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South East Queensland Regional Water Supply Strategy

Desk Top Review of Identified Dam and Weir Sites

Report to the Bulk Supply Infrastructure Task Group
June 2006

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**Your attention is drawn to the following sections of the report:
Section 1.3 Purpose of Report
Section 1.4 Limitations of Report**

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Appendices

A Initial Scoping Report

Executive Summary

Due to unprecedented population growth in South East Queensland, the South East Queensland 2021 Project (SEQ 2021) required the formulation of regional strategies for meeting the future water supply needs of South East Queensland and led to the South East Queensland Water and Wastewater Management and Infrastructure Study in 1999.

In 2000, following initiatives of the SEQ 2021 project, a workshop involving major stakeholders was undertaken and a working group formed, which included representatives from local government, conservation interests and State agencies. This group was responsible for developing a project proposal. Subsequently, a Steering Committee including state and Local government, and other stakeholder representatives was established to develop a Regional Water Supply Strategy for South East Queensland.

As part of the SEQ Regional Water Supply Strategy Project Team, the Bulk Supply Infrastructure Task Group has responsibility for a desktop review of potential dam and weir sites. This report summarises the findings from this review.

The desktop review initially included a review of previous reports on potential water supply options in the South East Queensland study area and direct contact with Local Governments and Water Authorities in the region to ascertain what studies of potential water augmentation in their region they had undertaken or were planning to undertake. This review identified some 80 potential dam and weir site options that had been studied in the past. These options were reviewed at a high level on the basis of the reported potential to reliably supply significant amounts of water. This resulted in the projects being classified into the following reported potential yield groups:

- ▶ Potential bulk water supply greater than 50,000 ML/a;
- ▶ Potential bulk water supply between 20,000 and 50,000 ML/a;
- ▶ Potential bulk water supply between 5,000 and 20,000 ML/a; and,
- ▶ Potential bulk water supply less than 5,000 ML/a.

From this overall comparative review, 15 projects were identified that had the potential to supply a significant proportion of the bulk water supply needs in the study area and were previously reported to result in the least environmental, social, archaeological and heritage impact.

The project options selected for further study under this desktop review comprised:

- | | |
|--|--|
| ▶ Albert River | Glendower Dam with a barrage on the Albert River |
| ▶ Coomera River: | Coomera Dam |
| ▶ Logan River | Cedar Grove Dam Tilley's Bridge Dam with Cedar Grove Weir |
| ▶ Teviot Brook | Wyaralong Dam with Cedar Grove Weir |
| ▶ Nerang River | Raising of Hinze Dam to Stage 3 |
| ▶ Water Harvesting to Hinze Dam ¹ : | From Coomera, Canungra, Mudgeeraba and Tallebudgera River and Nerang River |
| ▶ Caboolture River | Zillman's Crossing |
| ▶ Maroochy River | Raising Wappa Dam |
| ▶ Amamoor Creek | Amamoor Dam |
| ▶ Mary River | Cambroon Dam |
| ▶ Yabba Ck | Raising of Borumba Dam (Stage 3) |
| ▶ Obi Obi Creek | Kidaman Dam |
| ▶ Mary River | Traveston Dam; and |
| ▶ Brisbane River | Raise Wivenhoe Dam |

For each of these projects the potential historical no-failure yield (HNFY) for several different full supply levels was determined (by NRM&W²) and the cost of constructing dams to these various full supply levels was determined using the available quantities from the previous reports or quantities estimated specifically for this study. However, insufficient information was available to prepare cost estimates for raising the embankment of Wivenhoe Dam as part of this desktop review.

The cost of each of the options was updated using building cost indices so that projects evaluated at different times could be compared on the same basis. Most of the projects reported included indicative estimates of the cost of land acquisition, road and highway relocation, railway relocation, power supply, telecom and Council infrastructure relocation costs. A summary of the potential environmental, social, archaeological, and heritage issues on each of the projects was undertaken based on the information available in the reports. All the projects were found to contain, to varying extents, the potential to have an impact on the environmental, social, archaeological, or heritage values in the area concerned.

¹ Project not previously reported but suggested by NR&M¹ as worthy of consideration.

² NRM&W is Queensland Government department of Natural Resources, Mines and Water

For each of the options the full supply level that results in the least capital cost per megalitre of yield has been established. Using these (lowest) unit cost estimates the projects mentioned above have been sorted to indicate the potential project options cost ranking. This sorting on the basis of unit cost is shown in Table A1.

Table A1 Possible Projects or Combination of Projects Ranked by Unit Cost

| Option | Comment | FSL (m) | Storage Capacity (ML) | Yield (ML/a) | Estimated Capital | | Unit Capital Cost (\$/ML/a) |
|---|---|------------|-----------------------------|-----------------|--------------------|------|--------------------------------|
| | | | | | Cost \$ Million | Cost | |
| Mary River/Cambroon Dam | New Dam | 130.00 | 127,247 | 52,930 | 206.3 | | 3,898 |
| Flood Harvesting into a raised Hinze Dam. Cost of raising dam not included. | From Coomera River (Threshold 20 ML/d) | | | 11,000 | 46.9 | | 4,266 |
| Obi Obi Creek Kidaman Dam | New Dam | 130.00 | 172,898 | 36,883 | 172.5 | | 4,677 |
| Mary River Traveston Dam | New Dam | 85.00 | 1,130,000 | 215,340 | 1,011.1 | | 4,695 |
| Wyralong/Logan River Teviot Brook with Cedar Grove Weir | New Dam | 63.00 | 97,025 | 26,674 | 127.7 | | 4,790 |
| Logan River/Tilley's Bridge near Rathdowney | New Dam | 110.00 | 100,000 | 42,714 | 223.1 | | 5,223 |
| Flood Harvesting into a raised Hinze Dam. Cost of raising dam not included. | From Coomera River (Threshold 20 ML/d) + Canungra Creek (Threshold 90 ML/d) + Mudgeeraba Creek (Threshold 5 ML/d) + Tallebudgera Creek (Threshold 5 ML/d) | | | 22,600 | 129.1 | | 5,712 |
| Wyralong 104,000 ML and Tilley's Bridge 50,000 ML Dams + Cedar Grove Weir | New Dams | | | 50,000 | 301.3 | | 6,025 |
| Wyralong 104,000 ML and Tilley's Bridge 110,000 ML Dams + Cedar Grove Weir | New Dams | | | 59,000 | 356.8 | | 6,046 |
| Amamoor Creek/Amamoor Dam | New Dam | 145.00 | 218,685 | 26,654 | 162.2 | | 6,085 |

