FIGURE 4.5: Clyde River - Jervis Bay Basin

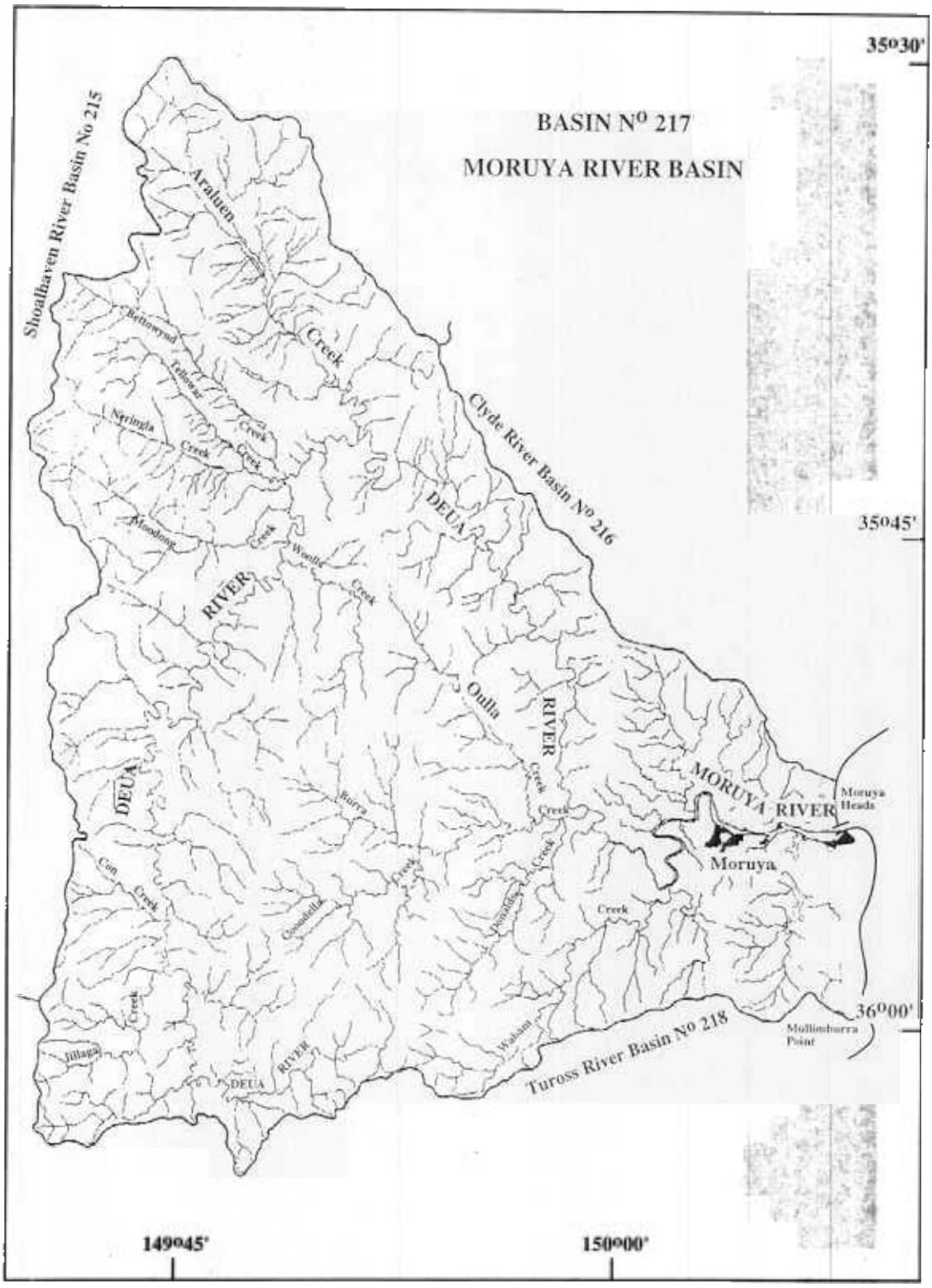

FIGURE 4.5: Moruya River Basin

FIGURE 4.7: Tuross River Basin

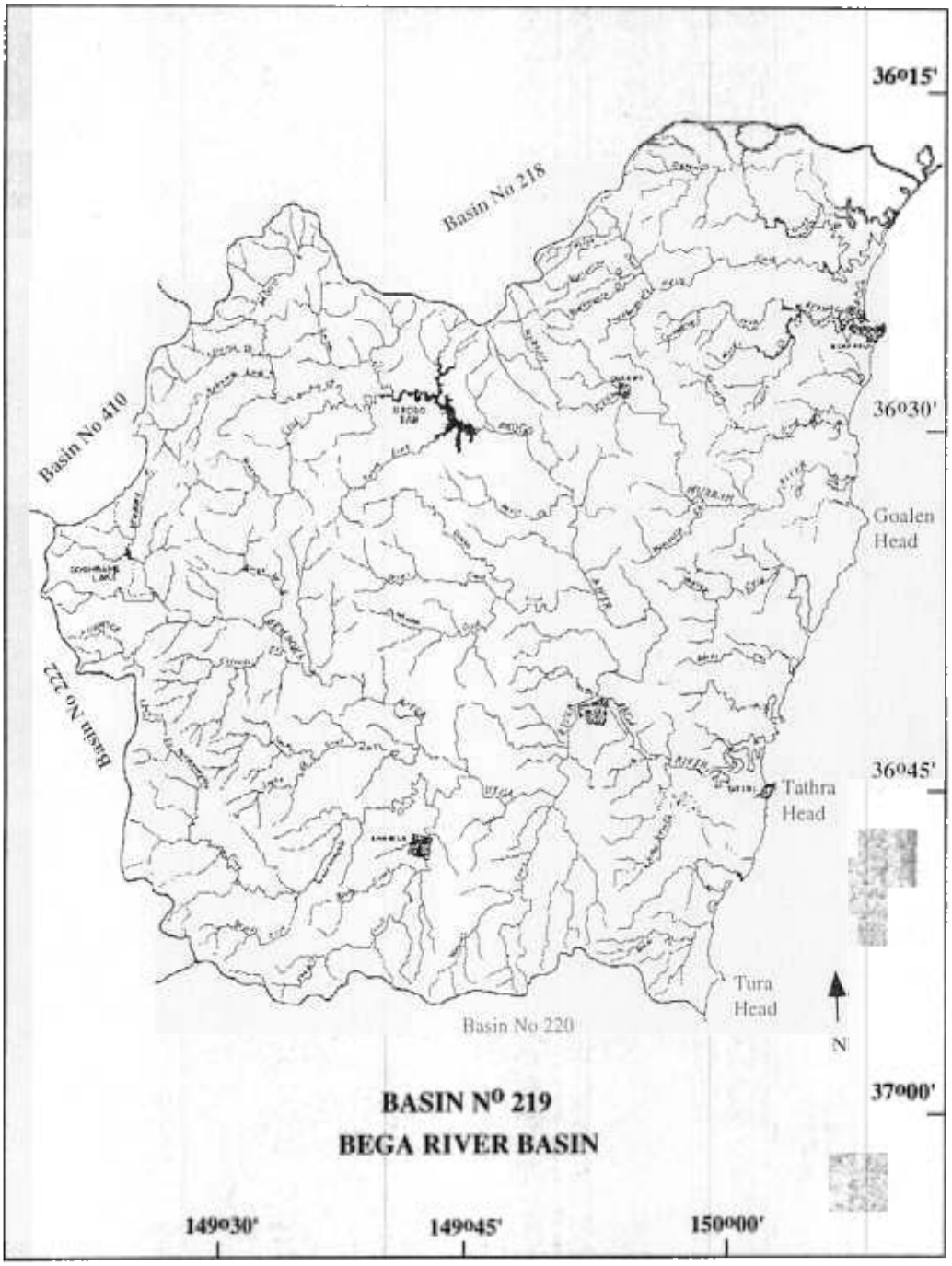

FIGURE 4.8: Bega River Basin

FIGURE 4.9: Towamba River and East Gippsland Basins

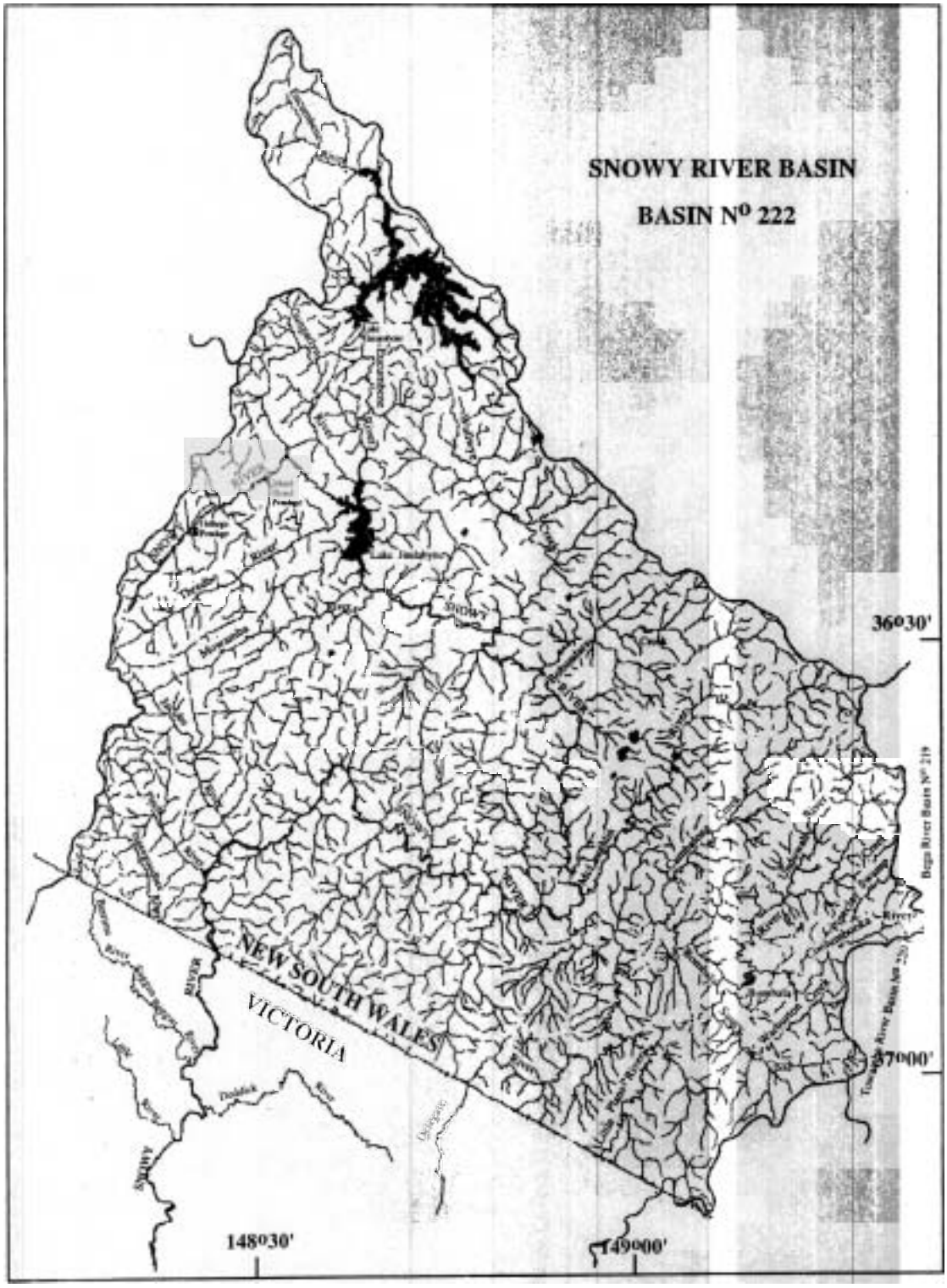

FIGURE 4.10: Snowy River Basin

4.2 Basin Summaries

4.2.1 Wollongong Coast Basin (No. 214)

The Wollongong Coast Basin is the northernmost of the nine drainage basins which were surveyed. It lies just south of Sydney, from the Hacking River (about 34°05' S) to Bare Bluff south of Kiama (about 34°30'S). All three catchments were surveyed, including Lake Illawarra, Macquarie Rivulet and Minnamurra River. A total of 43 obstructions were found on streams in the Wollongong Basin. The details of these obstructions are summarised in Table 4.3.

Table 4.3 Obstructions found in the Wollongong Coast Basin.

Type of structure	Number	Proportion
Causeway	24	51%
Culvert	13	28%
High dam	3	6%
Rock weir	2	4%
Fixed crest weir	5	11%
Total	47	100%

Identification, location and structural details of those obstructions which occur in the Wollongong Coast Basin are given in Appendix A, Tables 8.1, 8.2 and 8.3.

Fishways are fitted on two of the obstructions, MacDonalds Weir (Mac 12) (site code) and Kurarroo Rock Weir (Min 13). Both of these are rock-ramp fishways (Thorncraft and Harris 1997; Berghuis *et al.*. 1997; Harris *et al.*. 1998). The maximum vertical height of an obstruction (14.8 m) was at Fountaindale Dam (Min 02), the minimum height (0.25 m) at Miala Crossing (Ill 02), and the average obstruction height was 2.48 m.

