reservoir is,therefore, estimated to be 4089 m^3/year and dead volume of the reservoir reaches 0.29 MCM (100 year).

2.5 Geology

2.5.1 General

Geological investigations were executed for all the conceivable alternative project sites such as G1 (Guibies), MO4 (Baptiste), TRO, NWO, TR9 and CA2 sites for the comparative study on the alternative schemes. Then, further detailed geological investigation was executed on the selected scheme (TRO site).

The above geological investigations and findings including all other alternative sites are detailed in Appendix-B.

This section presents the geological conditions of the selected scheme (TRO site) on which further detailed investigation was executed. The geological investigations carried out for TRO site are 870 m (8 holes) of core drilling with field permeability tests and 1,370 m (7 lines) of seismic exploration, including the investigation carried out at the stage of comparative study on the alternative schemes. Some quantities of geological investigation were made at the proposed rock quarry site. The investigations performed at the quarry site are 60 m of core drilling and 830 m of seismic exploration.

Figs.2.5.1 to 2.5.2 show the location map of geological investigations. Figs.2.5.3 to 2.5.4 show the geological map of TRO damsite and reservoir area. Fig.2.5.5 presents the geological profile of damsite obtained through the investigation. Drill core logs in TRO damsite are given in Figs.2.5.6 to 2.5.13. As for all other details, reference is made to Appendix-B.

2.5.2 Topography and General Geology

The main rivers in the study area flow westward or northwestward in the upper and middle reaches, and they join at the downstream to change the name to be Ground River North West (G.R.N.W), which direct to the north in a straight to the Ground River Bay. The rivers meander frequently in the upper and middle reaches and they form very deep gorges in the downstream reach by dissecting gentle plateau, which is underlain by the young volcanic series. The area of the study basin is bounded by high mountain ranges, which are composed of the old volcanic rocks, in the northern and eastern parts. The eastern water shed is in the high lands from which many rivers rise in radial directions.

The TRO damsite is situated at about 6 km from the estuary of G.R.N.W (the Ground River Bay). Just downstream of the TRO damsite G.R.N.W starts after the confluence between the Terre Rouge river and the Plaines Wilhems. The damsite is situated in the straight section between two confluences; one is the starting point of G.R.N.W at the downstream side and the other is between the Terre Rouge river and the Profonde river. The proposed dam will be embanked in a deep gorge with the difference of height of 130 m; the elevation of top of the steep river bank is about 250 m and the riverbed at 120 m.

Along the riverbed there are continuous outcrops of the old volcanic series overlain by the young volcanic rocks in the lower slope of the river bank. The damsite has an unsymmetrical shape of triangle with steeper slope on the right bank. Several layers of the young volcanic lavas are seen in the river bank slopes.

The rock quarry site is situated in the mountain ranges at about 1 km south to the damsite. This mountain range is composed of densely consolidated old volcanic rocks. The mountain range is outstanding from the surrounding gentle plains.

2.5.3 Dam Foundation Rock

The upper parts of TRO dam foundation is composed of basaltic vesicular lavas and doleritic less vesicular lavas. The vesicles of these rocks are empty and fresh in general but some vesicles are filled up with whitish tuffaceous materials in the relatively deeper parts. The bottom part of the dam foundation is composed of basaltic vesicular lavas of the old volcanic rocks, of which vesicles are filled up with zeolite crystals.

Weathering is developed more on the basaltic vesicular lavas than dorelitic lavas in general. The weathering is developed irregularly without close relation with the depth from the ground surface. Drilled core recovery is very high, nearly 100 % generally except for the section without core recovery. Sections without core recovery are seldom encountered. These sections are located ,if any,in intensively weathered parts for less than 1.0 m in length. The sections without core recovery are not considered directly to be lava tunnels or cavities, because these sections coincide with intensively weathered zones. The main cause of existence of sections with no core recovery is considered to be the washing out of the intensively weathered materials during drilling. Moreover, the permeability coefficients of the sections without core recovery are in the order of 10^{-4} cm/s to 10^{-5} cm/s. This permeability test results indicate that the sections without core recovery do not coincide with predominant cavities.

RQD of the recovered core samples is relatively good in the old volcanic rocks but it ranges largely from 0% to 100% in the young volcanic rocks. This result implies that long cylindric cores are recovered from the old volcanic rocks but short cores and fragmental core are frequently extracted from the weathered section of the young volcanic rocks.

Core samples from the boreholes at the TRO damsite are classified into CH to CM class rocks in the old volcanic series and CM to CL in the young volcanic series. The adapted rock classification is based on the

six grades of rock classification depending on the rock condition of weathering and strength from strong to weak for a dam foundation rocks. CH to CL classes are considered to withstand the designed rock-fill type dam.

Uniaxial compressive strength of the drilled core samples ranges from 72.4 kg/cm^2 to more than 1275 kg/cm^2. Relatively low strength was measured on the core sample of the vesicular lavas. The bulk density of the sample is 2015 kg/m^3, indicating lowest values among the obtained samples. The values for other samples are more than 334 kg/cm^2 of uniaxial compressive strength and more than 2464 kg/m^3 of bulk density. The obtained values show sufficient strength for the dam designed.

Seismic exploration by refraction method was conducted at the damsite for several observation lines aligned in parallel and at right angle to the dam axis. The main purpose of the seismic exploration is to prepare velocity profiles of p-waves of the sub-surface zones. Development of weathering and geological discontinuities are able to be interpreted from obtained velocity profiles. The seismic exploration will supply supplemental geological information in connection with data obtained from each borehole. The confirmed velocities of the foundation rocks are 2.0 km/s to 2.3 km/s and 2.5 km/s to 3.0 km/s in the young volcanic rocks. Higher velocity of 4.0 km/s to 4.3 km/s is measured in the old volcanic rocks.

The obtained velocities seems to indicate normal condition of the foundation rocks. Lower velocities will be obtained if there are frequent spaces in the foundation rocks. Rather thick talus deposits and scree deposits are interpreted by seismic exploration and core drilling on the left abutment slope. The development of these materials is 10 m to 15 m at maximum. Low velocity zones are interpreted along one observation line but they are not interpreted along other observation lines. The measured low velocity zones are considered to be minor faults or disturbed zones or local development of weathering.

Lugeon test was carried out in boreholes by single packer method at every 6 m interval in a general rule. The measured permeability of the foundation rocks of the TRO damsite ranges from Lu=0.1 ($K=1.3\times10^{-6}$ cm/s) to Lu=68 ($K=9.6\times10^{-4}$ cm/s), generally falling in Lu=5 to Lu=20, which are in the lower range of $K=10^{-4}$ cm/s to 10^{-5} cm/s. The confirmed impermeability is sufficient for the foundation rocks of the designed rock-fill type dam.

The correlation between the yielded pressure and the amount of water leakage during Lugeon test is drawn as P-Q curves. If there is a clear refracting point on the curve, the pressure at the refracting point is called as critical pressure. The ciritical pressure indicates the maximum tolerable pressure for the foundation rocks. Though clear critical pressures are not found in the obtained P-Q curves, dam foundation rocks seem to be compact condition even in the parts including weathered portions.

In this investigation core drilling was concentrated on the area along the dam axis because a certain amount of investigation is allocated to the investigation for the water tightness of the rocks surrounding dam reservoir, and core drilling was not conducted at the major structure sites such as spillway, diversion tunnel and intake structure. Almost the same geological condition as confirmed along the dam axis is expected at the major structure sites, because the geological condition of the damsite is rather simple; the young lava bands strike nearly east and west and dip about 5 deg. to 10 deg. to the north and the northwest; the young volcanic rocks overlie the old volcanic rocks at elevation near the riverbed.

2.5.4 Engineering Geology

The foundation rocks of the TRO dam site are relatively in favorable condition. Although weathering is developed even in the deeper parts occasionally, the measured permeability of the foundation rocks is in rather low ranges. The foundation treatment can be performed appropriately by normal grouting which will improve into the

necessary permeability coefficient of $K=10^{-5}$ cm/s or less. The young volcanic rocks will withstand the designed rock-fill type dam without any serious problem. Grout gallery will be required to provide for unexpected grouting which may be necessary under some circumstances.

The rather thick talus deposits and scree deposits develop on the left abutment and the some extent of the young volcanic rocks underlying these deposits is highly weathered. These talus deposits, scree deposits or highly weathered young volcanic rocks should be removed for the foundation of the impervious core of rockfill dam, and therefore, the excavation depth of cut-off trench will be 10 m to 15 m on the left abutment. On the other hand, the slope of the right bank is overlain by talus deposits and scree deposit for 0 m to 5 m. Thus, the cut-off trench excavation depth of the right abutment will be about 5 m in average.

Observation of the groundwater tables in drilled boreholes had been continued in the investigation period. The groundwater table lines in the areas of the dam abutments and in surrounding areas of the reservoir decrease gradually to the damsite from the points assumed to be groundwater sources. Though there are no abnormal features in groundwater tables, predominant developments of the cavities and spaces are not expected in the concerned area.

