KARUAH BYPASS

FAUNA CROSSING REPORT

Prepared by David Bax
THIESS Pty Ltd
February 2006

Prepared for

Roads and Traffic Authority
www.rta.nsw.gov.au

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1. Introduction

This report has been prepared to describe the effectiveness of the aerial fauna crossings constructed on the Karuah Bypass.

The Karuah Bypass project included the design, construction and ten (10) year maintenance of a 9.8 kilometre (km) section of the Pacific Highway bypassing the town of Karuah. Karuah is approximately 3 hours north of Sydney, NSW. Construction of the Bypass occurred between January 2002 and December 2004.

Monitoring of one of the five aerial crossings using a remote motion-activated camera commenced in April 2005 and was completed in December 2005.

2. Original Glider Crossing Concept

The EIS provided a concept design for the glider crossings. The design included four separate glider 'zones'. These zones, 100m in length, were to have the natural vegetation retained both to the edges of the carriageways and within the median strip. This would (in theory) permit gliders to glide from the edge of the roadway to the centre vegetation, then after climbing to the top of this vegetation, glide across the second carriageway to the opposite side of the highway, see Figure 1.

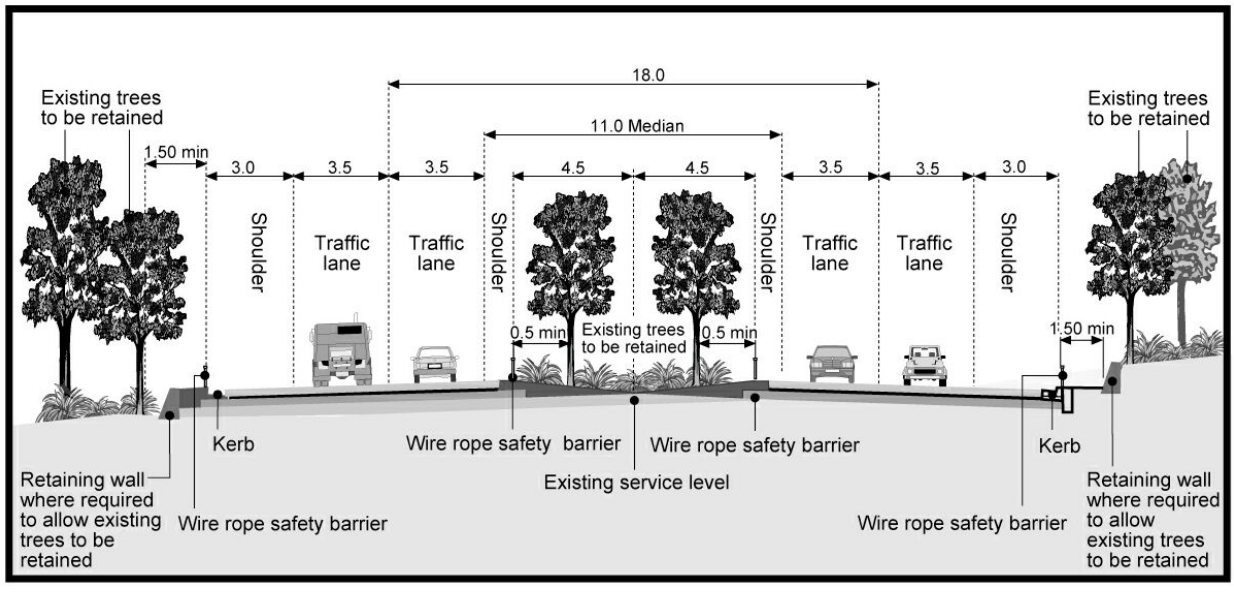


Figure 1. Glider Crossing Design in EIS

There were a number of reasons why this design was not pursued during the design and construction phases of the Karuah Bypass. They included :

- Insufficient tall trees in median
- Scarcity of trees in median
- Trees exposed to extra wind loading in the median

- Potential danger to motorists from trees falling on to the carriageway (one fell on the concrete pavement during construction !)

3. Final Adopted Crossing Design

Due to reasons described above, an alternative design was required to fulfill the obligations of the EIS.

Thiess in consultation with the DEC (NPWS) and RTA opted to use aerial overpass crossings on the Karuah Bypass. These structures consist of a rope tunnel structure adopted from a design used by researchers from James Cook University in Queensland (Weston 2003), which was highly successful for possums and tree kangaroos.

The design basically consisted of rope netting suspended across the entire roadway between poles on either side, see Figure 2.

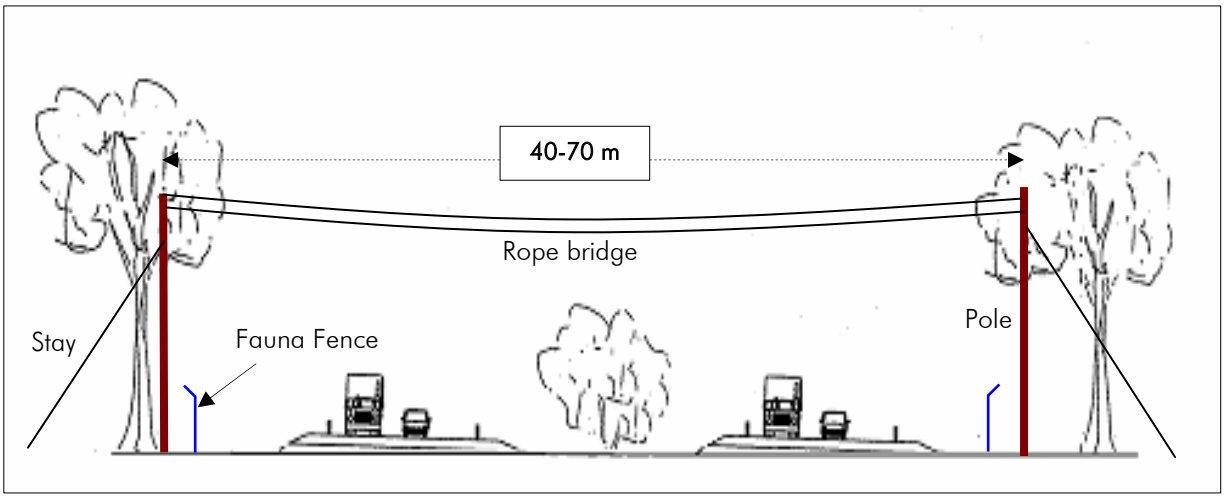
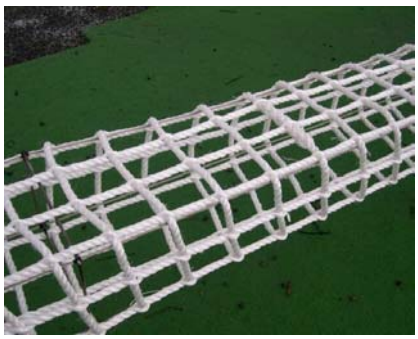


Figure 2. Alternative glider crossing design adopted on the Karuah Bypass.