4.2.2 Shoalhaven River Basin (No. 215)

The Shoalhaven River Basin lies south of the Wollongong Coast Basin and west of the Clyde River-Jervis Bay Basin. It has been classified into the Upper Shoalhaven River catchment and the Lower Shoalhaven catchment for the purpose of this survey. The Upper Shoalhaven catchment consists of the river and its tributaries in the region above Tallowa Dam, while the Lower Shoalhaven River consists of streams below Tallowa Dam. Tallowa Dam is a major barrier preventing fish from migrating upstream. All obstructions documented in the Lower Shoalhaven

River are those which were documented by Timms (1995) during his Honours Degree project at Wollongong University. Those listed for the Upper Shoalhaven were located and identified during the present project. A total of 89 obstructions are documented in the Shoalhaven River Basin. Identification, location and structural details are given in Appendix B, Tables 8.4, 8.5 and 8.6. The various types of structures found are listed in Table 4.4.

Table 4.4 Obstructions found in the Shoalhaven River Basin.

Type of structure	Number	Proportion
Culvert	30	33%
Causeway	24	27%
Floodgate	24	27%
Fixed crest weir	5	6%
High dam	5	5%
Stream gauging weir	2	2%
Total	90	100%

There are no fishways fitted on any of the above obstructions. The maximum vertical obstruction height was 43.0 m at Tallowa Dam (Sho 88), the minimum height was 0.05 m at Nowra Creek Crossing 2 (Sho 45), and the average height was 2.7 m.

4.2.3 Clyde River-Jervis Bay Basin (No. 216)

The Clyde River-Jervis Bay Basin occurs south of the Wollongong Coast Basin from Jervis Bay (35°00'S) to Burrowarra Point just south of Batemans Bay (35°45'S). This drainage basin consists of the Clyde River catchment and the Jervis Bay catchment, and a total of 25 obstructions were found here. The tables in Appendix C (Tables 8.7, 8.8 and 8.9) outline the identification, location and structural details. Table 4.5 summarises details of these obstructions.

Table 4.5 Obstructions found in the Clyde River-Jervis Bay Basin.

Type of structure	Number	Proportion
Causeway	10	40%
Culvert	4	16%
Fixed crest weir	8	32%
High dam	1	4%
Farm dam	1	4%
Stream gauging weir	1	4%
Total	25	100%

The only fishway on obstructions in the Clyde River-Jervis Bay Basin was at Buckenbowra Weir, but this fishway does not provide effective fish passage (Harris 1984b). The maximum vertical height was 17.0 m at Porters Creek Dam (Cly 18), the minimum height was 0.4 m at Boagsville Crossing (Jer 01), and the average height was 2.0 m. Most of the obstructions found were causeways (40%), with a large proportion of fixed crest weirs (32%) also being found. Culverts were the third most abundant structure to be identified and documented (16%), and stream gauging weirs and 5% high dams.

4.2.4 Moruya River Basin (No. 217)

The Moruya River Basin is located about two-thirds of the way down the coast between Sydney and the Victorian border. It is located between about 35°30'S to about 36°00'S. It is a relatively small basin compared to the Clyde River and Shoalhaven Basins. The area is partly agricultural, with a large portion of the region being made up of National Parks. The Deua River is the main tributary which runs into the Moruya River before it reaches marine waters. Only three obstructions were found in this basin. Table 4.6 summarises details of these. Appendix D contains Tables 8.10 - 8.12 with identification, location and structural details of these obstructions.

Table 4.6 Obstructions found in the Moruya River Basin.

Type of structure	Number	Proportion
culvert	3	100%
Total	3	100%

All three obstructions found in the Moruya River Basin were culverts. The maximum height was 2.2 m at South Head Road Crossing (Mor 01), the minimum height was 0.5 m at Candoin Creek Crossing (Mor 03), and the average height was 1.2 m.

4.2.5 Tuross River Basin (No. 218)

The Tuross River Basin lies south of the Moruya River Basin. It is located between about 36°00'S and 36°15' S. It is made up of the Tuross River catchment and its tributaries. The main tributaries are Reedy Creek, Wandella Creek, Wadbilliga River, Back Creek, Myrtle Creek, Belimbla Creek and Gulph Creek. A total of 18 obstructions were found in this drainage basin, as identified in Table 8.13 in Appendix E. The locations of these obstructions are defined in Table 8.14, and the structural details in Table 8.15. Table 4.7 summarises these details.

Table 4.7 Obstructions found in the Tuross River Basin.

Type of structure	Number	Proportion
Culvert	7	39%
Causeway	4	22%
Fixed crest weir	6	33%
Farm dam		6%
Total	18	100%

The maximum vertical height of these obstructions was 3.5 m, the minimum height was 0.2 m and the average vertical height for obstructions in the Tuross River Basin was 1.3 m. The majority of obstructions identified were culverts (50%), with a large proportion of causeways (36%) also being found. Fixed crest weirs and farm dams were both found in much smaller numbers, with 7% frequency.

4.2.6 Bega River Basin (No 219)

The Bega River Basin extends from about 36°S to about 37°S latitude, and is made up of four catchments . These include the Bermagui River, Brogo River, Bega River and Bemboka River catchments. A total of 24 obstructions was found in this drainage basin. Details of these obstructions are listed in Appendix F in Tables 8.16-8.18. Table 4.8 summarises these details.

Table 4.8 Obstructions found in the Bega River Basin.

Type of structure	Number	Proportion
Culvert	9	38%
Causeway	4	17%
Stream gauging weir	3	13%
High dam	2	8%
Farm dam		4%
Fixed crest weir	3	13%
Rock weir		4%
Bridge		4%
Total	24	100%

The maximum vertical height of the above structures was 43 m at Brogo Dam (Beg 05). The minimum height for a structure is the stream was Wicks End Weir (Beg 18) at 0.3 m, and the average height for the above structures was 4.2 m. The majority of obstructions found in the Bega River Basin were culverts (41%). Other obstructions were causeways (18%), stream gauging weirs (14%), high dams (9%), and fixed crest weirs, farm dams and bridges (each 5%).