2.5.5 Water Tightness of Damsite and Reservoir Area

The previous studies, especially the investigation report for the Soreze damsite located at about 1.0 km downstream of TRO damsite, point out the possibility of a lava tunnel or lava tube to cause an excessive leakage in the area or the possibility of an excessive leakage due to high permeability even without a lava tunnel or lava tube.

Therefore, paying a special attention for this matter, the detailed investigation and examination were made as described in Appendix-B. As seen in Appendix-B, the above investigation and examination come to a judgement that such a lava tunnel or tube as to cause an excessive

leakage is not likely to exist in the damsite or reservoir area. The examination also indicates that the damsite and reservoir area would be sufficiently water-tight. However, in some parts of the examination on the lava tunnel or tube, reliance is based mainly on visual inspection in field. Although the visual inspection in field was carefully carried out by paying a particular attention to the signs which should appear in the presence of lave tunnel or tube, it would still be insufficient due to thick vegetation or inaccessibility of the steep slope. Therefore, for a further detailed confirmation, it is noted that a very detailed field reconnaissance in the reservoir area should be carried out at the next detailed design stage by providing footpaths. It is also recommended to search for the presence of lava tunnels or tubes in the damsite by excavating test adits in both abutments of the damsite.

2.6. Construction Materials

2.6.1 General

The objectives of the construction material investigation were (1) to find adequate material sources of fill material for rockfill dam and concrete aggregate, (2) to estimate available quantity, and (3) to evaluate quality of the construction materials for Port Louis Water Supply Project.

The requirement of construction materials for the dam and related structures is estimated as follows:

(A)	Fill Material	
	1) Core	230,000 m^3
	2) Filter	100,000 m^3
	3) Rock	1,200,000 m^3
(B)	Concrete Aggregate	
	1) Fine	15,000 m^3
	2) Coarse	20,000 m^3

The results of construction material investigation are provided hereunder.

2.6.2 Construction Material Sources

(1) General

Taking into account the material requirement mentioned above, material investigation on fill material and concrete aggregate was carried out in the surrounding areas of the proposed damsite. The investigation areas are shown on Fig.2.5.2.

(2) Earth Borrow Area

Earth borrow areas S-3,5,7,8,9 and 10 were investigated for the possibility of core material sources by reconnaissance, test pitting and laboratory tests. Location and obtainable material of each borrow area are described below.

(a) Earth Borrow Area S-3

It is located at 0.8 km east from proposed damsite. The material consists of silty clay, and it is of a dark brown to reddish brown color.

(b) Earth Borrow Area S-5

It is located at 1.2 km southeast from proposed damsite. The material consists of clayey soil encountered with rock, and it is of a dark brown to reddish brown color.

(c) Earth Borrow Area S-7

It is located at 1 km south from proposed damsite. The material consists of clayey soil, and it is of a dark brown to reddish brown color.

(d) Earth Borrow Area S-8

It is located at 1.7 km south from proposed damsite. The material consists of almost the same material as earth borrow area S-7.

(e) Earth Borrow Area S-9

It is located at 2.6 km southeast from proposed damsite. The material consists of clayey soil, and it is of a dark brown color.

(f) Earth Borrow Area S-10

It is located at 3 km southeast from proposed damsite. The material consists of clayey soil, and it is of a dark brown color.

All the materials mentioned above are composed of residual soil originated from deteriorated basalt and agglomerate, and usable depth of those borrow areas are estimated about 3 to 4m in average.

(3) Quarry Site

Natural sand and gravel material is not available in the vicinity of the proposed damsite, therefore filter material and concrete aggregate must be produced from quarried rock from the massive basalt in the quarry site, which is located 1 km north of the proposed damsite.

Rock material in the shell zone of the rockfill dam will be obtainable from this quarry site, as the available quantity is much larger than its requirement. Quality of the rock was confirmed by core drilling at 2 sites of Q-(1) and Q-(2) (refer to Fig.2.6.1) and laboratory test. The rock in the quarry site is hard, fresh and durable. Boring logs at those sites are shown in Appendix B; Geology.

2.6.3 Laboratory Tests

All samples taken at prospective borrow areas and quarry site were tested in the Laboratory of University of Mauritius School of Industrial Technology during the period from October 1988 to January 1989.

(1) Test Method

In principle, the laboratory test was carried out in the aforementioned laboratory in accordance with American Society for testing and Materials (ASTM).

(2) Test Results

(a) Core Material

Table 2.6.1 indicates that the materials of all borrow areas are basically suitable for core material of the rockfill dam, because their soil properties satisfy the criteria of core material such as plasticity index (>13%) except some samples, imperviousness ($K<5x10^{-5}$ cm/sec) etc.

Outline of test results of the core material is as follows:

Specific gravity	:	2.8 to 2.8, *(2.9)
Plasticity index	:	13 to 17%, *(16%)
Natural moisture content	:	37 to 50%, *(41%)
Optimum moisture content	:	29 to 36%, *(32%)
Maximum dry density	:	1.3 to 1.5 tf/m^3, *(1.4 tf/m^3)
Cohesion (Total stress)	:	0.8 to 1.4 kgf/cm^2, *(1.1 kgf/cm^2)

(Effective stress)	:	0.4 kgf/cm^2, *(0.4kgf/cm^2)
Angle of internal friction		
(Total)	:	7 to 22 deg., *(13 deg.)
(Effective stress)	:	31 to 33 deg., *(32 deg.)
Coefficient of permeability	:	1x10^{-5} to 5x10^{-7} cm/sec, *(1x10^{-5} to 1x10^{-7} cm/sec)

*( ): shows test results of material samples at S-3 and S-5.

Detailed test results are shown in Table 2.6.1 and Figs. C.2 to C.5 in Appendix-C.

(b) Filter and Concrete Aggregate

Four samples of sand and gravel materials were purchased from a local supplier. Laboratory tests such as specific gravity and absorption, unit weight, particle size, abrasion loss by Los Angeles machine etc. were carried out in the said laboratory. Test results of them are shown in Table 2.6.2 and Fig.C.6 in Appendix-C.

(c) Rock Material

Laboratory test of rock materials taken at said quarry site by core drilling Q-(1) was carried out. Test results are summarized in Table 2.6.3. This table suggests that hard rock can be obtained from the massive basalt lava and comparatively hard rock can be obtained from agglomerate strata in the quarry site.

2.6.4 Conclusions and Recommendations

(1) Fill Material

Based on the field investigation and laboratory test results, quality, available quantity and effective utilization of construction materials such as core, filter, shell materials and concrete aggregate were studied. Conclusions and recommendations are given below:

(a) Core Material

Adequate core material is obtainable qualitatively and quantitatively at the earth borrow areas S-3,5,7,8,9 and 10.

Out of these 6 borrow areas, S-3 and S-5 are considered to be the most suitable borrow areas, because they are very close to the damsite, and adequate material can be obtained and its available quantity is assumed to be much more than required quantity of the core material.

Natural moisture content is about 3 to 15% and the wet side of optimum moisture content over the whole borrow area. Therefore, drying will be necessary to obtain suitable properties as a core material such as high dry density and high shear strength, low coefficient of permeability and sufficient trafficability.

To reduce moisture content of the residual soil, seepage water and capillarity of the ground water must be stopped by deep trench cutting or other methods.

It is recommended that field work on the core material be carried out during dry season to maintain an appropriate moisture content.

(b) Filter Material

Sand and gravel materials taken from a local supplier were tested in the laboratory. These sand and gravel materials can be used for filter material and concrete aggregate. However, the supply capacity of the material by the supplier is judged to be insufficient. Consequently, it is recommended that all filter material and concrete aggregate be obtained by quarrying and crushing.

Suitable filter material and concrete aggregate can be obtained from the massive basalt in the quarry site, because the massive basalt is hard, fresh and durable enough.

(c) Rock Material

Bulk density, specific gravity, absorption, uniaxial compressive strength were obtained by the laboratory test. These results shown in Table 2.6.3 indicates that the rock taken in the borehole Q-(1) is suitable for rock material for the shell zone of the rockfill dam, because the compressive strength, specific gravity and bulk density is comparatively high except for some portions of the drilled core.

(2) Concrete Aggregate

As mentioned above, all concrete aggregate will be obtainable from quarried rock. Judging from the laboratory test results, suitable fine and coarse aggregates are obtainable from the the quarry site by crushing. Since a huge quantity of rock material will be obtained from the quarry site, only high quality rock should be used as concrete aggregate.

(3) Design Values of Fill materials

Design values of fill materials are assumed based on the construction material investigation. These are shown in Table 2.6.4.