The predominant material of the crossing was 14mm diameter marine grade 'silver rope'. It was woven into a rectangular tube 300mm wide and 200mm high. The tube shape was adopted in lieu of a flat 'ladder' configuration to provide protection for crossing fauna from predators.



The tube was kept in shape by a series of stainless frames and four 4mm diameter longitudinal stainless steel cables in the corners.

The rope tunnel was divided into a number sections for easy erection. They were attached to two main 10mm galvanized cables strung between the poles. The poles themselves were braced back to concrete footings in the ground by 16mm dia galvanized cables. Complete technical details of the crossings can be found in Appendix A to this report.

Five crossings were adopted at Chainages 1600, 1700, 2400, 3300 and 3800.

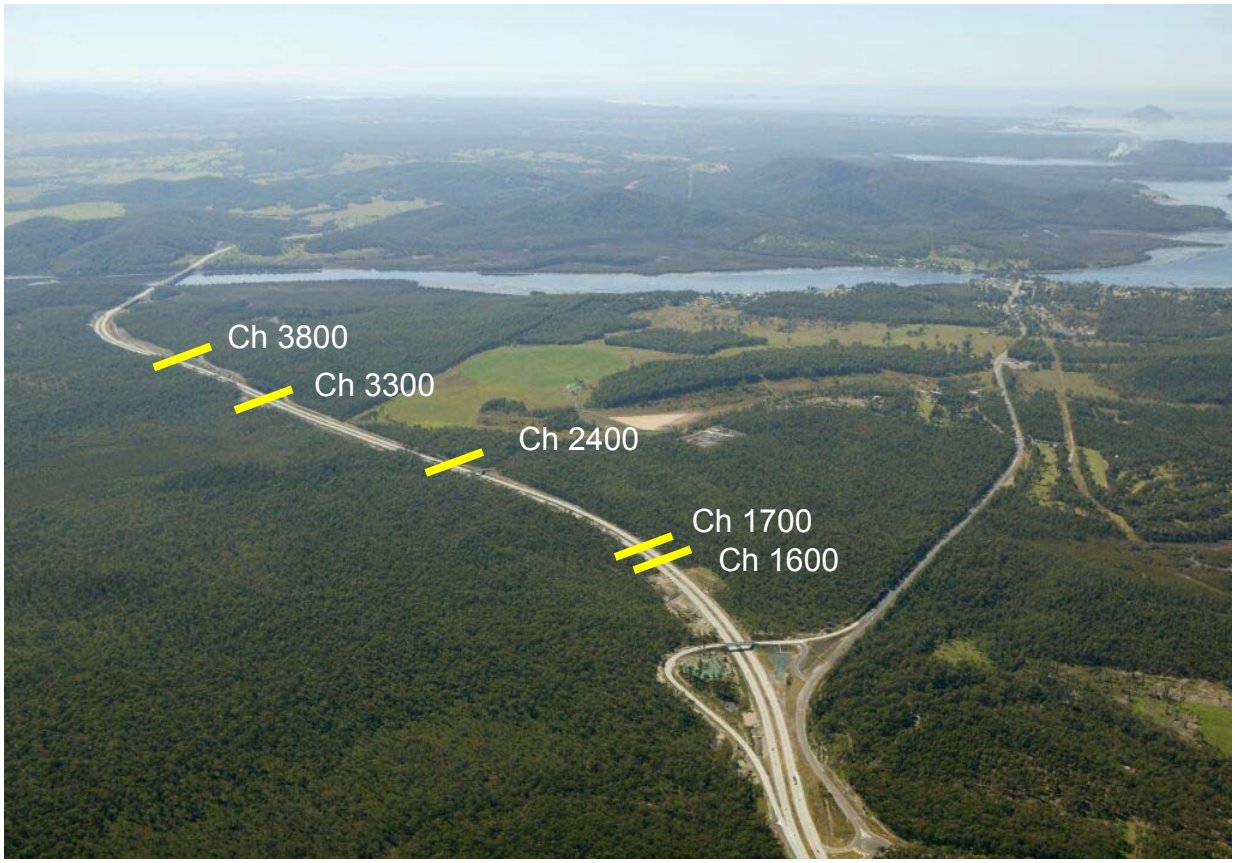


Figure 3. Close up views of a typical rope crossing.

The poles were situated as close as possible to existing trees to encourage fauna use, and several ropes were draped to the poles from adjacent vegetation to further improve the likelihood of use.

Figure 4. Two of the rope crossings, one closed with headlight glare protection

The materials were supplied by the following :

Poles and net erection
Michael Mirow
MRM Powerline Construction
and Maintenance Pty Ltd
PO Box 70
Bulahdelah NSW 2423
0408 669 105
mrmpowerlines@bigpond.com

Rope tunnel supply
Chris Hyde
Nationwide Netmakers Pty Ltd

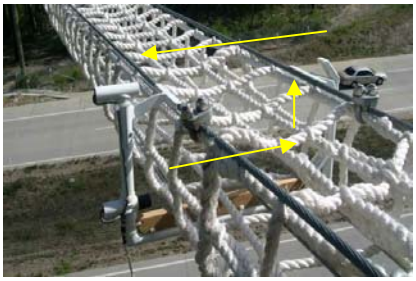
PO Box 270
Mayfield NSW 2304
02 4928 1188
chyde@netmaker.com.au
www.netmaker.com.au

4. Monitoring Equipment

To monitor the effectiveness of the crossings a motion-detecting camera system was mounted on the eastern side of the crossing at Chainage 3320. This crossing was chosen as the most likely to be used by fauna after discussions with DEC and RTA. This camera was in operation for 8 months from April 2005 to December 2005.

The camera system included the following components :

- Olympus Digicam model C350 3.5 Megapixel digital camera & waterproof housing
- Infrared (IR) motion-detecting sensors for top & bottom of the rope tunnel
- Solar panel and accompanying 12V battery and junction box
- Control box at base of pole for connecting to a notebook computer



The sensor arrangement had to be designed to pick up movement both on the top of the rope tunnel and inside it. To achieve this, a pair of 45 degree mirrors were used. The IR beam would emanate from the lower left transmitter and shoot across the lower inside of the net before hitting the first angled mirror on the right hand side. It would then deflect up to the top mirror which subsequently deflected the beam back across the top to the receiver on the left hand side. Any interruption of the beam by fauna would trigger the camera to shoot. The sensor frame was mounted on to the rope structure in lieu of the pole because the rope bridge sways in windy conditions which would trigger the camera. By having the sensors sway with the bridge, there is no relevant movement.

The system was powered by a solar panel mounted near the pole top and angled optimally towards the sun.

The flash type was infra red to avoid startling any fauna.

The images were stored on the 500Mb xD memory card in the camera. Access to the images was done via a standard notebook computer hooked into the control box mounted near the base of the pole. A double-ended USB cable was required for this connection.

