 3233.00 | 0.00 | 0.37 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 7.05 |
| 3 | River | 3640.00 | 5.60 | 0.33 | 0.33 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.33 | 3.30 |
| | Tributary | 6336.00 | 0.76 | 0.38 | 0.19 | 0.00 | 0.00 | 0.00 | 0.19 | 0.00 | 0.19 | 11.36 |
| 4 | River | 3408.00 | 2.46 | 0.00 | 0.00 | 0.35 | 0.00 | 0.00 | 14.08 | 0.00 | 0.70 | 0.70 |
| | Tributary | 6246.00 | 1.54 | 0.58 | 0.38 | 0.19 | 0.00 | 0.00 | 6.92 | 0.00 | 0.58 | 2.50 |
| 5 | River | 6103.00 | 4.13 | 0.79 | 0.39 | 0.59 | 0.00 | 1.57 | 19.86 | 0.00 | 1.77 | 0.79 |
| 7 | River | 1170.00 | 0.00 | 0.00 | 0.00 | 5.13 | 0.00 | 0.00 | 6.15 | 0.00 | 4.10 | 0.00 |
| 8 | River | 3790.00 | 2.22 | 0.00 | 0.63 | 0.95 | 0.00 | 0.00 | 0.95 | 0.00 | 0.63 | 5.07 |
| | Tributary | 3761.00 | 0.32 | 0.00 | 0.00 | 4.79 | 0.00 | 0.00 | 7.98 | 0.00 | 0.00 | 3.51 |
| 9 | River | 2.37 | 0.95 | 0.00 | 0.00 | 0.00 | 2.85 | 18.05 | 0.00 | 9.02 | 0.95 | 2.37 |
| 13–14 | River | 0.31 | 0.62 | 0.62 | 0.31 | 0.31 | 0.00 | 7.70 | 0.00 | 2.47 | 3.08 | 0.31 |

Table A9-3 Fish monitoring sites pre-Basslink

Key: 'X' indicates occasions when sampling occurred, '!' indicates either could not be sampled due to high water flows, or was completed on second attempt. Denison u/s Maxwell was removed from sampling program in December 2002 as this site can only be accessed/sampled under very low flows. It was replaced with Orange River, which has been reclassified as essential

| Zone | Type | Class | Priority | Site name | Site no. | Dec 01 | Apr 02 | Dec 02 | Mar 03 | Nov 03 | Apr 04 | Dec 04 | Apr 05 | Dec 05 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | River | test | essential | Gordon @ G3 (d/s) | 73 | x | x | x | x | x | x | x | x | x |
| | | test | essential | Gordon @ G3 (u/s) | 73 | x | x | x | x | x | x | x | x | x |
| | | test | essential | Gordon @ G4 | 75 | x | x | x | x | x | x | x | x | x |
| | | test | essential | Gordon @ G4a | 74 | x | x | x | x | x | x | x | x | x |
| | | test | optional | Gordon @ G2 | 76 | | x | | x | x | | x | | |
| | Tributary | test | essential | Indigo Creek | | x | x | x | x | x | x | x | x | x |
| | | test | essential | Piguenit Rivulet | | x | x | x | x | x | x | x | x | x |
| | | test | essential | Serpentine River | | x | x | x | x | x | x | x | x | x |
| | | test | optional | Left bank creek at G4 | | x | | | | | | | | |
| 2 | River | test | essential | Gordon @ G5 (lower) | 72 | x | x | x | x | x | x | x | x | x |
| | | test | essential | Gordon @ G5 (upper) | 72 | x | x | x | x | x | x | x | x | x |
| | | test | essential | Gordon @ G5a (pipe) | 71 | x | x | x | x | x | x | x | x | x |

*Table A9-3 continued next page*

| Zone | Type | Class | Priority | Site name | Site no. | Dec 01 | Apr 02 | Dec 02 | Mar 03 | Nov 03 | Apr 04 | Dec 04 | Apr 05 | Dec 05 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | River | test | essential | Gordon @ G5a (water) | 71 | x | x | x | x | x | x | x | x | x |
| | | test | essential | Gordon @ G6 | 69 | x | ! | x | x | x | x | x | x | x |
| | | test | optional | Gordon @ Grotto Creek | 64 | | x | | x | | | x | x | x |
| | Tributary | test | essential | Albert River | | x | x | x | x | x | x | x | x | x |
| | | test | essential | Mudback Creek | | x | ! | x | x | x | x | x | x | x |
| | | test | essential | Splits Creek | | x | x | x | x | x | x | x | x | x |
| | | test | optional | Grotto Creek | | | | | x | x | | x | x | x |
| 3 | River | test | essential | Gordon @ G7 | 63 | x | x | x | x | x | x | x | x | x |
| | | test | essential | Gordon @ Harrison Creek (G16) | 57 | x | x | x | x | x | x | x | x | x |
| | | test | essential | Gordon @ Orange River (G6a) | 68 | x | x | x | x | x | x | x | x | x |
| | | test | optional | Gordon @ G9 | 60 | x | | | x | | | | x | x |
| | | test | optional | Gordon @ G8 | | x | | | | x | x | x | | |
| | | test | optional | Gordon @ Fluffies | | | | | x | x | | x | x | x |
| | Tributary | test | essential | Denison u/s Gorge | | x | x | x | x | x | x | x | x | x |

*Table A9-3 continued next page*

| Zone | Type | Class | Priority | Site name | Site no. | Dec 01 | Apr 02 | Dec 02 | Mar 03 | Nov 03 | Apr 04 | Dec 04 | Apr 05 | Dec 05 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | Tributary | test | removed | Denison u/s Maxwell | | ! | ! | removed | removed | removed | removed | removed | removed | removed |
| | | test | essential | Denison @ Maxwell River | | ! | x | x | x | x | x | x | x | x |
| | | test | essential | Harrison Creek | | x | x | x | x | x | x | x | x | x |
| | | test | essential | Smith River | | x | x | x | x | x | x | x | x | x |
| | | test | opt/essent | Orange River | | optional | optional | essential | essential | essential | essential | essential | essential | essential |
| | | test | optional | Denison @ Denison Camp | | | x | | | | | | | |
| 4 | River | test | essential | Gordon @ Howards Creek | 54 | x | x | x | x | x | x | x | x | x |
| | | test | essential | Gordon @ Platypus Creek | 51 | x | x | x | x | x | x | x | x | x |
| | | test | essential | Gordon u/s Sprent River | 46 | x | x | x | x | x | x | x | x | x |
| | Tributary | test | essential | Howards Creek | | x | x | x | x | x | x | x | x | x |
| | | test | essential | Olga @ Gordon | | x | x | x | x | x | x | x | x | x |
| | | test | essential | Platypus Creek | | x | x | x | x | x | x | x | x | x |
| | | test | essential | Sprent River | | x | x | x | x | x | x | x | x | x |