| Option | Comment | FSL (m) | Storage Capacity (ML) | Yield (ML/a) | Estimated Capital Cost \$ Million | Unit Capital Cost (\$/ML/a) |
|---|--|--------------------|--------------------------------------|-------------------------|--|--|
| Flood Harvesting into a raised Hinze Dam. Cost of raising dam not included. | From Coomera Creek (Threshold 20 ML/d) + Mudgeeraba Creek (Threshold 5 ML/d) | | | 12,500 | 77.7 | 6,215 |
| Yabba Creek/Borumba Stage 3 with Coles Crossing Weir | Dam Raising | 170.50 | 475,581 | 39,236 | 266.7 | 6,797 |
| Maroochy River/Raising Wappa Dam | Dam Raising | 77.50 | 81,230 | 30,004 | 238.0 | 7,932 |
| Albert River/Glendower Dam acting in conjunction with a barrage on the Albert River | New Dam | 79.17 | 111,800 | 30,000 | 261.5 | 8,717 |
| Logan River/Cedar Grove Dam | New Dam | 40.00 | 295,136 | 78,346 | 768.9 | 9,814 |
| Coomera River/Coomera Dam | New Dam | 64.00 | 110,678 | 42,688 | 503.9 | 11,804 |
| Nerang River/Hinze Dam Raising | Dam Raising | 95.3 | 323,000 | 8,150 | 127.5 | 15,638 ³ |
| Caboolture River/Zillman's Crossing | New Dam | 70.00 | 56,630 | 9,554 | 189.5 | 19,837 |

³ Although Hinze 2++ has a lesser unit cost, the yield from this option is not considered regionally significant. Therefore, the least unit capital cost for a significant increase in yield is shown above.

Construction of the following options are anticipated to be feasible but based on the findings of this study appear to result in relatively high unit capital costs for the supply of water:

- ▶ Cedar Grove Dam,
- ▶ Coomera Dam,
- ▶ Glendower Dam,
- ▶ Zillman's Crossing dam

The yields available from the development of Amamoor, Kidaman, Traveston and Cambronn Dams and the raising of Borumba Dam are, to varying extents, interacting and therefore it is not accurate to derive the total yield for a combination of developments by summing the yield of the individual developments. Similar interaction would occur with the development of multiple new storages in the Logan catchment.

At the time of drafting this report, environmental flow requirements had not yet been given consideration in the determination of yields. Consideration of environmental flows will reduce the potential yield and will modify the unit cost and may affect unit cost ranking of the options.

This review was a desktop review of existing reports and data, and publicly available information. In the process of the study, it became apparent that the environmental, social and heritage information was often out of date and may not have been sufficient to enable definitive comparison. The geotechnical and survey information varied between options with some options having sufficient information to make reasonable estimates of cost while other options had only general geological and geotechnical information and survey was limited to the publicly available 1: 25,000 scale topographic maps. This has meant that the comparative cost of the options should be considered to be approximate only.

Within the constraints of a desk top study every effort has been made to identify the issues associated with each option, however, there is some likelihood that issues, which are imperative to the viability of the damsites have not been identified.

Abbreviations

| | |
|---------------------|---|
| AEP | Annual Exceedance Probability |
| AMTD | Adopted Middle Thread Distance (kilometres) |
| AUD | Australian Dollars |
| BSI | Bulk Supply and Infrastructure |
| CFRD | Concrete faced rockfill dam |
| ck | creek |
| ERFD | Earth and rockfill dam |
| EL | Elevation (metres) |
| FSL | Full Supply Level (metres) |
| IL | Invert Level |
| ha | hectares |
| HNFY | Historic No failure Yield |
| kL | kilolitres |
| km | kilometres |
| km ² | square kilometres |
| m | metres |
| mg/L | milligrams per litre |
| ML | megalitre |
| ML/a | megalitres per annum |
| ML/d | megalitres per day |
| mm | millimetres |
| m ³ /day | cubic metres per day |
| m ³ /s | cubic metres per second |
| MPFR | Monthly probability of failure rate |
| NRM&W | Queensland Government, Natural Resources, Mines and Water |

| | |
|------|--------------------------------|
| R | River |
| RCCD | Roller compacted concrete dam |
| RWSS | Regional Water Supply Strategy |
| °C | degrees Celsius |
| \$M | million dollars |
| % | percent |

1. Introduction

1.1 Background

Due to unprecedented population growth in South East Queensland, the South East Queensland 2021 Project (SEQ 2021) required the formulation of regional strategies for meeting the future water supply needs of South East Queensland and led to the formation of the South East Queensland Water and Wastewater Management and Infrastructure Study in 1999. At the time, this study identified the need for further work in order to finalise a regional plan.

In 2000, following initiatives of the SEQ 2021 project, a workshop involving major stakeholders was undertaken and a working group formed, which included representatives from local government, conservation interests and State agencies. This group was responsible for developing a project proposal. Subsequently, a Steering Committee including State and local government representatives was established to develop a Regional Water Supply Strategy (RWSS) for South East Queensland.

The Steering Committee prepared Terms of Reference for developing the RWSS and commissioned the preparation of a Preliminary Project Plan.

The overall purpose of the SEQ Regional Water Supply Strategy is to provide strategic advice to SEQROC and the State Government regarding options for regional urban, industrial and rural water supply, distribution and implementation to meet sustainable future needs. As outlined in the Consultancy Brief, the Strategy outlook is to 2050.

The key objectives of the complete project (Stages 1, 2 and 3) include:

- ▶ Assess future needs for a safe and reliable supply of water in SEQ;
- ▶ Review the processes and mechanisms available for meeting those needs; and,
- ▶ Develop strategies for achieving optimum outcomes in social, environmental and economic terms.

In 2003, Stage 1 was initiated by the Regional Co-ordination Committee (RCC) and South East Queensland Regional Organisation of Councils (SEQROC). The main objectives of Stage 1 was to ensure that all local governments in the study area would be able to meet their water supply needs to 2020 and to identify regional infrastructure that would be required in the short to medium term. Stage 1 also included the preparation of a project plan for subsequent stages. The *Stage 1 Report* was completed in 2004.

Following the completion of the Stage 1 Report, one of the recommendations for Stage 2 was the formation of several task groups. These included:

- ▶ Implementation, Information Systems, Communication and Coordination Task Group;
- ▶ Water Recycling and Integrated Urban Water Management Task Group;
- ▶ Water Availability and Entitlements Task Group;
- ▶ Water Needs and Accounting Task Group;
- ▶ Rural Water Supply Task Group;
- ▶ **Bulk Supply Infrastructure Task Group**; and the,
- ▶ Water Balance Solutions Task Group.

