STATISTICAL COMMISSION and ECONOMIC COMMISSION FOR EUROPE

COMMISSION OF THE EUROPEAN COMMUNITIES

CONFERENCE OF EUROPEAN STATISTICIANS

EUROSTAT

Joint ECE/Eurostat Work Session on Methodological Issues of Environment Statistics
(Ma’ale Hachamisha (15 km from Jerusalem), Israel, 11-14 October 1999)

Working paper No.17

Water Account for Australia

Submitted by the Australian Bureau of Statistics[1]

Abstract: The Australian climate is characterised by relatively low median annual rainfall and high rates of evaporation. Australia's water storage per capita is the highest of any nation in the world. Thus, water supply and distribution, and the appropriate use of scarce resources, are major issues for Australia. This paper describes the ABS' efforts to compile physical information relating to the supply and use of water from a vast number of sources, and to integrate this into a framework compatible with economic data sets. The resulting information includes a set of Assets tables and a Water Balance table for one State (Victoria), and a set of Flow tables for Australia.

---

[1] Prepared by Sarah Coleman, Environment and Energy Statistics Section.

1. BACKGROUND

Most of Australia's land mass is classed as arid or semi-arid, with median rainfall of less than 600mm for 80% of the continent. High rates of evaporation and relatively low relief result in low percentage runoff from precipitation that result in streamflow and groundwater. These features explain why Australia has the highest level of water storage per capita of any nation in the world (SoE 1996).

Irrigation for agriculture is by far the largest use of water, representing about 70% of a Australia's water use annually. Many of Australia's rivers are becoming increasingly degraded, as evidenced by blue-green algal blooms, declining fish stocks, high levels of salinity or acidity, the loss of wetlands, and significantly reduced environmental flows (SoE 1996).

Initiatives to improve this situation include a wide range of water reforms designed to address issues such as inadequate pricing mechanisms, over-allocation of water resources and the implementation of environmental flows to improve and maintain river health.

1.1 What is the Water Account?

The Australian Bureau of Statistics (ABS) is currently developing environmental accounting systems for a number of Australia's natural resources. The Water Account for Australia is one of the physical accounts being developed and will consist of a number of tables depicting physical information on Australia's water resources. It is intended to present data based on a financial year basis and eventually to link it to monetary data on the water industry in the national accounts. This will be achieved by working cooperatively with State/Territory/Local governments and water authorities to utilise existing data collection activities.

The methodology which has been developed for the Water Account has required the integration of environmental data into a framework that is applicable for economic analysis. A view of Australia's water resources has been developed based on the physical resource accounts concepts in the United Nations System for Integrating Environmental and Economic Accounts (SEEA) (UN 1993) and spatial and physical parameters which will consider the variability of Australian water resources. A perspective of annual and long term conditions has been developed.

The Water Account will also include Water Flow Tables describing usage of water by different industries and households in order to measure the flow of water through the economy. The basis for the Water Flow Tables will be the ABS's economic Input Output tables which, once suitably augmented, provide a useful framework to study the interaction between environment and economic activity. Such a framework will allow the quantification in physical terms of the volume of water supplied and used within the economy, based on standard industry classifications.

1.2 Reasons for Developing a Water Account

Each State and Territory in Australia undertakes water resource monitoring and assessment. The aim of the Water Accounts project is to provide a mechanism to tie together data from different sources into one consolidated information set and link this to economic data sets such as Australia's National Accounts and other natural resource data sets.

Information from the Water Account will be available for better decision making on sustainability issues, highlighting changes in water use and resource availability. This information will be useful for the government and private sectors in Australia for the analysis of resource based issues, and for international organisations such as the OECD and UNEP. Environmental accounting will provide better information for macroeconomic, social and environmental decisions and the basic information on natural resources will be available (in an appropriate framework) for modellers who now have considerable economic data.

1.3 Supplementary Information and Linkages to the National Land and Water Resources Audit

Supplementary information will be included where it is considered appropriate. For example a summary of climatic conditions and the impact of El Nino will be detailed throughout the measurement period. The ABS is working in consultation with the National Land and Water Resources Audit (NLWRA) to ensure that the Commonwealth requests for similar data is undertaken in a coordinated manner.