*Table A9-3 continued next page*

| Zone | Type | Class | Priority | Site name | Site no. | Dec 01 | Apr 02 | Dec 02 | Mar 03 | Nov 03 | Apr 04 | Dec 04 | Apr 05 | Dec 05 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | Tributary | test | optional | Howards Ck inundation | | x | | | | | | | | |
| | | test | optional | Olga @ Riffles | | | x | x | x | x | x | x | x | x |
| 5 | River | test | essential | Gordon @ G14 | 44 | x | x | x | x | x | x | x | x | x |
| | | test | essential | Gordon @ G15 | 42 | x | x | x | x | x | x | x | x | x |
| | | test | essential | Gordon d/s Sprent River | 45 | x | x | x | x | x | x | x | x | x |
| | | test | optional | Gordon @ Angel Cliffs | 45a | x | x | x | x | x | x | x | x | x |
| | | test | essential | Franklin @ Pyramid Island | | x | x | x | x | x | x | x | x | x |
| 7 | River | reference | essential | Franklin d/s Big Fall | | x | x | x | x | x | x | x | ! | x |
| 8 | River | reference | essential | Franklin @ Canoe Bar | | x | x | x | x | x | x | x | x | x |
| | | reference | essential | Franklin u/s Big Fall | | x | x | x | x | x | x | x | x | x |
| | | reference | optional | Franklin @ Forester Creek | | x | x | x | x | | x | x | | x |
| | | reference | optional | Franklin @ Wattle Camp Creek | | x | x | x | x | x | ! | x | x | x |
| | Tributary | reference | essential | Ari Creek | | x | x | x | x | x | x | x | x | x |

*Table A9-3 continued next page*

| Zone | Type | Class | Priority | Site name | Site no. | Dec 01 | Apr 02 | Dec 02 | Mar 03 | Nov 03 | Apr 04 | Dec 04 | Apr 05 | Dec 05 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8 | Tributary | reference | essential | Forester Creek | | x | x | x | x | x | x | x | x | x |
| | | reference | essential | Wattle Camp Creek | | x | x | ! | x | x | ! | x | x | x |
| 9 | River | reference | essential | Sorell River | | x | x | x | x | x | x | x | x | x |
| | Tributary | reference | essential | Pocacker River | | ! | x | x | x | x | x | x | x | x |
| 13 | River | reference | essential | Henty @ Yolande | | x | x | x | x | x | x | x | x | x |
| | | reference | essential | Henty u/s Bottle Creek | | x | x | x | x | x | x | x | x | x |
| 14 | River | reference | essential | Henty @ Sisters | | x | x | x | x | x | x | x | x | x |
| | | reference | optional | Henty @ West Sister | | x | | | | | | | | |

Table A9-3 continued

Table A9-4 Fish monitoring sites post-Basslink

Key: 'X' indicates occasions when sampling occurred, '!' indicates sampling could not initially be completed due to high water flows but was completed on second attempt. Denison u/s Maxwell was removed (R) from sampling program in December 2002 as this site can only be accessed/sampled under very low flows. It was replaced with Orange River, which has been reclassified as essential. The Serpentine River was removed (R) from sampling in December 2006 as the site cannot be sampled safely due to slippery boulders. The Olga @ Gordon site could not be sampled in November 2008 and April 2009 due to a tree fall blocking access. The Franklin @ Flat Island site was added in March 2011, as Wattle Camp Creek is increasingly difficult to sample due to high flows.

| Zone | Type | Class | Priority | Site Name | Site No. | Apr 06 | Dec 06 | Apr/May 07 | Dec 07 | May 08 | Nov 08 | Apr 09 | Dec 09/ Jan 10 | May 10 | Dec 10 | Mar 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | River | test | essential | Gordon @ G3 (d/s) | 73 | x | x | x | x | x | x | x | x | x | x | x |
| | | test | essential | Gordon @ G3 (u/s) | 73 | x | x | x | x | x | x | x | x | x | x | x |
| | | test | essential | Gordon @ G4 | 75 | x | x | x | x | x | x | x | x | x | x | x |
| | | test | essential | Gordon @ G4a | 74 | x | x | x | x | x | x | x | | x | x | x |
| | | test | optional | Gordon @ G2 | 76 | | x | x | x | | | | | | | |
| | Tributary | test | essential | Indigo Creek | | x | x | x | x | x | x | x | x | x | x | x |
| | | test | essential | Piguenit Rivulet | | x | x | x | x | x | x | x | x | x | x | x |
| | | test | essential | Serpentine River | | x | R | R | R | R | R | R | R | R | R | R |
| | | test | optional | Left bank creek at G4 | | | x | x | x | x | x | x | x | x | x | x |
| 2 | River | test | essential | Gordon @ G5 (lower) | 72 | x | x | x | x | x | x | x | x | x | x | x |
| | | test | essential | Gordon @ G5 (upper) | 72 | x | x | x | x | x | x | x | x | x | x | x |
| | | test | essential | Gordon @ G5a (pipe) | 71 | x | x | x | x | x | x | x | x | x | x | x |
| | | test | essential | Gordon @ G5a (water) | 71 | x | x | x | x | x | x | x | x | x | x | x |

*Table A9-4 continued next page*

| Zone | Type | Class | Priority | Site Name | Site No. | Apr 06 | Dec 06 | Apr/May 07 | Dec 07 | May 08 | Nov 08 | Apr 09 | Dec 09/ Jan 10 | May 10 | Dec 10 | Mar 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 (cont) | River (cont) | test | essential | Gordon @ G6 | 69 | x | x | x | x | x | x | x | x | x | ! | x |
| | | test | optional | Gordon @ Grotto Creek | 64 | x | x | x | x | | x | x | x | | | x |
| | Tributary | test | essential | Albert River | | x | x | x | x | x | x | x | x | x | x | x |
| | | test | essential | Mudback Creek | | x | x | x | x | x | x | x | x | x | x | x |
| | | test | essential | Splits Creek | | x | x | x | x | x | x | x | x | x | x | x |
| | | test | optional | Grotto Creek | | x | x | | x | | x | x | x | | | x |
| 3 | River | test | essential | Gordon @ G7 | 63 | x | x | x | x | x | x | x | x | x | x | x |
| | | test | essential | Gordon @ Harrison Creek (G16) | 57 | x | x | x | x | x | x | x | x | M | x | x |
| | | test | essential | Gordon @ Orange River (G6a) | 68 | x | x | x | x | x | x | x | x | x | x | x |
| | | test | optional | Gordon @ G9 | 60 | x | x | x | x | | x | x | x | | | x |
| | | test | optional | Gordon @ G8 | | | x | x | x | | | | | | | x |
| | | test | optional | Gordon @ Fluffies | | x | | x | x | | x | | x | | | x |
| | Tributary | test | essential | Denison u/s Gorge | | x | x | x | x | x | x | x | x | x | x | x |
| | | test | removed | Denison u/s Maxwell | | R | R | R | R | R | R | R | R | R | R | R |
| | | test | essential | Denison @ Maxwell River | | x | x | x | x | x | x | x | x | x | x | x |
| | | test | essential | Harrison Creek | | x | x | x | x | x | x | x | x | x | x | x |
| | | test | essential | Smith River | | x | x | x | x | x | x | x | x | M | x | x |