4.2.7 Towamba River Basin (No. 220)

The Towamba River Basin extends from Merimbula on the far south coast of New South Wales at about 36°45'S to just south of the Victorian Border at Cape Howe (about 37°30'S). It consists of the Towamba River catchment and its tributaries, including Nadgee River, Merrica River, Pericoe Creek, Wog Wog River, Stockyard Creek, Black Log Creek, New Station Creek, Mataganan Creek and Myrtle Creek. The Pambula River catchment, which includes the Yowaka River as its main tributary, is also a part of the Towamba River Basin. Tables 8.19 to 8.21 in Appendix G lists the identification, location and structural details the 18 obstructions found in this drainage basin. Table 4.9 summarises these details.

Table 4.9 Obstructions found in the Towamba River Basin.

Type of structure	Number	Proportion
Culvert	9	53%
Causeway	5	29%
Bridge	2	12%
Fixed crest weir		6%
Total	17	100%

No fishways were found fitted to obstructions in the Towamba River Basin. The maximum vertical obstruction height was 3.5 m at Ruggs Road Crossing (Pam 08), the minimum height was 0.35 m at Gill Fire Trail (Pam 06), and the average height was 1.4 m. Most of the obstructions found were culverts, with a high proportion of causeways as well. A few of bridges and fixed crest weirs were also present.

4.2.8 East Gippsland Basin (No 221)

The East Gippsland Basin lies in the far south of New South Wales and extends into Victoria. Only streams located in New South Wales were surveyed for obstructions. The main rivers in this basin are the Wallagaraugh and Genoa Rivers and their tributaries. A total of six obstructions were found in this basin. Details of these are listed in Tables 8.22 to 8.24 in Appendix H. These details are summarised in Table 4.10.

Table 4.10 Obstructions found in the East Gippsland Basin.

Type of structure	Number	Proportion
Culvert	6	100%
Total	6	100%

All obstructions found in the East Gippsland Basin were culverts. The maximum vertical obstruction height was at Imlay Road Crossing (Gip 01), with a value of 3.0 m. The minimum height was 0.6 m at Bungan Road Crossing (Gip 05). The average vertical height for these obstructions was 1.53 m.

4.2.9 Snowy River Basin (No. 222)

The Snowy River Basin is located west of the Bega River, Towamba River and East Gippsland Basins. It comprises the Snowy River, with its main tributaries being Little Plains River, Delegate River, Ingeegoodbee River, Pinch River, Jacobs River, Mowamba River, Thredbo River, Gungarlin River, Eucumbene River, Wullwye Creek, Bobundara Creek, McLaughlin River, Cambalong Creek, Bombala River and Coolumbooka River. A total of 24 obstructions were identified in this river basin. A substantial proportion of these obstructions found were high dams, built for the Snowy Mountains Hydro Electric Scheme. The details of these are summarised in Table 4.11. The identifications, location and structural details are listed in Tables 8.25 to 8.27 in Appendix H.

Table 4.11 Obstructions found in the Snowy River Basin.

Type of structure	Number	Proportion
Fixed crest weir	9	38%
Culvert	6	25%
High dam	4	17%
Causeway	3	13%
Farm dam	2	8%
Total	24	100%

Three fishways were found fitted to obstructions in the Snowy River Basin. The McLaughlin River Weir (Sno 04) has a pool and weir type fishway constructed on it, the Dalgety Weir on the Dalgety River (Sno 08) has a combined vertical slot/rock-ramp fishway, which was being constructed at the time of the field observation (6 March 1997) and is now operational. Anglers Creek Weir (Sno 24) also has a pool and weir fishway constructed on it. Both the McLaughlin River fishway and Anglers Creek Weir fishway are ineffective (Harris 1984b). The maximum height for obstructions found was 116.1 m at Eucumbene Dam (Sno 17), the minimum height was 0.6m at Brivale Crossing (Sno 19), and the average height was 13.96 m.

Figure 4.11: Culvert in the Shoalhaven River Basin (Sho 70).

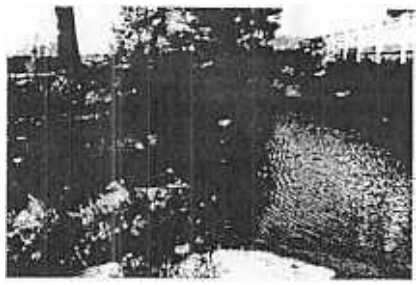

Figure 4.12: A causeway in the Wollongong Coast Basin (Min 17).

Figure 4.13: A fixed-crest weir in the Clyde River-Jervis Bay Basin (Cly 05).

Figure 4.14: A stream gauging weir in the Shoalhaven River Basin (Sho 71).

Figure 4.15a: View across a rock ramp fishway in the Wollongong Coast Basin (Mac 12).

Figure 4.15b: View showing pools both upstream and downstream of the fishway

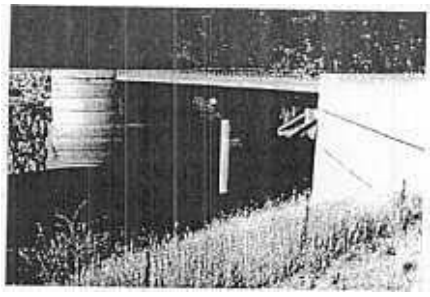

Figure 4.16a: Upstream view of high dam wall at Jindabyne on the Snowy River Basin (Sno 06).

Figure 4.16b: View of the storage upstream of Sno06.

Figure 4.16c: Downstream view of the dam wall of Sno 06.

Figure 4.16d: View of the river downstream of Sno 06.

Figure 4.17: View of a farm dam in the Bega River Basin.

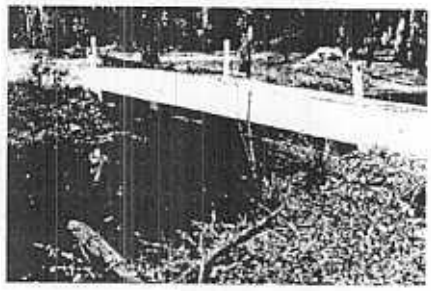

Figure 4.18: A low bridge in the Moruya River Basin (Mor 02).

4.3 Fishway Priority Scheme

To allocate priority rankings to fish-passage restoration work throughout New South Wales as objective and strategically based method was developed.. The criteria that need to be considered when assessing the priority of individual structures include the following features:

the size of the river or stream,

2.) whether or not the structure occurs in a tidal zone, in coastal regions, or in a 'core habitat area' (see 4.3.1 below) in inland waters,

3. the presence of threatened or endangered fish species,

4.) the amount of fish habitat upstream of the structure,

5.) the number of obstructions which occur downstream,

6.) the proportion of the river obstructed by the barrier,

7.) the drownout frequency of the obstruction,

8.) the type of barrier (weirs, culvert, causeway, etc.),

9.) the presence and effectiveness of any existing fishways,

10.) the cost of building a fishway and

11) the level and support from community and other groups for providing fish passage.

