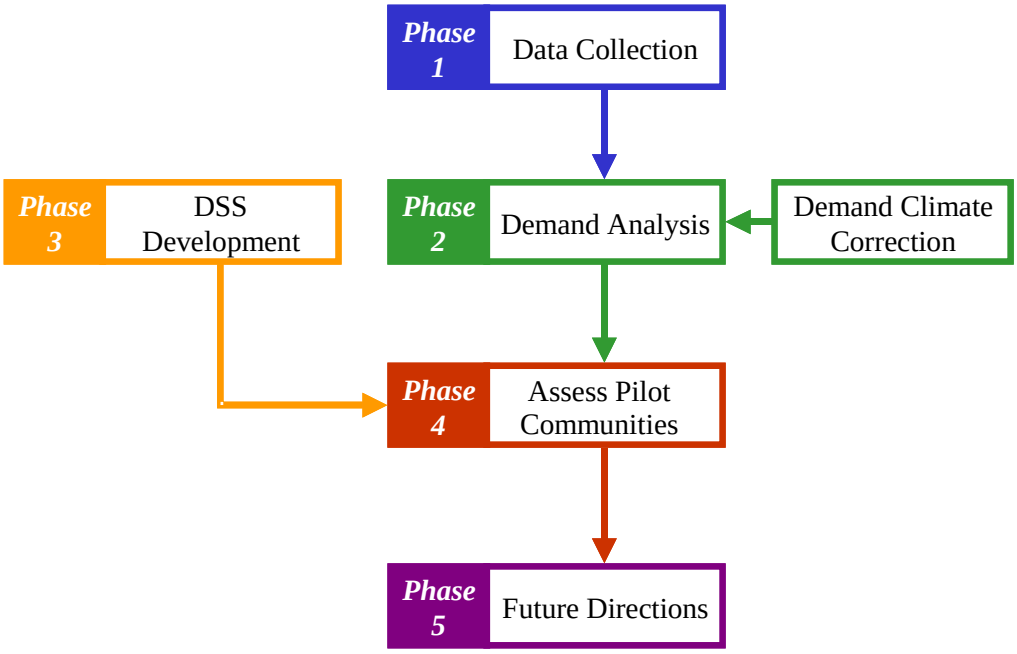
2. STUDY METHODOLOGY

2.1 Overview

The project methodology involved a number of phases aimed at rigorously evaluating demand management potential in five urban communities in Queensland. A flowchart of the methodology adopted is given in **Figure 2.1**.

Figure 2.1: Project Methodology



A brief description of each of the phases is as follows:

Phase 1 Initial Data Collection

Five urban communities were chosen as pilots to assess the least cost planning approach. Data was collected from each selected Council.

Phase 2 Demand Analysis

Detailed demand analysis is undertaken by developing a monthly demand model and determining the influence of climate and other variables on water usage. The model is then used to determine the projected demand and the residential internal/external demand.

Phase 3 DSS Development

To assist in the evaluation of alternatives for Least Cost Planning, a Decision Support System (DSS) was developed. The DSS is used for the benefit/cost analysis of water demand reduction measures and initiatives.

Phase 4 Assessment of Pilot Communities

A shortlist of measures is developed for each of the five pilot areas based on developed evaluation criteria. These measures, including specific measures outlined in the project brief, were evaluated using the DSS to determine a benefit/cost ratio. The B/C ratio is considered from the water utility's perspective as well as the overall community's perspective, as detailed in Section 3.1. The calculation of benefits includes avoided costs such as delaying capital works, reducing water and sewerage operational costs and reducing energy costs. On completion of the analysis, passive and active water efficiency plans are developed using a combination of measures and the overall reduction in water usage was determined.

Phase 5 Future Directions

Based on the evaluation of Least Cost Planning in each of the communities recommendations are made to provide direction for the implementation of conservation programs in Queensland. A program of field trials is also recommended to prove the critical assumptions made in the evaluation.

2.2 Least Cost Planning Approach

Least Cost Planning is the approach adopted to identify an appropriate balance between system operation / capacity expansion costs and the savings associated with programs aimed at increasing the efficiency of water use.