*Table A9-4 continued next page*

| Zone | Type | Class | Priority | Site Name | Site No. | Apr 06 | Dec 06 | Apr/May 07 | Dec 07 | May 08 | Nov 08 | Apr 09 | Dec 09/ Jan 10 | May 10 | Dec 10 | Mar 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 (cont) | Tributary (cont | test | opt/essent | Orange River | | essential | x | x | x | x | x | x | x | x | x | x |
| | | test | optional | Denison @ Denison Camp | | | | | | | | | | | | |
| 4 | River | test | essential | Gordon @ Howards Creek | 54 | x | x | x | x | x | x | x | x | x | x | x |
| | | test | essential | Gordon @ Platypus Creek | 51 | ! | x | x | x | x | x | x | x | x | x | x |
| | | test | essential | Gordon u/s Sprent River | 46 | x | x | x | x | x | x | x | x | x | x | x |
| | Tributary | test | essential | Howards Creek | | x | x | x | x | x | x | x | x | x | x | x |
| | | test | essential | Olga @ Gordon | | x | T | x | x | x | T | T | T | T | x | x |
| | | test | essential | Platypus Creek | | ! | x | x | x | x | x | x | x | x | x | x |
| | | test | essential | Sprent River | | x | x | x | x | x | x | x | x | x | x | x |
| | | test | optional | Howards Creek inundation | | | | | | | | | | | | |
| | | test | optional | Olga @ Riffles | | x | x | x | x | x | x | x | x | x | x | x |
| 5 | River | test | essential | Gordon @ G14 | 44 | x | x | x | x | x | x | x | x | x | x | x |
| | | test | essential | Gordon @ G15 | 42 | x | x | x | x | x | x | x | x | x | x | x |
| | | test | essential | Gordon d/s Sprent River | 45 | x | x | x | x | x | x | x | x | x | x | x |
| | | test | optional | Gordon @ Angel Cliffs | 45a | x | x | x | x | | x | x | x | x | x | x |
| | | test | essential | Franklin @ Pyramid Island | | x | x | x | x | x | x | x | x | x | x | x |
| 7 | River | reference | essential | Franklin d/s Big Fall | | x | x | x | x | x | x | x | x | x | x | x |

*Table A9-4 continued next page*

| Zone | Type | Class | Priority | Site Name | Site No. | Apr 06 | Dec 06 | Apr/May 07 | Dec 07 | May 08 | Nov 08 | Apr 09 | Dec 09/ Jan 10 | May 10 | Dec 10 | Mar 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8 | River | reference | essential | Franklin @ Canoe Bar | | x | x | x | x | x | x | x | x | x | x | x |
| | | reference | essential | Franklin u/s Big Fall | | x | x | x | x | x | x | x | x | x | x | x |
| | | reference | optional | Franklin @ Forester Creek | | x | x | x | x | x | x | | x | x | x | x |
| | | reference | optional | Franklin @ Wattle Camp Creek | | x | x | x | | x | x | | | x | x | |
| | | reference | optional | Franklin @ Flat Island | | | | | | | | | | | | x |
| | Tributary | reference | essential | Ari Creek | | x | x | x | x | x | x | x | x | x | | |
| | | reference | essential | Forester Creek | | x | x | x | x | x | x | x | x | x | | |
| | | reference | essential | Wattle Camp Creek | | x | x | x | x | x | x | x | x | x | | |
| 9 | River | reference | essential | Sorell River | | x | x | x | x | x | x | x | x | x | x | x |
| | Tributary | reference | essential | Pocacker River | | x | x | x | x | x | x | x | x | x | x | x |
| 13 | River | reference | essential | Henty @ Yolande | | x | x | x | x | x | x | x | x | x | x | x |
| | | reference | essential | Henty u/s Bottle Creek | | x | x | x | x | x | x | x | x | x | x | x |
| 14 | River | reference | essential | Henty @ Sisters | | x | x | x | x | x | x | x | x | x | x | x |
| | | reference | optional | Henty @ West Sister | | | | | | | | | | | | |

