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EXECUTIVE SUMMARY

This Report: “Flow Releases Downstream of the Lesotho Highlands Water Project (LHWP) Structures – March 2004” provides an update of the amount of water that has been released downstream of the four operational structures of the LHWP, namely the Katse Dam, ‘Muela Dam, Mohale Dam and the Matsoku Diversion Weir and Tunnel, from the 1st April 2003 to the 30th September 2003.

The report indicates that a total amount of 24.735 MCM (1.56 m^3/s) was released from the Katse Dam. This quantity of water is comprised of 11.241 MCM (0.71 m^3/s) released through the Low Level Outlets, 11.543 MCM (0.73 m^3/s) released through the Compensation Sleeve Valve and 1.951 MCM (0.12 m^3/s) released through the Mini – Hydro. There was no spillage experienced from the Katse Dam for the period reported on.

The total amount of 29.793 MCM (1.88 m^3/s) was released from the Mohale Dam through the alternate operation of a 500mm diameter Sleeve Valve and a 200mm diameter Sleeve Valve. There was also no spillage experienced. The Dam is still on its impoundment phase.

‘Muela Dam released 2.372 MCM (0.15 m^3/s) which is the long term Mean Annual Runoff of the Nqoe River as had been derived from an upstream Hydrometric Station – Nqoe River at ‘Muela. No spill occurred at ‘Muela.

Downstream releases are estimated as 5.703 MCM (0.36 m^3/s) from the Matsoku Diversion Weir and Tunnel. The estimations are based on the downstream Hydrometric Station (Matsoku River at Ha – Seshote) records and on the fact that the design operation of the Weir demands that flows below and up to 0.6 m^3/s be released downstream prior to any transfers into the Katse Dam. The amount of 1.439 MCM (0.091 m^3/s) is the estimated transfer into the Katse Dam. No spill was experienced.

The tables indicating all the downstream releases and river flows are included in this report for clarity, good understanding and timely reference.

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FOREWORD

This Report is the fourth publication of the Flow Releases Downstream of LHWP Structures. It was initially agreed that this report must be published every six (6) months taking into consideration the Hydrological Year which begins from the 1st October every year and ends on the 30th September of the following year, therefore this report provides an update of the records from the 1st April to the 30th September 2003.

It is, however, important to note that some of the information regarding downstream flow releases and their compliance to the In – stream Flow Requirement (IFR) Policy and Procedures is now being published monthly since the beginning of October 2003, hence the delay in the preparation and publication of this report.

The decision to report on a monthly basis with effect from October 2003 was taken as a result of the late implementation of the IFR Policy and Procedures that was approved on the 13th December 2002.

It is worth mentioning that this Policy was not implemented before October 2003 due to the World Bank's conditions that were set out for impounding and filling Mohale Dam whilst also fulfilling the issues that were agreed to in relation to the exploration of the possibilities to release the discharge up to 2.0 m^3/s through the Compensation Outlet from the Katse Dam.

Despite the monthly reporting that is being done since October 2003, the intensive annual report of the Flow Releases Downstream of the LHWP Structures will still be published. The produced monthly reports and their monthly total flows will be consolidated, at the end of

each Hydrological Year to indicate how LHDA has performed and complied with the scheduled and targeted IFR Flows.

INTRODUCTION

The Report “Flow Releases Downstream of the Lesotho Highlands Water Project (LHWP) Structures” is being published to provide the recorded flow volumes, in Million Cubic Metres (MCM), released downstream of the existing and operating LHWP structures for the six (6) months period. The operational structures that are being reported on are the Katse Dam, the 'Muela Dam, the Mohale Dam and the Matsoku Diversion Weir and Tunnel.

Katse Reservoir started impoundment in October 1995 when the two Diversion Tunnels that were used to pass water downstream were closed. Construction was still in progress at that stage and impoundment was thus restricted to rise at a pace lagging behind construction.

The discharge facilities at Katse Dam are composed of a ten (10) bay Spillway with a crest level of 2053 metres above sea level (masl) designed for a Probable Maximum Flood (PMF) of 6252 m^3/s at a surcharge level of 7.2 m above its crest. There are two (2) Low - Level Outlets (LLOs) at an elevation of 1938 masl, each with a capacity of 422 m^3/s at Full Supply Level (FSL). Each LLO has one emergency gate and one radial gate installed in series. A third discharge facility consists of a Compensation pipe capable of discharging up to 1,530 litres per second (1.53 m^3/s) through a Sleeve Valve at the water level of 2048.398 masl. The fourth discharge facility consists of a Mini – Hydro pipe capable of discharging the maximum up to 0.5 m^3/s.

The ‘Muela Dam is provided with a Compensation pipe with a capacity of 0.4 m^3/s and one bottom outlet (sleeve) valve capable of discharging 7.6 m^3/s at full supply level. The spillway is designed for a PMF of 584 m^3/s.