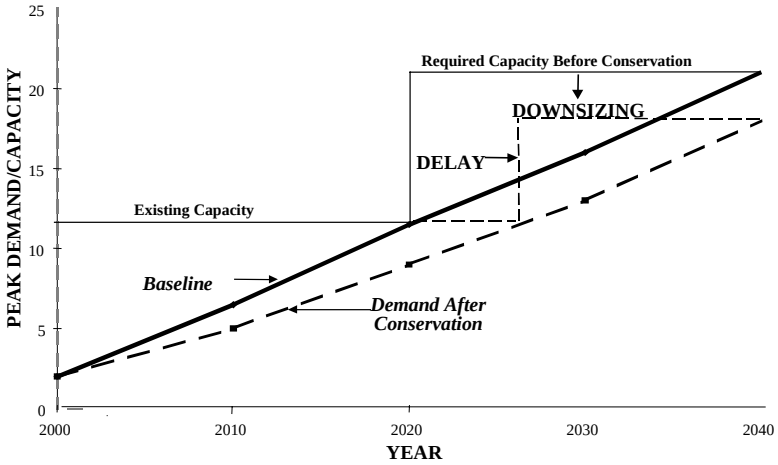
Historically, water supply planning has been based on the projection of demands at the existing rate or assuming an increase in the per capita demand. This approach, known as supply side planning, neglects the fact that a program aimed at improving the efficiency of water use will in many cases delay the timing of capacity expansion and reduce system operating costs.

Least Cost Planning takes into account both the supply side and demand side of the equation to provide a balanced solution and more cost effective provision of infrastructure. To undertake a Least Cost Planning study of a water supply system it is necessary to follow a rigorous methodology as shown in **Figure 2.2**.

Figure 2.2: Least Cost Planning Approach

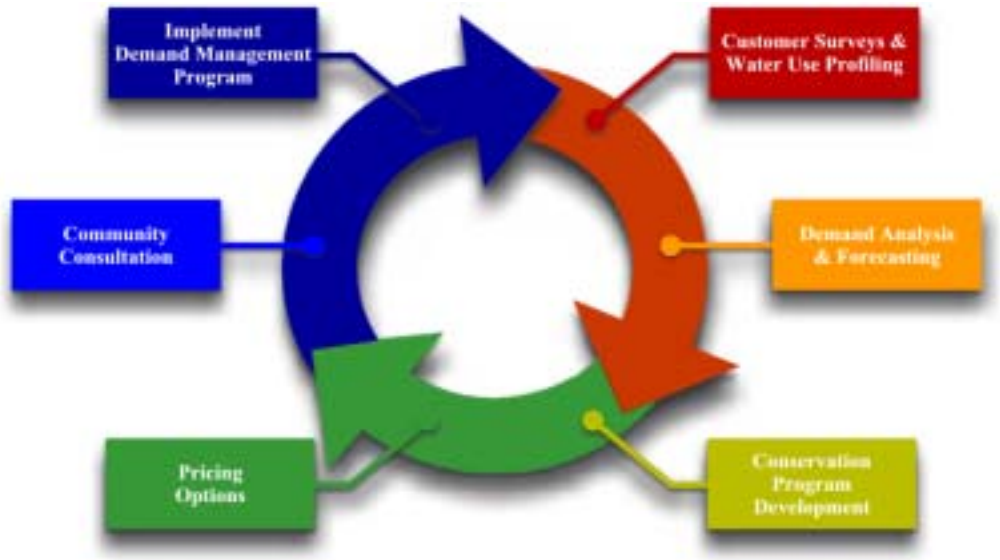
The benefits to the water supply utility of Least Cost Planning are demonstrated in **Figure 2.3**. This figure illustrates the delay and downsizing of proposed capacity expansion based on reduction in the system demand resulting from the implementation of a water efficiency program. Benefits relating to the reduction of demand include the delay and permanent downsizing of infrastructure required to service the same population. Benefits are also derived from the avoidance of costs relating to water treatment and transmission and the operating cost for sewerage collection systems. Such costs relate only to the marginal cost of power and chemical consumption, not to the overall cost of the water and sewerage operations as a whole. The total cost of water (which includes fixed costs such as staff, depreciation, interest and redemption, management) varies little with changes in demand.

Figure 2.3: Example of Capital Investment Benefits



Least Cost Planning is a cyclical process as shown in **Figure 2.4.** Planning of water supply demand management requires feedback from the success of various water efficiency measures, and continuous improvement, to be successful. In this way strategies can be fine tuned and promotional/marketing activities optimised to achieve the highest participation rates.

