



Samoa Bureau of Statistics

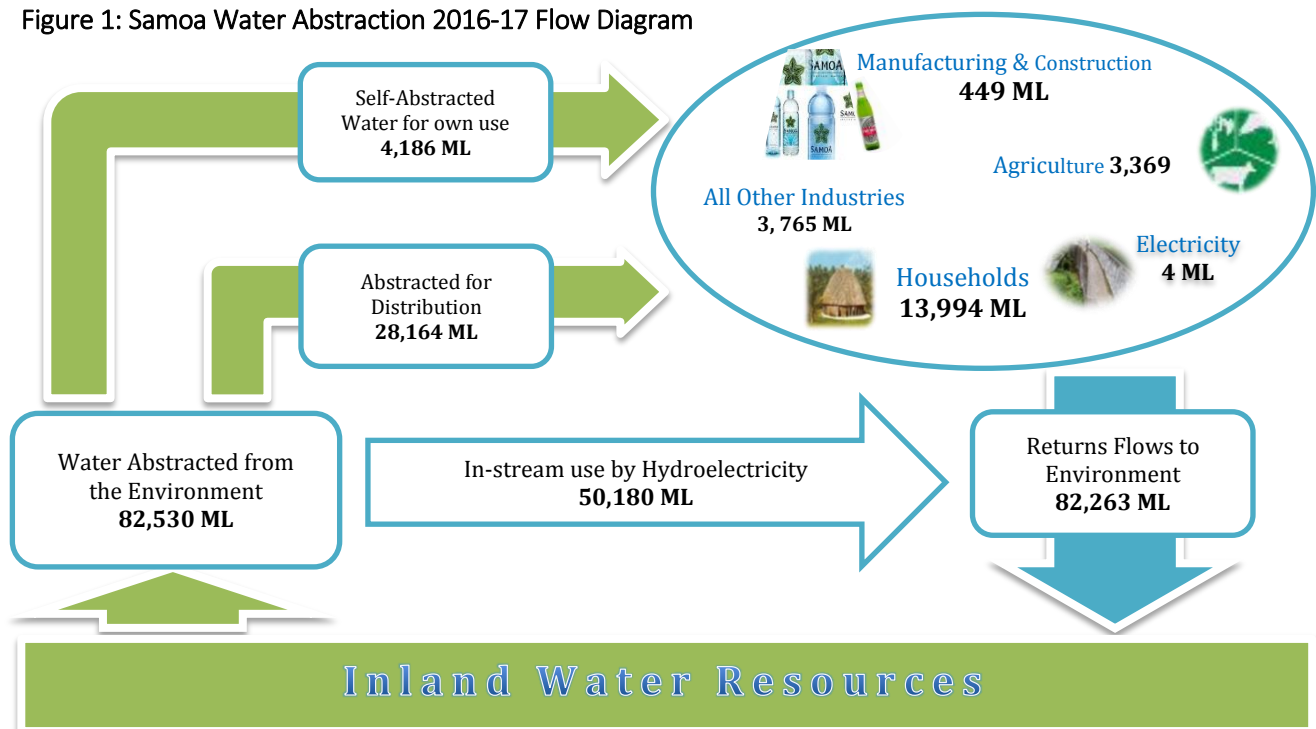
Environment Statistics

Water Accounts for Samoa, 2016 -17

Executive Summary

The 2016-17, Samoa Water Account provides information on the Physical Supply and Use of water in Samoa's economy. The water accounts are compiled using the UN System of Environmental Economic Accounting (SEEA) Central Framework. Furthermore, the physical supply (abstraction) and use tables present aggregates of all the available physical data in **Megalitres (ML)**¹ in terms of the supply and use of water in Samoa's economy, including households. **Figure 1** summarizes the main water flows for Samoa in FY2016-17.

Figure 1: Samoa Water Abstraction 2016-17 Flow Diagram



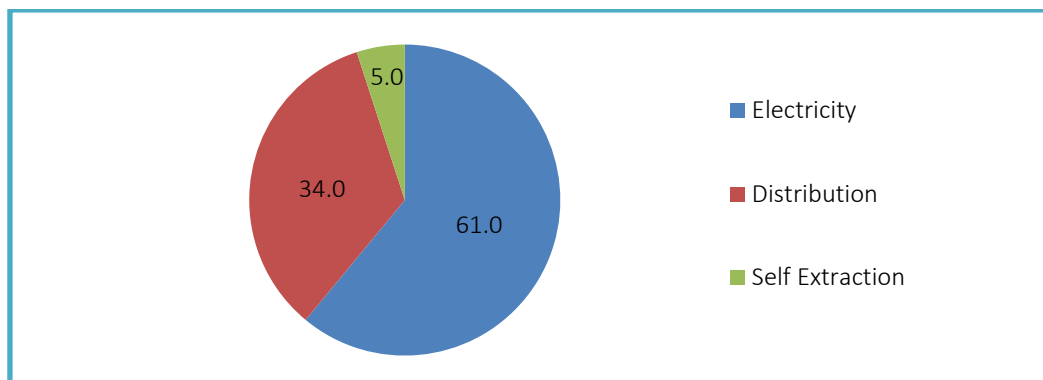
The flow diagram is a simplified representation of the Physical Supply and Use Tables (PSUTS) for the SEEA Central Framework. The diagram highlights the flow of water abstracted from the environment into the economy, its uses within the economy and the flows of water back into the environment.

During the financial year 2016-17, a total of **82,530 ML** of water was abstracted from the environment to use in Samoa's economy. **34%** or **28,164 ML** of this amount was abstracted by the water supply industry mainly for distribution to households and industries.

¹ 1 ML = 1,000 Cubic meters (m³)
1m³ = 1,000Litres (L)

The Electricity industry abstracted a total of **61%** or **50,180 ML** from the environment for hydro power generation. The remaining **5%** or **4,186 ML** was self-abstraction for own use by industries and households. (Refer Figure 2).

Figure 2: Total Abstracted Water (ML), 2016-17



Introduction

This report is the 3rd version of Samoa's water accounts. The previous report was for the financial period 2014-15. The compilation of the 2015-16 Water Accounts was delayed due to data abstraction and compilation, hence, this account will focus on the FY2016-17 as the most recent time period with available data. The Water Accounts for Samoa 2016 – 17 included some improved estimates from new data sources and new environment surveys to capture water used by commercial agricultural farmers and water use in manufacturing, mainly for Water and Beverage Companies.

The accounts also incorporated livestock number estimates from GDP production datasets to improve the accounts estimates. This will be discussed in the Methodology section of the report in regards to different data sources and their use in the accounts.

Table 1 summarises water statistics for the last six financial years from 2011-12 to 2016-17. The table generally indicates that Total Water Abstraction has decreased during this time period and the most notable reduction was in surface water which has decrease by about 21% between 2015-16 and 2016-17. This reduction was caused mainly by less water abstracted to generate electricity resulting from the breakdown some hydro plants during the financial period.

By Industry, the most significant decrease was recorded by the Electricity Industry where it has decreased by about 26% between 2015-16 and 2016-17 (Refer Chart 1).