TABLES

Table 2.1.1 POPULATION OF MAURITIUS BY 1983 CENSUS

Island	Both sexes	Male	Female
Total Mauritius	1,000,432	498,257	502,175
Island of Mauritius	966,863	481,368	485,495
Rodrigues	33,082	16,552	16,530
Agalega	350	200	150
St. Brandon	137	137	-

Source: 1983 Housing and Population Census of Mauritius
Vol II Demographic Characteristics, Central
Statistics Office, November 1984

Table 2.1.2 POPULATION OF ISLAND OF MAURITIUS AT EACH CENSUS

Census Year	Population enumerated at each census			(1) Sex ratio	Intercensal increase	Average annual rate of increase (%)
	Both sexes	Male	Female			
1846	158,462	104,598	53,864	194.2		
1851	180,823	119,341	61,482	194.1	22,361	2.68%
1861	310,050	202,961	107,089	189.5	129,227	5.54%
1871	316,042	193,575	122,467	158.1	5,992	0.19%
1881	359,874	208,655	151,219	138.0	43,832	1.31%
1891	370,588	206,038	164,550	125.2	10,714	0.29%
1901	371,023	199,552	171,471	116.4	435	0.01%
1911	368,791	194,095	174,696	111.1	-2,232	-0.06%
1921	376,485	194,108	182,377	106.4	7,694	0.21%
1931	393,238	200,609	192,629	104.1	16,753	0.44%
1944	419,185	210,326	208,859	100.7	25,947	0.49%
1952	501,415	252,032	249,383	101.1	82,230	2.26%
1962 (2)	681,619	342,306	339,313	100.9	180,204	3.12%
1972 (2)	826,199	413,580	412,619	100.2	144,580	1.94%
1983 (2)	966,863	481,368	485,495	99.1	140,664	1.44%

Remarks: (1) Number of males per 100 females
(2) de facto´ population

Source: 1983 Housing and Population Census of Mauritius, Vol II
Demographic Characteristics, Central Statistical Office, November 1984

Table 2.1.3 POPULATION OF PORT LOUIS DISTRICT BY SEX

Locality	Both Sexes	Male	Female
District of Port Louis	133,702	66,132	67,570
Port Louis Ward 1	24,052	11,874	12,178
Port Louis Ward 2	12,424	5,984	6,440
Port Louis Ward 3	25,388	12,558	12,830
Port Louis Ward 4	15,710	7,938	7,772
Port Louis Ward 5	20,704	10,221	10,483
Port Louis Ward 6	35,424	17,557	17,867

Table 2.1.4 POPULATION OF MAURITIUS BY GEOGRAPHICAL DISTRICT AND BY SEX

Geographical district	Area in sq. km	31st December 1983			31st December 1984			31st December 1985		
		Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female
Port Louis	42.7	135,629	67,321	68,308	136,812	68,019	68,793	138,272	68,951	69,321
Pamplemousses	178.7	91,782	46,070	45,712	92,706	46,557	46,149	93,647	47,239	46,408
Riviere du Rempart	147.6	82,188	41,215	40,973	83,035	41,752	41,283	83,856	42,246	41,610
Flacq	297.9	109,290	54,803	54,487	110,341	55,432	54,909	111,551	56,228	55,323
Grand Port	260.3	94,490	47,380	47,110	95,294	47,844	47,450	96,146	48,438	47,708
Savanne	244.8	59,611	29,918	29,693	60,051	30,173	29,878	60,610	30,553	30,057
Plaines Wilhems	203.3	308,015	153,229	154,786	310,160	154,729	155,431	313,025	156,800	156,225
Moka	230.5	62,024	30,934	31,090	62,488	31,279	31,209	63,028	31,679	31,349
Black River	259.0	37,470	18,826	18,644	37,895	19,079	18,816	38,336	19,383	18,953
Island of Mauritius	1864.8	980,499	489,696	490,803	988,782	494,864	493,918	998,471	501,517	496,954
Island of Rodrigues	104.0	33,472	16,723	16,749	34,652	17,460	17,192	35,284	17,892	17,392
Other islands	71.2	500	350	150	500	350	150	500	350	150
Mauritius	2040.0	1,014,471	506,769	507,702	1,023,934	512,674	511,260	1,034,255	519,759	514,496

Remarks: (1) Based on the 1983 population census data adjusted for underenumeration of young children.
No account has been taken of internal migration in computing these estimates.
(2) End of year estimates

Source: Digest of Demographic Statistic 1985, Central Statistical Office, August 1986

Table 2.1.5 MAURITIUS POPULATION AGED 15 YEARS AND ABOVE BY ACTIVITY STATUS AND SEX IN MAURITIUS ISLAND IN 1986

	1986		
	Male	Female	Both Sexes
Employed	238,000	106,000	344,000
Unemployed	37,000	18,000	55,000
Labour force	275,000	124,000	399,000
Inactive	64,000	219,000	283,000
Total	339,000	343,000	682,000

Source: 1983 Housing and Population Census of Mauritius (Island of Mauritius), Vol. IV Economic Activity Central Statistical Office, April 1987

Table 2.1.6 EMPLOYMENT (1) IN LARGE ESTABLISHMENTS BY MAJOR INDUSTRIAL GROUP FOR MARCH 1980 - MARCH 1987 PERIOD

Industrial Group	1980	1981	1982	1983	1984	1985	1986	1987
Agriculture and fishing	54,014	53,456	52,457	52,145	49,803	48,292	46,910	46,381
Sugar (2)	47,493	47,271	46,457	46,082	44,628	42,882	41,718	40,974
Tea (3)	4,963	4,582	4,747	4,613	3,643	3,508	3,173	3,133
Tobacco	857	729	275	239	263	384	424	455
Other	701	874	978	1,211	1,269	1,518	1,595	1,819
Mining and quarrying	145	147	147	160	164	164	198	171
Manufacturing	36,172	36,889	38,329	36,924	42,168	56,113	76,503	93,311
Electricity and water	4,639	4,430	4,451	4,231	4,084	3,914	3,635	3,688
Construction	8,144	7,257	5,659	4,525	3,971	4,771	5,001	7,191
Wholesale, retail trade, restaurants and hotels	9,297	9,122	9,129	9,070	8,882	9,251	9,573	10,583
Transport, storage and communication	8,987	7,842	8,147	7,963	8,219	8,408	8,611	10,097
Financing, insurance, real estate and business services	4,369	4,576	4,669	4,699	4,784	4,986	5,229	5,672
Community, social and personal services	62,712	62,822	64,008	63,388	62,887	62,991	63,020	63,292
Government:								
(a) Central	48,728	49,029	50,163	49,811	49,538	49,919	49,715	49,669
(b) Local (4)	5,389	5,522	5,536	5,265	5,217	5,109	5,187	5,188
Other	8,595	8,271	8,309	8,312	8,132	7,963	8,118	8,435
Activities not elsewhere specified	8,118	6,913	6,376	6,151	5,864	4,725	4,496	4,995
Grand Total	196,597	193,454	193,372	189,256	190,826	203,615	223,176	245,381

Remarks: (1) Classified according to the International Standard Industrial Classification, 1968 edition
(2) Including factories
(3) Including factories and Tea Development Authority
(4) Municipalities and district councils

Source: Bi-annual Survey of Employment and Earnings in Large Establishments, March 1987, Central Statistical Office, August 1987

Table 2.1.7 EMPLOYMENT IN EPZM BY INDUSTRIAL GROUP AND SEX (MARCH 1985 - MARCH 1987)

Industrial Group	March 1985			March 1986			March 1987		
	Males	Females	Both Sexes	Males	Females	Both Sexes	Males	Females	Both Sexes
Manufacturing	9,459	31,575	41,034	18,689	42,724	61,413	26,542	50,004	76,546
of which:									
Textiles	1,219	940	2,159	1,545	959	2,504	2,223	1,074	3,297
Wearing apparel (except footwear)	6,609	27,853	34,462	15,081	38,734	53,815	21,789	45,794	67,583
Wood and Furniture	267	98	365	278	90	368	269	92	361
Jewellery and related articles	504	248	752	602	291	893	637	347	984
Other	860	2,436	3,296	1,183	2,650	3,833	1,624	2,697	4,321
Other non-manufacturing	99	78	177	150	98	248	161	112	273
TOTAL	9,558	31,653	41,211	18,839	42,822	61,661	26,703	50,116	76,819

Source: Bi-annual Survey of Employment and Earnings in Large Establishments March 1987
Central Statistical Office, August 1987