2. WATER ACCOUNT STRUCTURE

The following discussion details the structure of the Water Account for Australia after consultation with key stakeholders across Australia. The first Water Account will be experimental and feedback will be used to refine the framework, the concepts and data sources used. The Water Account will consist of a view of Australia's water resources and Water Flow Tables describing the supply and use of water by various sectors of the economy.

2.1 Water Assets Table

As water resources are being constantly renewed a clear distinction is required between the capacity of a system and its potential yield. The potential yield of the system is dependent upon long term climatic variability, and not solely upon the system capacity. The influence of climatic variability on water resources is fundamental to the whole issue of environmental sustainability (Moran, *pers. comm.,* 1997).

An Asset Table intends to show long term availability of water resources in a particular river basin or groundwater province. This assessment has been made at particular points in time (in this case 1985 and 1998) so a time-series of Asset Tables can in theory be compared to demonstrate the changes in resources through time. An example of asset tables and a water balance have been compiled for one State (Victoria) only due to data unavailability for most of Australia.

2.1.2 Surface Water Asset Table

The Surface Water Asset Table (table 1) includes measures of the volume of water allocated for economic and environmental use and the volume of unallocated resources. It is hoped that average annual water resources will give an indication of the long term availability of water. A limitation of this approach for surface water allocated for environmental purposes is that many allocations for river basins are not derived on a megalitres per year basis but on passing flows at particular times during the year. Passing flow allocations for environmental purposes will not be identified by this approach.

TABLE 1 . SURFACE WATER ASSET TABLE

	Resources Available (Megalitres)			
River basin level total	Economic	Environmental		Total Assets (Mean Annual Runoff)
	Allocated	Allocated	Unallocated	
1985 Assessment				
Volume Change				
1998 Assessment				

2.1.3 Groundwater Asset Table

Of the 2.7% of the world' fresh water, about 95% is groundwater (excluding the fresh water frozen at the poles) (Water Resources Commission of NSW). Groundwater underlies about 60% of Australia and there is a heavy dependence of some Australian communities on this fresh water source. The volume of water stored in groundwater systems is not well known and the sustainable yield is a better measure of groundwater resources available than the volume in storage (Evans, *pers. comm.,*1998). There is concern that groundwater may be at risk from inefficient or excessive use in Australia, and modelling of some regions of Australia indicates declining yields of water, and that extractions probably exceed rates of recharge. The volume in storage is an estimate and not necessarily fully available. Table 2 details the structure of the Groundwater Asset Table being compiled for Victoria.

TABLE 2. GROUNDWATER ASSET TABLE

	Sustainable Yield[1]				
Groundwater province level total	Fresh	Marginal	Brackish	Saline	Total
1985 Assessment					
Volume Change[2]					
1998 Assessment[3]					

1. Split based on the salinity of the groundwater
2. The Volume Change can be influenced by the time interval between assessments. Sustainable Yield can change depending on when the system is reviewed. For example a system reviewed every 10 years may have a larger volume of recharge than if assessments are done on a 5 yearly basis.
3. The later assessment is not necessarily available for 1998.

At this stage it is proposed to define the resources in groundwater systems as "Sustainable Yield". Evans *et. al.* (1998) defines "Sustainable Yield" for the Australian aquifers as the level of extraction, measured over a specified planning timeframe, that should not be exceeded to protect the higher value uses associated with the aquifer. Most managed aquifers in Australia are done so according to the assumption that average annual recharge is an acceptable approximation for "Sustainable Yield" (Evans *et. al.,* 1998). This assumption is invalid in a number of cases.

The 'Volume Change' category includes changes that have occurred due to a range of factors including: as a result of having a longer period of record to determine/model the resources available; improved estimation techniques; and policy changes on the volume of water allocated for various uses. At this stage the total resources and the amount required to maintain environmental factors of groundwater systems are unknown so have not been incorporated in Table 2.

2.2 Annual Water Balance for Victoria

Table 3 details the components to be measured in a water balance with more detailed definitions provided in Appendix 1. A water balance has only been compiled for Victoria at this point in time. No other States have the information to compile such a table.