Although the camera system worked exceptionally well, a number of matters would need to be addressed on future projects. These include : the sensitivity of the camera needs to address the unwelcome triggering from fog and rain, and ongoing maintenance is required to combat triggering from grasshoppers and spiders. As mentioned earlier it is desirable to place the top of the pole in amongst the vegetation for easy access by fauna, but this has the disadvantage of the branches triggering the camera in high wind situations as they passed by the sensors.

The entire camera system was designed and manufactured by :

Ross Meggs
Faunatech / Austbat
PO Box 1655
Bairnsdale VIC 3875
Ph +61 3 5157 9001
goodgear@faunatech.com
www.faunatech.com

5. Monitoring Results

The camera was in operation from 21/4/05 to 16/12/05, a period of 244 days. During that time, fauna was photographed on 50 separate occasions.

The image in Figure 5 was captured within hours of commissioning the camera on Day 1.

Figure 5. Brushtail possum using the inside of the rope tunnel

Of the 50 crossings, 46 were from a brushtail possum and 4 were from a squirrel glider. Figure 6 graphs the time and dates of each of the crossings.

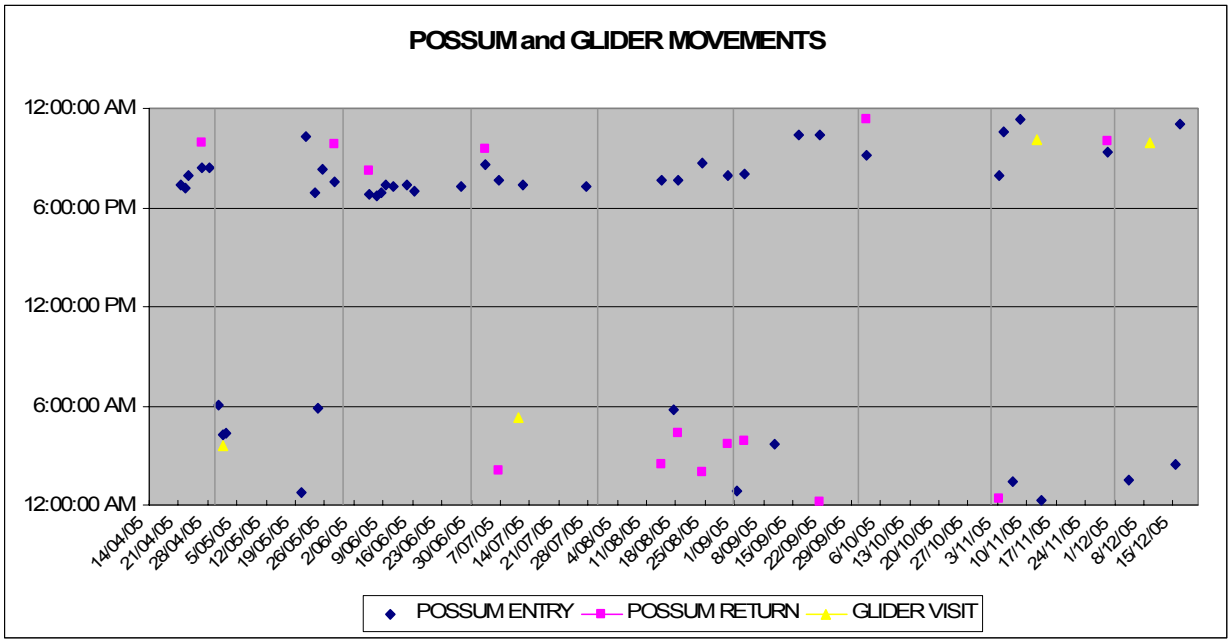


Figure 6. Graph of crossing times and dates

Most of the crossings originated between 6.30pm and 8.30pm. All crossings were completed by 6.00am. It was possible to tell conclusively on a number of occasions that possums came across the rope bridge from the far side, jumped on to an adjacent tree near the camera, and after varying amounts of time jumped back on to the crossing and returned across the bridge. The photos in Figure 7 demonstrate this typical behaviour.

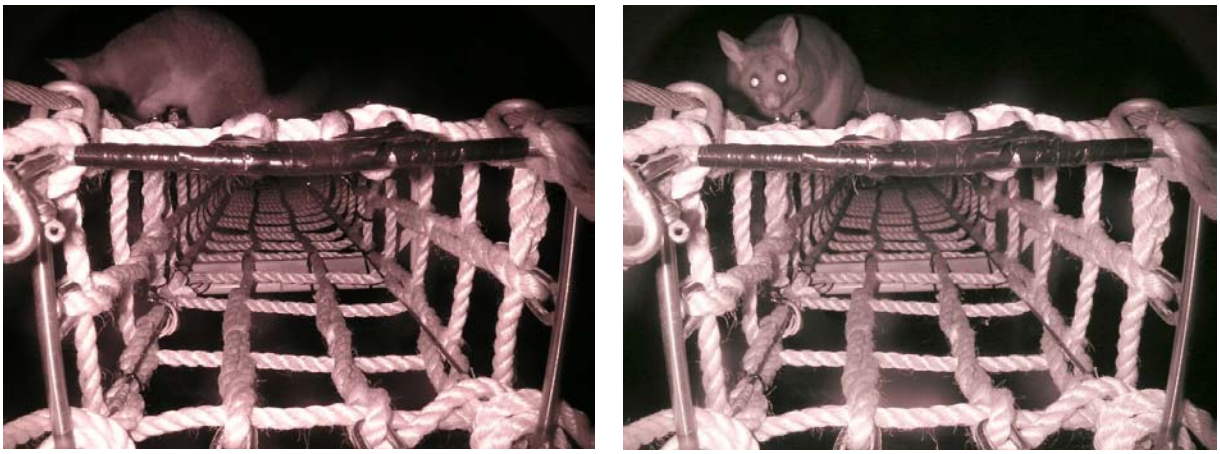


Figure 7. Brushtail possum exiting to an adjacent tree and returning afterward

There is some conjecture about whether the fauna completely crossed the rope bridge or whether they entered from the camera side, triggered the camera then left from the same side without crossing.

To attempt to confirm this scenario, nine evening spotlighting runs were conducted. Unfortunately there was no fauna usage on any of these nights, which was confirmed by the absence of camera images on the nights of monitoring, however photographic evidence suggests that the fauna do actually cross from one side to the other. This is borne by the fact that on most occasions the first image that is taken on any given night the possum is facing the camera. This indicates it came from the direction of the far side, and the last image on the same night is of the rear end of the possum heading in the direction of the far side. Figure 8 demonstrates this typical pattern of full crossing.