The key actions required to deliver the tasks assigned to the BSI Task Group include:

- ▶ BSI 01– Bulk Supply Pipeline Network Model;
- ▶ BSI 02– Review of Southern Area Augmentation Planning;
- ▶ BSI 03 – Review of Other Augmentation Planning;
- ▶ **BSI 04 – Desktop Review of Identified Dam and Weir Sites;**
- ▶ BSI 05 – Preliminary Studies of Dams and Weirs;
- ▶ BSI 06 – Infrastructure Assessment for Alternative Bulk Water Supplies;
- ▶ BSI 07 – Infrastructure Assessment for Groundwater Supplies; and,
- ▶ BSI 08 – Optimisation of Infrastructure.

This report has been prepared to present the outcomes of a desktop review that addressed the requirements of BSI02, BSI03 and BSI04 for the Bulk Supply Infrastructure Task Group.

1.2 Overall Purpose and Objectives

The desktop review has been undertaken in 4 parts as follows:

- ▶ Part 1 (BSI 02) – Review of Table 16 incorporated in the Stage 1 report;
- ▶ Part 2 (BSI 03) – Review of Other Augmentation Planning, which is aimed at identifying bulk water supply studies undertaken by or being undertaken by the councils and water authorities in the study area;
- ▶ Part 3 (BSI 04) – Desktop Review of Identified Dam and Weir Sites, which is aimed at reviewing the options previously investigated for bulk water supply in the study area. Each of the previous studies was evaluated to identify any major gaps in information on aspects such as, for example, environmental impacts, cultural heritage issues or foundation conditions, and to formulate a program of field

investigations formulated to investigate these potential “show stoppers” for each proposed structure required.

- ▶ Part 4 (BSI 04) – Preparation of Terms of Reference (TORs) for Further Studies under BSI05. Where major gaps were identified, Terms of Reference to undertake the work to obtain the necessary information were to be prepared as a requirement of the brief. Recommendations regarding the nature of the work required have been made in each of Sections 3.1 to 3.15 of this report, though NRM&W directed that actual TOR’s would not be required under this contract.

1.3 Purpose of Report

This report has been formulated in order to provide suitable high-level comparisons between various projects. As indicated in the TOR it was not intended that a detailed feasibility study would be undertaken.

The intended result of the report was to:

- ▶ Indicate the costs associated with the development of selected sites to a range of capacities, including an indicative assessment of land acquisition costs and modifications to infrastructure; and,
- ▶ Recommend further studies necessary to assess “show stoppers”;
- ▶ Make recommendations regarding those projects that did not warrant further consideration.

1.4 Limitations of Report

Substantial additional information is required in order to undertake definitive assessments and cost estimates of the options for the potential bulk water dam / weir projects in South East Queensland. Such information includes:

- ▶ Survey to confirm topographical information so that dam storage curves and dam wall / spillway configurations may be developed;
- ▶ Flood hydrology studies including estimates of Annual Exceedence Probabilities and Probable Maximum Precipitation (PMP) and Probable Maximum Flood (PMF) estimates;
- ▶ Flood routing for a range of spillway crest levels and widths to optimise the spillway and dam design;
- ▶ Dam break analyses to identify potential risks / losses;
- ▶ Flood mitigation effects;
- ▶ Diversion risk assessments and designs of appropriate solutions;
- ▶ Geotechnical and geological investigations and assessments to define the engineering properties of the dam foundations, diversion structures and spillway;
- ▶ Geological and geotechnical investigations to ascertain the location and properties of construction materials;

- ▶ Update yield, land development limitations, topographical constraints, and other constraints to determine optimised full supply level.
- ▶ Pre-feasibility design of dam type, size and configuration, spillway configurations, diversion works and outlet works;
- ▶ Undertake preliminary land acquisition valuations using land values developed from field evidence;
- ▶ Complete an assessment of the affected infrastructure in conjunction with infrastructure owners and undertake cost estimates for relocations or reinstatement of affected infrastructure;
- ▶ Undertake field based environmental studies including assessments of vegetation, wildlife, and riverine ecosystems and review relevant conservation databases;
- ▶ Undertake field based social environment studies including number of properties/persons affected, population profiles, economic profiles, and industry profiles, including recreation, heritage, strategic land use planning, agriculture, forestry and other relevant land uses;
- ▶ Complete cost estimates appropriate to the stage of the study including operation, maintenance, distribution and treatment costs;
- ▶ Economic and financial analyses including cost of financing; and,
- ▶ Assess financing, construction and operation and maintenance options.

This review was in the main a desktop review of existing reports and data, and publicly available information. In the process of the study, it became apparent that the environmental, social and heritage information was often out of date and may not have been sufficient to enable definitive comparison. The geotechnical and survey information varied between options with some options having sufficient information to make reasonable estimates of cost while other options had only general geological and geotechnical information and survey was limited to the publicly available 1: 25,000 scale topographic maps. This has meant that the comparative cost of the options should be considered to be approximate only.

Within the constraints of a desk top study every effort has been made to identify the issues associated with each option, however, there is some likelihood that issues that are imperative to the viability of the damsites have not been identified.

1.4.1 Geographical Information Mapping

Due to the date of publication of the information available, the information presented to estimate the potential impacts of the damsites may or may not reflect the current conditions.

The inundation boundaries shown in the figures are based on preliminary assessments of water levels and buffer zones and approximate survey information and therefore are indicative only.