Table A9-4 continued

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# A10 Formal trigger levels

## A10.1 Fluvial geomorphology

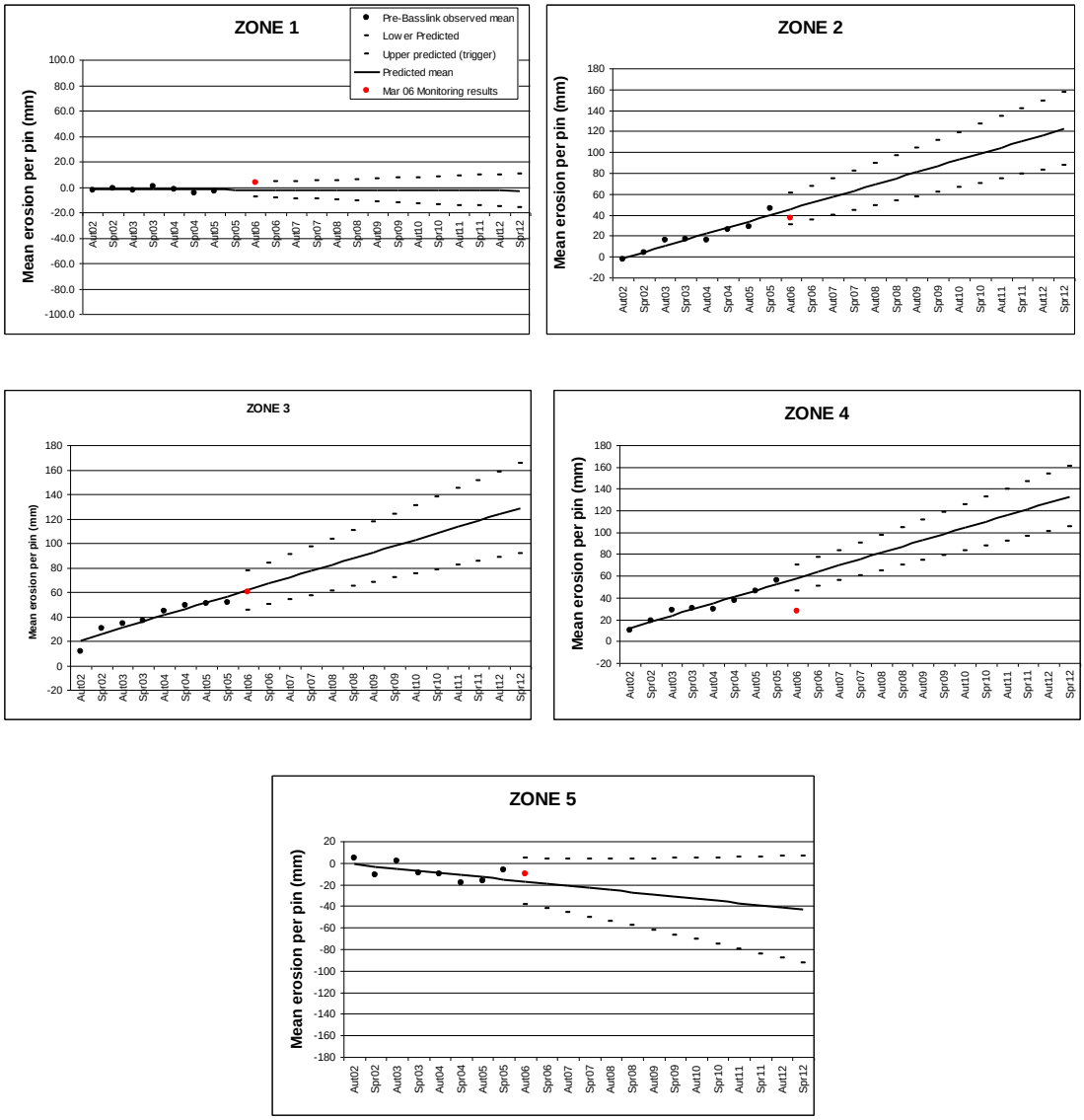


Figure A10-1 Graphical depiction of trigger values, showing linear trend fit to pre-Basslink monitoring results extended six years into the future, along with the 95th percentile confidence limits

The upper limits in each graph are the trigger values for that zone. Also shown are the March 2006 monitoring results. Note upper and lower limit of erosion scales differ, but each axis depicts 200 mm.

Table A10-1 Summary of trigger values for each zone for years March 2007–March 2012 shown as cumulative values relative to spring 2001. Values indicate maximum erosion in mm expected based on present trends. All values in mm

| Year | Zone 1 | Zone 2 | Zone 3 | Zone 4 | Zone 5 |
|---|---|---|---|---|---|
| March 2007 | 4 | 75 | 90 | 83 | 4 |
| March 2008 | 5 | 89 | 103 | 97 | 3 |
| March 2009 | 6 | 104 | 117 | 111 | 4 |
| March 2010 | 7 | 119 | 131 | 125 | 4 |
| March 2011 | 9 | 134 | 144 | 139 | 5 |
| March 2012 | 10 | 149 | 158 | 153 | 6 |

Table A10-2 Summary of trigger values for each zone for years March 2007–March 2012 shown as annual rates. Values indicate maximum erosion in mm expected based on present trends. All values in mm

| Year | Zone 1 | Zone 2 | Zone 3 | Zone 4 | Zone 5 |
|---|---|---|---|---|---|
| March 2007 | 0.9 | 14.9 | 18.1 | 16.7 | 0.7 |
| March 2008 | 0.8 | 13.9 | 16.1 | 15.1 | 0.5 |
| March 2009 | 0.9 | 14.0 | 15.8 | 15.0 | 0.5 |
| March 2010 | 0.9 | 14.1 | 15.5 | 14.9 | 0.5 |
| March 2011 | 0.9 | 14.2 | 15.3 | 14.8 | 0.5 |
| March 2012 | 0.9 | 14.3 | 15.2 | 14.7 | 0.6 |

# A10.2 Riparian vegetation

## A10.2.1 Community composition

### *A10.2.1.1 Similarity index*

Table A10-3 Mean values and 95 % confidence interval range for Bray Curtis similarity index for all zones based on annual similarity values calculated on presence-absence data

| Zone | Quadrat | pre-Basslink mean | Confidence interval range |
|---|---|---|---|
| 3 | Above | 53.94 | 51.95 – 55.17 |
| | High | 59.05 | 56.42 – 62.45 |
| | Low | 59.99 | 52.43 – 66.41 |
| 4 | Above | 41.37 | 37.86 – 45.52 |
| | High | 35.98 | 35.59 – 36.39 |
| | Low | 38.01 | 36.13 – 40.32 |
| 5 | Above | 59.10 | 53.31 – 66.35 |
| | High | 59.40 | 57.18 – 61.08 |
| | Low | 61.55 | 57.33 – 65.51 |

### *A10.2.1.2 Species/taxa richness*

Table A10-4 95 % confidence intervals for species richness values for each zone and quadrat type calculated from pre-Basslink data

| Zone | Quadrat type | pre-Basslink mean | Confidence interval range |
|---|---|---|---|
| 3 | Above | 4.89 | 2.74 – 7.04 |
| | High | 3.94 | 2.18 – 5.70 |
| | Low | 2.06 | 0.48 – 3.63 |
| 4 | Above | 7.15 | 3.26 – 11.04 |
| | High | 4.45 | 2.53 – 6.37 |
| | Low | 4.00 | 1.40 – 6.60 |
| 5 | Above | 4.33 | 1.30 – 7.36 |
| | High | 5.78 | 2.14 – 9.41 |
| | Low | 1.83 | 0.17 – 3.50 |

#### *A10.2.1.3 Species/taxa evenness*

Table A10-5 95 % confidence intervals for species evenness values for each zone and quadrat type calculated from pre-Basslink data

| Zone | Quadrat type | pre-Basslink mean | Confidence interval range |
|---|---|---|---|
| 3 | Above | 0.73 | 0.56 – 0.89 |
| | High | 0.59 | 0.35 – 0.84 |
| | Low | 0.41 | 0.04 – 0.79 |
| 4 | Above | 0.61 | 0.37 – 0.85 |
| | High | 0.64 | 0.40 – 0.87 |
| | Low | 0.55 | 0.24 – 0.85 |
| 5 | Above | 0.48 | 0.21 – 0.76 |
| | High | 0.54 | 0.27 – 0.81 |
| | Low | 0.28 | 0 – 0.60 |