These criteria are arranged into a priority ranking scheme for assessing individual structures in Figure 6.1.

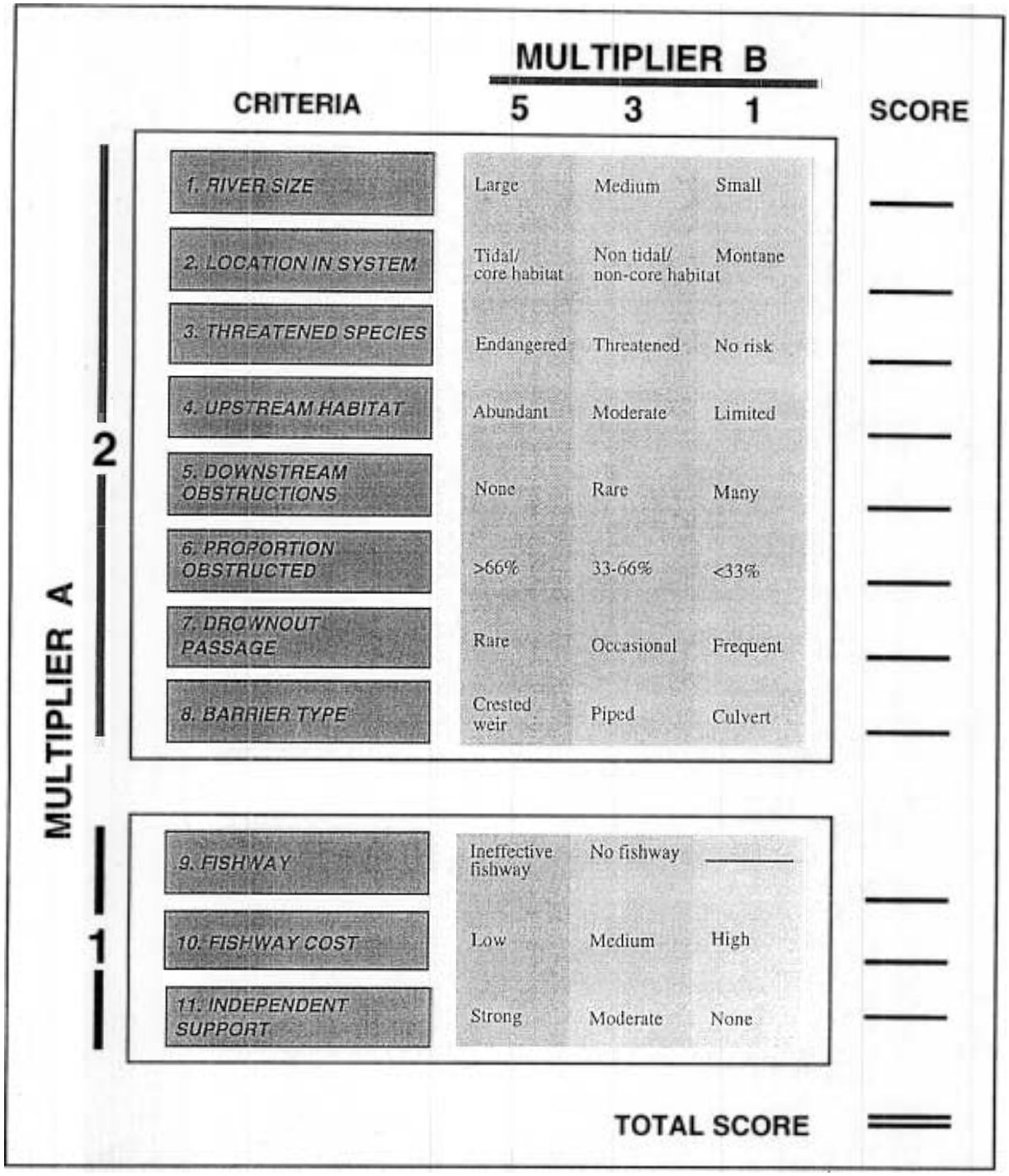

Figure 6. Priority-ranking scheme for fish passage obstructions

4.3.1 Using the Fishway Priority Scheme

This scheme provides a quantitative method for ranking the priority of sites for providing fishways. Rankings are produced by assessing each site according to all of the 11 criteria listed, then classifying it according to the descriptors in the three associated columns in the right side of the scheme.

The 11 criteria (rows) are grouped in the scheme in order of importance, with two broad groups having priority-weighting multipliers (multiplier A) of one or two. Multiplier B is allocated to the three descriptor columns, with weighting levels of five, three and one. To apply the scheme for a site, a score is produced for each of the 11 criteria by multiplying the two relevant priority-weighting multipliers , recording the result in the 'Score' column, then summing over all criteria. The total score is then used as the measure of the overall priority of any particular site against other sites on a local, river-basin, regional or state-wide basis. Notes explaining details of the individual criteria are listed below.

1. River size: Relative size of the whole catchment of the particular river or stream

2. Location in system: Tidal sites in coastal rivers are critical for migration of juveniles of many fish species. Similarly 'core habitat' in inland rivers refers to sites in lowland regions believed to be critical for large-scale recruitment of fish. These are generally downstream of Echuca (Murray River), Wilcannia (Darling River), Narrandera (Murrumbidgee River) and Condobolin (Lachlan River). Montane habitats are above 700 m in altitude.

3. Threatened species: Refers to the presence of in the river reach of species nationally classified as endangered, threatened or not at risk.

4. Upstream habitat: Amount of upstream habitat which would become accessible when a fishway is installed.

5. Downstream obstructions: Occurrence and severity of other artificial and natural barriers downstream of the site.

6. Proportion obstructed: Proportion of the whole catchment of the particular stream which lies upstream of the site.

7. Drownout passage: Frequency with which high flows create effective drownout conditions at the site, so that head-loss and velocity are minimal and fish can pass upstream.

8. Barrier type: basic structure of the barrier, which influences the ability of migrating fish to pass upstream.

9. Fishway: Presence/absence of an effective fishway on the barrier

10. Fishway cost: Likely cost of building a fishway

11. Independent support: Level of financial and other support from local government, landholders, industry, community groups, etc.

5. DISCUSSION

This survey has identified a large number (254) of obstructions throughout the coastal streams of southern New South Wales. The number and type of obstructions varied greatly from basin to basin, and from catchment to catchment. There was no pattern determined as to the locations of these obstructions. For example, the numbers of obstructions did not decrease with distance south of Wollongong, the regional centre of human population.. The Bega River Basin (No. 219) contained the most varied types of structures, with all structure types being identified except for tidal floodgates, which were only documented in the Shoalhaven River Basin. Included in the Bega River Basin were high dams, farm dams, fixed-crest weirs, rock weirs, stream gauging weirs, culverts, causeways and bridges. The Moruya River and East Gippsland Basins both contained only one type of structure, culverts. Culverts were common to all drainage basins (see Figure 4.2).