Table 2.1.8 GROSS NATIONAL PRODUCT BY INDUSTRIAL ORIGIN AT CURRENT FACTOR COST

Unit: Rs. million

	1981	1982	1983	1984	1985	1986(1)	1987(2)
1. Agriculture, hunting, forestry and fishing	1,251	1,530	1,465	1,736	2,123	2,395	2,495
2. Mining and quarrying	16	17	18	19	20	22	25
3. Manufacturing	1,377	1,560	1,678	2,183	2,864	3,730	4,530
4. Electricity, gas and water	188	260	245	296	397	462	510
5. Construction	588	625	655	690	775	895	1,015
6. Wholesale & retail trade, and restaurants & hotels	1,219	1,290	1,455	1,640	1,834	2,210	2,420
of which Wholesale & retail trade	(1,004)	(1,050)	(1,180)	(1,340)	(1,494)	(1,805)	(1,950)
7. Transport, Storage and communications	997	1,112	1,230	1,372	1,510	1,700	1,875
8. Financing, insurance, real estate and business services	1,517	1,755	1,890	2,050	2,190	2,300	2,435
of which Ownership of dwellings	(1,085)	(1,270)	(1,360)	(1,460)	(1,535)	(1,580)	(1,625)
9. Producers of government services	1,104	1,275	1,327	1,379	1,447	1,565	1,885
10. Other services	502	596	650	685	720	766	830
Gross Domestic Product at factor cost	8,765	10,020	10,613	12,050	13,880	16,055	18,020
Net factor income from the rest of the world	-408	-498	-485	-626	-700	-729	-520
Gross National Product at factor cost	8,357	9,522	10,128	11,424	13,180	15,326	17,500

Remarks : (1) Revised
(2) Estimates

Source : Central Statistical Office, Government of Mauritius

Table 2.1.9 IMPORTS AND EXPORTS BY MAJOR COMMODITY GROUP

Unit: Rs. million

Imports (c.i.f Value)	1985	1986	1987 (1)	
			1st Qr.	2nd Qr.
Food and live animals	1,347.8	1,182.2	355.1	331.1
Beverages and Tobacco	25.9	33.7	9.2	12.8
Crude materials, inedible except fuel	394.5	365.8	79.8	123.1
Mineral fuels, lubricants and related materials	1,144.6	706.6	216.1	190.3
Animals and vegetable oils and fats	261.7	158.7	5.6	47.6
Chemicals	554.0	597.5	157.2	229.2
Manufactured goods classified chiefly by material	2,645.7	3,830.3	962.1	1,236.2
Machinery and transport equipment	1,114.3	1,583.4	504.5	610.9
Miscellaneous manufactured articles	624.3	732.8	197.6	229.4
Commodities and transactions not classified according to kind	6.3	8.0	7.4	0.8
TOTAL	8,119.1	9,199.0	2,494.7	3,011.4

Exports (f.o.b Value)	1985	1986	1987 (1)	
			1st Qr.	2nd Qr.
Sugar	2,866.6	3,553.0	1,054.6	866.6
Molasses	89.2	90.3	10.5	1.7
Tea	178.3	104.3	32.0	22.6
Export Processing Zone Products	3,272.2	4,950.5	1,197.3	1,617.2
Other	126.6	218.8	48.5	61.9
Re-exports	110.8	145.1	35.3	46.2
TOTAL	6,643.7	9,062.0	2,378.2	2,636.2
Bankers and Ships' Stores (f.o.b value)	379.0	350.0	85.3	105.8

Remarks: Figures may not add up because of rounding
(1) Provisional

Source: Central Statistical Office

Table 2.1.10 BALANCE OF PAYMENTS

Unit: Rs. million

Item	1981		1982		1983		1984		1985		1986 Revised	
	Credit	Debit	Credit	Debit	Credit	Debit	Credit	Debit	Credit	Debit	Credit	Debit
A.GOODS AND SERVICES	4,628	6,096	5,572	6,400	5,982	6,513	7,029	8,136	8,925	9,940	11,995	11,412
B.UNREQUITED TRANSFERS	211	64	424	53	374	80	466	75	632	76	755	85
C.CAPITAL(EXCLUDING RESERVES AND ITEMS)	238			118		435	163			73	35	
NON-MONETARY SECTORS	248		41			438	200		177		243	
MONETARY SECTORS		10		159	3			37		250		208
D.ALLOCATION OF SDRs	28											
E.RESERVES AND RELATED ITEMS	932		643		510		290			258		1,716
NET ERRORS AND OMMISSIONS	123			68	162		263		790		428	

Table 2.1.11 CONSUMER PRICE INDICES

Year	1980	1981	1982	1983	1984	1985	1986	1987
Annual Average	199.4	223.1	248.6(1)	106.6	114.4	122.1	124.3	125.4(2)
Yearly Change (%)	42	14.5	11.4	5.6	7.3	6.7	1.8	1.2

Remarks: As from July 1982, a new index (Base January-June, 1982=100) has been introduced: from July, 1976 to June, 1982, the base period was January-June1976=100

(1) Calculated as an average of twelve months on the basis of a conversion of the new indices to the previous base

(2) 6 months average

Table 2.1.12 FOREIGN EXCHANGE RATE

	Currency and Unit	Dec. 1985		March 1986		June 1986		Sept 1986		Dec. 1986		March 1987		June 1987	
		Buying	*Selling*	*Buying*	*Selling*	*Buying*	*Selling*	*Buying*	*Selling*	*Buying*	*Selling*	*Buying*	*Selling*	*Buying*	*Selling*
Japan	Yen 100	6.996	7.170	7.571	7.760	7.952	8.150	8.499	8.690	8.108	8.290	8.587	8.780	8.793	8.990
United States(2)	Dollar 1	14.241	14.454	13.692	13.897	13.342	13.541	13.168	13.332	13.109	13.272	12.652	12.809	12.997	13.158
United Kingdom	Pound 1	20.427	20.614	20.328	20.514	20.308	20.494	18.840	19.028	19.193	19.385	20.341	20.544	20.790	20.998

Remarks: (1) End of Month T.T. and DD. Rupee Rates
(2) above $12,000
(3) Telegraphic Transfer Rates

Source: Mauritius Bankers Association

Table 2.1.13 HOUSEHOLD EXPENDITURE

	1980/81	% total	1986/87	% total	% change 1980/81-1986/87
Food and drinks	920.0	44.4	1,158.0	41.9	25.9
Alcohol & tobacco	122.0	5.9	198.0	7.2	62.3
Clothing & footwear	178.0	8.6	232.0	8.4	30.3
Fuel & light	126.0	6.1	157.0	5.7	24.6
Housing & household operations	280.0	13.5	374.0	13.5	33.6
Medical care & health expenses	60.0	2.9	83.0	3.0	38.3
Transport & communications	207.0	10.0	257.0	9.2	24.2
Education & other services	91.0	4.4	166.0	6.0	82.4
Total incl others	2,073.0	100.0	2,764.0	100.0	33.3
Average monthly income	2,212.0		3,496.0		58.0
Inflation rate (1980 index=100)	107.2		158.1		47.5

Sorce : Country Report :Madagascar, Mauritius,Seychelles,Comoros, No.2 1988,Economic Intelligence Unit

Table 2.1.14 GOVERNMENT RECURRENT BUDGET

Unit: Rs. million

	1983-84 Actual	1985-84 Actual	1985-86 Actual	1986-87 Revised Estimated	1987-88 Budget Estimated
REVENUE:					
Direct Taxes	547.6	564.2	550.5	759.0	894.2
Indirect Taxes	2,256.5	2,443.0	2,960.8	3,541.1	4,122.1
Receipt from public utilities	145.9	171.2	198.6	198.9	232.0
Receipt from public services	104.2	89.1	108.2	99.7	112.7
Rental of public property	6.3	7.3	7.2	7.6	8.6
Other	195.9	284.2	305.7	303.7	451.0
TOTAL	3,256.8	3,559.0	4,131.0	4,910.0	5,820.6
EXPENDITURE:					
General Administration	337.4	474.1	504.4	538.4	867.0
Economic Services	548.0	467.9	443.3	477.5	610.2
Social Services	1,132.5	1,185.2	1,280.3	1,394.2	1,718.2
Local Government and Rodrigues	244.7	250	267.8	285.9	369.6
Public Debt and Pensions	1,810.1	1,844.3	1,992.8	1,929.0	2,340.0
TOTAL	4,072.7	4,261.5	4,488.2	4,625.0	5,905.0
Surplus (+) or deficit (-)	-815.9	-702.5	-357.2	285.0	-84.4

Source : Financial Reports, Budget Estimates, Government of Mauritius

Table 2.1.15 GOVERNMENT CAPITAL BUDGET

	1982-83 Actual	1983-84 Actual	1984-85 Actual	1985-86 Actual	1986-87 Revised Estimates	1987-88 Budget Estimates
RECEIPTS						
Domestic Revenue	463.7	587.6	516.2	506.0	727.0	834.0
External Receipts	378.5	617.9	1,432.7	592.5	756.9	1,342.0
TOTAL CAPITAL REVENUE	842.2	1,205.5	1,948.9	1,098.5	1,483.9	2,176.0
EXPENDITURE:						
Economic Services	701	646.9	686.4	840	1170.5	1117.6
Social Services	145.9	108.9	124.9	135.5	145.3	204.8
Local Government and Rodrigues	36.4	32.9	39.5	47.2	60.8	65.6
Transfer to International Financial Organisations	16.9	84.6	405.4	364.1	41.5	115.7
Central Administration and Other	109.3	114.6	163.4	213.2	236.9	626.3
TOTAL	1,009.5	987.9	1,419.6	1,600.0	1,655.0	2,130.0
Surplus (+) or deficit (-)	-167.3	217.6	529.3	-460.0	30.0	-43.0