Figure 2.4: Least Cost Planning Cycle



2.3 Selection of Pilot Communities

2.3.1 Selection

Five pilot communities were chosen for the study. The selection of the pilots was undertaken to ensure that a range of situations were tested during the study. The criteria considered when selecting the communities were as follows:

- Geographic Location – a range of geographic and climatic locations was considered including south coastal, south west, central coast, central west and northern.
- Community Size – the study needed to determine benefits in communities with population from 5,000 to 100,000+ persons.
- Availability of Data – analysis of options requires a significant amount of demand and land use data.
- Future Capital Works Program – a range of probable growth rates was required to provide various levels of future capital works programs, i.e. a range of possible benefits.
- Cooperation and Commitment – an important consideration was to conduct the study on communities that could provide the necessary support to the project in terms of time and data collection.

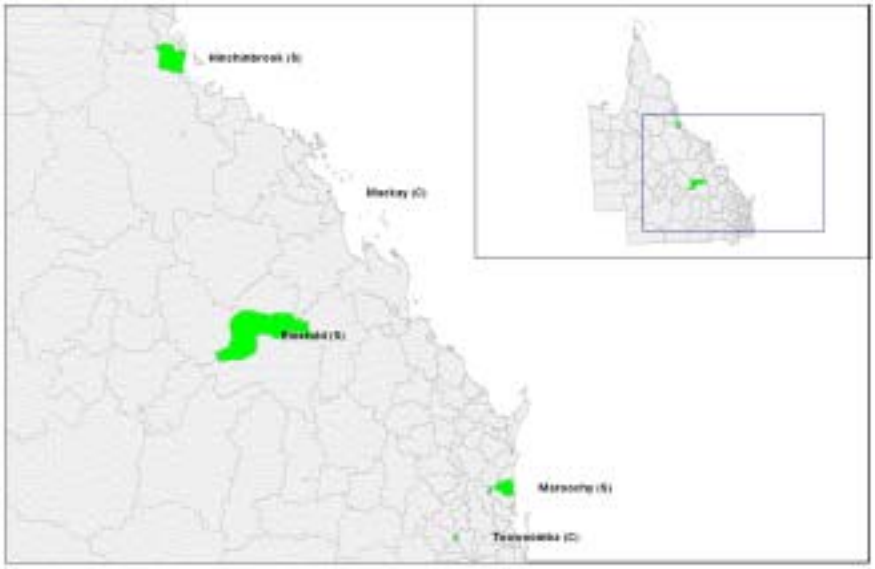
A number of communities were short listed and contacted regarding the critical criteria as listed above. Communities chosen for the study are summarised in **Table 2.1**. The locations of these communities are shown in **Figure 2.5**.

Table 2.1: Selected Pilot Communities

Pilot Area	Estimated Population (1999)	Averaged Annual Growth Rate	Location	Water Meters	Average Daily Production (ML/d)	Average Residential Account Consumption (kL/account/a) excluding unaccounted for water	Average per capita Consumption (L/person/day) [1]
Emerald (Township)	12,200	7.8%	Central West	✓	6.6	1147	300
Ingham (Township)	6,766	0.0%	North	✓	3.5	827	337
Mackay	67,479	2.2%	Central Coast	✓	31.1	827	281
Maroochy Shire	110,414	5.5%	South Coast	✓	38.4	747	266
Toowoomba	88,729	0.6%	South West	✓	28.1	574	197

[1] Based on average residential house population density (ie. Toowoomba = 2.92)

Figure 2.5: Location of Pilot Communities



2.4 Pilot Community Statistics

2.4.1 Capital Works Programs

Capital works programs were supplied by the pilot community's local authority, or derived from recent planning reports.

The assumed Capital Works Program for Emerald is listed in **Table 2.2**. As planning provided little data for system upgrading beyond 2010 an average of $750,000 for each 5 years was assumed.