The net anthropogenic changes parameter considers the volume of water diverted for economic use from surface and groundwater resources and subsequent return flows. Economic use of water can also occur in-stream for activities such as hydro-electricity generation, recreation and navigation. The volume of water required for most in-stream uses cannot be accounted for, with the exception of hydro-electricity generation. Inter-basin transfers of water are also measured in net anthropogenic changes and will be included where such transfers originate or are destined for a region outside the measurement area.

Changes in the storage of lakes and dams measures the amount of storage at the start and end of the accounting period in order to determine the difference in the amount in storage.

TABLE 3. ANNUAL WATER BALANCE TABLE FOR VICTORIA

PARAMETERS	**MEGALITRES**			
	1993-94	1994-95	1995-96	1996-97
A. Inflows				
A.1 Precipitation				
A.2 Natural inflow from adjacent basins (if applicable)				
A.3 Total inflows (A.1+A.2)				
B. Net Anthropogenic Changes				
B.1 Net Economic Changes[B.1(i) - B.1(ii)] i. Water used for economic purposes ii. Return flow discharges				
B.2 Water transfers [B.2(i) - B.2(ii)] i. Water transfers into the measurement region ii. Water transfers from the measurement region	n.a.	n.a.		
B.3 Total net anthropogenic changes (B.1+B.2)				
C. Net Changes in Storage				
C.1 Changes in the storage in lakes and dams				
C.2 Net groundwater recharge	n.a.	n.a.	n.a.	n.a.
C.3 Other volume changes nec				
C.4 Total net changes in storage (C.1+C.2+C.3)				
D. Outflows				
D.1 Evapotranspiration				
D.2 Basin outflow (mean annual runoff)				
D.3 Total outflows (D.1+D.2)				

2.3 The Water Flow Tables

The water flow tables will indicate the physical amount of water (megalitres) supplied from the environment and water authorities for use by industry, households, government and the amount available for return flow to the environment. The Flow Table provides the mechanism that links water resources to economic accounts.

2.3.1 Temporal Disaggregation of Data

The Water Account will focus on 4 financial years (1 July to 30 June the following year) 1993/94, 1994/95, 1995/96 and 1996/97. Other data sets that will be used for comparison include the *1985 Review of Australia's Water Resources and Water Use* (AWRC, 1987) and the *1975 Review of Australia's Water Resources* (ADNR, 1976).

2.3.2 Spatial Disaggregation of Data

Australia is divided into 245 river basins and 61 groundwater provinces. Spatial disaggregation is important due to the variable hydrological conditions across Australia. As such, data were originally sought on a river basin and groundwater province level rather than the use of states or other such political boundaries as a spatial unit. However, due to State government jurisdiction where water matters are concerned, and the fact that many river basins and groundwater provinces cross state boundaries, it was not possible to collect data by geographic region.

2.3.3 Structure of the Flow Table

The flow tables will adopt the Input Output framework used by the ABS, which is based on SNA93 (UN, *et. al.,* 1993). The Input Output framework will describe the movement of water from the environment as input into economic activity, as well as the return flow from production and consumption activities back into the environment. Input Output analysis can be used to identify the total volume of water directly used by an industry.

Tables 4 through to 7 detail the Supply and Use Tables being developed. The supply and use tables attempt to cover the use of water from the extraction of water from the 'environment' through to consumptive use, regulated discharges to the environment, and reuse.

Industry data will be aggregated according to the ABS's Input Output Industry Group Classification (IOIG). Appendix 2 lists the input-output groups being used. The commodity water will be split into the IOCC (Input Output Commodity Classification) for mains water (IOCC 37000010), and self supplied surface water (surface and groundwater combined). It is recognised that self supplied water may be transformed into mains water (eg a bulk water authority extracts water, and supplies it to another water authority as mains water). Producer and Distributor Water Authorities will be identified to avoid double counting.