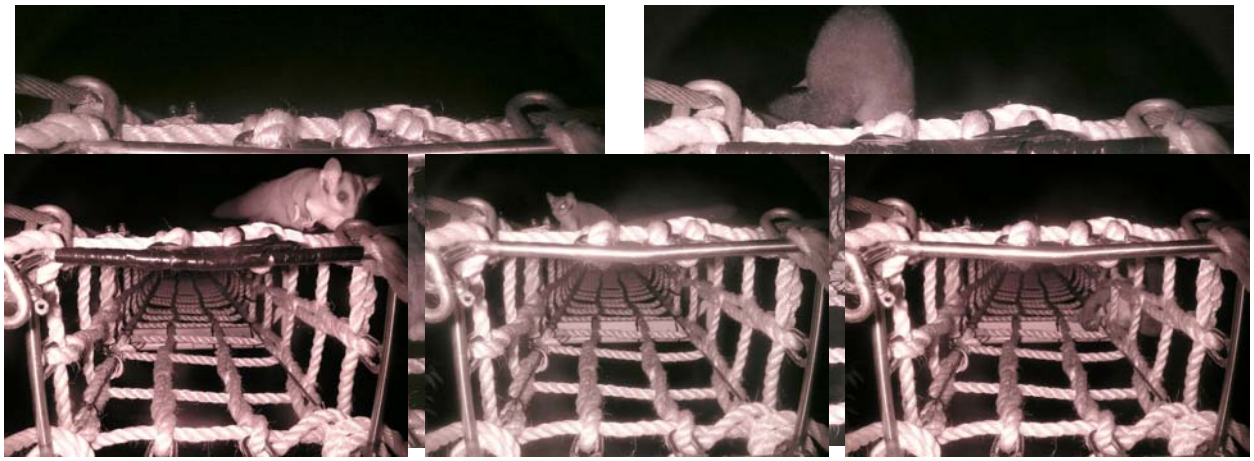


Figure 8. Typical nightly first and last shots indicating full crossings of the bypass

As the original fauna crossing was designed specifically for gliders, it was satisfying to find a squirrel glider being photographed on four separate occasions. This was particularly so as only two gliders were found during the EIS investigative stage in the entire study area. Figure 9 shows several shots of the glider.

Figure 9. Squirrel glider

A number of other observations can be made from the photographs. They include that fauna tended to use the top of the crossing much more frequently than the inside, and that possums move around during wet weather but never during foggy conditions.

A detailed summary of the crossing times and dates forms Appendix B of this report.

6. Recommendations

A number of recommendations can be made as a result of the successful Karuah Bypass fauna crossings. They are :

- To confirm the complete crossing of fauna a second camera at the other end could be implemented on future projects
- While placing the crossing ends amongst vegetation is beneficial in terms of encouraging fauna use, any vegetation must be trimmed back from any motion detecting camera system
- Maintenance of pole-top camera systems is required on a regular basis as insect build-up can trigger false shots
- Future applications of a similar camera system would require the technical issues of false triggering from fog and rain to be addressed
- Any camera should contain the largest memory card available at the time to ensure false triggers do not unduly fill up the system and prevent fauna being photographed

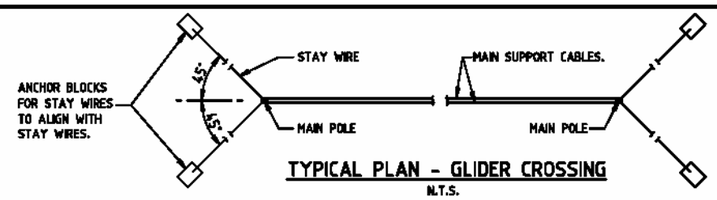
7. Conclusions

A number of conclusions can be made as a result of the successful Karuah Bypass fauna crossings. They are:

- Possums and gliders do traverse aerial ropeways across median divided freeways up to 70m in length
- The technical design of the crossing, e.g silver rope, cables, poles, etc as shown in Appendix A is satisfactory as currently designed. However alternate approaches may be developed
- Placing the crossing ends close to vegetation is beneficial in terms of encouraging fauna use
- Fauna tended to use the top of the crossing rather than the inside so future crossings may be able to simplify the rope structure to a ‘ladder’ configuration rather than a tube (assuming the risk of predator attack is acceptable). This would significantly reduce costs.
- The aerial ropeway design is superior to the original EIS concept of ‘trees in the median’ at specific crossing points because
    a) It permits non-gliding fauna, e.g possums to migrate across the roadway
    b) It provides a concentrated monitoring location to test the effectiveness of crossing zones
    c) It reduces the likelihood that gliders would get on to the roadway from the median, i.e there was no certainty with the ‘trees-in-the-median’ system that they would glide the second stage to the other side of the freeway
- It improves road safety by eliminating trees in the median strip

APPENDIX A

TECHNICAL DRAWINGS

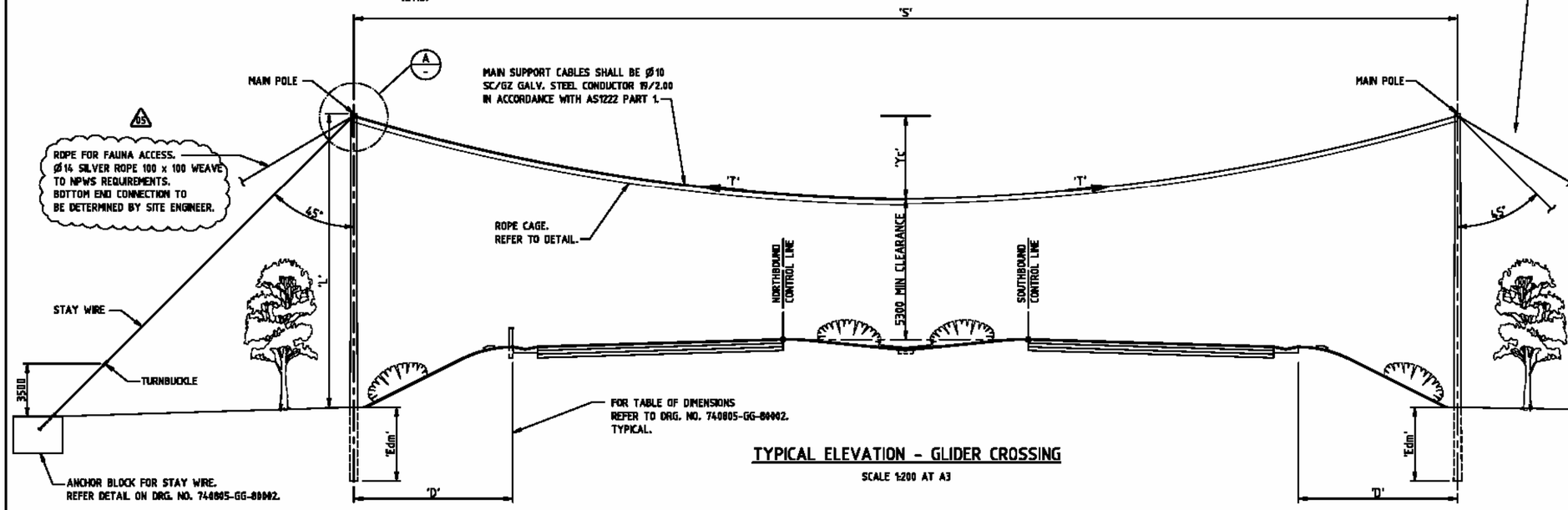


TYPICAL PLAN - GLIDER CROSSING

N.T.S.