Table 1: Total Water Abstraction, Water Use by Water Type and by Industries & Households, FY2011-12 to 2016-17 (ML)

	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Total Abstracted Water by Water Type	116,170	137,000	121,480	115,004	101,836	82,530
Surface Water	-	-	-	106,634	93,335	74,045
Ground Water	-	-	-	7,670	7,912	7,843
Rainwater	-	-	-	700	589	641
Total Abstracted Water by Industry	116,170	137,000	121,480	115,004	101,836	82,530
Industries	115,650	136,550	121,000	114,304	101,247	81,892
Electricity	71,700	85,460	71,700	75,250	68,130	50,180
Water Collection, Treatment & Supply	41,440	48,640	46,890	35,428	29,727	28,164
Agriculture, Livestock and Fishing	2,100	2,040	2,000	3,040	3,127	3,277
Manufacturing and Construction	380	380	380	550	83	92
Other Industries	30	30	30	36	180	180
Households	520	450	480	700	589	637

Total Water Use by Industry (a)	116,170	137,000	121,480	115,004	101,836	82,530
Industries	102,510	124,550	107,860	98,174	88,262	68,536
Electricity	71,790	85,580	71,790	75,260	68,131	50,184
Agriculture, Livestock and Fishing (b)	2,100	2,040	2,000	3,110	3,206	3,369
Other Industries	1,530	1,440	1,880	2,190	3,475	3,765
Manufacturing & Construction	850	850	850	710	415	449
Water Collection, Treatment and Supply	-	-	-	-	1	2
Sewerage	2	2	2	2	2	2
Losses	26,238	34,638	31,338	16,902	13,032	10,765
Households	13,660	12,450	13,620	16,830	13,574	13,994

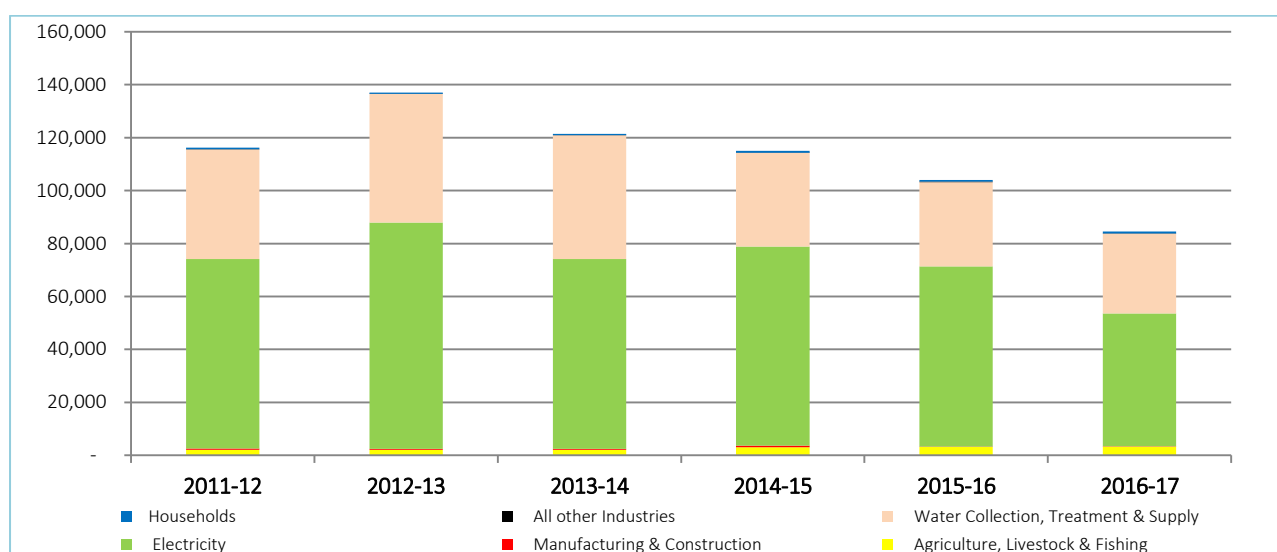
Note:

(a) Total Water Use = Abstracted water + Distributed water + Re-use Water

(b) Agriculture water use is for livestock only for 2011-12 to 2013-14. Water used by fishing and agricultural crops is included in years 2014-15 to 2016-17.

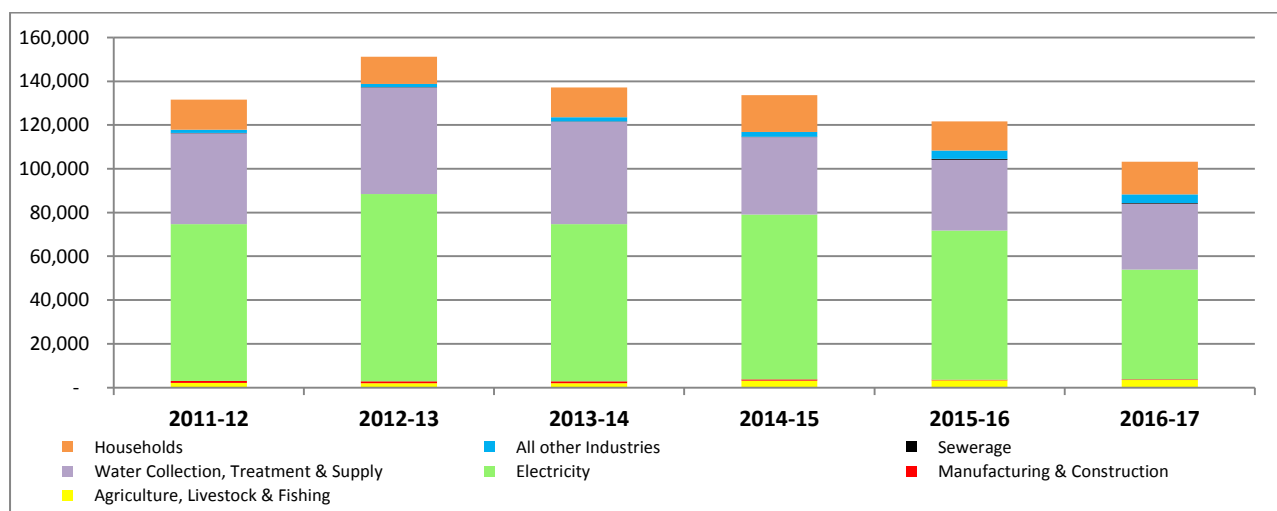
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Chart 1: Total Water Abstraction by Industries and Households, FY2011-12 to 2016-17 (ML)



In terms of Water Use by Industry, this has also decreased over the same time period where the most significant reduction was recorded by the Electricity Industry where it has decreased by about 26% between 2015-16 and 2016-17 (Refer Chart 2).

Chart 2: Total Water Use by Industries and Households, FY2011-12 to 2016-17 (ML)



Account Highlights

Physical Water Supply and Use

- Total abstracted water in 2016-17 was **82,530 ML**, a decrease of about **18%** when compared with 2015-16. Decrease in hydropower abstraction due to power plant breakdown and water supply industry attributed mainly to the overall decrease.
- A slight increase of **5%** was recorded for the Agriculture Industry. This increase was mainly attributed to the inclusion of irrigation water (in the 2016-17 account) used by commercial farmers to raise their livestock and crops. Rains fed agricultural crops were not included due to the unavailability of the required data.
- Improved in data coverage for Manufacturing and Construction industry resulted in an increase of **8%** from **415 ML** in 2015-16 to **449 ML** in 2016-17. A mini Water Use Survey conducted by the Bureau for Water and Beverage companies as well as the inclusion of GDP production estimates contributed to the improved coverage of information.
- The increase in the number of household metered water connections from 18,768 in 2015-16 to 19,686 in 2016-17 was the major contributing factor to the increase in water been supplied to households by **3%** from **13,574 ML** in 2015-16 to **13,994 ML** in 2016-17.