## A10.2.2 Community structure

#### *A10.2.2.1 Ground cover and vegetation cover data*

Table A10-6 The range within which 95 % of values are likely to lie for means of ratios for selected ground cover variables based on monitoring for one year and five years in the post-Basslink period. Note that seasonal figures are not provided because monitoring occurs only once per year

| Post-Basslink | Ratio (% above 3-turbines+1) to (% between 2- and 3-turbines+1) | | | |
|---|---|---|---|---|
| | 1 year | | 5 year mean | |
| | Lower | Upper | Lower | Upper |
| % bare ground | 0.32 | 0.78 | 0.45 | 0.6 |
| % bryophyte | 1.60 | 7.19 | 3.24 | 4.97 |
| % fern | 0.80 | 1.96 | 1.15 | 1.50 |
| % shrub | 0.95 | 2.29 | 1.34 | 1.76 |
| % total vegetation | 1.11 | 2.13 | 1.41 | 1.72 |
| **Post-Basslink** | **Ratio (% above 3-turbines+1) to (% between 1- and 2-turbines+1)** | | | |
| | 1 year | | 5 year mean | |
| | Lower | Upper | Lower | Upper |
| % bare ground | 0.44 | 0.65 | 0.45 | 0.60 |
| % bryophyte | 12.54 | 21.23 | 10.75 | 14.33 |
| % fern | 3.13 | 5.12 | 2.73 | 3.54 |
| % shrub | 2.60 | 4.20 | 2.27 | 2.93 |
| % total vegetation | 5.00 | 7.92 | 4.39 | 5.60 |

## A10.3 Macroinvertebrates

Table A10-7 Trigger values for benthic macroinvertebrate community structure variables, for whole-of-river, zones, seasons and sites, for each year of a five-year monitoring cycle. Seasonal values are shown only where statistically significant differences between seasonal pre-Basslink values were detected. Alpha levels indicated

| Variable Alpha | Post-Basslink | Trigger bounds (lower) | | | | |
|---|---|---|---|---|---|---|
| | | 1 year | 2 years | 3 years | 4 years | 5 years |
| Bray Curtis (abundance) alpha 0.05 | **Whole-of-River** | | | | | |
| | Av (all times) | 21.4 | 22.6 | 23.1 | 23.2 | 23.5 |
| | **Zone group 1** | | | | | |
| | Av (all times) | 9.0 | 10.8 | 11.5 | 11.9 | 12.2 |
| | Spring | 0.9 | 5.4 | 5.7 | 7.4 | 7.0 |
| | Autumn | 13.8 | 14.8 | 15.3 | 15.5 | 15.6 |
| | **Zone group 2** | | | | | |
| | Av (all times) | 27.1 | 29.3 | 30.1 | 30.6 | 31.0 |
| | Spring | 34.8 | 36.4 | 36.5 | 37.1 | 37.0 |
| | Autumn | 17.7 | 21.0 | 22.3 | 23.1 | 23.5 |
| | **Sites** | | | | | |
| | Site 42 | 23.1 | 25.7 | 26.7 | 27.3 | 27.7 |
| | Site 48 | 25.0 | 27.6 | 28.6 | 29.2 | 29.6 |
| | Site 57 | 32.1 | 33.4 | 33.9 | 34.2 | 34.4 |
| | Site 60 | 16.0 | 21.1 | 23.2 | 24.3 | 25.1 |
| | Site 63 | 18.5 | 21.1 | 22.2 | 22.8 | 23.2 |
| | Site 69 | 0.0 | 2.5 | 4.1 | 5.1 | 5.7 |
| | Site 72 | 15.5 | 17.4 | 18.2 | 18.6 | 18.9 |
| | Site 74 | 9.0 | 10.8 | 11.5 | 11.9 | 12.2 |
| O/Erk Alpha 0.05 | **Whole-of-River** | | | | | |
| | Av (all times) | 0.71 | 0.75 | 0.76 | 0.77 | 0.77 |
| | Spring | 0.84 | 0.86 | 0.86 | 0.87 | 0.87 |
| | Autumn | 0.62 | 0.66 | 0.67 | 0.68 | 0.68 |
| | **Zone group 1** | | | | | |
| | Av (all times) | 0.57 | 0.60 | 0.61 | 0.62 | 0.63 |
| | **Zone group 2** | | | | | |
| | Av (all times) | 0.81 | 0.85 | 0.87 | 0.88 | 0.89 |
| | **Sites** | | | | | |
| | Site 42 | 0.80 | 0.84 | 0.86 | 0.87 | 0.87 |
| | Site 48 | 0.76 | 0.82 | 0.84 | 0.86 | 0.87 |
| | Site 57 | 0.82 | 0.86 | 0.88 | 0.89 | 0.90 |
| | Site 60 | 0.64 | 0.71 | 0.75 | 0.77 | 0.78 |
| | Site 63 | 0.71 | 0.78 | 0.80 | 0.82 | 0.83 |
| | Site 69 | 0.56 | 0.61 | 0.63 | 0.64 | 0.65 |
| | Site 72 | 0.66 | 0.70 | 0.71 | 0.72 | 0.72 |
| | Site 74 | 0.45 | 0.50 | 0.53 | 0.54 | 0.55 |
| | Site 75 | 0.46 | 0.49 | 0.50 | 0.50 | 0.51 |

Table A10-8 Trigger values for benthic macroinvertebrate community composition variables, for whole-of-river, zones, seasons and sites, for each year of a five-year monitoring cycle. Seasonal values are shown only where statistically significant differences between seasonal pre-Basslink values were detected. Alpha levels indicated