CONSTRUCTION PROCEDURE

1. INSTALL MAIN POLES.
2. CONSTRUCT STAY WIRE ANCHOR BLOCKS.
3. INSTALL STAY WIRES (TENSION TO SNUG TIGHT).
4. INSTALL MAIN SUPPORT CABLES & TENSION IN ACCORDANCE WITH TABLE 1 ON DRG. NO. 740805-GG-80002.
5. INSTALL ROPE CAGES.

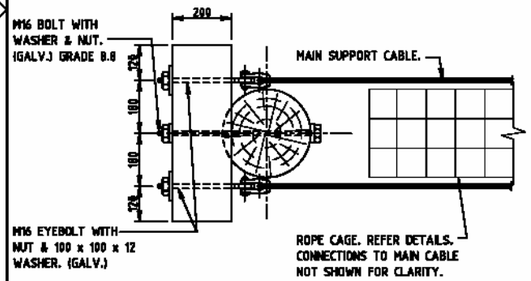


TYPICAL ELEVATION - GLIDER CROSSING

SCALE 1:200 AT A3

NOTES

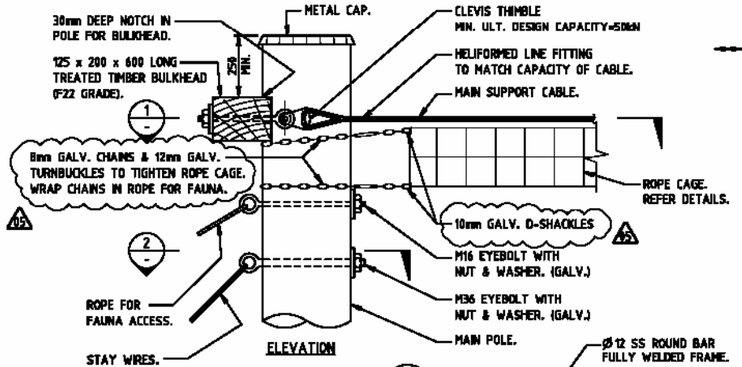
1. DIMENSIONS ARE IN MILLIMETRES.
2. DESIGN LIFE OF STRUCTURES IS 25 - 50 YEARS.
3. DESIGN LOADS:-
   LIVE LOAD = 6.66kN POINT LOAD
4. TIMBER POLES TO BE PLACED INSIDE THE CURRENT LINE OF TREES.
5. TIMBER POLES SHALL BE IN ACCORDANCE WITH AS 2209 AND TREATED GRADE SD2. ALL EXPOSED SURFACES TO BE TREATED.
6. TIMBER POLES TO BE BACKFILLED WITH COMPACTED STABILISED SAND AFTER PLACEMENT IN GROUND.
7. STEEL ITEMS SHALL BE HOT-DIP GALVANISED IN ACCORDANCE WITH AS 4680 U.N.O.
8. NOT USED.
9. ISO METRIC PRECISION HEXAGON BOLTS AND SCREWS SHALL BE PROPERTY CLASS 4.6 TO AS 1110 U.N.O.
10. ISO METRIC HEXAGON COMMERCIAL BOLTS AND SCREWS SHALL BE PROPERTY CLASS 4.6 TO AS 1111 U.N.O.
11. BOLTING CATEGORY FOR COMMERCIAL BOLTS SHALL BE 4.6/S IN ACCORDANCE WITH AS 4100 U.N.O.
12. ISO METRIC HEXAGONAL NUTS SHALL BE PROPERTY CLASS 5 TO AS 1112 U.N.O.
13. DAMAGED GALVANISED SURFACES SHALL BE RENOVATED WITH A SUITABLE TWO PACK ORGANIC ZINC-RICH PRIMER.
14. BOLTS, NUTS AND WASHERS SHALL BE HOT-DIP GALVANISED IN ACCORDANCE WITH AS 1214.
15. REFERENCE SHALL ALSO BE MADE TO RTA SPECIFICATION B241 - MANUFACTURE AND SUPPLY OF MINOR STEEL ITEMS.
16. NOT USED.
17. NOT USED.
18. FOUNDATION LEVELS OF POLES ARE BASED ON THE FOLLOWING GEOTECHNICAL INFORMATION:-
    TP106 - CROSSING 1a
    TP204 - CROSSING 1b
    TP108 - CROSSING 2
    TP517 - CROSSING 3
    BH107 - CROSSING 4
19. FOUNDING LEVELS SHALL BE VERIFIED ON SITE BY AN EXPERIENCED GEOTECHNICAL ENGINEER PRIOR TO PLACING OF POLES.
20. STAINLESS STEEL SHALL BE GRADE 316SS U.N.O.
21. THE WELD CATEGORY SHALL BE GP IN ACCORDANCE WITH AS 1554 PART 1.
22. WELDING SYMBOLS COMPLY WITH AS 1101 PART 3.
23. NOT USED.