Partial Monetary Supply and Use Table

- Coverage of financial information was very limited to the water supplied mainly by the two major water suppliers, the Samoa Water Authority (SWA) and the Independent Water Scheme (IWS).

Table 2: Partial Monetary Supply and Use Table for 2015-16 to 2016-17

	Water Supplied m ³	Value \$SAT	Implicit Price \$SAT/m ³
2016-2017			
Metered Water			
Industries	3,226,295	7,194,083.40	2.23
Households	8,410,178	10,790,350.70	1.28
Unmetered Water			
Industry (a)	228,844	26,072.00	0.11
Households (b)	7,197,621	831,684 (c)	0.12
Total	16,553,996	18,842,190.10	
2015-2016			
Metered Water			
Industry	2,962,228	6,487,517.20	2.20
Households	7,709,566	9,896,208.00	1.28
Unmetered Water			
Industry (a)	629,418	37,456.00	0.06
Households (b)	6,656,007	947,388 (c)	0.14
Total	16,175,263	17,368,569.20	

Source: Samoa Water Authority (SWA) and Independent Water Scheme (IWS)

Note:

- Unmetered water for industry estimated by the average metered water use by each individual industry
- Unmetered households estimated using the average household metered water use
- Revenue is estimated by \$SAT10 maintenance fee/month by IWS customers, and \$SAT20/month flat rate by SWA customers

- In 2016-17, the **implicit price**² paid for metered water supplied to households was estimated to be \$SAT1.28/m³ and \$SAT2.23 for metered water used by industries. The implicit price paid

² **Implicit price** represents a price that is not recorded but instead implied or imputed, calculated by Water Value / Water Supplied (\$SAT/m³)

for unmetered water supplied to both households and industries are very cheap, estimated at a low implicit price of around \$SAT0.12/m³

- Hence, unmetered water is much cheaper than metered water supplied as both household and commercial customers are paying flat rates of \$SAT20 and \$SAT32 per month respectively, with unlimited amount of water use.
- As presented in Table 3, the Total Value of Water Supplied to Samoa's economy in 2016-17 was \$SAT18.4 million, an increase of 9% when compared to 2015-16.
- Additionally, the Value of Water Supplied to all industries totaled \$SAT7.2 million in 2016-17, an increase of 11% when compared to 2015-16 while households on the other hand had an increase of 8%.
- By industry, the most significant contributors to the Total Value of Water Supplied were depicted by both the Accommodation and Food Services and the Education Industries representing 20% and 15% respectively.

Table 3: Total Water Value on Supplied Water Use by SWA for 2015-16 to 2016-17 (\$SAT).

Industries	2015-16	2016-17
Agriculture, Livestock and Fishing	147,916.70	152,762.70
Manufacturing, Mining & Quarrying and Construction	606,379.80	628,073.20
<i>Manufacturing</i>	538,457.20	546,828.70
<i>Construction</i>	62,250.10	79,926.50
<i>Mining & Quarrying</i>	5,672.50	1,318.00
Electricity, Gas and Air Condition Supply	1,379.00	6,749.00
Water Supply, Collection and Treatment	480.00	400.00
Sewerage	1,364.00	3,542.00
Other Industries	5,767,453.70	6,428,628.50
<i>Accommodation and Food Services</i>	1,010,250.40	1,415,161.10
<i>Education</i>	1,108,299.40	1,102,703.00
<i>Public Administration and Defense</i>	753,963.20	754,431.90
<i>Wholesale & Retail Trade</i>	665,723.00	710,681.40
<i>Human Health and Social Work</i>	384,237.20	607,176.10
<i>Real Estate, Rental and Leasing Activities</i>	480,756.30	499,702.60
<i>Other Service Activities</i>	465,054.10	379,767.10
<i>Financial and Insurance Services</i>	443,391.00	356,712.60
<i>Arts, Entertainment and Recreation</i>	171,747.50	214,746.80
<i>Transportation and Storage</i>	170,033.30	197,676.10
<i>Administrative and Support Service Activities</i>	88,250.10	92,106.60
<i>Activities of Extraterritorial Organizations</i>	47,850.30	63,120.50
<i>Information and Communication</i>	13,295.00	20,158.80
<i>Professional, Scientific and Technical Activities</i>	12,452.70	14,483.90
Total Industries	6,524,973.20	7,220,155.40
Households	10,356,546.30	11,182,834.70
Grand Total	16,929,369.80	18,402,990.10

- Table 4 highlights the water intensity³ and efficiency⁴ over the last four financial years. On average, Samoa's economy in 2016-17 produced \$SAT25.86 of economic output, from every cubic meter of total abstracted water, which is an increase of about 22% from 2015-16. i.e. 1m³ = \$SAT25.86 of GDP.

³ **Intensity** is the ratio between water intake and the defined unit of production.

⁴ **Efficiency** is the amount of \$SAT generated per unit of water used.

- Furthermore, Samoa's Water efficiency has been increasing over the last four financial years implying that less water was used to produce more GDP
- Conversely, Samoa's economy in 2016-17 took 0.04 m³ of total abstracted water to produce \$1SAT of GDP. i.e. 0.04 m³ = \$1SAT GDP.
- Also, Samoa's Water Intensity has been decreasing over the years implying that less water abstracted to produce \$1SAT GDP.

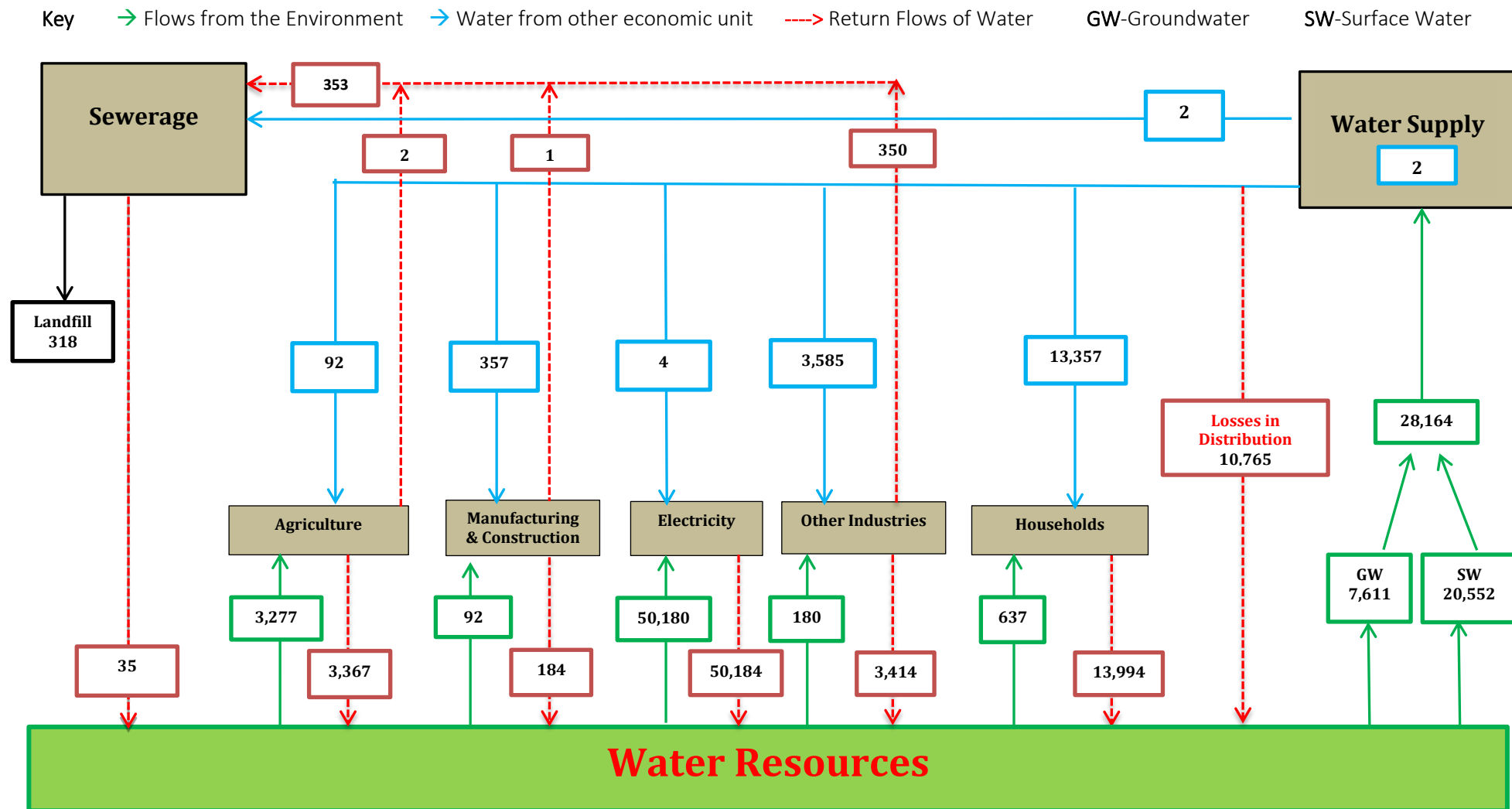
Table 4: Samoa Water Intensity and Efficiency for the financial years 2013-14 to 2016-17