Source : Financial Reports, Budget Estimates, Government of Mauritius

Table 2.1.16 REVENUE ACCOUNT OF CWA FOR 1980/81-1985/86

	1985/86 (Rs. M)	1984/85 (Rs. M)	1983/84 (Rs. M)	1982/83 (Rs. M)	1981/82 (Rs. M)	1980/81 (Rs. M)
Income	184.5	162.4	125.0	110.8	86.4	80.5
Expenditure	173.5	166.3	150.5	126.2	111.2	91.8
Prior year adjustment & exceptional items	2.7	2.3	12.1	8.7	1.8	1.2
Deficit		6.2	37.6	24.1	26.6	10.1
Surplus	8.3					

Source: Summary of Financial Matters for the year 1985/86, CWA, 1987

Table 2.2.1 EXISTING TRANSMISSION, DISTRIBUTION MAINS

	Pailles Plant	Water Reservoirs	Pipe Materials
1.	D 19" (482 mm)	to Maupin R.	
2.	D 18" (457 mm)	" "	
3.	D 27" (686 mm)	to Maupin R.	
4.	D 800 mm	to Plaine Lauzun R,	
5.	D 500 mm	" " "	
6.	D 6" (150 mm)	MDA pipeline (Industrial)	
	Soreze Pipeline		
7.	D 6" (150 mm)		CIP
	Pierrefonds Pipeline		
8.	D 9" (228 mm)		

Water Reservoirs - Distribution Network

1.	D 800 mm	from Plaine Lauzun R.	
2.	D 450 mm	" "	
3.	D 12" (300 mm)	from Maupin R.	ACP
4.	D 9" (230 mm)	" "	CIP
5.	D 5" (125 mm)	" "	ACP
6.	D 10" (250 mm)	from Labourdonnais R.	CIP
7.	D 4" (100 mm)	" "	CIP
8.	D 6" (150 mm)	from Monneron R.	CIP
9.	D 18" (450 mm)	from Monneron R.	ACP
10.	D 10" (250 mm)	from Diego Garcia	CIP
11.	D 6" (150 mm)	from Diego Garcia R.	ACP
12.	D 6" (150 mm)	from New Monneron R.	CIP

Note: MDA - Mon Desert Alma

Table 2.2.2 EXISTING RESERVOIRS

No.	NAME	CAPACITY m/gal	CAPACITY m^3	ELEVATION Metres A.M.S.L	REMARKS
	PAILLES FILTERS			70.24 (T.W.L)	CSP 88 & 88A
1	LABOURDONNAIS RES.	0.60	2725	54.09	CSP/161
2	MAUPIN RES.	0.96	4360	54.79	CSP/160
3	MONNERON RES.	1.35	6135	54.52	CSP/162
4	DIEGO GARCIA RES.	0.795	3615	46.32	CSP/86
5	PLAINE LAUZUN RES.	1.54	7000	53.34 (T.W.L)	CSP/85
6	PRIEST PEAK RES.	1.45	6600	76.30 (T.W.L)	CSP/142A
7 - 1	PAILLES RES.	5.28	24000	66.00 (T.W.L)	
7 - 2	PAILLES FILTERS (Extension)			69.10 (T.W.L)	CSP/143
8 - 1	MONNERON (Extension)	0.440	2000	95.25 (T.W.L)	CSP/251
8 - 2	MONNERON (Additional Site)				CSP/230
9	ANSE COURTOIS (Guibies)	0.88	4000	117.06 (T.W.L)	CSP/298
10	LA CURE	0.15	680		
		13.445	61,115		

Table 2.2.3 PORT LOUIS SYSTEM WATER SUPPLY

Present Service Area		Remarks: Urbanization & Industrial Zone
1. Old Town	629.3 ha	Saturated
2. Roche Bois	274.4 ha	Saturated Mer Rouge 38 ha
3. Sainte Croix	564.5 ha	Space still exist little
4. Vallee des Pretres	1,003.6 ha	Space exist
5. Vallee Pitot	265.5 ha	Residential area limited
6. Tranquebar	566.6 ha	Newly developed area Space little
7. Belle Village	105.2 ha	Residential area limited Saturated P. Lauzun 25 ha
8. Grand River North West	379.2 ha	Koenig Tour
9. Cassis	119 ha	partly saturated (25 ha)
Total	3,907.3 ha	
cf	4,270 ha (42.7 km^2)	Saturated area total $\doteqdot$ 1,400 ha
		Space can be developed
Ref. National Physical plan Space for residential buildings		$\doteqdot$ 1,000 ~ 1,500 ha

Table 2.3.1 : POPULATION AND VITAL STATISTICS IN PORT LOUIS , 1972-1985

Period	Population at mid-period	1) Live births registered	Deaths	Natural increase	Increase rate/year %
1972	133,966				
1973					
1974					
1975	133,915				
1976	133,888	3,305	1,213	2,092	1.56
1977	133,861	3,341	1,250	2,091	1.56
1978	133,834	3,169	1,189	1,980	1.48
1979	133,807	3,508	1,113	2,395	1.79
1980	133,780	3,431	1,190	2,241	1.67
1981	133,753	3,384	1,082	2,302	1.72
1982	133,726	3,070	1,013	2,057	1.54
1983	133,702	2,884	1,042	1,842	1.38
1984	135,200	2,878	1,086	1,792	1.33
1985	136,323	2,865	1,104	1,761	1.29

Note: 1) Figures refer to total population (i.e. Mauritian and non Mauritian).
2) Average increase rate/year
1975 - 1985 : 1.78%
1982 - 1985 : 1.33%

Table 2.3.2 : PAST TREND OF POPULATION AND ESTIMATED POPULATION IN PREVIOUS STUDIES FOR PORT LOUIS

Year	1 National Census	2 ODA M/P	3 Digest of Demographic Statistics (1)	4 Updated M/P CWA & Estimate
1972	133,996	133,918	-	-
1977	-	140,694	-	-
1982	-	146,914	-	-
1983	133,702	-	133,943	-
1984	-	-	135,200	-
1985	-	-	136,323	-
1987	-	151,919	-	144,000
1992		151,919	-	152,850(2)

Note: (1) Mid year estimates 1983 - 1985
(2) Appried annual increase rate, 1.2% p.a from 1987-1992

Ref: Symbol Mark for Fig. 2.3.2
1 ・ 2 × 3 ◎ 4 △

Table 2.3.3 : RESULT OF PROJECTION OF FUTURE POPULATION IN PORT LOUIS

Year	High Series Increase	Medium Series Increase	Low Series Increase
1985	136,323	136,323	136,323
1990	146,173	144,701	142,172
1995	156,657	153,594	147,817
2000	167,934	163,033	153,092
2005	180,023	173,053	157,986
2010	192.983 (1.051)	183,688 (1.0)	162,494 (0.885)
2030	254,846 (1.093)	233,180 (1.0)	176,838 (0.784)
Note annual increase:	@1.4% p.a	@1.2% p.a	Logistic Curve

Table 2.3.4 WATER CONSUMPTION RECORD IN PORT LOUIS WATER SUPPLY SYSTEM (1984-1987)

Year/Month		Monthly consumption (m^3/Month)	Daily Consumption (m^3/Day)	Remarks
1984	Jul	1787440	57,660	1984:
	Aug	1302867	47,630	Max. 57,660 m^3/d
	Sep	1458552	48,620	Min. 39,370 m^3/d
	Oct	1449034	46,740	
	Nov	1477039	49,230	
	Dec	1220483	37,370	
1985	Jan	1288696	41,570	1985:
	Feb	1183750	42,280	Avg. 35,780 m^3/d
	Mar	1010801	32,610	Max. 42,280 m^3/d
	Apr	1153524	38,450	Min. 30,700 m^3/d
	May	1180501	38,080	
	Jun	1103586	36,790	
	Jul	951767	30,700	
	Aug	1073978	34,560	
	Sep	993195	32,110	
	Oct	998967	32,220	
	Nov	1071416	35,710	
	Dec	1030995	33,260	
1986	Jan	1255053	40,490	1986:
	Feb	1042981	37,250	Avg. 40,570 m^3/d
	Mar	1269334	40,950	Max. 43,920 m^3/d
	Apr	1143934	38,130	Min. 37,250 m^3/d
	May	1361375	43,920	
	Jun	1223951	40,800	
	Jul	1168539	37,690	
	Aug			
	Sep	1252260	41,740	
	Oct	1345682	43,410	
	Nov	1250078	41,670	
	Dec	1245955	41,190	
1987	Jan	1463860	47,220	1987:
	Feb	1313703	46,920	Avg. 42,370 m^3/d
	Mar	1214544	39,180	Max. 47,220 m^3/d
	Apr			Min. 39,180 m^3/d
	May	1259056	40,610	
	Jun	1200366	40,010	
	Jul	1249064	39,890	
	Aug	1236475	39,890	
	Sep	1260074	42,000	
	Oct	1408949	45,450	
	Nov	1338851	44,630	
	Dec	1235189	39,840	

Note: These volumes have been obtained by addin g the volumes measured for each consumer.