TABLE 4. SUPPLY TABLE STRUCTURE

		A	B	C	D
Supplier		Mains water (IOCC 37000010)	Self-supplied (surface and groundwater)	Effluent reuse	Regulated discharge
Environment			X		
IOBIG code	Name				
1	Agriculture				
2	Forestry and fishing				
3	Mining				X
20	Water supply, sewerage & drainage	X		X	X
etc					
	Households				
	Total Supply	X	X	X	X

TABLE 5. SUPPLY TABLE DESCRIPTIONS

Column	Category	Description
A	IOCC 37000010 - Mains water	Input output commodity code (IOCC) for water. Includes water measured within the system of the economy through an economic transaction. Who is supplying mains water. The majority of mains water is supplied by the water supply; sewerage and drainage service industry.
B	Self supplied water	Includes surface and groundwater and is that volume of water directly extracted from the environment. All self supplied water is supplied from the environment.
C	Effluent reuse	Who is supplying treated effluent for subsequent reuse The majority of reuse water is supplied by the water supply; sewerage and drainage services industry.
D	Regulated discharge	Who is supplying the discharge of regulated water. Regulated discharge includes disposal of water to the ocean, land and rivers. The majority tends to be from sewerage. Other contributors include industries which discharge effluent directly and in-stream users.

TABLE 6. USE TABLE STRUCTURE

		A	B	C	D
User		Mains water (IOCC 37000010)	Self-supplied (surface and groundwater)	Effluent reuse	Regulated discharge
Environment					X
IOBIG code	Name				
1	Agriculture	X	X	X	
2	Forestry and fishing	X			
3	Mining	X	X	X	
20	Water supply, sewerage & drainage	X	X	X	
etc					
	Households	X	X		
	Total Use	X	X	X	X

TABLE 7. USE TABLE DESCRIPTIONS

Column	Category	Description
A	IOCC 37000010 - Mains water	Shows the industries that use water that has been supplied through a water supply system. It is a subset of self supplied water, and excludes direct losses incurred by the water supply ; sewerage and drainage services industry. Distribution losses are included for water that is supplied from, for example, a bulk water supplier onto a retail water supplier.
B	Self supplied water	Shows the industry that use water that is extracted directly from either surface or groundwater sources. Includes water that is used by water providers and also their losses.
C	Effluent reuse	Shows the industries that use water that has been supplied for reuse.
D	Regulated discharge	Includes regulated discharge that is being used by the 'environment'.

3. DATA COLLECTION & ESTIMATION

Th data collection phase for the Water Account Project is now complete. Data were obtained from State and Territory government databases (where available); local councils and water authorities; and industry. The quality of the data obtained to develop the supply and use tables varied. Some respondents were able to provide detailed information from their records, while others provided estimates of the volume of water used. The data have been modified where necessary to ensure they can be presented in a consistent format.

3.1 Supply

Details collected from water suppliers included water intake, distribution of supply to various users, discharges of treated and untreated water, and estimates of losses from the supply system. This information was collected directly from suppliers via a mail-out questionnaire.

3.2 Use

Estimates of self supplied water were also determined for private organisations or individuals not covered by a regulatory water authority. This involved requesting data from relevant state government authorities which hold details of licences and estimated extraction of water by self supply. It is recognised that estimates of self supply are likely to be less accurate than data on diverted water supplies.

Industry usage was determined using both data supplied directly from water suppliers (which, in some cases, were the industry bodies directly), and ABS data. In the absence of any water use data for industries, case studies on water usage by specific high water using sectors were developed. This involved determining water usage coefficients for particular industries based on their employment or production statistics. Typically in Australia high water using industry sectors include agriculture, mining, mineral processing, paper and pulp making, food, beverage, textiles and power generation. ABS data sources that proved useful included the Agricultural census (for land area under irrigation and agricultural land use data); manufacturing turnover and employment data, and mining production data. Appendix 3 describes the estimation techniques and methodologies in more detail.

4. PRELIMINARY RESULTS AND FUTURE WORK

Supply and use tables for each State, and Australia, are currently being finalised. Preliminary results show the largest user of mains water to be the group 'livestock, pasture, grains and other agriculture', consuming around 40% of total water supplied through mains. The next largest users of mains water are the household sector and the rice industry, each consuming around 15%. Most use of self-supplied surface and groundwater is by the electricity and gas industry group (about 70%), primarily due to the activities of hydro-electric power generation in a couple of States. It should be noted that this is considered a 'non-consumptive' use of the resource, as the water is discharged for further use ('in-stream use'). Ignoring the extraction of water by the water supply, sewerage and drainage services sector (most of which is ultimately used for distribution through mains), the next largest users of self-supplied water resources are the 'livestock, pasture, grains and other agriculture' group and the sugar industry.