| Variable Alpha | Post-Basslink | Trigger bounds (lower) | | | | |
|---|---|---|---|---|---|---|
| | | 1 year | 2 years | 3 years | 4 years | 5 years |
| Bray Curtis (pres/abs data) alpha 0.05 | **Whole-of-River** | | | | | |
| | Av (all times) | 30.8 | 32.2 | 32.8 | 33.2 | 33.4 |
| | **Zone group 1** | | | | | |
| | Av (all times) | 13.3 | 16.4 | 17.7 | 18.4 | 18.9 |
| | **Zone group 2** | | | | | |
| | Av (all times) | 28.3 | 30.2 | 31.0 | 31.4 | 31.7 |
| | **Sites** | | | | | |
| | Site 42 | 30.7 | 33.8 | 35.0 | 35.8 | 36.2 |
| | Site 48 | 39.5 | 41.7 | 42.5 | 43.0 | 43.4 |
| | Site 57 | 38.2 | 40.3 | 41.1 | 41.6 | 41.9 |
| | Site 60 | 29.0 | 33.5 | 35.3 | 36.3 | 37.0 |
| | Site 63 | 28.8 | 33.1 | 34.9 | 35.9 | 36.5 |
| | Site 69 | 0.9 | 6.9 | 9.3 | 10.7 | 11.5 |
| | Site 72 | 20.6 | 23.8 | 25.2 | 25.9 | 26.4 |
| | Site 74 | 13.7 | 16.8 | 18.1 | 18.8 | 19.2 |
| O/Epa Alpha 0.05 | **Whole-of-River** | | | | | |
| | Av (all times) | 0.74 | 0.78 | 0.80 | 0.81 | 0.81 |
| | Spring | 0.72 | 0.76 | 0.76 | 0.78 | 0.77 |
| | Autumn | 0.86 | 0.89 | 0.91 | 0.91 | 0.92 |
| | **Zone group 1** | | | | | |
| | Av (all times) | 0.60 | 0.63 | 0.65 | 0.66 | 0.66 |
| | **Zone group 2** | | | | | |
| | Av (all times) | 0.86 | 0.92 | 0.94 | 0.95 | 0.96 |
| | **Sites** | | | | | |
| | Site 42 | 0.75 | 0.82 | 0.85 | 0.87 | 0.88 |
| | Site 48 | 0.88 | 0.93 | 0.95 | 0.97 | 0.97 |
| | Site 57 | 0.77 | 0.85 | 0.89 | 0.91 | 0.92 |
| | Site 60 | 0.72 | 0.80 | 0.83 | 0.85 | 0.86 |
| | Site 63 | 0.68 | 0.77 | 0.80 | 0.82 | 0.83 |
| | Site 69 | 0.58 | 0.63 | 0.65 | 0.66 | 0.67 |
| | Site 72 | 0.62 | 0.68 | 0.70 | 0.71 | 0.72 |
| | Site 74 | 0.54 | 0.59 | 0.61 | 0.62 | 0.63 |
| | Site 75 | 0.37 | 0.41 | 0.42 | 0.43 | 0.44 |

Table A10-9 Trigger values for benthic macroinvertebrate taxonomic richness variables, for whole-of-river, zones, seasons and sites, for each year of a five-year monitoring cycle. Seasonal values are shown only where statistically significant differences between seasonal pre-Basslink values were detected. Alpha levels indicated

| Variable Alpha | Post-Basslink | Trigger bounds (lower) | | | | |
|---|---|---|---|---|---|---|
| | | 1 year | 2 years | 3 years | 4 years | 5 years |
| Number of families alpha 0.05 | **Whole-of-River** | | | | | |
| | Av (all times) | 12 | 12 | 13 | 13 | 13 |
| | Spring | 11 | 12 | 12 | 12 | 12 |
| | Autumn | 13 | 13 | 13 | 13 | 13 |
| | **Zone group 1** | | | | | |
| | Av (all times) | 7 | 8 | 8 | 9 | 9 |
| | **Zone group 2** | | | | | |
| | Av (all times) | 15 | 15 | 16 | 16 | 16 |
| | **Sites** | | | | | |
| | Site 42 | 12 | 13 | 13 | 14 | 14 |
| | Site 48 | 14 | 14 | 15 | 15 | 15 |
| | Site 57 | 14 | 15 | 15 | 16 | 16 |
| | Site 60 | 11 | 12 | 13 | 13 | 13 |
| | Site 63 | 12 | 13 | 14 | 14 | 14 |
| | Site 69 | 6 | 7 | 7 | 8 | 8 |
| | Site 72 | 8 | 9 | 9 | 10 | 10 |
| | Site 74 | 8 | 9 | 9 | 10 | 10 |
| | Site 75 | 3 | 4 | 4 | 4 | 4 |
| NEPT Sp. Alpha 0.05 | **Whole-of-River** | | | | | |
| | Av (all times) | 6.0 | 6.5 | 6.8 | 6.9 | 7.0 |
| | **Zone group 1** | | | | | |
| | Av (all times) | 3.1 | 3.6 | 3.9 | 4.0 | 4.1 |
| | **Zone group 2** | | | | | |
| | Av (all times) | 8.1 | 8.9 | 9.3 | 9.5 | 9.6 |
| | **Sites** | | | | | |
| | Site 42 | 7.3 | 8.3 | 8.7 | 9.0 | 9.2 |
| | Site 48 | 6.7 | 7.5 | 7.8 | 8.0 | 8.1 |
| | Site 57 | 6.5 | 7.5 | 8.0 | 8.3 | 8.4 |
| | Site 60 | 3.9 | 5.1 | 5.8 | 6.1 | 6.4 |
| | Site 63 | 6.0 | 7.4 | 8.1 | 8.5 | 8.7 |
| | Site 69 | 2.7 | 3.4 | 3.7 | 3.9 | 4.0 |
| | Site 72 | 3.4 | 4.3 | 4.7 | 4.9 | 5.1 |
| | Site 74 | 3.2 | 3.7 | 4.0 | 4.1 | 4.2 |
| | Site 75 | 1.3 | 1.7 | 1.9 | 2.0 | 2.1 |

Table A10-10 Trigger values for benthic macroinvertebrate ecologically significant species variables, for whole-of-river, zones, seasons and sites, for each year of a five-year monitoring cycle. Seasonal values are shown only where statistically significant differences between seasonal pre-Basslink values were detected. Alpha levels indicated

| Variable Alpha | Post-Basslink | Trigger bounds (lower) | | | | |
|---|---|---|---|---|---|---|
| | | 1 year | 2 years | 3 years | 4 years | 5 years |
| Proportional abundance EPT species alpha 0.1 | **Whole-of-River** | | | | | |
| | Av (all times) | 0.17 | 0.19 | 0.19 | 0.20 | 0.20 |
| | **Zone group 1** | | | | | |
| | Av (all times) | 0.14 | 0.16 | 0.16 | 0.17 | 0.17 |
| | **Zone group 2** | | | | | |
| | Av (all times) | 0.11 | 0.15 | 0.16 | 0.17 | 0.18 |
| | **Sites** | | | | | |
| | Site 42 | 0.13 | 0.15 | 0.16 | 0.17 | 0.17 |
| | Site 48 | 0.04 | 0.06 | 0.07 | 0.08 | 0.08 |
| | Site 57 | 0.02 | 0.09 | 0.11 | 0.13 | 0.14 |
| | Site 60 | 0.07 | 0.16 | 0.19 | 0.21 | 0.22 |
| | Site 63 | 0.22 | 0.30 | 0.34 | 0.36 | 0.37 |
| | Site 69 | 0.07 | 0.10 | 0.12 | 0.13 | 0.13 |
| | Site 72 | 0.10 | 0.15 | 0.17 | 0.19 | 0.19 |
| | Site 74 | 0.09 | 0.11 | 0.12 | 0.13 | 0.13 |
| | Site 75 | 0.07 | 0.09 | 0.10 | 0.10 | 0.10 |
| Abundance Ephemeroptera Alpha 0.05 | **Whole-of-River** | | | | | |
| | Av (all times) | 2.9 | 3.5 | 3.8 | 3.9 | 4.0 |
| | Spring | 3.7 | 4.5 | 4.5 | 4.9 | 4.8 |
| | Autumn | 0.4 | 1.0 | 1.3 | 1.5 | 1.6 |
| | **Zone group 1** | | | | | |
| | Av (all times) | 0.7 | 1.0 | 1.11 | 1.2 | 1.3 |
| | **Zone group 2** | | | | | |
| | Av (all times) | 4.2 | 5.5 | 6.1 | 6.5 | 6.8 |
| | Spring | 14.2 | 15.5 | 15.6 | 16.1 | 16.0 |
| | Autumn | 0.5 | 1.3 | 1.7 | 1.9 | 2.1 |
| | **Sites** | | | | | |
| | Site 42 | 9.9 | 11.27 | 11.9 | 12.2 | 12.5 |
| | Site 48 | 5.1 | 5.94 | 6.3 | 6.5 | 6.7 |
| | Site 57 | 3.0 | 4.12 | 4.7 | 5.0 | 5.2 |
| | Site 60 | 0.2 | 1.22 | 1.8 | 2.3 | 2.6 |
| | Site 63 | 1.6 | 2.25 | 2.6 | 2.8 | 2.9 |
| | Site 69 | 0.0 | 0.00 | 0.1 | 0.2 | 0.3 |
| | Site 72 | 2.2 | 3.06 | 3.5 | 3.7 | 3.9 |
| | Site 74 | 0.0 | 0.00 | 0.0 | 0.0 | 0.0 |
| | Site 75 | 0.0 | 0.00 | 0.1 | 0.15 | 0.19 |