Table 2.3.5 WATER SALES RECORDS IN PORT LOUIS WATER SUPPLY SYSTEM (1981/82-1986/87)

	Demand Categories	Year	Number of Connection[1] (Nos.)	Annual Water Vol. (10^3m^3)	Average Daily Water Vol. (m^3/day)
1.	Domestic Water	1981/82	10,572	*	*
		82/83	10,793	*	*
		83/84	22,055	*	*
		84/85	25,073	12,830	35,055
		85/86	24,090	9,685	26,534
		86/87	27,010	10,234	28,038
2.	Non-Domestic Water	1981/82	1,403	1,683	4,611
		82/83	1,355	1,895	5,192
		83/84	2,084	1,583	4,377
		84/85	2,093	2,204	6,022
		85/86	2,164	2,958	8,104
		86/87	2,287	4,545	12,452
3.	Government Office	1981/82	252	585	1,607
		82/83	263	747	2,047
		83/84	1,204	262	718
		84/85	1,268	583	1,593
		85/86	849	747	2,121
		86/87	840	793	2,173
4.	Total	1984/85		15,617	42,670
		85/86		13,390	36,759
		86/87		15,572	42,663

Note: 1/: Nos. of subscribers

* : Data are not available

Table 2.3.6 MONTHLY WATER CONSUMPTION IN PORT LOUIS WATER SUPPLY SYSTEM IN 1988

Month	Domestic Consumption		Total Consumption	
	m^3/month	m^3/day	m^3/month	m^3/day
Jan	741,680	23,925	1,082,677	34,925
Feb	634,680	23,925	1,082,677	34,925
Mar	697,821	22,510	983,583	31,728
Apr	791,557	26,385	1,136,517	37,884
May	657,977	21,225	961,833	31,027
June	700,798	23.360	1,042,658	34.755
Avg.		23,210		33,573

Source: CWA Commercial Service Section

Table 2.3.7 : ESTIMATED PER CAPITA WATER CONSUMPTION 1985-1987

Water Consumption	1985		1986		1987		1988		
	Aveg. Day Water Vol. (m3/d)	Estimated LPCD	Aveg. Day Water Vol. (m3/d)	Estimated LPCD	Aveg. Day Water Vol. (m3/d)	Estimated LPCD	Aveg. Day Water Vol. (m3/d)	Estimated LPCD	Population
Domestic		1)		1)		1)			
	26,534	216	28,038	226	21,920	178	23,210	180	128,800
Non Domestic		2)		2)	3)	2)			
	8,104	59	12,452	91	12,400	89	8,543	94	110,000
Government		2)		2)	3)	2)	1,820		
Institutions	2,120	16	2,173	16	2,470	18			
Public standpipes	-	-	-	-	-	-	-	-	11,200
4)		2)		20		2)			
Total	36,785	270	42,663	310	36,790	290	33,573	240	140,000

Note: 1) Population private connection
2) Total Population
3) CWA 1987 Record & past consumption %
4) Tentative except public standpipes
LPCD: Litres per Capita per Day
Ref Table 2.4.8 for applied population served.

Table 2.3.8 PROJECTION OF DOMESTIC WATER DEMAND

Items	Year				
	1988	1990	2000	2010	2030
1. Population in Port Louis:	140,000	142,170	153,090	162,490	176,840
2. Served Population:	128,800 (92 %)*	135,100 (95 %)	153,090 (100 %)	162,490 (100 %)	176,840 (100 %)
3. Per Capita Consumption (l/day):	180	180	190	200	200
4. Domestic Water Demand (m^3/day):					
Average	23,184	24,318	29,087	32,498	35,368
Maximum (Average x 1.2)	27,820	29,182	34,904	38,998	42,442

* : Ref. Table 2.3.9

Table 2.3.9 : ESTIMATED AND APPLIED POPULATION SERVED IN PORT LOUIS

Population	1985		1986		1987		1988	
Total population 1)	136,323		137,440		138,580		140,000	
Population by Type of Supply								
1. Private connection 2)	122,690	(90%)	124,250	(90)%	126,822	(92)%	128,800	(92)%
2. Stand Pipes 3)	13,633	(10%)	13,190	(10)%	11,758	(8)%	11,200	(8)%

Note:
1) Digest Demographic Statistics, 1985
2) No. of subscriber × avag. member 4.6
3) Total population - pop. private connection

Table 2.3.10 PROJECTION OF COMMERCIAL WATER DEMAND

Items	Year 1988	1990	2000	2010	2030
1. Number of Emloyments	56,000	70,000	90,000	100,000	110,000
2. Per Capita Consumption (l/day)	80	80	90	90	90
3. Commercial Water Demand (m^3/day)					
- Average	4,480	5,600	8,100	9,000	9,900
- Maximum (Average x 1.2)	5,376	6,720	9,720	10,800	11,880

Table 2.3.11 PROJECTION OF NON-DOMESTIC WATER DEMAND

(m^3/d)

Items	Year				
	1988	1990	2000	2010	2030
1. Commerce	4,480	5,600	8,100	9,000	9,900
2. Industry	2,320	5,000	6,560	8,600	11,150
3. Education	1,500	1,500	1,750	2,000	2,500
4. Hospital	200	240	320	400	450
Total	8,500	12,340	16,730	20,000	24,000

Table 2.3.12 SUMMARY OF WATER DEMAND PROJECTION
(Low Estimate)

(m^3/d)

Sector/Category	Year				
	1988	1990	2000	2010	2030
Domestic	23,200	24,320	30,618	32,498	35,368
Non-domestic	8,500	12,340	16,730	20,000	24,000
Government	1,800	2,500	2,500	2,500	2,500
Total volume requirements	33,500	39,160	49,848	54,998	61,868
Total demand at production level	62,000	60,250	71,210	78,569	82,490
UFW(%)	46	35	30	30	25

Note: UFW: The percentage of unaccounted- for water assumed in accordance with the schedule of leakage reduction program.

Table 2.3.13 SUMMARY OF WATER DEMAND PROJECTION (Medium and High Estimate)

	Year				
	1988	1990	2000	2010	2030
1. Domestic Demand:					
- Population					
Medium increase	143,000	144,701	163,033	183,688	233,180
High increase	144.200	146.173	167,934	192,983	254,846
- Served population					
Medium increase	131,560 (92%)	137,466 (95%)	163,033 (100%)	183,688 (100%)	233,180 (100%)
High increase	132,664 (92%)	138,864 (95%)	167,934 (100%)	192,983 (100%)	254,846 (100%)
- Per Capita consumption (l/day)	180	180	190	200	200
- Domestic water demand (m^3/day)					
Medium increase	23,680	24,744	30,976	36,738	46,636
High increase	23,880	24,996	31,907	38,597	50,969
2. Non-Domestic Demand (m^3/day):	8,500	12,340	16,730	20,000	24,000
3. Government Demand (m^3/day):	1,800	2,500	2,500	2,500	2,500
4. Total Requirement (m^3/day):					
Medium increase	33,980	39,584	50,206	59,238	73,136
High increase	34,180	39,836	51,137	61,097	77,469
5. UFW (%)	46	35	30	30	25
6. Total Demand at Production Level (m^3/day):					
Medium increase	62,926	60,898	71,723	84,626	97,520
High increase	63,296	61,286	73,053	87,281	103,290

Table 2.4.1 PROBABLE RAINFALL

PROBABLE ONE-DAY RAINFALL

Unit : mm

Return Year	Gumbel	Pearson III	Harzen	Log-Normal (IWAI)	Maximum
10000	1168	1147	1053	1140	1168
1000	935	894	842	890	935
200	771	729	700	728	771
100	701	661	642	661	701
50	630	594	581	594	630
20	536	505	501	507	536
10	463	440	438	440	463
5	387	371	374	371	387
2	272	268	271	268	272

PROBABLE TWO-DAY RAINFALL

Unit : mm

Return Year	Gumbel	Pearson III	Harzen	Log-Normal (IWAI)	Maximum
10000	1674	1799	1208	1397	1799
1000	1339	1381	1032	1165	1381
200	1104	1114	894	985	1114
100	1003	1003	845	906	1003
50	901	895	781	827	901
20	765	751	696	718	765
10	661	647	619	631	661
5	551	538	541	538	551
2	386	378	398	388	398

PROBABLE THREE-DAY RAINFALL

Unit : mm

Return Year	Gumbel	Pearson III	Harzen	Log-Normal (IWAI)	Maximum
10000	1849	1999	1273	1360	1999
1000	1486	1551	1110	1189	1551
200	1231	1260	973	1037	1260
100	1122	1140	930	969	1140
50	1011	1021	867	898	1021
20	864	863	783	798	864
10	751	748	703	715	751
5	632	626	623	622	632
2	454	446	470	464	470

Table 2.4.2 ANNUAL RUNOFF RATIO

(after abstraction)