Although effluent reuse data are patchy, there appears to be a trend toward increased reuse over the four years surveyed. Almost all reported regulated discharge comprises of the supply back to the environment of water used in the generation of hydroelectricity.

4.1 Input-output (I-O) Analysis

With the finalisation of the data, the ABS will take the next step of linking the physical information with monetary data compiled by the Input-Output section of the ABS. In this manner, coefficients can be derived and indicators compiled to better reflect the economic structure of water demand.

Symmetric I-O tables are derived from the flow data and are primarily intended for analysis. Ultimately, an industry-by-industry I-O table will be created in which all secondary products (output and corresponding units) have been transferred from the industry in which the output actually takes place to the industry which primarily produces these products. The symmetric I-O industry-by-industry table will show the output of each industry in terms of the amounts used by all industries and the amounts sold to final users. This table provides input to economic models and provides the basis for a range of analyses including the derivation of direct and total requirement coefficients.

References

Australian Water Resources Council (AWRC). 1987. *1985 Review of Australia's Water Resources and Water Use. Vol. 2: Water Resources Data Set.* Australian Government Publishing Service, Canberra.

Evans, Ray. 1998. *Personal Communication.* Australian Geological Survey Organisation, Canberra.

Evans, R., Coram, J., Kellett, J. & Russell, L. 1998. *A toolkit for Determining Sustainable Yield for Groundwater.* Draft Discussion Paper, National Allocation Workshop July 1998.

Moran, Rae. 1997. *Personal Communication.* Department of Natural Resources and Environment, Melbourne.

United Nations. 1993. *Integrated Environmental and Economic Accounting. Handbook of National Accounting, Series F, No 61.* United Nations, New York. (SEEA).

United Nations *et. al.,* 1993 *System of National Accounts 1993.* United Nations, New York.

State of the Environment Advisory Council 1996, *Australian State of Environment Report 1996*, CSIRO Publishing, Melbourne.

Appendix 1. Water Balance Table Definitions

<u>Inflows</u>

A1. Precipitation- Areal precipitation for the measurement area ML/yr.

A2. Natural inflows into the measurement region- Volume of water naturally flowing into the measurement region from other river basins ML/yr (if applicable).

<u>Net Anthropogenic Changes</u>

B1. Net Economic Changes

i- Water used for economic purposes- Volume of water diverted for economic use from surface water and groundwater sources ML/yr. If possible detail as: surface water (hydro-electricity, irrigation, rural, domestic, industrial) and groundwater (irrigation, domestic, rural, industrial).

ii- Return flow discharges- Volume of water returned (after use for economic purposes) to a stream or water body, that is available for subsequent withdrawal. Includes point and non point discharges and if possible include the following breakdown; hydro-electricity, irrigation, rural, domestic, industrial. Includes discharges into lakes, rivers, dams, aquifers, estuaries and the ocean ML/yr.

B2. Water transfers-Includes surface water and groundwater transfers into and from the measurement region, for example interbasin transfers and artificial groundwater recharge.

<u>Net Changes in Storage</u>

C1. Changes in the volume of water in storage- Increase or decrease in the volume of water in storage from the previous year. Water in storage includes dams and lakes.
Dams- includes hydro-power, irrigation and water storage and mining dams, located both in-stream and off-stream.
<u>Referable dam</u>
Any artificial barrier, temporary or permanent, including appurtenant works which does or could impound, divert or control water, other liquids, silt, debris or other liquid-borne material and which:
-either is 10 m or more in height and has a storage capacity of more than 20 000m^3.
-or has a storage capacity of 50 000m^3 or more and is higher than 5 m.
<u>Large dam</u>
A dam satisfying the minimum requirements adopted for determining whether a large dam qualifies for inclusion in the ICOLD World Register of Dams, as follows:
-all dams above 15m in height, measured from the lowest portion of the general foundation area to the top of the dam.
-dams between 10m and 15m are included provided they comply with at least one of the following conditions:
(i) the length of the crest, ie. the top of the dam, to not be less than 500m;
(ii) the capacity of the reservoir formed by the dam to be not less than 1 000 000m^3;
(iii) the maximum flood discharge dealt with by the dam to be not less than 2000m^3/s;
(iv) the dam has specific foundation problems;
(v) the dam is of unusual design.