	Total Abstraction m ³	GDP (Bill. \$SAT)	Water Intensity m ³ /\$SAT	Water Efficiency \$SAT/m ³
2013-14	121,480,000.00	1,870,070,589.23	0.06	15.39
2014-15	115,004,000.00	1,949,220,221.95	0.06	16.95
2015-16	101,836,319.52	2,056,040,983.94	0.05	20.19
2016-17	82,529,566.10	2,133,804,758.48	0.04	25.86

Changes in this Issue

- Certain tables have changed from million cubic meters to megalitres for ease of reference, while for averages and other account calculations; cubic meters were used for simplicity.
- Inclusion of small survey results conducted on Commercial Farmers Agriculture Water Use and Water & Beverage Manufacturing companies were introduced for the 2015-16 and 2016-17 accounts.
- The use of livestock numbers from GDP datasets for the estimation of livestock water use.
- Small scale use of irrigation system in agricultural commercial farming was captured but very limited.
- Rainwater water harvesting was not able to be estimated due to limited data available hence, excluded from this account.
- It is important to note the improvements in some of the estimates presented in the 2016-17 edition of the account. However, because of these improved estimates, cautious must be taken into consideration in the interpretation of changes over time.

Figure 3: Major Water Flows in Samoa 2016-17_Megalitres (ML)



Note: 1 ML = 1,000 Cubic meters (m^3)
 $1m^3$ = 1,000 Liters (L)

Table 5: Physical Supply Table for FY2016-17_Megalitres (ML)

	Agriculture, Livestock & Fishing	Manufacturing & Construction	Electricity	Water Collection, Treatment & Supply	Sewerage	Other Industries	Households	Flows from the Environment	Total Supply
1. Sources of abstracted water									
Inland water resources									
Surface water								74,045	74,045
Ground water								7,843	7,843
Soil water								-	-
Total								81,888	81,888
Other water sources									
Precipitation								641	641
Total								641	641
Total abstracted water								82,530	82,530
2. Abstracted Water									
For distribution				17,398					17,398
For own use	3,277	92	50,180	637	-	180			54,366
<i>of which: Abstraction by Households</i>	-	-	-	637	-	-			637
3. Wastewater and reused water									
Wastewater									
Wastewater to treatment	3	1	0	0	0	350	0		353
Own treatment	-	21	-	-	-	-	-		21
Reused water									
For distribution	-	-	-	-	-	-	-		-
For own use	-	-	-	-	-	-	-		-
Total	3	22	-	-	-	350	-		375
4. Return flows of water									
To inland water resources									
Surface water	-	-	50,180	-	-	-	-		50,180
Ground water	3,367	184	4	10,765	72	3,414	13,994		31,800
Soil water	na	na	na	-	-	-	-		-
Total	3,367	184	50,184	10,765	72	3,414	13,994		81,980
To other sources	-	-	-	-	283	-	-		283
Total return flows	3,367	184	50,184	10,765	355	3,414	13,994		82,263
<i>of which: Losses in distribution</i>	-	-	-	10,765	-	-	-		10,765
5. Evaporation, transpiration, water incorporated into products									
Evaporation of abstracted water	-	-	-	-	-	-	-		-
Transpiration	-	-	-	-	-	-	-		-
Water Incorporated into products	-	264	-	2	-	-	-		267
TOTAL Supply	6,646	562	100,364	28,803	355	3,945	13,994	82,530	237,198

Note: - Not available

Table 6: Physical Use Table FY2016-17_Megalitres (ML)

	Agriculture, Livestock & Fishing	Manufacturing & Construction	Electricity	Water Collection, Treatment & Supply	Sewerage	Other Industries	Households	Accumulation	Flows to the Environment	Total Use
1. Sources of abstracted water										
Inland water resources										
Surface water	3,274	39	50,180	20,552	-	-				74,045
Ground water	-	52	-	7,611	-	180				7,843
Soil water	-	-	-	-	-	-				-
Total	3,274	91	50,180	28,164	-	180				81,888
Other water sources										
Precipitation	3	1	-	637	-	-				641
Total	3	1	-	637	-	-				641
Total abstracted water	3,277	92	50,180	28,801	-	180				82,530
2. Abstracted Water										
Distributed water	92	357	4	2	2	3,585	13,357			17,398
For own use	3,277	92	50,180	-	-	180	637			54,366
<i>of which :Abstraction by households</i>	-	-	-	-	-	-	637			637
3. Wastewater and reused water										
Wastewater										
From other units				-	353					353
Own treatment	-	21	-	-	-	-	-			21
Reused water										
Distributed reuse	-	-	-	-	-	-	-			21
For own use	-	-	-	-	-	-	-			-
Total	-	21	-	-	353	-	-			375
4. Return flows of water										
To inland water resources										
Surface water										
Ground water										
Soil water										
Total									81,980	81,980
To other sources									283	283
Total return flows									82,263	82,263
<i>of which: Losses in distribution</i>										
5. Evaporation, transpiration, water incorporated into products										
Evaporation of abstracted water									-	-
Transpiration									-	-
Water Incorporated into products								267		267
Total Use	6,646	562	100,364	28,803	355	3,945	13,994	267	82,263	237,198

Note: - Not Available

1. Methodological Notes

The 2016-17 version of the Water Account is the latest compilation since the last one for 2014-15 financial years. There are significant improvements in all levels of water data used for this accounts with still room for improvement. The most challenging situation was the effort in trying to calculate estimates for the household water use supplied by the Independent Water scheme association as they are 100 percent unmetered. The old method still stands. Rain fed agriculture farming still cannot be estimated despite so much effort put into it, hence there is still a gap in agriculture water use. However, an experimental agriculture water use survey for commercial farms managed to capture a very small but limited amount of irrigation water use for raising crops. This will be a major follow up for the next water accounts.