Table 2.2: Capital Works Plan - Emerald

Name of Project	Total Cost (Baseline Year Prices)	Baseline Construction Date
Additional Res Storage at E. Nogoa	$500,000	2001
2000-2005 Mains Augmentation	$750,000	2003
Selma Weir PS (46l/s)	$200,000	2009
Water Treatment Plant at E. Nogoa	$2,200,000	2009
2006-2010 Mains Augmentation	$750,000	2011
2011-2015 Mains Augmentation	$750,000	2017
2016-2020 Mains Augmentation	$750,000	2022
2021-2025 Mains Augmentation	$750,000	2028
2026-2030 Mains Augmentation	$750,000	2034

Hinchinbrook Shire advised that capital works are not scheduled for the next 30 years as the growth rate is low and sufficient capacity is available.
Mackay supplied a Capital Works Program for the next ten years based on recent planning. Because of growth in the area, it has been assumed that there will be a

substantial Capital Works Program over the next thirty years. An average of $400,000 per year has been assumed for general system capacity augmentation. The assumed program is given in **Table 2.3**.

Table 2.3: Capital Works Plan - Mackay

Name of Project	Total Cost (Baseline Year Prices)	Baseline Construction Date
Nindaroo Reservoir	$1,500,000	2003
Shoal Point Reservoir	$800,000	2003
Shoal Point PS	$170,000	2009
Blacks Beach PS	$220,000	2002
2001-2005 Mains Augmentation	$2,000,000	2003
2006-2010 Mains Augmentation	$2,000,000	2008
2011-2015 Mains Augmentation	$2,000,000	2013
2016-2020 Mains Augmentation	$2,000,000	2018
2021-2025 Mains Augmentation	$2,000,000	2023
2026-2030 Mains Augmentation	$2,000,000	2028

Maroochy Shire is projected to experience significant growth over the next thirty years. A Capital Works Program was supplied for the next 10 years. For the purposes of the analysis, some capital works were amalgamated as annual programs, and were included along with specific large scale works (such as a new water source), as indicated in **Table 2.4**.

Table 2.4: Capital Works Plan - Maroochy

Name of Project	Total Cost (Baseline Year Prices)	Baseline Construction Date
Coast Main Augmentation	$630,000	2010
Sippy Downs 500mm water main	$600,000	2010
Woombye Montville Rd 200 & 250mm wmain	$200,000	2003
Tanawha Reservoir	$650,000	2010
Kiel Mountain Reservoir	$830,000	2004
Image Flat Reservoir	$1,800,000	2005
Upgrade Kunda Park HL & LLZ PS	$250,000	2003
Jones Rd PS	$150,000	2003
Mountain Creek Rd Temporary Booster	$200,000	2001
Landers Shute TP Upgrade	$7,500,000	2018
New Water Supply	$45,000,000	2018
2006/2007 Mains Augmentation	$4,000,000	2007
2008/2009 Mains Augmentation	$13,000,000	2009
2009/2010 Mains Augmentation	$1,300,000	2010
2011/2012 Mains Augmentation	$1,700,000	2012
2013/2018 Mains Augmentation	$5,000,000	2018
2019/2024 Mains Augmentation	$5,000,000	2023
2024/2030 Mains Augmentation	$5,000,000	2027

A capital works program was provided by Toowoomba City Council for the next ten years. It was assumed that further capacity related expansion would not be required due to the low expected growth rate. A summary of costs is given in **Table 2.5**.

Table 2.5: Capital Works Plan - Toowoomba

Name of Project	Total Cost (Baseline Year Prices)	Baseline Construction Date
Mt Kynoch Treatment Plant Augmentation (100 ML/d)	$5,600,000	2007
Boothby PS	$500,000	2010
Cranley Res	$800,000	2010

2.4.2 Operations and Maintenance Costs

To undertake benefit/costs analysis, it is necessary to define the actual costs associated with the transfer/treatment of water and wastewater in each of the pilot communities. Each authority provided estimates for the marginal costs of transfer and treatment of water and for the transfer, treatment and disposal of sewerage and sewerage effluent. These costs related to the electricity and chemical costs only as other costs are fixed and not related to marginal reductions in production.

Table 2.6**: Adopted Operations and Maintenance Costs (per ML)**

Pilot Community		Transfer	Treatment	Total
Emerald	*Water*	$8	$92	$100
	Wastewater	$25	$66	$91
Ingham	*Water*	$17	$45	$62
	Wastewater	$25	$60	$85
Mackay	*Water*	$78	$22	$100
	Wastewater	$105	$65	$170
Maroochy	*Water*	$20	$75	$95
	Wastewater	$35	$70	$105
Toowoomba	*Water*	$63	$45	$108
	Wastewater	$35	$60	$95