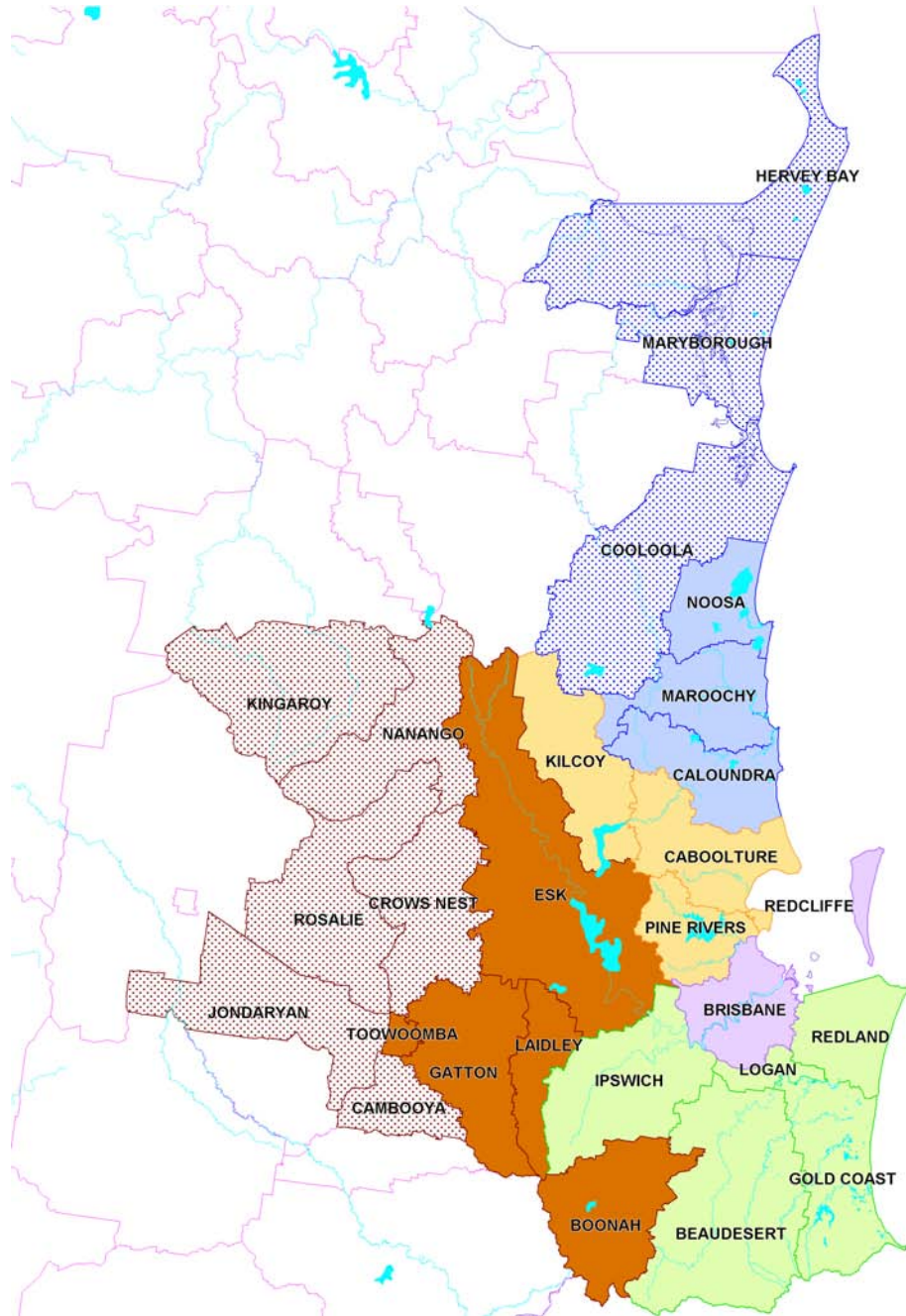
1.4.2 Concept Design Drawings

The drawings are intended to be indicative only and are based on information available at the time of writing. The concept designs are based on relatively limited geotechnical information and will require review and reconsideration when additional information becomes available.

1.5 Geographic Extent

Dam and weir sites relevant to the project study area as depicted in Figure 1 of the RWSS Stage 1 Report were considered.

Figure 1 Study Area



LEGEND

Local Government Area Regions - SEQROC

- Northern
- Southern
- Sunshine Coast
- Western

Local Government Area Regions - Non-SEQROC

- Sunshine Coast
- Western

2. Scope and Methodology

This report includes:

- ▶ A review of existing information on previous investigations;
- ▶ A summary of the bulk water supply options identified through the review of existing reports. The basic features of each of these was summarised in the Initial Scoping Report. The Initial Scoping Report is shown in its entirety in Appendix A. This report identified 82 surface water supply projects that had been considered in the past. The Initial Scoping Report also included an assessment of the surface water supply projects, which are unlikely to result in significant improvement in the bulk water supply at reasonable cost or contained environmental or social issues that were not sustainable. This comparative assessment of options included environmental and social issues, yield, and where applicable, comparative costs;
- ▶ Updating of the yield and cost estimates from the original reports so that the cost of projects could be compared for the bulk water supply options that are considered to result in the least environmental constraints and have the potential to result in significant improvements in the bulk water supply in the South East Queensland project area; and,
- ▶ Identification of significant shortfalls in information that have the potential to modify the cost or risk associated with the options evaluated in greater detail and under separate reports.

This report was compiled to summarise the findings of the desktop review of dam and weir sites.

2.1 Scope of Report

The report contains the findings of the desktop review. The basis for the review can be generally split into the following categories:

- ▶ Cost estimates;
- ▶ Yield;
- ▶ Cost / Yield Comparisons;
- ▶ Geological / geotechnical aspects;
- ▶ Environmental, including biodiversity;
- ▶ Social, Archaeological, Cultural and Heritage;
- ▶ Native Title;
- ▶ In-stream water quality;
- ▶ Downstream water quality;
- ▶ State and local infrastructure; and,
- ▶ Other potential impacts, such as contaminated land, dam safety, defence land etc.

2.2 Basis for Cost Estimates

2.2.1 Approach

Generally, the cost estimates were undertaken at July 2005 cost levels.

Initially, cost estimates were updated from the date of preparation of the original cost estimates by considering the construction cost index as reported by Rawlinsons Building Index and Rider Hunt Tender Level Construction Index. This method was utilised to update cost estimates undertaken in previous reports so that comparative cost estimates could be obtained for all the projects previously identified in the South East Queensland project area and incorporated into the Initial Scoping Report (Appendix A). Based on these evaluations fourteen surface water storage projects and flood harvesting into Hinze Dam were assessed as being worthy of additional consideration under this desktop review. These were further assessed by undertaking more detailed cost estimates with the estimates updated using a combination of the following:

1. Cost estimates updated from previous internal NRM&W or Water Resources, DPI⁴ cost estimates utilising the quantities estimated in these reports and substituting unit rates based on tenders, labour and plant hire rates for similar work received in early 2005 or escalated unit rates as outlined above;
2. New quantity estimates based on indicative designs undertaken for this study to derive cost estimates for projects with little or no previous information or for new projects. In addition, quantity estimates have been prepared for new dams downstream of the existing dam where:
 - a. full supply levels greater than previously considered may make raising of the existing dam non feasible;
 - b. existing dams are evaluated for dam raising levels higher than previously considered where raising of the existing dam to the level proposed may be non feasible.
3. Incorporation of the following costs into the estimates:
 - a. 10% of the estimated construction cost for Establishment, Temporary Works and Site Facilities;
 - b. 1.7% of the estimated construction cost for Insurance Costs;
 - c. 0.2% of the estimated construction cost for the Contractors liaison and approvals;
 - d. 1% of the estimated construction cost for the Contractors preparation and implementation of Quality Assurance, Work Place Health and Safety and other management plans;
 - e. 3% of the estimated construction cost for a fish lift for each option, the Contractors provision and implementation of relevant standards,