2. Accounts Produced

Both 2015-16 and 2016-17 accounts are produced in this compilation with the 2016-17 the main focus and use 2015-16 accounts for comparison. Figure 2 shows a detail water flow diagram for 2016-17. Other financial periods flow diagrams are shown in the Appendices (A1-A3).

3. Data Sources and Methods

Data for Samoa's Water Accounts are sourced from different sources such as government ministries and corporations, water suppliers, businesses and existing surveys by the Bureau. The main sources are listed below in 3.1;

Population estimates and average household size (7.1 people) from the 2016 Population and Housing Census 2016 (PHC, 2016) were used for a range of calculations as tabulated in Table 7.

Table 7: Estimated population and number of households, 2013 to 2017

	2013	2014	2015	2016 (a)	2017
Population	190,652	192,067	193,483	195,979	197,611
Estimated no. of households (b)	26,653	27,052	27,251	28,880	29,120

Note:

- (a) Population and Housing Census year
- (b) Based on 7.1 people per household (PHC, SBS 2016)

3.1 Data Sources

Samoa Water Authority

- Water production by sources: 2015-16 and 2016-17
- Metered water supply by volume and value: 2015-16 and 2016-17
- Unmetered water by charge
- Wastewater produced and expenditure: 2015-16 and 2016-17
- SWA Annual report 2015-16

Ministry of Natural Resources and Environment (MNRE)

- Water Abstraction Licensing administrative records: 2015-16 and 2016-17

Electric Power Corporation (EPC)

- Hydroelectricity Production by source and volume
- Hydroelectricity water abstraction by month/financial year

Finance Statistics Division (GDP datasets)

- Estimates of livestock numbers
- Volume of water and beer beverages produced
- GDP estimates

Independent Water Scheme Association

- Number of independent water schemes and connections
- Estimates of water use based on expert opinion
- Manufacturing Water and Beer Beverages water use survey 2015-16 and 2016-17

Experimental Water Use Surveys

- Agriculture Water Use Survey for Commercial farms
- Water use survey for Water and Beverage companies

3.2 Methodologies for Estimating Water Supply and Use

a) Water Supply

Samoa Water Authority (SWA): Samoa Water Authority has an established administrative information dataset on production by sources of water (borehole or surface water). The authority also provided the customer water use datasets which was then classified by the Bureau into different industries using the ISIC R4 Classification.

The available information was used to calculate the amount of water abstracted from the environment, distributed to households and industries and return flows to the environment.

The following tables summarise the metered and unmetered water distributed by SWA for households and industries. (Tables 8 to Table 11)

Table 8: Samoa Water Authority – Metered Water Supply FY2013-14 to 2016-17

	2013-14	2014-15	2015-16	2016-17
	Cubic meters (m ³)			
Household Metered Supply				
▪ Upolu urban	2,638,757	2,940,847	2,994,433	3,660,867
▪ Upolu rural	2,323,974	3,027,456	3,065,581	3,159,498
▪ Savaii	1,334,987	1,395,675	1,642,506	1,797,337
▪ Total	6,297,718	7,363,978	7,702,520	8,617,702
Commercial Metered Supply				
▪ Upolu urban	1,402,429	1,484,897	1,703,959	1,872,127
▪ Upolu rural	452,741	454,395	511,312	572,334
▪ Savaii	231,895	234,972	242,205	238,641
▪ Total	2,087,065	2,174,264	2,457,476	2,683,102
Total SWA metered (m³)	8,384,783	9,538,242	10,159,995	11,300,805
Total SWA metered (ML)	8,384.78	9,538.24	10,159.99	11,300.81

Source: Samoa Water Authority

Water is also supplied to unmetered households and commercial operations but is not separately identified in the SWA Annual Report but is included as part of unaccounted water. Total water supply by SWA therefore includes both metered and unmetered components. Another component

of the unmetered water is water losses (e.g. leakages from pipes), also known as non-revenue water.

Table 9: Number of households supplied by SWA, metered and unmetered FY2013-14 to 2016-17.

	Unit	2013-14	2014-15	2015-16	2016-17
Upolu urban (June)					
■ Total no. of SWA households		7,519	9,675	10,020	10,503
- No. of SWA metered households	Households	6,973	6,151	7,423	7,916
- No. of SWA Unmetered households	Households	546	3,524	2,597	2,587
Upolu rural (June)					
■ Total no. of SWA households		7,391	9,413	10,065	10,555
- No. of SWA metered households	Households	7,081	5,797	7,063	7,264
- No. of SWA Unmetered households	Households	310	3,616	3,002	3,291
Savaii (June)					
■ Total no. of SWA households		3,901	5,088	5,645	5,797
- No. of SWA metered households	Households	3,811	3,319	4,282	4,506
- No. of SWA Unmetered households	Households	90	1,769	1,363	1,291
Samoa					
■ Total no. of SWA households		18,811	24,176	25,730	26,855
- No. of SWA metered households	Households	17,865	15,267	18,768	19,686
- No. of SWA Unmetered households	Households	946	8,909	6,962	7,169

Source: Samoa Water Authority

Using information on the number of households supplied by SWA but unmetered (Table 9) and the average amount of water used by households supplied but metered by SWA, an estimated average amount of water supplied by SWA to these unmetered households was derived.

These average estimates are tabulated in Table 10. The amounts estimated were added as part of total water supplied to households by the Samoa Water Authority (SWA).

Table 10: Estimated Unmetered Household Water Use, Supplied by SWA FY2013-14 to 2016-17.

	Unit	2013-14	2014-15	2015-16	2016-17
1. Water use by SWA metered households (from Table 8)	m ³	6,297,718	7,363,978	7,702,519	8,617,702
2. No. of SWA metered households (from Table 9)	Households	17,865	15,267	18,768	19,686
3. Av. water use by SWA metered households (Line 1/Line 2)	m ³ /Households	353	482	410	437
4. No. of SWA unmetered households (from Table 9)	Households	946	8,909	6962	7169
5. Estimated water use by SWA unmetered households (Line 3 x Line 4)	m ³	333,481	4,297,221	2,857,254	3,138,286
6. Estimated water use by SWA unmetered households (Line 5/1,000)	ML	333	4,297	2,857	3,138

Table 11 summarises the estimated volume of unmetered water used by different industries with their respective value by customer use data provided by SWA. The amount of water use by different industries was estimated by using the average metered water use for each individual industry.

Table 11: Estimated Unmetered Water Use by Industries and Households for SWA-2016-17

All Industry	\$\$SAT	Estimated _ML
Agriculture, Forestry and Fishing	444.0	13.6
Manufacturing, Mining & Quarrying and Construction	2,508.0	26.2
<i>Manufacturing</i>	908.0	18.7
<i>Construction</i>	1,600.0	7.5
<i>Mining & Quarrying</i>	0.0	0.0
Electricity, Gas and Air Condition Supply	0.0	0.0
Water Supply, Collection & Treatment	0.0	0.0
All Other Industries	22,720.0	186.7
<i>Real Estate, Rental and Leasing Activities</i>	6,984.0	59.5
<i>Education</i>	3,288.0	35.5
<i>Accommodation and Food Services</i>	1,916.0	23.6
<i>Other Service Activities</i>	2,548.0	19.9
<i>Wholesale & Retail Trade</i>	3,888.0	16.0
<i>Arts, Entertainment & Recreation</i>	1,520.0	10.8
<i>Public Administration & Defense</i>	800.0	7.8
<i>Human Health and Social Work</i>	240.0	6.7
<i>Administrative and Support Service Activities</i>	1,392.0	5.4
<i>Transportation and Storage</i>	160.0	2.3
<i>Waste management</i>	384.0	1.4
Total Industry	26,072.0	228.8
Households	392,484.0	3,138.3
Total	418,556.0	1,058.2

Source: Samoa Water Authority & Samoa Bureau of Statistics

Independent Water Scheme (IWS) The IWS previously estimated that 17% of the total population receives water via their system. However, the Population and Housing Census 2016 indicated that around 77% of households receive water from SWA supply with 12% been supplied by IWS. The remaining 11% are supplied by other means such as springs, rainwater harvesting, wells and water truck.