Matsoku Diversion Weir and Tunnel was inaugurated and commissioned on the 26th October 2001. That is, Matsoku became operational from its inauguration date. The weir is equipped with a tunnel facility to transfer water from Matsoku River to Katse Reservoir. The facility has been designed such that all the flows up to 0.60m^3/s (600 litres per second) pass through a discharge valve downstream. Water in excess of 0.60 m^3/s is diverted via the tunnel into Katse Reservoir up to a maximum of 47 m^3/s. All amounts of flow in excess of 47 m^3/s will then spill downstream over the weir. This weir has, therefore been transferring water since its inauguration and commissioning date, 26th October 2001.

Impoundment of Mohale Dam began on the 1st November 2002 with the lowering of the stoplogs to close the second diversion tunnel. The first diversion tunnel had been plugged in early 2002. Initially water was released through valves built into the stoplogs until the reservoir rose to sufficient level (1985.0 masl) to allow safe releases through the Low Level Outlet (LLO) system and then once the reservoir level reached 2005.0 masl through the Compensation pipe work and the LLO. Any release through the stoplogs has to be piped through the concrete plug being constructed to permanently close the tunnel behind the stoplogs; the pipe will be blocked once the plug has cooled and has been grouted.

The LLO leads to a 1400mm sleeve valve, which can safely discharge between 5 m^3/s and 36 m^3/s at 1985.0 masl, and between about 10 m^3/s and 65 m^3/s at full supply level.

The Compensation pipe work leads from a series of intake valves at 10m vertical intervals in the compensation intake structure to a bifurcation, one branch terminating in a 200mm sleeve valve and the other in a 500mm sleeve valve, allowing safe releases in the range 0.1 m^3/s to nearly 5 m^3/s at the 2005.0 masl reservoir minimum

operating level. (There is also a connection built in for a future Mini-Hydro set currently closed by a blank flange.)

A 200mm bypass allows water from the LLO system to be discharged into the Compensation pipe work. The dam is protected by a 50m wide free discharge ogee spillway at 2075 masl.

This report provides information on the quantity of water that has been discharged downstream of all LHWP structures from the 1st April 2003 to the 30th September 2003. Firstly, the chronology of events and the summaries of flow releases as well as the figures and the tables for each of the four operational structures are presented. Finally, conclusions and recommendations are also presented.

1.0 CHRONOLOGY OF EVENTS AND SUMMARIES OF FLOW RELEASES FROM THE FOUR OPERATIONAL STRUCTURES.

1.1 Chronology of Events of the Katse Dam:

1.1.1 Compensation Outlet

A one day cavitations and vibration test was done on the sleeve valve of the compensation pipe at the Katse Reservoir on the 17th June 2003, and it was discovered that the sleeve valve can safely discharge water up to 1.53 m^3/s at the reservoir levels of 2048.398 masl. This discovery implies that the sleeve valve is capable of discharging approximately 2.0 m^3/s under FSL conditions at the reservoir level of 2053 masl. The valve was, however, constantly set at 35% to release the discharge of 0.75 m^3/s ± 10% deviation during the period April to September 2003. That is, before IFR Policy and Procedures could be fully implemented. The deviation of ± 10% had been included to cater for the variations in reservoir levels, as the discharge through the sleeve valve of the Compensation pipe

is a function of the reservoir level. The total volume of water released through the Sleeve valve of the Compensation pipe from the 1st April to the 30th September 2003 is 11.543 MCM, an average flow rate of 0.73 m^3/s.

1.1.2 Low level Outlet for Water Quality Testing (Test 4 April 2003)

The Low – Level Outlets (LLOs) were opened on the 8th April 2003 in order to conduct the fourth Water Quality test on water released from the bottom of the reservoir. The test was conducted in two steps of LLO gate opening, the step up opening and then the step down opening. One LLO gate was opened at 85% releasing the discharge of 290.00 m^3/s for two (2) hours from 07:45 hours to 09:45 hours to start the test. There was no pre – filling up of the tail water pond. The volume released was 2.09 MCM at the reservoir level of 2052.56 masl. The LLO opening was then stepped up to 90% releasing the flow rate of 319.88 m^3/s for two (2) hour, from 09:45 hours to 11:45 hours. The volume released was 2.30 MCM. The reservoir level had reduced to 2052.49 masl. The LLO gate was finally stepped up to 95% opening for the completion of the step up test. It was also opened for two (2) hours, from 11:45 hours to 13:45 hours with a release rate of 369.84 m^3/s, which converts to a volume of 2.66 MCM. The reservoir level reduced also to 2052.43 masl.