Hydrological Year	W03	W04	W05	W08
1967		0.30	0.35	0.45
1968		0.42	0.48	0.39
1969		0.27	0.33	0.53
1970		0.55	0.54	0.70
1971			0.29	0.60
1972		0.28	0.35	0.39
1973	0.23	0.35	0.43	0.47
1974	0.18	0.21	0.35	0.24
1975		0.28	0.39	0.36
1976		0.33	0.42	0.43
1977	0.11	0.18	0.36	0.41
1978	0.12	0.31	0.43	0.42
1979	0.12	0.27	0.40	0.41
1980	0.47	0.64	0.61	0.77
1981	0.12	0.21	0.33	0.37
1982	0.28	0.44	0.55	0.58
1983	0.17	0.29	0.48	0.43
1984	0.21	0.34	0.51	0.53
1985	0.30	0.42	0.61	0.58
1986	0.17	0.33	0.43	0.54
Average	0.21	0.34	0.43	0.48
Maximum	0.47	0.64	0.61	0.77
Minimum	0.11	0.18	0.29	0.24
Var.	0.10	0.11	0.09	0.12

Var. : Standard Deviation

Table 2.4.3 COEFFICIENT FOR ADDITIONAL FLOW DOWNSTREAM

Moka River

Date	W10	A-6	Pailles Canal	W002	Total of (2) to (4)	Increase Ratio
	(1)	(2)	(3)	(4)	(5)	
Area (km2)	15.1	24.7	-	-	-	1.64
3/Jun.	300	304	142	2	448	1.49
8/Sep.	166	193	85*)	2	280	1.69
30/Oct.	70	46	45	2	93	1.33
3/Nov.	70	40	54	2	96	1.37
				Average		1.47

*) : estimate from formula

Plaines Wilhems River

Date	W03	B-1	P.W Canal	Total of (2)+(3)	Increase Ratio
	(1)	(2)	(3)	(5)	
Area (km2)	27.5	31	-	-	1.13
3/Jun.	297	50*)	297	347	
8/Sep.	116	-	116	-	-
30/Oct.	84	59	84	143	1.70
3/Nov.	98	59	98	157	1.60
			Average		1.65

*) : Estimated volume from field observation

Other rivers (Terre Rouge, Cascade, Profonde)

Date	W04+W05+W08	B-4	Bagatelle Canal	W026	Total of (2) to (4)	Increase Ratio
	(1)	(2)	(3)	(4)	(5)	
Area (km2)	46.9	55.0	-	-	-	1.17
3/Jun.	1200	-	345	25*)	-	-
8/Sep.	509	-	163	25	-	-
30/Oct.	496	-	113	25	-	-
3/Nov.	380	128	115	25	527 **)	1.39
				Average		1.39

*) Information from CWA

**) Discharges of W04,W05 and W08 are included

Table 2.4.4 AVERAGE WATER BALANCE (1966-1986) (with leakage)

Total Water Requirement : 1.05 m^3/sec

LWL : 139.0 m HWL : 189.0 m

Effective Storage : 6.4 MCM Dead Storage : .275 MCM

SEASON		INFLOW* Resi (MCM)	INFLOW* Dam (MCM)	PIPELINE SUPPLY (MCM)	RELEASE (MCM)	SPILLOUT (MCM)	DEFICIT & NUMBER (MCM)		WATER LEVEL (m)	EVAPORATION (MCM)	LEAKAGE (MCM)
NOV.	1	0.28	0.47	0.18	0.45	0.17	0.00	0	185.2	0.010	0.020
	2	0.24	0.40	0.18	0.50	0.11	0.00	0	184.0	0.010	0.019
	3	0.32	0.51	0.19	0.47	0.23	0.00	0	183.0	0.009	0.017
DEC.	1	0.47	0.68	0.19	0.40	0.30	0.00	0	182.6	0.009	0.015
	2	0.71	0.90	0.20	0.33	0.52	0.00	0	182.4	0.009	0.015
	3	1.32	1.56	0.22	0.29	0.98	0.00	0	184.7	0.009	0.017
JAN.	1	0.69	0.88	0.20	0.21	0.54	0.00	0	185.0	0.010	0.016
	2	1.60	1.82	0.19	0.23	1.53	0.00	0	185.2	0.010	0.018
	3	2.74	2.92	0.24	0.15	2.64	0.00	0	185.6	0.010	0.021
FEB.	1	3.42	3.99	0.24	0.04	3.45	0.00	0	187.8	0.009	0.020
	2	2.95	3.97	0.24	0.06	3.87	0.00	0	187.8	0.009	0.024
	3	2.03	2.44	0.20	0.05	2.34	0.00	0	187.9	0.009	0.020
MAR.	1	2.03	2.55	0.24	0.03	2.38	0.00	0	188.4	0.009	0.024
	2	2.54	2.95	0.24	0.01	2.86	0.00	0	188.6	0.010	0.025
	3	2.13	2.40	0.26	0.05	2.27	0.00	0	188.8	0.009	0.028
APR.	1	1.39	1.59	0.24	0.04	1.48	0.00	0	189.0	0.009	0.026
	2	1.51	2.08	0.24	0.06	1.98	0.00	0	189.0	0.008	0.026
	3	1.20	1.77	0.24	0.06	1.68	0.00	0	189.0	0.008	0.026
MAY.	1	0.96	1.24	0.24	0.07	1.14	0.00	0	189.0	0.007	0.026
	2	0.75	1.00	0.23	0.11	0.87	0.00	0	188.9	0.007	0.026
	3	0.88	1.15	0.25	0.15	1.00	0.00	0	188.8	0.007	0.029
JUN.	1	0.74	1.02	0.23	0.13	0.89	0.00	0	188.7	0.006	0.026
	2	0.68	0.95	0.23	0.12	0.78	0.00	0	188.7	0.006	0.025
	3	0.63	0.91	0.22	0.16	0.71	0.00	0	188.8	0.006	0.025
JUL.	1	0.55	0.81	0.21	0.18	0.61	0.00	0	188.8	0.006	0.026
	2	0.57	0.80	0.22	0.17	0.61	0.00	0	188.8	0.006	0.026
	3	0.71	1.00	0.24	0.17	0.80	0.00	0	188.7	0.007	0.028
AUG.	1	0.63	0.83	0.21	0.15	0.65	0.00	0	188.7	0.007	0.025
	2	0.77	1.13	0.22	0.15	0.96	0.00	0	188.6	0.007	0.025
	3	0.77	1.13	0.24	0.16	0.94	0.00	0	188.6	0.008	0.028
SEP.	1	0.56	0.71	0.21	0.19	0.51	0.00	0	188.5	0.008	0.025
	2	0.49	0.56	0.21	0.22	0.34	0.00	0	188.3	0.008	0.025
	3	0.40	0.49	0.20	0.29	0.23	0.00	0	188.0	0.009	0.025
OCT.	1	0.40	0.58	0.20	0.34	0.29	0.00	0	187.6	0.009	0.024
	2	0.31	0.46	0.20	0.39	0.15	0.00	0	187.0	0.010	0.023
	3	0.29	0.45	0.21	0.48	0.10	0.00	0	186.2	0.010	0.024
		38.69	49.10	7.88	7.06	40.92	0.00	0	-	0.301	0.835

* Dam : inflow into TRO dam reservoir

Resi: river flow of residual basin

Table 2.4.5 FREQUENCY OF DEFICIT AND SUPPLY REDUCTION RATIO (1966-1986)

: Numbers of 10-day deficit series Water demand :1.00 cumec + 5 % loss at Pailles treatment plant