C.2 Other diffuse losses- Includes other losses from the system that have not been included elsewhere (eg groundwater recharge), this will be derived as a balancing item.

<u>Outflows</u>

D1. Evapotranspiration- Areal evapotranspiration for the measurement area ML/yr.

D2. Basin outflow- Mean annual runoff ML/yr from basins in the measurement.

Appendix 2. Input-Output Industry Groups

Livestock, pasture, grains, and other agriculture
Vegetables
Sugar
Fruit
Grapevines
Cotton
Rice
Services to agriculture; hunting and trapping
Forestry and fishing
Mining
Meat and dairy products
Other food products
Beverages, tobacco products
Textiles
Clothing and footwear
Wood and wood products
Paper, printing and publishing
Petroleum and coal products
Chemicals
Rubber and plastic products
Non-metallic mineral products
Basic metals and products
Fabricated products
Transport equipment
Other machinery and equipment
Miscellaneous manufacturing
Electricity and gas
Water supply; sewerage and drainage services
Construction
Wholesale and retail trade
Accommodation, cafes and restaurants
Transport and storage
Finance, property and business services
Government administration
Education
Health and community services
Cultural, recreational and personal services
Household

Appendix 3. Methodology for Estimating Missing Data (total use, domestic use)

Local Government data

Data were requested from all Local Government Authorities (LGA), excluding those where water reticulation is covered by water boards.

Data in the supply and use tables were primarily sourced from the ABS data request. In cases where a LGA did not send back any data, State land and water conservation agencies data were used. These data did not include responses for all LGAs for all of the 4 reference years. and no data were available for some LGAs. Data for missing years were imputed using an average of the available data. For LGAs where no data were available, water use was estimated by comparing the Megalitres (ML) and population for the LGAs . This resulted in a ML/person co-efficient for total water use.

This co-efficient (approx 0.14 ML/person/year) was used for areas within LGAs that do not have access to the reticulated supply (determined by comparing data on population serviced and unserviced). It was also used for LGAs with no supply data or those with only part data (where averages could not be used to fill in the gaps). The areas without reticulated supplies tend to be the rural LGAs and represent that population which exists outside the main townships.

An average domestic water use was calculated from responses for NSW and this rate was applied to calculate the proportion of water used for domestic purposes for those LGAs that were unable to provide a split for these data. Some data were provided on top water users which was assigned to the appropriate industry. The remaining volume of water was then assigned to manufacturing and service industries based on ABS economic data.

A similar method was used to derive the missing sewage treatment data (STP), those LGAs who provided data were used to derive a STP ML/person rate. This rate had a high RSE so it was decided to use this only for those LGAs where no data was available. For instance where 2 or 3 years of data were available the numbers were averaged. If the same number was given for between 1 to 3 years then it was assumed it would be the same for the year(s) of the missing data. For those LGAs with no data and for the unserviced the STP ML/person rate was used.

Methodology for categorising water usage

Some data respondents were able to provide a split of their water use by domestic, rural, commercial and industrial categories, as well as a list detailing the water usage of their top customers. The top water customers were categorised to an industry type based on a classification the Australian and New Zealand Standard Industry Classification (ANZSIC) and domestic use was assigned to a category called Households, and Rural water was assigned to Agriculture (see notes below). Another category was derived called the not assigned category. Water use for the not assigned category includes that volume of water that data respondents (local government or water boards) could not adequately categorise to an industry type. For each State and Territory water use coefficients were calculated for industries, from those users where data were available. These were applied to the profile of economic activity in each State and Territory.

Service industries

Coefficients were developed for the services industries (ANZSIC codes 0211 to 0420, 3610 to 9634) based on employed persons. This was developed based on top water users. The customer details and water consumption were linked to other ABS information on the number of employed persons at a particular establishment and a Megalitres/employment coefficient was derived for each industry. Labour force numbers were then multiplied by the ML/employee coefficient to estimate the water used for a particular industry. Adjustments were made to eliminated any discrepancy between the total water usage derived from this method and the total water usage provided by water boards. The electricity generation sector (ANZSIC 3610) was included in these calculations, however it excluded the water used in the actual generation process and measured the business needs of water for running other parts of the business. The majority of water used by the electricity generation sector was collected from the companies directly or from water providers who service the electricity generators.