⁴ DPI = Queensland Government Department of Primary Industries

monitoring and implementation of environmental and safety management;

- f. 0.5% of the estimated construction cost for the Contractors preparation of drawings, survey and operations and maintenance manuals;
- g. 15% of the estimated items of work to allow for un-estimated items;
- h. A general contingency provision equal to 30% of the estimated construction cost to allow for unforeseen costs. This contingency provision has been adopted because of the uncertainty associated with data such as survey, flood hydrology and geotechnical information. In some cases, however, the information is not sufficient for this level of accuracy and in these cases additional work is required as per the Terms of Reference for this study, which anticipated the need to prepare Terms of Reference for additional investigations to assess potential “show stoppers”;
- i. Investigation, design and construction supervision costs equal to 15% of the estimated construction cost; and,
- j. Owner Costs equal to 10% of the estimated construction costs to allow for indirect costs associated with overall administration, maintenance of standards and management of the project.

No allowance has been provided for the costs of financing during construction.

Other cost estimate exclusions are documented in Sections 3.1 to 3.15 inclusive.

- 4. Cost estimates undertaken by others at 2005 cost levels have been reviewed and modified to allow for items not incorporated in the original estimate such as land acquisition costs, road deviation, council infrastructure, environmental controls and establishment costs etc.

2.2.2 Cost Estimates Updated from 1991 Water Resources Report

Cost estimates previously undertaken during the compilation of the 1991 “Water Supply Sources in South East Queensland” report (Reference 6) included the following projects:

- ▶ Cedar grove damsite;
- ▶ Coomera damsite;
- ▶ Glendower damsite;
- ▶ Tilley’s Bridge damsite;
- ▶ Wyaralong damsite; and,
- ▶ Zillman’s Crossing damsite;

As well as the information provided in the above reports, cost estimates were prepared for:

- ▶ RCC dam options at each site. These alternative estimates were undertaken to provide comparative costs for alternative dam types to indicate that other options for design exist at each site and that the study has not been undertaken in sufficient detail to define a final arrangement for any of the options; and,
- ▶ Additional higher full supply levels for Glendower damsite and Zillman's Crossing.

2.2.3 Cost Estimates Updated from Previous Internal Water Resources (DPI) Estimates

Cost estimates previously undertaken by Water Resources (DPI) for planning purposes (References 10 to 16 inclusive) were not formally reported and as such, have remained in NRM&W work files since approximately 1993 for the following projects:

- ▶ Amamoor damsite;
- ▶ Borumba Dam raise;
- ▶ Cambroon damsite
- ▶ Kidaman damsite; and,
- ▶ Wappa Dam raise.

Generally, the engineering designs and quantities included in those files were used to update costs for each site. In addition, pre-feasibility designs and quantity estimates were completed for:

- ▶ RCC dam options at each site. As indicated, these estimates were undertaken to provide comparative costs for alternative dam types to indicate that other options for design exist at each site and that the study has not been undertaken in sufficient detail to define a final arrangement for any of the options.
- ▶ Additional higher full supply levels for:
 - Borumba Dam Raising (downstream alignment for raising options greater than 25m above the current dam crest level);
 - Cambroon Dam for full supply levels about 8m higher than previously considered;
 - Kidaman Dam 10m higher full supply level than previously considered; and,
 - Wappa Damsite an alignment 900m downstream of the existing alignment was considered for most potential raising levels due to the poor topography at the existing site for full supply levels higher than the existing dam and because there is significant concern about stability of the abutments of the dam for any significant raisings.

2.2.4 New Cost Estimates for Water Harvesting or Projects with Little or No Previous Information

The following projects had no previous cost estimates available and therefore some pre-feasibility engineering designs and quantities were completed for the present study:

- ▶ Water harvesting to Hinze Dam; and,
- ▶ Traveston damsite. A roller compacted concrete dam founded on rock (assumed to require 20m depth of excavation across the flood plain) was priced for this site; however, geotechnical investigations may show that the alluvial soils are adequate for a zoned earthfill dam at this site. If this is the case the cost of construction of a dam at this site may be able to be reduced significantly.

2.2.5 Cost Estimates by Others / Not Available

Cost estimates undertaken by others and used in this report or which were unavailable at this time were:

- | | |
|----------------------|--|
| Hinze Dam Raising | ▶ SKM May 2005 - Gold Coast City Council – Gold Coast Water |
| Wivenhoe Dam Raising | ▶ South East Queensland Water Corporation (not completed at the time of writing) |

2.2.6 Mapping and Pre-feasibility Design Figures

In preparation of this report, geographical mapping and drawings were undertaken to provide indicative inundation mapping and to indicate engineering pre-feasibility designs.

Geographical Information Mapping

The mapping contained within this report were sourced and compiled as follows:

- ▶ Locality Plan:
 - Information obtained from NRM&W using cadastral data and satellite imagery;
- ▶ Dam Wall Location:
 - Information obtained from NRM&W using contour data;
- ▶ Satellite and Cadastral Plan:
 - Information obtained from NRM&W using cadastral data and satellite imagery;
- ▶ General Site Geology:
 - Information from Mapinfo;

- ▶ Land Use Plan:
 - Dataset supplied by NRM&W;
- ▶ Environment and Vegetation Plan:
 - Regional ecosystem dataset supplied by the Environmental Protection Agency;
- ▶ Agricultural Land Capacity:
 - Dataset supplied by NRM&W.

This information has been used to estimate the potential impacts of the damsite and may not reflect the actual conditions current in 2006.

Any analyses of potential impacts contained within this report are intended to provide comparative information and should not be relied upon as complete, accurate or final. It should be further noted that the inundation boundaries shown in the figures are indicative only.

Concept Design Drawings

Concept designs were either based on previous design assumptions by NRM&W or on assumptions used for new cost estimates contained herein, using contour information supplied by NRM&W.

The drawings are intended to be indicative only and are based on the preliminary information available at the time of writing. The concept design should be reviewed when additional information becomes available.

2.2.7 Costs of Land Resumptions and Infrastructure

Generally the costs for land acquisition and infrastructure were estimated on the basis of typical rates. This approach was adopted primarily due to the fact that the actual impact of each dam site or project on land resumptions and infrastructure could not be properly defined without undertaking site based valuations.