Little primary data are available and estimates of water use were made using data on SWA average water use by households and assumptions based on expert opinion about patterns of water use.

With regards to the patterns of water use, the efficiency tends to improve from previous accounts to the current one. The excess use which was around four times the amount used by SWA metered customers in 2011-2014, closely related to old and leaky systems as well as households having some wasteful water use practices since they are all unmetered connections.

The recent advice from IWS stated a positive change, which saw the estimated water use for IWS customers to be less than two times the amount used by SWA household metered water use, i.e. a 15% improvement from 2013-14. The latest upgrades to their system lines and the effectiveness of their awareness programs at the community level to combat wasteful water use practices are the major contributing factors.

Table 12: Estimated Unmetered Household Water Use, Supplied by IWS FY2013-14 to 2016-17.

	Unit	2013-14	2014-15	2015-16	2016-17
1. Average water use by SWA metered households	m ³ /Households	353	482	410.4	437.8
2. Estimated no. of households supplied by IWS (a)	Households	4,599	4,633	3,466	3,494
3. Estimated water use by households supplied by IWS (Line 1 x Line 2) (b)	m ³	6,484,618	4,469,121	2,417,921	2,600,492
4. Estimated water use by households supplied by IWS (Line 3/1,000)	ML	6,485	4,469	2,418	2,600

Note:

- (a) 17% of total population was applied for 2013-14 to 2014-15, while new census coverage of 12% applied to 2015-16 to 2016-17
- (b) Four times the average SWA Household metered use in 2013-14, two times in 2014-15 and for 2015-16 to 2016-17, an improvement of 15% from previous year or 1.7 times the average SWA household average metered water use.

Water supplied for industry use was assumed to be 5% of IWS household supply for each year. Water losses by IWS were assumed to be the same percentage as reported by SWA for each year. Total abstraction by IWS was calculated as the amount supplied to households and industry plus the amount of losses (Table 13.)

Table 13: Estimated Water Supply, Water Losses and Water Abstraction by IWS FY2013-14 to 2016-17 (ML)

	2013-14	2014-15	2015-16	2016-17
Estimated water use by households supplied by IWS	6,485	4,469	3,425	3,684
Estimated water use by industry supplied by IWS	324	223	171	184
Estimated losses by IWS	13,754	4,282	3,297	2,493
Estimated abstraction by IWS	20,564	8,975	6,893	6,361

b) Agriculture

Agricultural Crops: Obtaining data for rain fed agriculture is still the major challenge for this account because of very limited data from relevant ministries and agencies. A mini survey using paper questionnaire was introduced to capture the water use by semi-commercial and commercial farming but few were able to provide feedback before the account compilation.

The result is included in all water supply and use for the whole of agriculture industry. The survey objective was to capture the following data items from Agriculture;

- Self-abstracted water by source
- Water use by source of water
- Water use by type of agricultural activity (livestock, crops etc.)
- Distributed water use & distributed re-use water
- Wastewater produced by agricultural activity
- Treatment of Wastewater produced
- Expenditure on water use and water related costs

Livestock: As information on all types of livestock was not available for all years, a range of data sources and methods were used to generate estimates. The latest Agriculture Survey 2015 was used and livestock estimates from GDP production for the years without an Agriculture census or survey. All these numbers were used to calculate and estimated water use by livestock for the account period.

Those numbers were used together with FAO coefficients on water requirement for each livestock animal to generate estimates for livestock water use. Table 14 tabulates livestock numbers with FAO water requirement for each animal.

Table 14: Livestock Numbers and Daily Water Requirement used to estimate water use FY2013-14 to 2016-17

Livestock	2013-14 (a)	2014-15 (a)	2015-16 (b)	2016-17 (b)	Daily water requirement used
	Numbers				Liters
Cattle (c)	26,667	56,504	58,834	62,597	75
Horses	1,259	1,259	1,259	na	45
Pigs	144,643	168,597	170,046	172,981	23
Chickens	307,060	513,260	535,711	583,601	0.30
Sheep and goats	658	827	451	494	18

Source: FAO AGRI FACTS Water Requirements for Livestock (Upper limit)

http://www.fao.org/prods/gap/database/gap/files/1342_WATER_REQUIREMENTS_LIVESTOCK.PDF

Note:

- (a) Livestock numbers from Agriculture Survey 2015
- (b) Samoa Bureau of Statistics (Livestock numbers from GDP production)
- (c) Beef cattle requirement used.

Estimates of livestock water use in megalitres are shown in Table 15.

Table 15: Estimated Water Use by Livestock FY2013-14 to 2016-17 (ML)

	2013-14	2014-15	2015-16	2016-17
Cattle-beef	730	1,547	1,611	1,714
Pigs	1,214	1,415	1,428	1,452
Chickens	34	56	59	64
Horses, sheep and goats	25	31	29	24
Total	2,003	3,045	3,127	3,254

The Samoa Water Authority customer use data was used to extract data on distributed water use for agricultural activities. These include the distributed water to livestock farming, some fishing activities and crops and forestry nursery sites. The classification of these activities based on ISIC R4 is still a development process to be improved for the next accounts.

Fishing: Water use for fishing activities was limited to supply water for few of the fishing companies around Apia area. The supplied water information from SWA was used to compute the amount used by the fishing industry.

c) Manufacturing & Construction

Water abstraction from the environment was calculated from both the Water Abstraction Licensing administrative data by the Ministry of Natural Resources and Environment (MNRE) and results of a mini survey conducted for the Water and Beverage Manufacturing companies.

- The water use survey conducted for the water and beverage companies was able to account for the self-abstracted water by source, main source of water for production and wastewater produced and treatment.
- The amount incorporated into products was consulted with the GDP production datasets before it was used in the account.
- Water supply and use were estimated from Samoa Water Authority customer use data together with the mini survey results.

d) Electricity

- Hydroelectricity water use was provided by the Electric Power Corporation (EPC) while supplied water for cooling and other purposes by the industry was abstracted from the SWA customer use data. Table 16 tabulates a quarterly abstraction by stations.

Table 16: Hydro Electricity Water Abstraction FY2014-15 to 2016-17 (ML)

	Total Abstraction	Quarter 1	Quarter 2	Quarter 3	Quarter 4
2014-15					
Vaisigano	11,940	1,350	1,500	5,500	3,590
Lalomauga	34,520	6,340	9,030	9,730	9,420
Afulilo	28,800	7,220	6,260	6,930	8,390
Total	75,260	14,910	16,790	22,160	21,400
2015-16					
Vaisigano	7,090	1,310	3,000	1,160	1,620
Lalomauga	37,150	7,260	8,830	9,250	11,810
Afulilo	23,890	8,610	6,640	4,420	4,220
Total	68,180	17,180	18,470	14,830	17,650
2016-17					
Vaisigano	8,280	500	510	2,140	5,130
Lalomauga	23,770	4,640	6,830	9,050	3,250
Afulilo	18,130	4,780	4,250	4,880	4,220
Total	50,180	9,920	11,590	16,070	12,600

Source: Electric Power Cooperation (EPC)

e) Households

- SWA data on both metered and unmetered household water use was the primary source for this calculation. (Refer Tables 8-13)
- Proportions from SWA metered households were used to estimate the unmetered Households covered by Independent Water Scheme (IWS) as they are all unmetered supply.