Period	Effective Storage Volume (MCM) 0.00	0.50	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50	5.00	5.50	6.00	6.50	7.00	Required Volume (MCM)
1966 - 1967	24 (0.19)	14 (0.28)	9 (0.37)	7 (0.40)	5 (0.44)	5 (0.32)	3 (0.34)	1 (0.45)	-	-	-	-	-	-	-	3.889
1967 - 1968	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000
1968 - 1969	25 (0.23)	16 (0.32)	15 (0.30)	13 (0.30)	11 (0.30)	9 (0.31)	8 (0.27)	5 (0.32)	2 (0.51)	1 (0.44)	-	-	-	-	-	4.883
1969 - 1970	7 (0.34)	5 (0.36)	4 (0.30)	3 (0.21)	1 (0.06)	-	-	-	-	-	-	-	-	-	-	2.053
1970 - 1971	13 (0.33)	11 (0.33)	10 (0.31)	8 (0.31)	7 (0.28)	5 (0.27)	4 (0.19)	-	-	-	-	-	-	-	-	3.668
1971 - 1972	13 (0.27)	11 (0.27)	9 (0.26)	6 (0.30)	4 (0.30)	3 (0.21)	1 (0.05)	-	-	-	-	-	-	-	-	3.046
1972 - 1973	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000
1973 - 1974	9 (0.13)	6 (0.10)	-	-	-	-	-	-	-	-	-	-	-	-	-	0.997
1974 - 1975	10 (0.09)	4 (0.07)	-	-	-	-	-	-	-	-	-	-	-	-	-	0.739
1975 - 1976	11 (0.21)	7 (0.25)	6 (0.19)	4 (0.15)	1	-	-	-	-	-	-	-	-	-	-	2.003
1976 - 1977	5 (0.09)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.369
1977 - 1978	13 (0.19)	9 (0.20)	8 (0.16)	4 (0.17)	1 (0.11)	-	-	-	-	-	-	-	-	-	-	2.091
1978 - 1979	8 (0.11)	2 (0.15)	-	-	-	-	-	-	-	-	-	-	-	-	-	0.754
1979 - 1980	9 (0.16)	4 (0.21)	1 (0.27)	-	-	-	-	-	-	-	-	-	-	-	-	1.230
1980 - 1981	21 (0.14)	17 (0.14)	12 (0.15)	8 (0.15)	5 (0.12)	1 (0.01)	-	-	-	-	-	-	-	-	-	2.509
1981 - 1982	14 (0.12)	6 (0.19)	3 (0.20)	1 (0.01)	-	-	-	-	-	-	-	-	-	-	-	1.508
1982 - 1983	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000
1983 - 1984	22 (0.33)	20 (0.33)	17 (0.36)	13 (0.43)	11 (0.45)	10 (0.44)	9 (0.42)	8 (0.40)	7 (0.38)	5 (0.41)	4 (0.37)	4 (0.23)	1 (0.23)	-	-	6.285
1984 - 1985	9 (0.16)	6 (0.15)	3 (0.11)	-	-	-	-	-	-	-	-	-	-	-	-	1.278
1985 - 1986	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.111
Total failur (days)	2130	1380	970	670	460	330	250	140	90	60	40	40	10	0	0	-
Annual Ave. (days)	106.5	69.0	48.5	33.5	23	16.5	12.5	7	4.5	3	2	2	0.5	0	0	-
Reliability (%)	70.82	81.10	86.71	90.82	93.70	95.48	96.58	98.08	98.77	99.18	99.45	99.45	99.86	100.00	100.00	-

Ref: *Figure in bracket shows supply reduction ratio during the failure in order to cope with deficit
*Water through Soreze pipe line (0.052 cumec)is considered not to be used for Pailles treatment plant

Table 2.4.6 SUPPLY WITHOUT THE PROJECT

(hydrological condition of 1983)

Unit : m^3/sec

	Year				
	1988	1990	2000	2010	2030
(a) Demand	0.800	0.780	0.920	1.000	1.050
(b) Deficit	0.063	0.060	0.124	0.170	0.199
(c) : (a)-(b)	0.737	0.720	0.796	0.830	0.851
Capacity of Existing Facilities					
(d) Pailles pipelines	0.622	0.618	0.591	0.502	0.470
(e) Montebello pipeline	0.283	0.283	0.283	0.283	0.283
(f) : (d)+(e)	0.905	0.901	0.874	0.785	0.753
(g) Supply by Existing facilities	0.737	0.720	0.796	0.785	0.753
(h) : (g)/(a)	(0.92)	(0.92)	(0.87)	(0.79)	(0.72)

(average hydrological condition)

Unit : m^3/sec

	Year				
	1988	1990	2000	2010	2030
(a) Demand	0.800	0.780	0.920	1.000	1.050
(b) Deficit	0.016	0.014	0.033	0.048	0.060
(c) : (a)-(b)	0.784	0.766	0.887	0.952	0.990
Capacity of Existing Facilities					
(d) Pailles pipelines	0.622	0.618	0.591	0.502	0.470
(e) Montebello pipeline	0.283	0.283	0.283	0.283	0.283
(f) : (d)+(e)	0.905	0.901	0.874	0.785	0.753
(g) Supply by Existing facilities	0.784	0.766	0.874	0.785	0.753
(h) : (g)/(a)	(0.98)	(0.98)	(0.95)	(0.79)	(0.72)

Table 2.6.1 SUMMARY OF SOIL PROPERTIES

Item	3-1	3-2	5-1	5-2	7-1	7-2	8-1	8-2	9-1	9-2	10-1	10-2
Sampling depth (m)	2.0	4.0	2.0	4.0	2.0	4.0	2.0	4.0	2.0	4.0	2.0	4.0
Natural Moisture Content W (%)	43.0	39.2	42.6	37.9	42.3	44.5	41.5	49.2	37.0	46.1	41.1	49.6
Specific Gravity GS	2.91	2.84	2.93	2.91	2.85	2.86	2.84	2.79	2.91	2.90	2.83	2.82
Grain Size Analysis												
Maximum Particle Size (mm)												
Gravel (4.76 - 76.2 mm) (%)	-	2	2	2	12	2	3	8	-	1	1	1
Sand (0.074 - 4.76 mm) (%)	30	15	20	36	20	26	26	38	15	30	35	43
Silt (0.002 - 0.074 mm) (%)	30	47	45	46	42	55	45	49	65	53	39	42
Clay (< 0.002 mm) (%)	40	36	33	16	26	17	27	5	20	16	25	14
Unit Weight (tf/m^3)												
Unified Soil Classification System	MH	MH	MH	MH	MH	MH	MH	ML	MH	MH	MH	MH
Consistency												
Liquid Limit WL (%)	74.2	72.3	68.0	52.0	55.9	54.8	56.0	48.4	58.2	64.0	60.0	50.5
Plastic Limit WP (%)	36.4	55.8	54.6	36.4	42.1	39.1	40.3	NP	41.2	NP	46.5	NP
Plasticity Index IP (%)	37.8	16.5	13.4	15.6	13.8	15.7	15.7	NP	17.0	NP	13.5	NP
Optimum Moisture Content (%)		36.0		28.5	34.0							34.5
Maximum Dry Density Dd (tf/m^3)		1.36		1.53	1.41							1.35
Triaxial Compression Test												
Unconsolidated Undrained Test												
95% of Dd max, dry side		c:0.5,ϕ:28		c:0.8,ϕ:23								c:0.2,ϕ:32
Dd max		c:1.4,ϕ:7		c:0.8,ϕ:18								c:1.0,ϕ:22
95% of Dd max, dry side		c:0.4,ϕ:9		c:0.8,ϕ:5								c:0.3,ϕ:16
Consolidated Undrained Test												
95% of Dd max, dry side		c':0.9,ϕ':28		c':1.0,ϕ':30								c':0.5,ϕ':29
Dd max		c':0,ϕ':26		c':0.4,ϕ':31								c':0.8,ϕ':32
95% of Dd max, dry side		c':0.4,ϕ':31		c':0.4,ϕ':33								c':0.4,ϕ':33
Coefficient of Permeability K (cm/s)												
95% of Dd max, dry side		$2.0x10^{-4}$		$2.2x10^{-5}$								$8.8x10^{-6}$
Dd max		$7.3x10^{-7}$		$1.4x10^{-5}$								$4.9x10^{-7}$
95% of Dd max, dry side		$2.1x10^{-6}$		$8.2x10^{-7}$								$5.6x10^{-6}$

Note : c,c' (Unit:kgf/cm^2) ; Cohesion
: ϕ,ϕ' (Unit:degree) ; Angle of Interim Friction

Table 2.6.2 SUMMARY OF CONCRETE AGGREGATE

	Test Sample Purchased from Supplier			
	Rocksand	(b)	(c)(i)	(c)(ii)
Specific Gravity				
Oven dry	3.14	2.74	2.96	2.48
Surface dry	3.07	2.68	2.94	2.27
Absorption (%)	1.08	1.92	0.78	9.35
Unit Weight (tf/m3)	1.818	1.385	1.550	1.428
Abrasion Loss (Los Angeles)				
100 revolutions (%)	-	5.9	4.1	13.4
500 revolutions (%)	-	23.3	13.3	34.1

Table 2.6.3 LABORATORY TEST RESULTS OF ROCK MATERIAL

Sample No. Depth	Bulk Density (tf/m3)	Compressive Strength (kgf/cm2)	Specific Gravity Dry	***Satu.	Absorption (%)
*Q(1) 7.5-7.8m	2.90	1370	2.94	2.96	0.8
*Q(1) 11.5-11.7m	2.93	710	2.96	2.97	0.6
**Q(1) 12.3-12.5m	2.70	580	2.57	2.70	4.9
**Q(1) 15.2-15.3m	2.42	320	2.19	2.43	11.0

Remarks: * Massive basalt
** Agglomerate
*** Saturation

Table 2.6.4 ASSUMED DESIGN VALUES OF FILL MATERIALS

	Core Material	Filter Material	Rock Material
Wet Density Dt (tf/m3)	1.80	2.00	1.95
Saturated Density Dsat (tf/m3)	1.90	2.15	2.10
Cohesion C (tf/m2)	2.0	0	0
Angle of Internal Friction / (degree)	25	35	41
Coefficient of Permeability Permeability K (cm/sec)	1x10 -5	1x10 -3	1x10 -1