A discussion of the issues and / or methodology affecting the calculation of estimated costs for these items is provided throughout the text of Section 3 for land resumptions and infrastructure.

Concurrently, Queensland State Valuation Service, through NRM&W completed indicative land resumption assessments for the following sites and scenarios:

| Damsite | Location | Full Supply Level |
|-----------------|-----------------------------|--------------------------|
| Cedar Grove | Logan River (AMTD 81.8 km) | 37 |
| Cedar Grove | Logan River (AMTD 81.8 km) | 42 |
| Wyralong | Teviot Brook (AMTD 14.8 km) | 63.6 |
| Tilley's Bridge | Logan River (AMTD 153.4 km) | 105 |
| Tilley's Bridge | Logan River (AMTD 153.4 km) | 120 |
| Cambroon | Mary River (AMTD 274.2 km) | 128 |
| Cambroon | Mary River (AMTD 274.2 km) | 158 |
| Traveston | Mary River (AMTD 206.7 km) | 74 |

2.3 Yield

Updated yield calculations were completed by NRM&W for this study. The yield estimates do not include environmental flow release requirements and as such should be taken as a guide only. The reported yields are 'historical no failure yield'.

The Flood Harvesting estimates into Hinze dam make provision for "threshold" flows, which are preliminary estimates only and therefore may not represent the actual yield available from the schemes.

The yield figures reported by NRM&W are generally lower than those listed in past documentation. It is hypothesised that the recent droughts and improved modelling techniques have affected critical failure periods in yield simulation.

The yield calculations include allowances for evaporation losses.

2.4 Unit Cost and Marginal Cost of Water per ML/a Yield

As each of the projects result in different yields and costs, the unit cost of water is utilised to assess the comparative cost of each of the projects. This is determined by dividing the Total Capital Cost of the project by the yield to determine the Capital Cost per megalitre per annum of yield. When this unit cost is plotted against the storage capacity, the comparative cost of similar sized projects can indicate the least cost per ML/a yield.

The marginal cost of providing water has been calculated for each of the projects. This was determined by calculating the incremental cost for providing the additional yield. Where this marginal cost is high it may be beneficial to source the water from an alternative source rather than raising the dam or constructing it to the level where the marginal cost is high.

2.5 Geology and Geotechnical

The information outlined in this report regarding geological and geotechnical aspects of each of the proposed damsites, was obtained by a review of existing reports, or other data and from geological mapping, which was completed using datasets from Mapinfo.

No site inspection, geological or geotechnical or geophysical investigations were undertaken at any of the sites for this study.

Geological and geotechnical features have the capacity to impact on both the viability of a dam structure and the cost of the project. Although an attempt has been made in the costing of each option to anticipate such issues, the geophysical features of each site are largely unknown.

Additionally, the sourcing of construction materials of a large dam can have significant implications on cost and the environment. This information was absent on all project sites and was therefore not able to be assessed at this time.

2.6 Environmental

The review of environmental issues for the purposes of this report were conducted using previous information from reports or other data, and from current GIS mapping information provided by the Environmental Protection Agency (EPA). No field investigations were undertaken for this study.

Generally, an attempt has been made to highlight any major environmental features affecting each option.

All of the project options have the potential to impact on flora and fauna in the reservoir area and at the dam site, however, no site-specific studies have been undertaken to quantify the potential impact. In addition most of the project options result in changes to the flow patterns in the river and will impact on the invertebrates and fish in the river. The magnitude of these effects differs for each of the potential options. The options identified as having the greatest potential to provide bulk water supply generally appear to have been significantly modified from the original condition by various agricultural developments with small areas of disturbed habitat remaining.

In South East Queensland there are numerous plans and guidelines in place intended to preserve the biodiversity of the region. These plans, for example, Queensland Parks and Wildlife Service –Recovery Plan for Stream Frogs, typically include habitat conservation measures, which seek to restrict development of those habitats.

The Federal Government also provides for biodiversity protection through the Environment Protection and Biodiversity Conservation Act 1999 (EPBC). This Act is also triggered when RAMSAR listed wetlands are affected by development. Two relevant wetlands are listed on RAMSAR, Moreton Bay and Great Sandy Strait. These two listings affect almost all of the damsite projects examined in this report and, the implications of this warrant further investigation, particularly in light of recent court actions in respect of the proposed Nathan Dam on the Dawson River.

Although some attempt at identifying these areas has been made through the Environment and Vegetation Plan mapping and a review of information as outlined previously, biodiversity values have not been specifically identified for each project site. This should be subject to further investigation.

2.7 Social, Archaeological and Cultural Heritage

No social, archaeological, cultural or heritage related investigations have been undertaken for this study, however the following database searches were carried out:

- ▶ Department of Environment and Heritage: “Australian Heritage Places Inventory”;
- ▶ Australian Heritage Council: “Register of National Estate”; and,
- ▶ Environmental Protection Agency (Queensland), “Queensland Heritage Register”.

In addition, where issues relating to these aspects have been identified in previous reports, they have also been noted in this report.

The majority of the project options able to provide bulk water supply to the South East Queensland Region have been developed into rural holdings and some have rural residential and residential subdivisions within the reservoir area. All of the potential project options will have site-specific issues to be resolved. For comparison purposes the social issues have been quantified by undertaking estimates of the number of residents affected by each projects (where data available) and the area of land impacted has been identified, together with comment on existing industry, or zoning and strategic planning. As this is a desktop study not all of the potential issues have been identified.

No attempt has been made to develop social profiles of the population affected by the developments. It is anticipated that these studies would be undertaken in feasibility level investigations.

Where text has referred to Land Use Mapping or figures, which display land use data completed by GIS⁵, this information is based on mapping that was current in 1999 and thus may not be relevant or accurate in 2006. This mapping is for indicative purposes only.

2.7.1 Archaeological Aspects

Aboriginal cultural heritage sites tend to be buried and are generally concentrated at creek or river sites, especially alluvial river terraces. Although an attempt was made to highlight archaeological sites, there is generally insufficient information regarding the impact of these sites on the proposed dam projects. These may not be identified until the local Aboriginal groups are consulted.

⁵ Geographical Information Systems

2.8 Native Title

Native Title issues could not be quantified with the information currently available on each of the proposed projects. Therefore, while Native Title claims are probable over the majority of the sites, the impact of claims on each project and whether potential claims have been extinguished will require case-by-case consideration.

2.9 In-stream Water Quality

With the construction of any large water storage, in-storage and downstream water quality issues may be experienced. These may include:

- ▶ Elevated water turbidity;
- ▶ Increased aquatic plant growth;
- ▶ Blue-green algae outbreaks;
- ▶ Effect on potability of water supply; and/or,
- ▶ Effect on well being of aquatic flora and fauna (Reference 23).