Table 17: Total Estimates of Water Use by Households FY2013-14 to 2016-17 (ML).

	2013-14	2014-15	2015-16	2016-17
Estimated water use by households supplied by SWA	6,631.2	11,661.2	10,566.8	11,756.0
<i>Metered</i>	6,297.7	7,363.98	7,709.6	8,617.7
<i>Unmetered</i>	333.5	4,297.2	2,857.2	3,138.3
Estimated water use by households supplied by IWS	6,484.6	4,469.1	2,417.9	2,600.5
Estimated water use by households self-abstracted	476.8	657.2	588.8	637.4
Total Estimated water use by households	13,592.6	16,787.5	13,573.7	14,993.9

f) Other Industries

SWA data was the primary source for the amount of water supplied and used by all other industries. The customer use datasets was classified into different industries using the ISIC R4 Classification.

Water losses by the main suppliers are estimated in the amount of the water that was abstracted from the environment

Water Loss Management – SWA continues to face a challenge in reducing its level of unaccounted water.



The Authority uses the term Non-Revenue Water (NRW) to classify this issue because of its impact on the revenue generating capacity of the Authority. Such losses are classified into three (3) components.

1. **Real Losses** : leakages from distribution network through aging assets, leaking connections and overflows from storage tanks
2. **Apparent Losses**: commercial losses from illegal connections, customer meter under registration and data handling errors
3. **Unbilled Authorized Consumption**: water used by the Authority for operational purposes, firefighting and water carting.

Source: Samoa Water Authority Annual Report 2015-16

4. Wastewater Treatment Plant

The Wastewater Treatment Plant operated by SWA is used mainly by some industries and government properties around the Apia business area. There are no households connected to the system so data on household wastewater cannot be calculated.

Table 18 summarises the volume of wastewater produced by each industry and the expenditure spent on using the treatment service. Expert advice from SWA estimated that 10% of wastewater inflows return to the environment via evaporation, while 90% of inflow is part of the sewerage sludge which is transported to Tafaigata Landfill after treatment.

Table 18: Wastewater Inflow to Wastewater Treatment Plant by Volume and Charge FY2014-15 to 2016-17

	Megalitres (ML)			Charge (\$SAT)		
	2014-15	2015-16	2016-17	2014-15	2015-16	2016-17
Agriculture and Fishing	4.9	3.5	2.5	9,374.0	5,714.5	2,166.0
Manufacturing	1.2	0.7	0.7	2,118.0	1,474.5	2,432.5
Other Industries	326.7	366.3	350.2	633,598.0	924,783.2	1,728,860.7
<i>Public Administration and Defense</i>	114.6	129.9	128.5	224,730.0	325,865.6	658,785.1
<i>Wholesale and Retail Trade</i>	70.6	79.5	63.3	134,559.0	208,201.6	298,319.3
<i>Accommodation and Food Services</i>	50.8	57.8	83.8	98,941.0	134,196.0	399,937.9
<i>Financial and Insurance Services</i>	50.5	58.1	40.1	99,349.0	160,886.1	223,939.8
<i>Other Service Activities</i>	12.4	11.0	10.6	23,417.5	25,988.1	42,672.2
<i>Education</i>	9.2	10.1	7.1	17,848.0	22,616.4	28,435.7
<i>Human Health & Social Work</i>	7.9	9.3	5.9	15,581.5	24,990.5	32,142.4
<i>Arts and Entertainment</i>	7.2	8.0	7.7	13,286.0	16,656.4	32,999.7
<i>Professional, Scientific and Tech. Activities</i>	2.2	1.6	1.2	3,867.0	3,160.0	4,350.9
<i>Activities of Extraterritorial Organizations</i>	0.8	0.5	0.5	1,305.5	1,022.0	1,620.5
<i>Information and Communication</i>	0.4	0.6	1.4	713.5	1,200.5	5,657.2
Total	332.8	370.5	353.4	645,090.0	931,972.2	1,733,459.2

Source: Samoa Water Authority

5. Conclusion and Way Forward

The physical supply and use account for Samoa has progressively improved since its first ever edition published in 2015, in terms of data coverage and the quality of available information.

The application of the accounts and its usefulness for policy and decision making will come as the accounts will be produced consistently over the years. There is great opportunity for self-learning and building the team capacity that will surely enhance the production of the accounts for the next financial periods.

Further improvement in terms of access to primary data and quality of information, can be achieved through better data sharing between the Bureau and key stakeholders.

6. Feedback on the Accounts

The accounts will be improved significantly as we keep publishing series of water accounts over the years and any feedback provided will further enhance that. The bureau will be very pleased to receive any form of feedback on any issue or account related matters, for future improvements.

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8. References

Electric Power Corporation. EPC *Hydroelectricity Water Usage* 2017.

Food Agriculture Organisation. Water requirement Livestock. Available URL (http://www.fao.org/prods/gap/database/gap/files/1342_WATER_REQUIREMENTS_LIVESTOCK.PDF)

Independent Water Scheme. *Estimated water use by Industry and Household 2011-2015*.

Samoa Bureau of Statistics. 2016. *Population and Housing Census 2016 Analytical report*. Available URL (<https://www.sbs.gov.ws/populationanddemography>)

Samoa Bureau of Statistics. 2017. *Gross domestic product report*. Available URL (<http://sbs.gov.ws/index.php/new-document-library?view=download&fileId=1492>)

Samoa Bureau of Statistics. *Agriculture Census 2009*. Available URL (<https://www.sbs.gov.ws/digi/2009Census%20&%20SurveyAgriculture%20Census%20%20Analytical%20Report.pdf>)

Samoa Bureau of Statistics. *Agriculture Water Questionnaire 2015-16 and 2016-17*

Samoa Bureau of Statistics. *Samoa Agriculture Survey 2015*. Available URL (<https://www.sbs.gov.ws/digi/2015%20Samoa%20Agricultural%20Survey.pdf>)

Samoa Bureau of Statistics. *Water and Beverage Companies Water Questionnaire 2015-16 and 2016-17*

Samoa Water Authority. 2016. *Annual Report 2015-16*

Samoa Water Authority. *Samoa Water Authority Supplied Water Use by Industries and Household Data 2011-17*

Samoa Water Authority. *Samoa Water Authority Wastewater Data 2011-17*

United Nations et al. 2013. *System of Environmental-Economic Accounting Central Framework*. United Nations New York. Available URL (https://seea.un.org/sites/seea.un.org/files/seea_cf_final_en.pdf)

9. Appendices

A1: Physical Supply Table for 2015-16 (ML)