Table A10-11 Trigger values for benthic macroinvertebrate biomass/productivity variables, for whole-of-river, zones, seasons and sites, for each year of a five-year monitoring cycle. Seasonal values are shown only where statistically significant differences between seasonal pre-Basslink values were detected. Alpha levels indicated

| Variable Alpha | Post-Basslink | Trigger bounds (lower) | | | | |
|---|---|---|---|---|---|---|
| | | 1 year | 2 years | 3 years | 4 years | 5 years |
| Total benthic macroinvertebrate density alpha 0.1 | **Whole-of-River** | | | | | |
| | Av (all times) | 80 | 88 | 92 | 94 | 95 |
| | **Zone group 1** | | | | | |
| | Av (all times) | 26 | 32 | 35 | 37 | 38 |
| | **Zone group 2** | | | | | |
| | Av (all times) | 130 | 147 | 155 | 160 | 163 |
| | **Sites** | | | | | |
| | Site 42 | 96 | 114 | 122 | 127 | 130 |
| | Site 48 | 118 | 131 | 137 | 140 | 142 |
| | Site 57 | 94 | 113 | 123 | 128 | 132 |
| | Site 60 | 109 | 140 | 156 | 165 | 171 |
| | Site 63 | 78 | 98 | 107 | 112 | 116 |
| | Site 69 | 12 | 18 | 21 | 22 | 24 |
| | Site 72 | 29 | 38 | 42 | 45 | 47 |
| | Site 74 | 25 | 33 | 37 | 40 | 42 |
| | Site 75 | 14 | 18 | 21 | 22 | 23 |

# A10.4 Filamentous algae and moss

Table A10-12 Trigger values for benthic filamentous algae cover (set at alpha 0.1)

| Variable Alpha | Post-Basslink | Trigger bounds (lower) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 year | | 2 years | | 3 years | | 4 years | | 5 years | |
| | | Lower | Upper | Lower | Upper | Lower | Upper | Lower | Upper | Lower | Upper |
| Algal cover Alpha 0.1 | **Whole-of-river** | | | | | | | | | | |
| | Av (all times) | 0.84 | 4.48 | 1.09 | 3.83 | 1.20 | 3.59 | 1.26 | 3.46 | 1.31 | 3.38 |
| | Spring | 1.23 | 5.12 | 1.58 | 4.43 | 1.63 | 4.04 | 1.77 | 4.03 | 1.76 | 3.83 |
| | Autumn | 0.00 | 7.51 | 0.06 | 5.54 | 0.18 | 4.87 | 0.26 | 4.53 | 0.30 | 4.33 |
| | **Zone group 1** | | | | | | | | | | |
| | Av (all times) | 1.82 | 12.62 | 2.39 | 10.35 | 2.65 | 9.54 | 2.80 | 9.11 | 2.90 | 8.85 |
| | Spring | 4.84 | 11.44 | 5.53 | 10.38 | 5.62 | 9.76 | 5.88 | 9.75 | 5.85 | 9.43 |
| | Autumn | 0.06 | 15.33 | 0.45 | 11.00 | 0.64 | 9.59 | 0.76 | 8.88 | 0.84 | 8.46 |
| | **Zone group 2** | | | | | | | | | | |
| | Av (all times) | 0.00 | 1.73 | 0.10 | 1.42 | 0.15 | 1.31 | 0.18 | 1.24 | 0.20 | 1.20 |
| | **Sites** | | | | | | | | | | |
| | Site 42 | 0.00 | 5.07 | 0.23 | 3.92 | 0.34 | 3.52 | 0.40 | 3.31 | 0.45 | 3.18 |
| | Site 48 | 0.00 | 3.20 | 0.01 | 2.48 | 0.09 | 2.23 | 0.13 | 2.09 | 0.17 | 2.01 |
| | Site 57 | 0.00 | 1.08 | 0.00 | 0.84 | 0.00 | 0.75 | 0.00 | 0.70 | 0.00 | 0.67 |
| | Site 60 | 0.00 | 1.44 | 0.00 | 1.10 | 0.00 | 0.97 | 0.00 | 0.90 | 0.00 | 0.86 |
| | Site 63 | 0.00 | 15.23 | 0.07 | 10.37 | 0.24 | 8.83 | 0.34 | 8.07 | 0.41 | 7.61 |
| | Site 69 | 0.00 | 10.75 | 0.18 | 7.69 | 0.33 | 6.69 | 0.42 | 6.18 | 0.49 | 5.87 |
| | Site 72 | 0.80 | 5.80 | 1.10 | 4.83 | 1.24 | 4.48 | 1.32 | 4.29 | 1.37 | 4.17 |
| | Site 74 | 2.90 | 45.28 | 4.19 | 33.77 | 4.84 | 29.93 | 5.23 | 27.98 | 5.50 | 26.80 |
| | Site 75 | 1.90 | 32.22 | 2.85 | 24.06 | 3.32 | 21.33 | 3.60 | 19.95 | 3.80 | 19.10 |