PLAN

SECTION 1

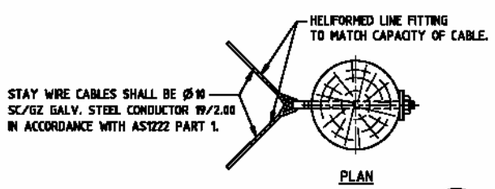
SCALE 1:20 AT A3



ELEVATION

DETAIL A

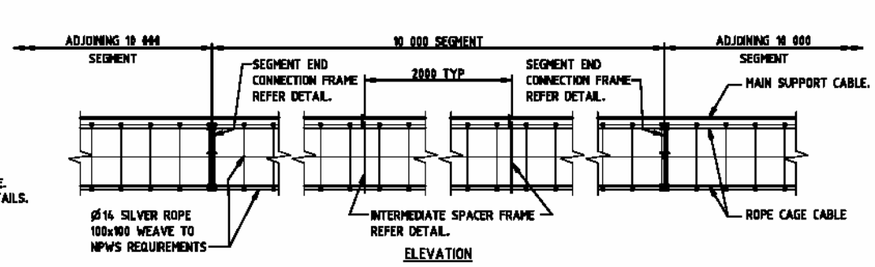
SCALE 1:20 AT A3



PLAN

SECTION 2

SCALE 1:20 AT A3

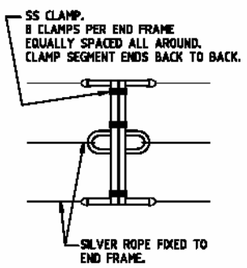


ELEVATION

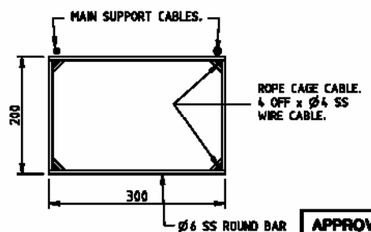
ROPE CAGE SEGMENT

SCALE 1:20 AT A3

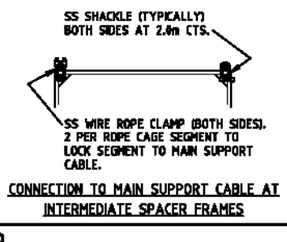
SEGMENT END CONNECTION FRAME



SEGMENT END CONNECTION DETAIL



INTERMEDIATE SPACER FRAME



CONNECTION TO MAIN SUPPORT CABLE AT INTERMEDIATE SPACER FRAMES

ROPE CAGE DETAILS

SCALE 1:10 AT A3

SCALE 1: 2000 | ON A3 SHEET |

SCALE 1: 20 | ON A3 SHEET |

SCALE 1: 10 | ON A3 SHEET |

REV	DATE	AMENDMENT / REV DESCRIPTION	AUTHORISED
1	07.06.04	ISSUED FOR FINAL DESIGN	
2	22.06.04	RE-ISSUED FOR FINAL DESIGN	
3	06.08.04	ISSUED FOR INFORMATION - NOT FOR CONSTRUCTION	
4	16.08.04	RE-ISSUED FOR FINAL DESIGN	
5	19.08.04	RE-ISSUED FOR FINAL DESIGN - HOLD POINTS REMOVED	

TITLE	INITIAL	SIGNATURE	DATE
DRAFTSPERSON	A.W.	A.WILSON	06.08.04
DRAFTING CHECK			
DESIGNER	A.G.	A.GEBREMEDHIN	06.08.04
DESIGN CHECK			
PROJECT MANAGER	I.L.	I.LEACH	19.08.04

SPECIALIST BRIDGE CONSULTANT
BG&E
BRUECHLE GILCHRIST & EVANS PTY
CONSULTING CHARTERED ENGINEERS
ABN 39 096 727 155
SYDNEY
LEVEL 1, 1 KENT STREET, SYDNEY NSW 2000 AUSTRALIA
TEL: +61 2 8964 0888 FAX: +61 2 8964 0988
E-MAIL: bge@bgeplanning.com.au
PERTH
6/44 STIRLING STREET, SOUTH PERTH WESTERN AUSTRALIA 6151 AUSTRALIA
TEL: +61 8 9367 5411 FAX: +61 8 9367 5770
E-MAIL: bge@bgeperth.com.au
BG&E PROJECT No. 20393

DESIGNER
SMEC
SMEC AUSTRALIA PTY LTD
A.B.N. 47 065 475 149
LEVEL 5 118 WALKER STREET NORTH SYDNEY NSW. 2060
PH 02 9925-5555 FAX 02 9925-5566
SMEC PROJECT No. 31277

CONTRACTOR
THIESS
Thiess Pty Ltd
A.B.N. 87 010 221 486
Level 5
26 College Street
Sydney NSW 2000
Tel: (02) 9332 9444
Fax: (02 9332 9481

APPROVED

PROJECT VERIFIER ..... DATE .....

THIESS DESIGN MANAGER ..... DATE .....

RTA PLAN REGISTRATION No: 0010.362.RC.5197.0402 | SHEET

PROJECT TITLE: S.H. 10 - PACIFIC HIGHWAY UPGRADE KARUAH BYPASS

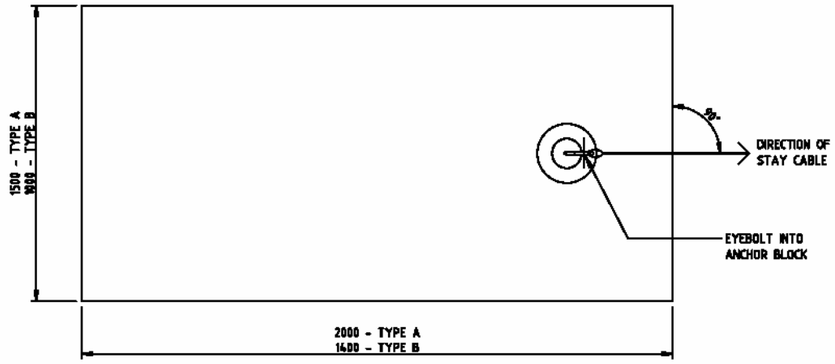
GLIDER CROSSING DETAILS - SHEET 1

SCALE AT A3	STATUS	PROJECT / DRAWING No.	REV	CATEGORY
AS SHOWN	IC	740805-GG-80001	5	FD

150 MM ON ORIGINAL

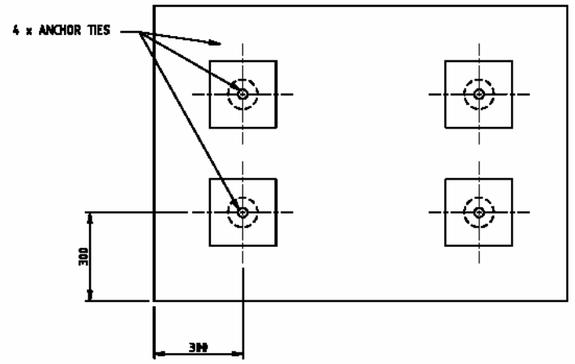
NOTES

1. REFER NOTES ON DRG NO. 740805-GG-80001.



PLAN - (REINFORCEMENT NOT SHOWN FOR CLARITY)

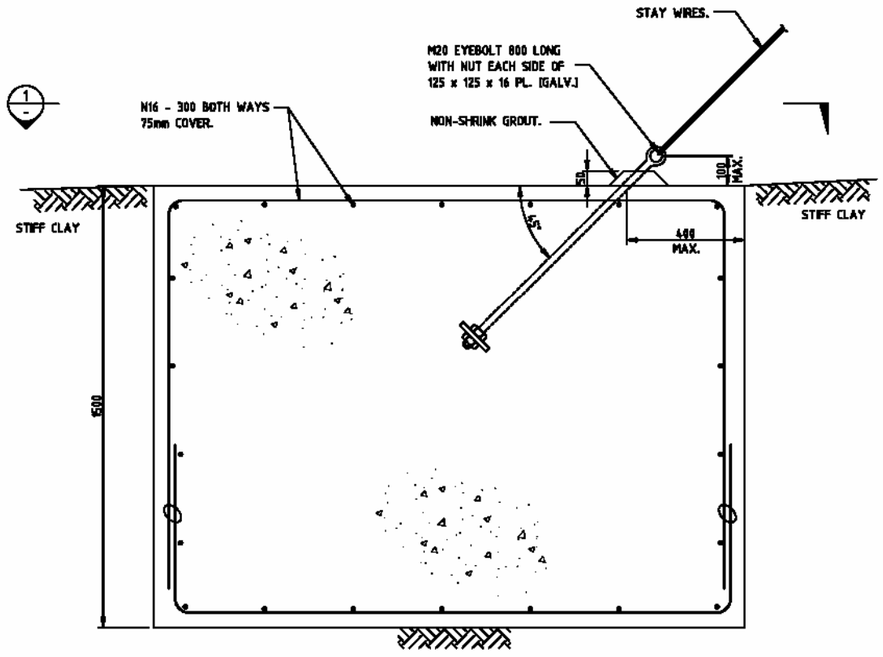
SECTION 1 - SCALE 1:20 AT A3



PLAN - (REINFORCEMENT NOT SHOWN FOR CLARITY)

SECTION 2 - SCALE 1:20 AT A3

ANCHOR BLOCKS (TYPE A & B)
CONCRETE STRENGTH
TO BE f'c=32 MPa.