All nine drainage basins surveyed suffered at least some alienation of fish habitat. In order to determine the amount of habitat alienated, it would be necessary to study the individual streams within catchments and to estimate what proportion of stream length was compromised by these obstructions. This would involve the quantitative study of relevant 1: 25 000 topographic maps with all obstructions marked on them. These maps are now available because of this study, but such a analysis was beyond the scope of the present study.

The majority of obstructions found throughout the nine drainage basins were road crossings, which were made up of causeways and culverts. These road crossings occurred most frequently and were the easiest to survey. However, most of these crossings were low in height and often contained pipes or culverts, which allow for some water to flow through. Therefore, many of them would not have as great an impact on fish passage as a large weir or dam would have.

Fixed crest weirs were the next most common type of obstruction identified. Many of these occurred on private properties, and were therefore difficult to locate because they may not be licensed or legally constructed. Also, gaining access to private properties can be sometimes difficult and time consuming. Some of the weirs found in this survey were found by chance, and not through the available sources of information.

Tidal floodgates were the third most frequently identified obstructions. However, as they were identified only from the Shoalhaven River Basin this pattern does not give an overall representation of the signifance of these obstructions throughout the south coast region

High dams were the fourth most common obstructions throughout the area. Even though these obstructions do not occur very frequently, they obviously create the biggest barrier to fish passage, because of their large size and because they control water flow over large reaches of the streams. Tallowa Dam alienates more than 200 km of fish habitat within the Shoalhaven River Catchment (Marsden *et al.*. 1996). However, a scientific study by NSW Fisheries is assessing the requirements and design of a fishway for this dam.

Smaller numbers of stream gauging weirs, farm dams, rock weirs and bridges were also located. Stream-gauging weirs ranged in height from 0.3m to1.1m. They have less impact than dams or most fixed-crest weirs, because the v-notch allows for concentrated water flow and some fish movement. Therefore, these structures are not as high on the priority list as some other obstructions requiring removal or modification to increase fish passage. The farm dams surveyed also had the potential to decrease fish habitat and impede fish passage by reducing stream flow. The bridges surveyed were low in impact, because they allowed for unimpeded stream flow at all times other than during floods. The two rock weirs found were constructed with rock ramp fishways, and therefore do not constitute barriers to fish passage. Rock-ramp fishways generally provide effective fish passage, and are simple and low-cost (Thorncraft and Harris 1996; Berghuis *et al.*; Harris *et al.* 1998). The bridges found were low bridges, and therefore unlikely to obstruct fish migration except perhaps at medium to high flows.

Table 2.1 lists the fish species found in streams within the study area, together with their known migratory requirements and distributions. Many of the fish species have been classified into the various categories according to their migration requirements after Harris (1984). However, it is important to note that these are not the only fishes which would have their life cycles affected by obstructions to river flow. All freshwater fishes must move between habitat areas to spawn or to seek food and shelter at some point in their life cycles.

There are important differences in the relative effects of the different types of structures. In culverts, even though water may be flowing through the pipes, these are often too narrow, or too elevated above the surface of the water, so they would not to allow fish passage upstream. An example of this type of culvert is the crossing near Thredbo (Sno 12) (see Figure 6.2).

Generally, causeways which have a large vertical height will obstruct fish passage far more than those which are low in height. This is because causeways do not contain outlet pipes to allow passage for those fish species which may be able to take advantage of piped flow. Furthermore, lower structures drown-out at lower stream-flows. Fixed-crest weirs identified in the survey varied in size considerably in vertical heigh from 0.3 m to 7.0 m. Again, the higher weirs would have a larger impact on fish passage than smaller weirs.

The impact of tidal floodgates is variable, depending on their location and whether they are held open or closed. However, because of their tidal position affecting very small catadromous fishes, floodgates may cause considerable impact.

High dams were usually located on large streams and used as water supply reservoirs. Therefore, they generally have the maximum impact upon fish migration requirements. Dam heights varied from 7.0 m at Stanwell Dam in the Wollongong Coast Basin to 116 m at Eucumbene Dam in the Snowy River Basin. A comparison of the upstream and downstream views of the river at Jindabyne Dam (Figures 4.14a-4.15b) show the huge difference in stream levels.

Although fishways have been constructed on seven of the south coast stream obstructions to allow for fish passage, some of them are ineffective. For example, the fishway observed on the McLaughlin River Weir (Sno 04) was a pool fishway, and completely ineffective at low flow because most of the pools are above the surface level of the water (see Figure 6.3). Fishways at Tapitallee Weir, Buckenbowra Weir and Anglers Reach were also recorded by Harris (1984b) as being non-functional.

5.1 Conclusions

An important conclusion from this study is that the migration requirements of all fish must be taken into account when structures are proposed to be built or modified. The various state and local government agencies involved must be aware of the environmental consequences of obstructions to fish passage in the regions under their control. Also, the possible removal, fitting of a fishway, or modification of existing structures should be considered at each site. The maintenance of fish passage through dams, reservoirs and impoundments is provided for in the NSW Fisheries Management Act (1994) (Smith and Pollard 1998). It is important for individuals, landowners, community groups and agencies (e.g. the Roads and Traffic Authority, State Rail, National Parks and Wildlife Service and local government councils) to ensure that obstructions to fish passage are not created in the future and that the environmental impact of existing obstuctions is mitigated as far as possible. Fish passage needs to be restored in south coast streams as a major step in rehabilitating their fish communities and restoring healthy rivers.