Table A10-13 Trigger values for moss cover (set at alpha 0.1)

| Variable Alpha | Post-Basslink | Trigger bounds (lower) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 year | | 2 years | | 3 years | | 4 years | | 5 years | |
| | | Lower | Upper | Lower | Upper | Lower | Upper | Lower | Upper | Lower | Upper |
| Moss cover Alpha 0.1 | **Whole-of-river** | | | | | | | | | | |
| | Av (all times) | 0.80 | 2.58 | 0.95 | 2.31 | 1.01 | 2.20 | 1.05 | 2.15 | 1.07 | 2.11 |
| | Spring | 0.46 | 2.69 | 0.67 | 2.30 | 0.70 | 2.08 | 0.79 | 2.08 | 0.78 | 1.97 |
| | Autumn | 0.67 | 3.85 | 0.88 | 3.30 | 0.98 | 3.09 | 1.03 | 2.98 | 1.07 | 2.92 |
| | **Zone group 1** | | | | | | | | | | |
| | Av (all times) | 1.05 | 5.16 | 1.32 | 4.42 | 1.45 | 4.15 | 1.52 | 4.00 | 1.57 | 3.91 |
| | **Zone group 2** | | | | | | | | | | |
| | Av (all times) | 0.14 | 1.90 | 0.27 | 1.61 | 0.32 | 1.49 | 0.36 | 1.43 | 0.38 | 1.39 |
| | **Sites** | | | | | | | | | | |
| | Site 42 | 0.00 | 3.74 | 0.00 | 2.83 | 0.01 | 2.51 | 0.06 | 2.34 | 0.09 | 2.24 |
| | Site 48 | 0.00 | 3.61 | 0.08 | 2.81 | 0.16 | 2.53 | 0.22 | 2.38 | 0.25 | 2.28 |
| | Site 57 | 0.14 | 1.08 | 0.22 | 0.94 | 0.26 | 0.89 | 0.28 | 0.86 | 0.29 | 0.84 |
| | Site 60 | 0.00 | 2.78 | 0.08 | 2.21 | 0.15 | 2.00 | 0.20 | 1.89 | 0.22 | 1.82 |
| | Site 63 | 0.45 | 3.66 | 0.65 | 3.07 | 0.75 | 2.85 | 0.80 | 2.73 | 0.84 | 2.66 |
| | Site 69 | 0.59 | 4.44 | 0.83 | 3.72 | 0.94 | 3.45 | 1.00 | 3.31 | 1.05 | 3.22 |
| | Site 72 | 0.00 | 2.42 | 0.00 | 1.86 | 0.00 | 1.65 | 0.00 | 1.55 | 0.00 | 1.48 |
| | Site 74 | 2.42 | 19.39 | 3.20 | 15.59 | 3.57 | 14.24 | 3.79 | 13.54 | 3.44 | 13.11 |
| | Site 75 | 0.90 | 7.86 | 1.27 | 6.42 | 1.44 | 5.90 | 1.54 | 5.62 | 1.61 | 5.45 |

## A10.5 Fish

Table A10-14 Community composition trigger values based on the ratio of native fish to exotic fish species abundance, with lower bounds based on both annual and autumn data and an alpha of 0.15

| **CPUE ratio natives to exotics<br>Limits of acceptable change (CPUE)** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Zones 1 to 5** | | | | | | | |
| Post-Basslink | | 1 year | 2 years | 3 years | 4 years | 5 years | 6 years |
| Annual | lower | 0.65 | 0.72 | 0.75 | 0.76 | 0.77 | 0.78 |
| | upper | 1.49 | 1.36 | 1.30 | 1.28 | 1.26 | 1.25 |
| Autumn | lower | 0.61 | 0.67 | 0.69 | 0.70 | 0.71 | 0.72 |
| | upper | 1.33 | 1.22 | 1.18 | 1.15 | 1.14 | 1.13 |

Table A10-15 Ecologically significant species trigger levels based on native fish relative abundance, with lower bounds based on both annual and autumn data and an alpha of 0.20

| **CPUE natives<br>Limits of acceptable change (CPUE)** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Zones 1 to 5** | | | | | | | |
| Post-Basslink | | 1 year | 2 years | 3 years | 4 years | 5 years | 6 years |
| Annual | lower | 2.2 | 2.5 | 2.6 | 2.7 | 2.8 | 2.8 |
| | upper | 6.3 | 5.6 | 5.4 | 5.2 | 5.1 | 5.1 |
| Autumn | lower | 2.1 | 2.4 | 2.5 | 2.6 | 2.6 | 2.6 |
| | upper | 6.0 | 5.4 | 5.2 | 5.0 | 4.9 | 4.9 |

Table A10-16 Ecologically significant species trigger levels based on exotic fish relative abundance, with upper and lower bounds based on both annual and autumn data and an alpha of 0.10

| **CPUE exotics<br>Limits of acceptable change (CPUE)** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Zones 1 to 5** | | | | | | | |
| Post-Basslink | | 1 year | 2 years | 3 years | 4 years | 5 years | 6 years |
| Annual | lower | 2.78 | 3.01 | 3.11 | 3.16 | 3.20 | 3.22 |
| | upper | 5.25 | 4.90 | 4.76 | 4.68 | 4.63 | 4.60 |
| Autumn | lower | 2.88 | 3.14 | 3.24 | 3.31 | 3.34 | 3.37 |
| | upper | 5.80 | 5.38 | 5.22 | 5.13 | 5.08 | 5.04 |

Table A10-17 Ecologically significant species trigger levels based on galaxiid relative abundance, with lower bounds based on both annual and autumn data and an alpha of 0.20

| **CPUE galaxiids<br>Limits of acceptable change (CPUE)** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Zones 1 to 5** | | | | | | | |
| Post-Basslink | | 1 year | 2 years | 3 years | 4 years | 5 years | 6 years |
| Annual | lower | 0.84 | 1.04 | 1.13 | 1.19 | 1.22 | 1.24 |
| | upper | 3.55 | 3.10 | 2.93 | 2.84 | 2.78 | 2.74 |
| Autumn | lower | 0.67 | 0.82 | 0.88 | 0.92 | 0.94 | 0.96 |
| | upper | 2.59 | 2.29 | 2.18 | 2.11 | 2.08 | 2.05 |

Table A10-18 Biomass/productivity trigger levels based on all species relative abundance, with lower bounds based on both annual and autumn data and an alpha of 0.15

| **CPUE all species<br>Limits of acceptable change (CPUE)** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Zones 1 to 5** | | | | | | | |
| Post-Basslink | | 1 year | 2 years | 3 years | 4 years | 5 years | 6 years |
| Annual | lower | 5.2 | 5.7 | 5.9 | 6.0 | 6.1 | 6.2 |
| | upper | 11.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 |
| Autumn | lower | 5.2 | 5.7 | 5.9 | 6.0 | 6.1 | 6.2 |
| | upper | 12.0 | 11.0 | 10.0 | 10.0 | 10.0 | 10.0 |

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