STAY WIRE ANCHOR BLOCK - TYPE A (IN SOIL)

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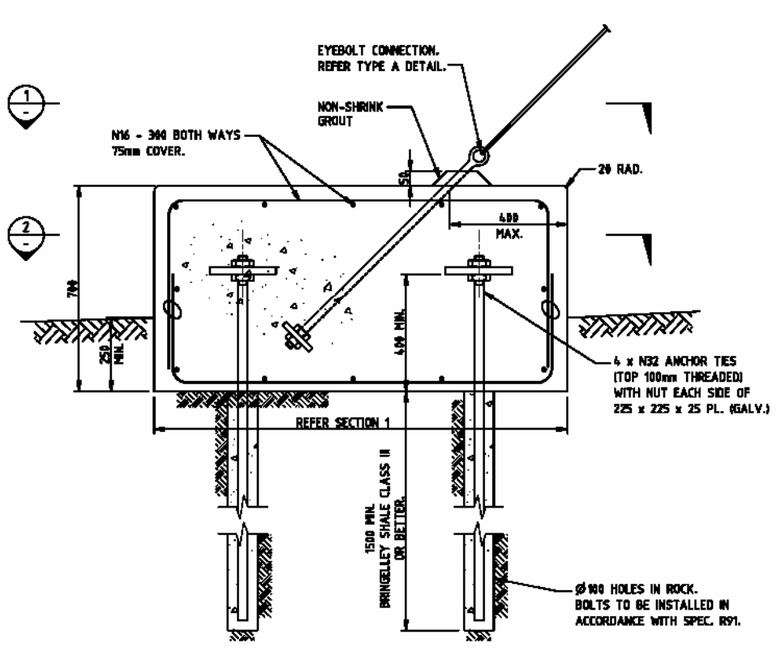

STAY WIRE ANCHOR BLOCK - TYPE B (IN ROCK)

SCALE 1:20 AT A3

TABLE 1 - CROSSING PARAMETERS

CROSSING	STATION	MAIN POLE LENGTH 'L' (m) NB	MAIN POLE LENGTH 'L' (m) SB	MAIN POLE EMBEDMENT 'Edm' (m) NB	MAIN POLE EMBEDMENT 'Edm' (m) SB	MAIN POLE MIN POLE HEAD DIA (mm)	MAIN POLE MIN POLE BASE DIA (mm)	SPAN DISTANCE 'S' (m)	DEFLECTION OF CABLE 'Yc' UNDER SELF WEIGHT (m)	MAX TENSILE FORCE 'T' UNDER SELF WEIGHT (kN)	APPROX DISTANCE MAIN POLE - CARRIAGEWAY 'D' (m) NB	APPROX DISTANCE MAIN POLE - CARRIAGEWAY 'D' (m) SB	FOUNDING MATERIAL
1a	1680	12	12	3.0	3.0	301	435	52.77	0.80	5.2	5	5	STIFF CLAY
1b	1700	12	12	3.0	3.0	301	435	55.70	0.84	5.5	5	5	STIFF CLAY
2	2400	15	15	3.0	3.0	302	449	41.82	0.675	3.8	4	4	STIFF CLAY
3	3320	15.5	13.5	1.9m STIFF CLAY AND 0.95m ROCK CLASS 4	3.0	298	472	46.75	0.725	4.47	5	5	STIFF CLAY
4	3820	12	12	0.2m STIFF CLAY AND 1.4m ROCK CLASS 2	3.0	301	435	65.31	1.60	6.3	15	15	MEDIUM STRENGTH ROCK R4

SCALE 1: 20 (ON A3 SHEET)

REV	DATE	AMENDMENT / REV DESCRIPTION	AUTHORISED
1	06.08.04	ISSUED FOR INFORMATION - NOT FOR CONSTRUCTION	
2	16.08.04	ISSUED FOR FINAL DESIGN	
3	19.08.04	RE-ISSUED FOR FINAL DESIGN - HOLD POINTS REMOVED	

TITLE	INITIAL	SIGNATURE	DATE
DRAFTSPERSON	A.W.	A.WILSON	06.08.04
DRAFTING CHECK			
DESIGNER	A.G.	A.GEBREMEDHIN	06.08.04
DESIGN CHECK			
PROJECT MANAGER	I.L.	I.LEACH	19.08.04

SPECIALIST BRIDGE CONSULTANT: BG&E — BRUECHLE GILCHRIST & EVANS CONSULTING CHARTERED ENGINEERS — SYDNEY / PERTH — BG&E PROJECT No. 20398

DESIGNER: SMEC AUSTRALIA PTY LTD — LEVEL 5 118 WALKER STREET NORTH SYDNEY NSW. 2060 — PH 02 9925-5555 FAX 02 9925-5566 — SMEC PROJECT No. 31277

CONTRACTOR: Thiess Pty Ltd — A.B.N. 87 010 221 486 — Level 5 26 College Street Sydney NSW 2000 — Tel: (02) 9332 9444 Fax: (02 9332 9481

APPROVED

PROJECT VERIFIER ..... DATE .....

THIESS DESIGN MANAGER ..... DATE .....

RTA PLAN REGISTRATION No: 0010.362.RC.5197.0402 — SHEET

PROJECT TITLE: S.H. 10 - PACIFIC HIGHWAY UPGRADE KARUAH BYPASS

GLIDER CROSSING DETAILS - SHEET 2

SCALE AT A3	STATUS	PROJECT / DRAWING No.	REV	CATEGORY
AS SHOWN	IC	740805-GG-80002	3	FD

150 mm ON ORIGINAL

APPENDIX B

CROSSING DETAILS

		POSSUM			GLIDER VISITS
		POSSUM ENTRY	POSSUM RETURN	DURATION	
1	21/04/2005	7:24:00 PM			
2	22/04/2005	7:11:00 PM			
3	23/04/2005	7:54:00 PM			
4	24/04/2005				
5	25/04/2005				
6	26/04/2005	8:22:00 PM	9:56:00 PM	1HR 34	
7	27/04/2005				
8	28/04/2005	8:24:00 PM			
9	29/04/2005				
10	30/04/2005	6:03:00 AM			
11	1/05/2005	4:15:00 AM			3:34:00 AM
12	2/05/2005	4:20:00 AM			
13	3/05/2005				
14	4/05/2005				
15	5/05/2005				
16	6/05/2005				
17	7/05/2005				
18	8/05/2005				
19	9/05/2005				
20	10/05/2005				
21	11/05/2005				
22	12/05/2005				
23	13/05/2005				
24	14/05/2005				
25	15/05/2005				
26	16/05/2005				
27	17/05/2005				
28	18/05/2005				
29	19/05/2005				
30	20/05/2005	12:47:00 AM			
31	21/05/2005	10:17:00 PM			
32	22/05/2005				
33	23/05/2005	6:54:00 PM			
34	24/05/2005	5:49:00 AM			
35	25/05/2005	8:21:00 PM			
36	26/05/2005				
37	27/05/2005				
38	28/05/2005	7:31:00 PM	9:51:00 PM	2HR 20	
39	29/05/2005				
40	30/05/2005				
41	31/05/2005				
42	1/06/2005				
43	2/06/2005				
44	3/06/2005				
45	4/06/2005				
46	5/06/2005	6:48:00 PM	8:15:00 PM	1HR 27	
47	6/06/2005				
48	7/06/2005	6:41:00 PM			
49	8/06/2005	6:53:00 PM			