In addition, water quality issues relating to the upstream catchment of any water storage may include:

- ▶ Seepage or inundation of areas containing contaminated sites (for example timber treatment sites, dairies, agricultural chemical sites);
- ▶ Seepage or inundation of areas containing high nutrient sites (for example, human waste storages or dairy waste storages) (Reference 23).

These values are beyond the scope of this report and have therefore not been discussed in detail for each of the proposed infrastructure projects.

2.10 Downstream Water Quality

It has long been recognised that the construction of dams and weirs can contribute to an altered state of downstream water quality. This can occur through changes to the flow regime, such as adjusting low flows and flood flows, or changes to water quality. Stream health indicators such as fish populations, estuarine and marine ecosystems, and chemical and physical indicators can be used to determine stream health, however, the impacts of the proposed water storages on downstream water quality cannot be quantified at this time.

2.11 State Infrastructure and Council Infrastructure

Most of the project options impact on:

- ▶ Main roads, local and minor roads;
- ▶ Electrical power distribution;
- ▶ Telecommunications;
- ▶ Gas, water or wastewater pipelines;

- ▶ Railways; and,
- ▶ Shire infrastructure.

Indicative estimates of cost for relocating these facilities have been undertaken for each of the potential infrastructure projects. However, it may be possible that infrastructure exists that was not revealed in the desktop review.

Other infrastructure impacts may include social infrastructure such as hospitals, fire fighting facilities, prisons, cemeteries, and waste facilities. The impact on these facilities is likely to be relatively limited.

2.12 Other Potential Impacts

2.12.1 South East Queensland Regional Plan and Infrastructure Plan

In 2005, the Queensland Government released the South East Queensland Regional Plan and the South East Queensland Infrastructure Plan and Program. These plans were intended to provide sustainable growth management strategy to the year 2026.

The application of these plans to this report lies in both a review of the Regional Land Use categories, and the Infrastructure Plan to identify any project conflicts or impacts on or by the proposed dam projects.

The regional land use categories were:

- ▶ Regional Landscape and Rural Production Area;
- ▶ Urban Footprint;
- ▶ Rural Living Area; and,
- ▶ Investigation Area.

The Regional Landscape and Rural Production Areas identified land that has regional landscape, rural production or other non-urban values. The intent of which is to protect these areas from encroachment by inappropriate development.

The Urban Footprint identifies land that may provide for the regions urban development needs and includes both existing urban areas and green-field areas, which may be suitable for urbanisation.

The Rural Living Area comprises locations currently designated for rural residential development in local government planning schemes.

An Investigation Area comprises a series of sites that provide a potential area for future medium to long-term urban development.

These terminologies have been used throughout Sections 3.1 to 3.15 inclusive.

2.12.2 Dam Safety Aspects

Due to the general population pressures of the South East region, some of the proposed dam projects are located in regions with urban or rural residential areas immediately downstream. This represents a dam safety risk where failure of a dam could result in loss of life.

Under the Queensland Dam Safety Management Guidelines, a Failure Impact Assessment is required to be completed for all large dams in Queensland. Such an assessment was outside the Terms of Reference for this report.

2.12.3 Contaminated Land

The Contaminated Land Register is specified on a lot-by-lot basis. Due to the fact that the proposed projects covers a significant number of lots, it was not possible to consult the register regarding possible contaminated land sites within the scope of this report.

Contaminated lands can impact on the proposed projects both in terms of constructing a dam on a contaminated site, and of areas with contaminants that form part of a catchment area for a damsite.

Sources of contamination may include, but not limited to:

- ▶ Mining – for example, mining of alluvial, gold or other precious metals. These can leave traces of cyanide, arsenic and other contaminants;
- ▶ Intensive animal production – contaminants include high nutrient levels or organics;
- ▶ Intensive animal production – cattle dips, etc which can include arsenic and DDT.
- ▶ Intensive horticulture – contaminants including pesticides, herbicides, organics and high nutrient levels.

Further investigation should be undertaken regarding the possible impact of contaminated sites on the proposed projects.

2.12.4 Current / Former Landfills

The desktop review did not reveal the existence of current or former landfills associated with any of the project areas, however, historical landfills are often only identified by contaminated land searches. It is therefore considered prudent that this is subject to further investigation as per Section 2.12.3.

2.12.5 Construction Resources

The provision of construction resources for dam projects, such as quarries for borrow material or concrete construction sites, can have an impact on the environmental aspects associated with the project.

The level of detail considered in preparing this report was insufficient to be able to identify suitable construction material sources. Therefore, the impact of those sources on the environment or other issues could not be quantified.

2.12.6 Defence Land or UXO's

Although the projects considered in this report do not directly coincide with any gazetted Department of Defence land, the issue of previous defence land or unexploded ordinances could not be assessed at this level of investigation.

3. Potential Water Supply Options

A review of all the available reports completed to assess potential water supply projects in the South East Queensland project area was undertaken and the Local Governments in the project area were contacted to identify any projects that they had undertaken, which may not have been previously identified. This approach was aimed at identifying, as far as practical, all of the potential surface water bulk water supply project options in the project area.

More than 80 bulk water supply options were identified as having been assessed previously.

A summary of the information on the dam and weir projects referred to in the reviewed reports and identified through the contact with relevant Councils are indicated in the Initial Scoping Report in Appendix A with each project tabulated according to the potential yield⁶ identified in the previous reports. The projects were grouped into four supply capacity options so that the projects can be reviewed on the basis of their potential benefits. The supply categories chosen were:

- ▶ Potential bulk water supply greater than 50,000 ML/a;
- ▶ Potential bulk water supply between 20,000 and 50,000 ML/a;
- ▶ Potential bulk water supply between 5,000 and 20,000 ML/a; and,
- ▶ Potential bulk water supply less than 5,000 ML/a.

Where variations in potential storage capacity and yield were reported, these have been noted in Appendix A.

The categories were chosen to highlight options that, at the upper supply range, had the potential to supply water to the entire region and in the lower supply range would result in supply only to the local area.

The previously reported costs to supply the anticipated yield were updated using a combination of the Rawlinsons building price adjustment and the Rider Hunt tender level index. In reviewing the costs it was found that there were four types of project:

- ▶ Existing dams not currently utilised that may provide a small increase in yield for the system;
- ▶ Projects previously costed and able to be compared;
- ▶ Projects that have not been costed but may have potential; and,
- ▶ Projects that were favoured but had been excluded previously on social or environmental grounds. In general however, the reports indicated that there are environmental or social issues associated with most, if not all of the potential bulk water supply projects.