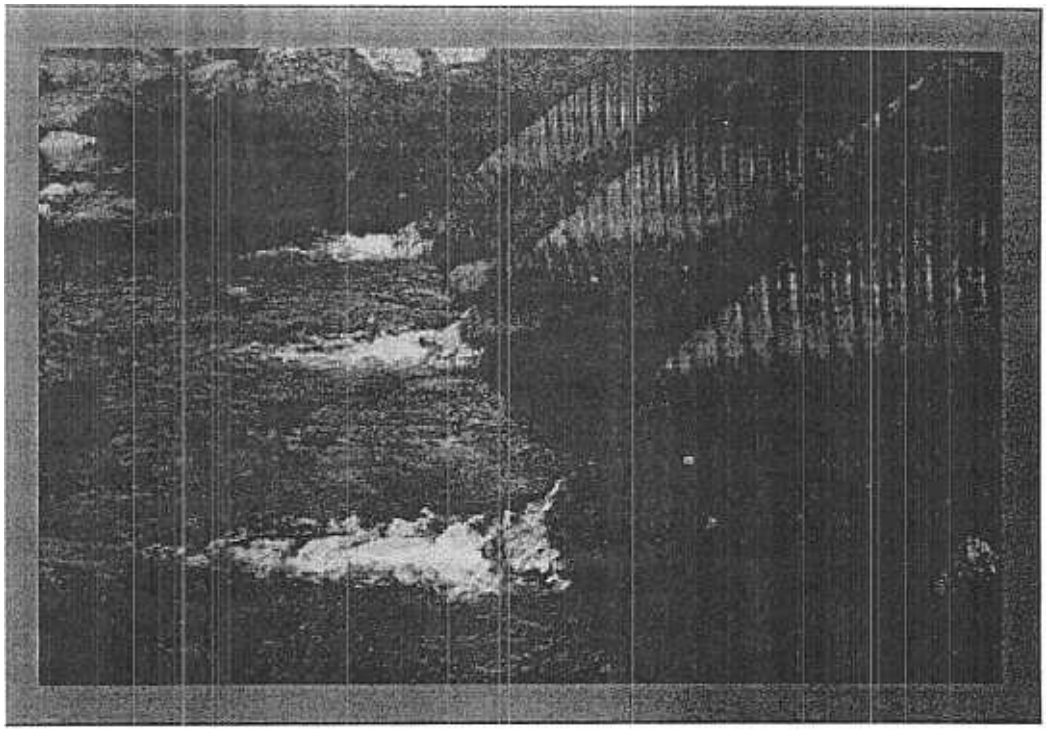

Figure 6.2: A culvert in the Snowy River Basin (Sno 13)

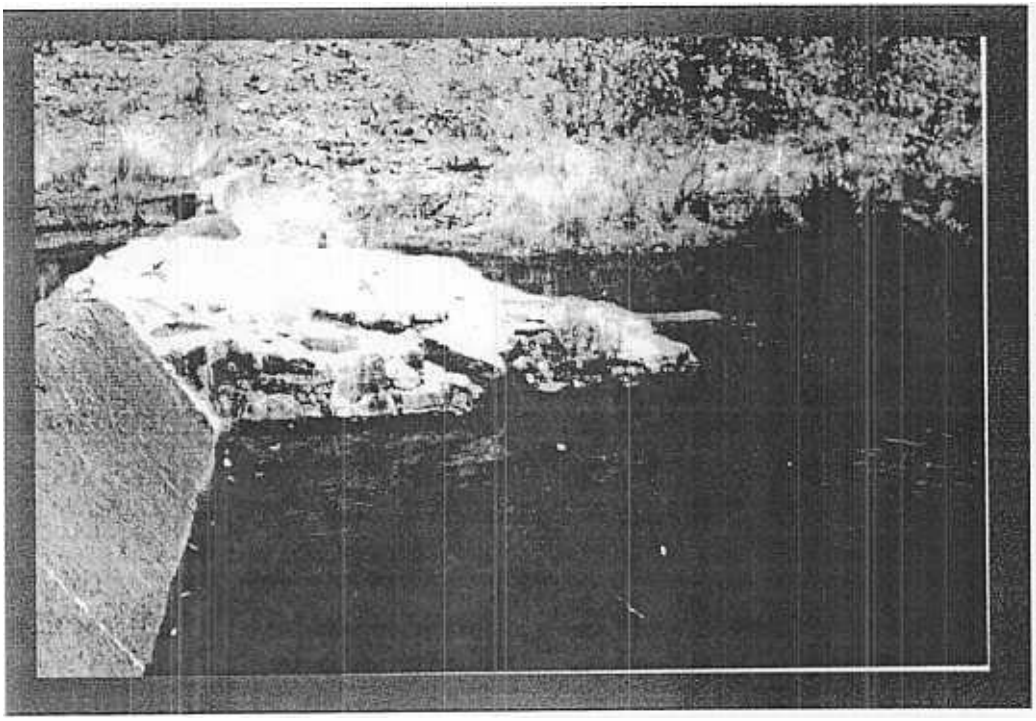

Figure 6.3: An ineffective fishway in the Snowy River Basin (Sno 04)

6.

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8. APPENDICES

APPENDIX A. Obstructions in the Wollongong Coast Basin (No. 214).

Table 8.1. Identification of obstructions in the Wollongong Basin

Structure ID	Catchment name	Structure name	Stream name
Ill 01	Lake Illawarra	Merrygold Crossing	Duck Creek
Ill 02	Lake Illawarra	Miala Crossing	Duck Creek
Ill 03	Lake Illawarra	Heather Brae Crossing	Duck Creek
Ill 04	Lake Illawarra	Woodville Crossing	Duck Creek
Ill 05	Lake Illawarra	Lakelands Drive Crossing	Brooks Creek
Ill 06	Lake Illawarra	Serenity Farm Crossing	Mullet Creek
Ill 07	Lake Illawarra	Serenity Farm Weir	Mullet Creek
Ill 08	Lake Illawarra	William Beach Park Weir	Mullet Creek
Ill 09	Lake Illawarra	Hooka Creek Road Crossing	Hooka Creek
Ill 10	Lake Illawarra	Illawarra Power Station	Duck Creek
Ill 11	Lake Illawarra	Northcliffe Drive 01	Minnegang Creek
Ill 12	Lake Illawarra	Northcliffe Drive 02	Budiong Creek
Ill 13	Lake Illawarra	Budiong Ck Causeway	Budiong Creek
Mac 01	Macquarie Rivulet	Hendry and James Crossing	Macquarie Rivulet
Mac 02	Macquarie Rivulet	Green Valley Crossing	Macquarie Rivulet
Mac 05	Macquarie Rivulet	Nth Macquarie Rd Crossing	Macquarie Rivulet
Mac 06	Macquarie Rivulet	Yellow Rock Road Crossing	Yellow Rock Creek
Mac 07	Macquarie Rivulet	Homewood Crossing 1	Yellow Rock Creek
Mac 08	Macquarie Rivulet	Homewood Crossing 2	Unnamed
Mac 09	Macquarie Rivulet	Calderwood Road Crossing	Marshall Mount Creek
Mac 10	Macquarie Rivulet	Oakleigh Crossing	Marshall Mount Creek
Mac 11	Macquarie Rivulet	Calderwood Farm Crossing	Marshall Mount Creek
Mac 12	Macquarie Rivulet	McDonald's Weir	Macquarie Rivulet
Min 01	Minnamurra River	Jerrara Creek Dam	Jerrara Creek
Min 02	Minnamurra River	Fountaindale Dam	Fountaindale Creek
Min 03	Minnamurra River	Hvams Ck Dam	Hvams Ck
Min 04	Minnamurra River	Derewinanka Crossing	Fountaindale Creek
Min 05	Minnamurra River	Elban Crossing	Jerrara Creek
Min 06	Minnamurra River	Clover Hill Road Crossing	Carwa Creek
Min 07	Minnamurra River	Nuninuna Dr Crossing 1	McFaul's Creek
Min 08	Minnamurra River	Nuninuna Dr Crossing 2	Tongalla Creek
Min 09	Minnamurra River	Nuninuna Dr Crossing 3	Fountaindale Creek
Min 10	Minnamurra River	Woodbrook Crossing	Wallaces Creek
Min 11	Minnamurra River	The Ridge Crossing	Hvams Creek
Min 12	Minnamurra River	Turpentine Creek C Crossing	Turpentine Creek
Min 13	Minnamurra River	Kurraroo Rock Weir	Minnamurra River
Min 14	Minnamurra River	Factory Lane Rd Crossing	Colvers Creek
Min 15	Minnamurra River	Curramore Rd Crossing 1	Turpentine Creek
Min 16	Minnamurra River	Curramore Rd Crossing 2	Turpentine Creek
Min 17	Minnamurra River	William Coles Bridge	Fry's Creek
Min 18	Minnamurra River	Minnamurra Falls Rd Crossing	Minnamurra River
Min 19	Minnamurra River	Daltons Rd Crossing 1	Fry's Creek
Min 20	Minnamurra River	Daltons Rd Crossing 2	Fry's Creek