Attempting to estimate water usage based on employment for Parks, zoos and gardens and sporting grounds is very difficult. The number of employees is not always categorised within ANZSICs related directly to parks, or sporting grounds (for example, local governments may have include employees for parks within the local government administration ANZSIC). The ABS has collected data on the zoos, parks and gardens industry and a coefficient was derived based on the ML/hectare. The proportion of water used for sporting activities had been estimated for Western Australia and it was assumed that this was similar for the rest of Australia (approx 1.58% of the total).

Manufacturing Water Use

Coefficients were developed for the manufacturing sector (ANZSIC codes 2111 to 2949) using turnover data. Turnover data from the ABS Manufacturing Census was used with case studies of water use to derive a Megalitre per $000's turnover. The ML/$'000's turnover rate was multiplied by turnover in each State and Territory for each manufacturing ANZSIC group in order to derive the total volume of water used by an industry. For a number of specific ANZSICs, insufficient turnover data was available, in these cases ML/employed persons was derived.

Once estimated water usage was derived it was compared with the actual data obtained from the water boards etc on their customer water usage. A proportion of the 'not assigned' water was allocated accordingly based on known water use and the industry profile in the State.

Mining

Water consumption site specific data for a number of the large mining companies was obtained. Coefficients were derived for each ANZSIC group in mining based on the site water usage and commodity production data from the Mining Census. In this manner, a ML/unit of production rate was derived and applied to the remaining production of commodities for mine sites where water usage is unknown. Insufficient production data was available for the construction material mining sector (ANZSICs 1411 and 1419) and employment data were used to derive a ML/employment coefficient. This was also used for the services to mining sector (ANZSICs 1511 to 1520).

It is recognised that the use of water in the mining industry is highly variable and depends on factors such as rock type, and whether or not the operation is open cut or underground.

Agriculture (example for NSW)

Estimates for irrigation water usage were derived on the basis of data compiled from the Department of Land and Water Conservation (DLWC) and NSW Agriculture data on regulated and unregulated river licences. These totals were then pro-rated using ABS Agricultural Census irrigation data adjusted to incorporate irrigation of rice and cotton, as well as a percentages of "area sown" (from the Agricultural Census) for pastures, vegetables, fruit, and grapevines. The percentages applied to Agricultural Census "area sown" data were sourced from NSW Irrigation Council data.

This water usage was pro-rated using Integrated Agricultural Census Collection (IACC) irrigation data co-efficients, adjusted to incorporate irrigation of cotton. The irrigation co-efficients were based on work undertaken in the ABS Agriculture NPC in Hobart - the resulting data provided estimates of area irrigated and application rates. Further derivations were applied to estimate the area irrigated on the basis of "area sown" (from IACC) for vegetables, fruit, and grapevines. A percentage was then applied to IACC area sown to provide an estimate of area irrigated; these percentages were sourced from NSW Irrigation

Council data.

Pro rata co-efficients for Irrigation water usage were imputed on the basis of the estimated area irrigated multiplied by water application rates sourced from the IACC.

Reuse

Reuse data were obtained from the water boards and LGAs. Some manufacturing and mining water reuse has been included, however this is not comprehensive, as a number of manufacturers reuse water on-site and these data were not collected. The majority of the reuse data was collected from water providers, some of whom were able to allocate customer usage information on who reused the treated effluent. Some water providers only gave total amount of water which was reused. This 'not assigned' reuse was then allocated to an industry based on data sourced from the Agricultural Census where reuse water was stated as being for irrigation or for crops, and reuse data provided by surrounding areas.

Other Comments

Data are likely to be more reliable for the 1996/97 year due to the fact that water providers are tending to improve their collection and collation of water data.

In some instances the losses may include environmental flows, where these have been set up.

The impact of stormwater runoff has not been included in the current figures. Stormwater infiltration into the sewerage reticulation system rates is variable across Australia and no estimation has been made its contribution in each State and Territory.