⁶ The reported yields were assessed a number of years ago. Since then procedures have changed and additional data has become available.

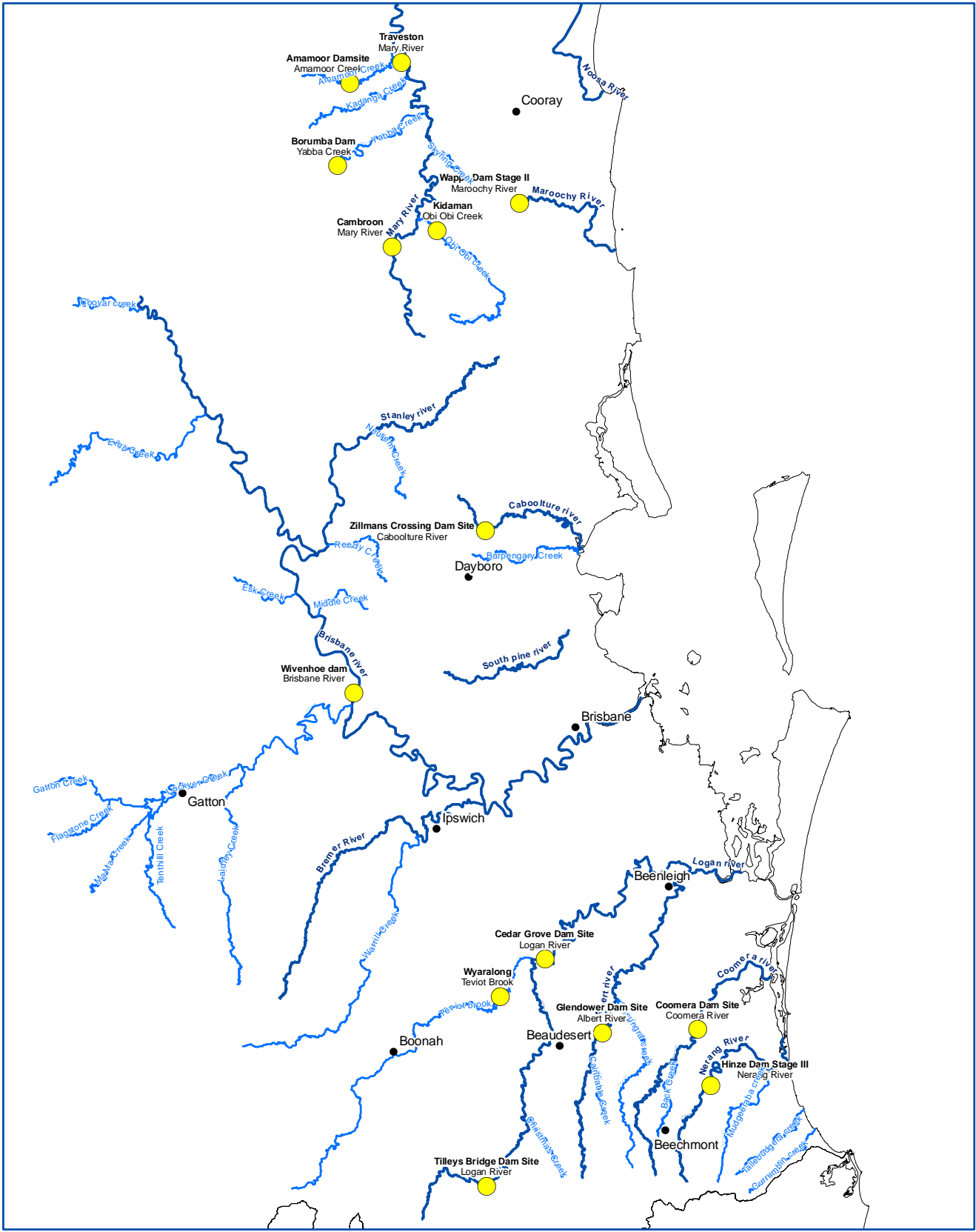
From this overall comparative review, 15 projects were identified that had the potential to supply a significant proportion of the bulk water supply needs in the study area and were previously reported to result in the least environmental, social, archaeological and heritage impact. The project options selected for further study under this desktop review are indicated in Table 3.1.

Table 3.1: Potential Water Supply Projects

| | |
|--|---------------------------------------|
| Albert River | ▶ Glendower Dam |
| Coomera River | ▶ Coomera Dam |
| Logan River | ▶ Cedar Grove Dam |
| Logan River | ▶ Tilley's Bridge near Rathdowney |
| Logan River (Teviot Brook) | ▶ Wyaralong Dam with Cedar Grove Weir |
| Nerang River | ▶ Hinze Dam Stage III Raise |
| Coomera, Canungra, Mudgeerabah and Tallebudgera River and Nerang River | ▶ Water Harvesting to Hinze Dam |
| Caboolture River | ▶ Zillman's Crossing |
| Maroochy River | ▶ Raising Wappa Dam |
| Mary River (Amamoor Creek) | ▶ Amamoor Dam |
| Mary River | ▶ Cambroon Dam |
| Mary River (Yabba Ck) | ▶ Borumba Stage 3 |
| Mary River (Obi Obi Creek) | ▶ Kidaman Dam |
| Mary River | ▶ Traveston Dam |
| Brisbane River | ▶ Raise Wivenhoe Dam |

Figure 2 shows the general location of each of these sites.

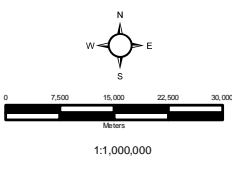
The information in the previous reports was reviewed and yield estimates were updated by NRM&W using IQQM models. The cost estimates were upgraded utilising, where possible, previous quantity estimates, current unit rates and where necessary, new designs were prepared along with new quantity estimates to provide comparative cost estimates for each of these project options. A summary of the results from each of these assessments is indicated in Sections 3.1 to 3.15.




Source: GIS data supplied by Geoscience Australia, NBSM
 Projection: MGA Zone 56
 Date Printed: 15 August 2016
 File: M:\1114849\gis\map\figure2_general_site_location.mxd
 Size: A4

Legend

- Potential Dam / Weir Site
- Towns
- River
- Creek



0 7,500 15,000 22,500 30,000
 Meters
 1:1,000,000

South East Queensland
 Regional Water Supply Strategy

General Location of Dam
 and Weir Sites Recommended
 for Further Consideration

Figure 2