Table 8.2. Location details of obstructions in the Wollongong Basin.

Structure ID	Nearest town	Location map	Map reference	Grid ref.	Lat/Long
Ill 01	Albion Park	Robertson	9028-4-N	911755	34°32.412'S. 150°43.422'E
Ill 02	Albion Park	Robertson	9028-4-N	935754	34°32.510'S. 150°44.965'E
Ill 03	Albion Park	Albion Park	9028-1-N	938755	34°32.430'S. 150°45.172E
Ill 04	Dapto	Albion Park	9028-1-N	950762	34°31.953'S. 150°46.086'E
Ill 05	Dapto	Albion Park	9028-1-N	975798	34°30.226'S. 150°47.636'E
Ill 06	Dapto	Wollongong	9029-2-S	968802	34°29.934'S. 150°47.212'E
Ill 07	Dapto	Wollongong	9029-2-S	968802	34°29.934'S. 150°47.212'E
Ill 08	Dapto	Wollongong	9029-2-S	986822	34°28.941'S. 150°48.381'E
Ill 09	Wollongong	Wollongong	9029-2-S	009823	34°28.859'S. 150°49.960'E
Ill 10	Dapto	Albion Park	9028-1-N	974767	34°31.829'S. 150°47.568'E
Ill 11	Warrawong	Wollongong	9029-2-S	047811	34°29.592'S. 150°52.592'E
Ill 12	Berkeley	Wollongong	9029-2-S	028829	34°29.086'S. 150°51.154'E
Ill 13	Berkeley	Wollongong	9029-2-S	028829	34°29.086'S. 150°51.154'E
Mac 01	Albion Park	Robertson	9028-4-N	865716	34°34'35"S. 150°40'15"E
Mac 02	Albion Park	Robertson	9028-4-N	894712	34°34'50"S. 150°42'10"E
Mac 05	Albion Park	Robertson	9028-4-N	913714	34°34'45"S. 150°43'25"E
Mac 06	Albion Park	Robertson	9028-4-N	928698	34°35'35"S. 150°44'25"E
Mac 07	Albion Park	Robertson	9028-4-N	918691	34°35'55"S. 150°43'45"E
Mac 08	Albion Park	Robertson	9028-4-N	918691	34°35'35"S. 150°43'45"E
Mac 09	Dapto	Robertson	9028-4-N	892745	34°32'55"S. 150°42'05"E
Mac 10	Dapto	Robertson	9028-4-N	916744	34°33'05"S. 150°43'35"E
Mac 11	Dapto	Robertson	9028-4-N	932741	34°33'10"S. 150°44'40"E
Mac 12	Albion Park	Albion Park	9028-1-N	962746	34°32'58"S. 150°46'50"E
Min 01	Kiama	Kiama	9028-1-S	993611	34°40'15"S. 150°48'40"E
Min 02	Kiama	Kiama	9028-1-S	971601	34°40'50"S. 150°47'10"E
Min 03	Jamberoo	Kiama	9028-1-S	946603	34°40'45"S. 150°45'35"E
Min 04	Kiama	Kiama	9028-1-S	976621	34°39'40"S. 150°47'20"E
Min 05	Kiama	Kiama	9028-1-S	998615	34°40'05"S. 150°48'35"E
Min 06	Jamberoo	Kiama	9028-1-S	972615	34°40'05"S. 150°47'15"E
Min 07	Jamberoo	Kiama	9028-1-S	963597	34°41'02"S. 150°47'15"E
Min 08	Jamberoo	Kiama	9028-1-S	964596	34°41'04"S. 150°46'45"E
Min 09	Jamberoo	Kiama	9028-1-S	965593	34°41'15"S. 150°46'50"E
Min 10	Jamberoo	Kiama	9028-1-S	951627	34°39'20"S. 150°45'55"E
Min 11	Jamberoo	Kiama	9028-1-S	946617	34°39'58"S. 150°45'40"E
Min 12	Jamberoo	Kiama	9028-1-S	947659	34°37'40"S. 150°45'40"E
Min 13	Jamberoo	Kiama	9028-1-S	982643	34°38'30"S. 150°47'55"E
Min 14	Jamberoo	Kiama	9028-1-S	975635	34°38'55"S. 150°47'30"E
Min 15	Jamberoo	Robertson	9028-4-N	935665	34°37'15"S. 150°44'50"E
Min 16	Jamberoo	Albion Park	9028-1-N	944661	34°37'28"S. 150°45'27"E
Min 17	Jamberoo	Kiama	9028-1-S	944644	34°38'30"S. 150°45'25"E
Min 18	Jamberoo	Kangaroo Val.	9028-4-S	924649	34°38'15"S. 150°44'10"E
Min 19	Jamberoo	Kangaroo Val.	9028-4-S	917627	34°39'20"S. 150°43'40"E
Min 20	Jamberoo	Kangaroo Val.	9028-4-S	915629	34°39'18"S. 150°43"33"E

Table 8.3. Structural details of obstructions in the Wollongong Basin