50	9/06/2005	7:25:00 PM			
51	10/06/2005				
52	11/06/2005	7:16:00 PM			
53	12/06/2005				
54	13/06/2005				
55	14/06/2005	7:23:00 PM			
56	15/06/2005				
57	16/06/2005	6:57:00 PM			
58	17/06/2005				
59	18/06/2005				
60	19/06/2005				
61	20/06/2005				
62	21/06/2005				
63	22/06/2005				
64	23/06/2005				
65	24/06/2005				
66	25/06/2005				
67	26/06/2005				
68	27/06/2005	7:14:00 PM			
69	28/06/2005				
70	29/06/2005				
71	30/06/2005				
72	1/07/2005				
73	2/07/2005				
74	3/07/2005	8:38:00 PM	9:33:00 PM	0HR 55	
75	4/07/2005				
76	5/07/2005				
77	6/07/2005	7:41:00 PM	2:07:00 AM	6HR 26	
78	7/07/2005				
79	8/07/2005				
80	9/07/2005				
81	10/07/2005				
82	11/07/2005				5:17:00 AM
83	12/07/2005	7:24:00 PM			
84	13/07/2005				
85	14/07/2005				
86	15/07/2005				
87	16/07/2005				
88	17/07/2005				
89	18/07/2005				
90	19/07/2005				
91	20/07/2005				
92	21/07/2005				
93	22/07/2005				
94	23/07/2005				
95	24/07/2005				
96	25/07/2005				
97	26/07/2005				
98	27/07/2005	7:18:00 PM			
99	28/07/2005				
100	29/07/2005				
101	30/07/2005				
102	31/07/2005				
103	1/08/2005				

104	2/08/2005				
105	3/08/2005				
106	4/08/2005				
107	5/08/2005				
108	6/08/2005				
109	7/08/2005				
110	8/08/2005				
111	9/08/2005				
112	10/08/2005				
113	11/08/2005				
114	12/08/2005				
115	13/08/2005				
116	14/08/2005	7:41:00 PM	2:30:00 AM	6HR 49	
117	15/08/2005				
118	16/08/2005				
119	17/08/2005	5:47:00 AM			
120	18/08/2005	7:39:00 PM	4:19:00 AM	8HR 40	
121	19/08/2005				
122	20/08/2005				
123	21/08/2005				
124	22/08/2005				
125	23/08/2005				
126	24/08/2005	8:42:00 PM	2:00:00 AM	5HR 18	
127	25/08/2005				
128	26/08/2005				
129	27/08/2005				
130	28/08/2005				
131	29/08/2005				
132	30/08/2005	7:54:00 PM	3:39:00 AM	7HR 45	
133	31/08/2005				
134	1/09/2005	12:53:00 AM			
135	2/09/2005				
136	3/09/2005	8:00:00 PM	3:52:00 AM	7HR 52	
137	4/09/2005				
138	5/09/2005				
139	6/09/2005				
140	7/09/2005				
141	8/09/2005				
142	9/09/2005				
143	10/09/2005	3:41:00 AM			
144	11/09/2005				
145	12/09/2005				
146	13/09/2005				
147	14/09/2005				
148	15/09/2005				
149	16/09/2005	10:24:00 PM			
150	17/09/2005				
151	18/09/2005				
152	19/09/2005				
153	20/09/2005				
154	21/09/2005	10:26:00 PM	12:12:00 AM	1HR 46	
155	22/09/2005				
156	23/09/2005				
157	24/09/2005				

158	25/09/2005				
159	26/09/2005				
160	27/09/2005				
161	28/09/2005				
162	29/09/2005				
163	30/09/2005				
164	1/10/2005				
165	2/10/2005	9:12:00 PM	11:21:00 PM	2HR 9	
166	3/10/2005				
167	4/10/2005				
168	5/10/2005				
169	6/10/2005				
170	7/10/2005				
171	8/10/2005				
172	9/10/2005				
173	10/10/2005				
174	11/10/2005				
175	12/10/2005				
176	13/10/2005				
177	14/10/2005				
178	15/10/2005				
179	16/10/2005				
180	17/10/2005				
181	18/10/2005				
182	19/10/2005				
183	20/10/2005				
184	21/10/2005				
185	22/10/2005				
186	23/10/2005				
187	24/10/2005				
188	25/10/2005				
189	26/10/2005				
190	27/10/2005				
191	28/10/2005				
192	29/10/2005				
193	30/10/2005				
194	31/10/2005				
195	1/11/2005				
196	2/11/2005				
197	3/11/2005	7:56:00 PM	12:21:00 AM	4HR 25	
198	4/11/2005	10:33:00 PM			
199	5/11/2005				
200	6/11/2005	1:26:00 AM			
201	7/11/2005				
202	8/11/2005	11:20:00 PM			
203	9/11/2005				
204	10/11/2005				
205	11/11/2005				
206	12/11/2005				10:04:00 PM
207	13/11/2005	12:18:00 AM			
208	14/11/2005				
209	15/11/2005				
210	16/11/2005				
211	17/11/2005				

212	18/11/2005				
213	19/11/2005				
214	20/11/2005				
215	21/11/2005				
216	22/11/2005				
217	23/11/2005				
218	24/11/2005				
219	25/11/2005				
220	26/11/2005				
221	27/11/2005				
222	28/11/2005				
223	29/11/2005	9:23:00 PM	10:01:00 PM	0HR 48	
224	30/11/2005				
225	1/12/2005				
226	2/12/2005				
227	3/12/2005				
228	4/12/2005	1:29:00 AM			
229	5/12/2005				
230	6/12/2005				
231	7/12/2005				
232	8/12/2005				
233	9/12/2005				9:55:00 PM
234	10/12/2005				
235	11/12/2005				
236	12/12/2005				
237	13/12/2005				
238	14/12/2005				
239	15/12/2005	2:28:00 AM			
240	16/12/2005	11:02:00 PM			
		46 No. possum crossings		14 expeditions to nearby tree Average duration 4hr 10min	4 no. glider crossings