Physical Supply Table 2015-16	Agriculture, Livestock & Fishing	Manufacturing & Construction	Electricity	Water Collection, Treatment and Supply	Sewerage	Other Industries	Households	Imports	Flows from the Environment	Total Supply
1. Sources of abstracted water										
Inland water resources										
Surface water									93,335	93,335
Ground water									7,912	7,912
Soil water									-	-
Total									101,247	101,247
Other water sources										
Precipitation									589	589
Total									589	589
Total abstracted water									101,836	101,836
2. Abstracted Water										
For distribution				16,697				-		16,697
For own use	3,127	84	68,130	589	-	180				72,109
of which: Abstraction by Households	-	-	-	589	-	-				589
3. Wastewater and reused water										
Wastewater										
Wastewater to treatment	4	1	-	-	-	366	-			371
Own treatment	-	19	-	-	-	-	-			19
Reused water										
For distribution	-	-	-	-	-	-	-			-
For own use	-	-	-	-	-	-	-			-
Total	3	20	-	-	-	366	-			389
4. Return flows of water										
To inland water resources										
Surface water	-	-	68,130	-	-	-	-			68,130
Ground water	3,206	231	1	13,032	74	3,118	13,574			33,226
Soil water	-	-	-	-	-	-	-			-
Total	3,206	231	68,131	13,032	74	3,118	13,574			101,356
To other sources	-	16	-	-	296	-	-			313
Total return flows	3,206	247	68,131	13,032	371	3,118	13,574			101,668
of which: Losses in distribution	-	0	-	13,032	-	-	-			12,032
5. Evaporation, transpiration, water incorporated into products										
Evaporation of abstracted water	-	-	-	-	-	-	-			-
Transpiration	-	-	-	-	-	-	-			-
Water Incorporated into products	-	167	-	-	-	-	-			167
TOTAL SUPPLY	6,336	518	136,261	30,318	371	3,665	13,756	-	101,836	292,868

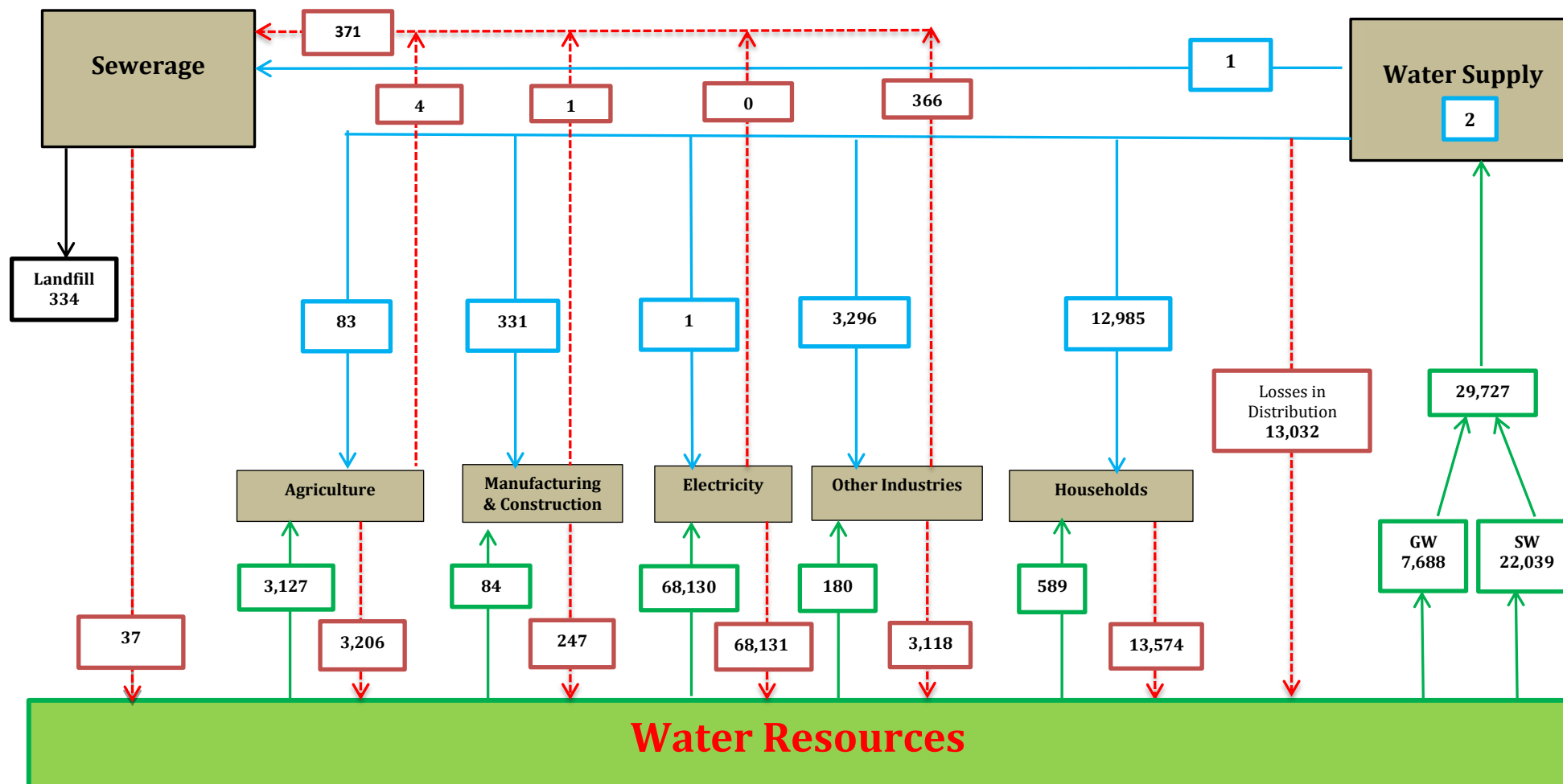
A2: Physical Use Table for 2015-16 (ML)

Physical Use Table 2015-16	Agriculture, Livestock & Fishing	Manufacturing & Construction	Electricity	Water Collection, Treatment and Supply	Sewerage	Other Industries	Households	Accumulation	Exports	Flows to the Environment	Total Use
1. Sources of abstracted water											
Inland water resources											
Surface water	3,127	39	68,130	22,039	-	-					93,335
Ground water	-	44	-	7,688	-	180					7,912
Soil water	-	-	-	-	-	-					-
Total	3,127	83	68,130	29,727	-	180					101,247
Other water sources											
Precipitation	-	1	-	589	-	-					589
Total	-	1	-	589	-	-					589
Total abstracted water	3,127	84	68,130	30,316	-	180					101,836
2. Abstracted Water											
Distributed water	83	331	1	2	1	3,296	12,985		-		16,697
For own use	3,127	84	68,130	-	-	180	589				72,109
of which: Abstraction by Households	-	-	-	-	-	-	589				589
3. Wastewater and reused water											
Wastewater											
From other units				-	371				-		371
Own treatment	-	19	-	-	-	-	-				19
Reused water											
Distributed reuse	-	-	-	-	-	-	-				-
For own use	-	-	-	-	-	-	-				-
Total	-	19	-	-	371	-	-		-		389
4. Return flows of water											
To inland water resources											
Surface water											
Ground water											
Soil water											
Total										101,356	101,356
To other sources										313	313
Total return flows										101,668	101,668
of which: Losses in distribution											
5. Evaporation, transpiration, water incorporated into products											
Evaporation of abstracted water										-	-
Transpiration										-	-
Water Incorporated into products								167			167
TOTAL USE	6,336	518	136,261	30,318	371	3,656	13,574	167	-	101,668	292,868

Note: 1ML = 1,000 Cubic meters (m³)
1 m³ = 1,000 Litres (L)

A3: Major Water Flows in Samoa 2015-16_Megalitres (ML)

Key → Flows from the Environment → Water from other economic unit - - -> Return Flows of Water GW-Groundwater SW-Surface Water



Note: 1 ML = 1,000 Cubic Meters (m³)
1 m³ = 1,000 Liters (L)