The gate was then closed down in a step down manner from 95% to 90% opening, which lasted two (2) hours, from 13:45 hours to 15:45 hours, releasing the flow rate of 319.76 m^3/s. Its corresponding volume was 2.30 MCM. The water level in the reservoir continued to decrease indicating that the reservoir outflows were in excess of the inflows as the weather conditions were then moving into a dry winter season. The

water level had reduced to 2052.37 masl. The LLO gate was finally stepped down to 80% opening for the completion of the test. It was also opened for two (2) hours, from 15:45 hours to 17:45 hours with a release rate of 261.76 m^3/s, which converts to a volume of 1.88 MCM. The water level in the reservoir had then reached 2052.31 masl. The gate was completely closed at 17:45 hours.

The total volume released for the fourth LLO test was 11.241 MCM.

1.1.3 Routine discharges through the Low level Outlet

The operational procedure at Katse Dam is to open the Low Level Outlets to prevent discharge over the dam crest spillway to protect the right bank immediately downstream of the dam wall. It was thus arranged that the openings must be done at night to make it easy for people to cross the river downstream during the day as it takes a lot of time for the river flow to reduce to near normal after the LLOs are opened and then closed.

There was, however, no routine discharge through LLOs due to the continually reducing reservoir level. There was no excess inflow into the reservoir as the climatic conditions were then moving into a dry period from April to September 2003.

1.1.4 Discharge over the spillway

There was no spill experienced from April to September 2003 from the Katse Dam.

1.2 Summary of Flow Volumes Released from the Katse Dam

1.2.1 Spillage

Katse Dam did not spill since April to September 2003.

1.2.2 Discharges through the Low Level Outlet

The volume released through the LLOs amounts to 11.241 MCM for this period, and equates to an average discharge of 0.71 m^3/s. This amount is only attributed to the LLO discharges for water quality testing as had been indicated earlier.

1.2.3 Compensation and Mini Hydro Discharges

The actual total volume of water released through the Compensation and Mini-Hydro Outlets is 13.494 MCM, which converts to 0.85 m^3/s for the same period.

1.2.4 In - stream Flow Requirements (IFR)

The IFR Policy was approved on the 13th December 2002 and was not implemented during the period April to September 2003. Its full implementation only started from the 1st October 2003. The downstream releases through both the Compensation Sleeve valve and the Mini – Hydro were 0.85 m^3/s for the period. This discharge is in excess of the then agreed release of 0.75 m^3/s that was meant to address the IFR releases. Summary of Discharges from Katse Dam are shown in Table 1 below.

Table 1: Flow Releases from Katse Dam

Discharge Facility	Volume (MCM)	Average Flow Rate (m^3/s)
Spillway	0.00	0.00
Low Level Outlet (including tests)	11.241	0.71
Compensation Outlet	11.543	0.73
Mini – Hydro Outlet	1.951	0.123
IFR Bulk	0.00	0.00
Total Downstream Flow	**24.735**	**1.56**
IFR Target Release	**11.858**	**0.75**

1.2.5 Hydrometric Monitoring

The Hydrometric stations downstream of the Katse Dam were also monitored and their discharges calculated. The Paray Hydrometric station registered a volume of 43.30 MCM, which converts to an average flow rate of 2.74 m^3/s for the period April to September 2003. And the volume recorded at the Weir at Paray amounts to 27.971 MCM and it is equivalent to the average flow rate of 1.77 m^3/s.

The Hydrometric Station that was rehabilitated downstream of the Katse Dam on Malibamatšo River at Katse Bridge recorded the total flow volume of 32.589 MCM, an equivalent of the average flow rate of 2.06 m^3/s.

1.2.6 Monthly Releases from Katse Dam

Table 2 below gives the volumes of water released downstream of the Katse Dam since April to September 2003 for each month. It also gives the overall total at the end of the period.

Table 2: Monthly Flow Releases from the Katse Dam

Months Since April 2003	Low – level Outlet (Radial Gates) Volume in Cubic Metres (m^3)	Compensation Volume in Cubic Metres (m^3)	Mini – Hydro Volume in Cubic Metres (m^3)	Spillway Volume in Cubic Metres (m^3)	Monthly total downstream flow in Cubic Metres (m^3)	Target IFR Releases in cubic metres (m^3)	Monthly total downstream flow in Million Cubic Metres (MCM)	Delivery To RSA in MCM	Katse Bridge Hydrometric Station Flows in cubic metres (m^3)	Paray Hydrometric Station Flows in cubic metres (m^3)	Paray Weir Station Flows in cubic metres (m^3)
Apr-03	11,240,928.00	1,943,481.60	207,360.00	0.00	13,391,769.60	1,944,000	13.39	44.52	13,553,568	18,271,008.00	6,921,504.00
May-03	0.00	1,993,135.68	214,272.00	0.00	2,207,407.68	2,008,800	2.21	46.00	3,632,256.00	5,556,384.00	5,070,816.00
Jun-03	0.00	1,978,948.80	207,360.00	0.00	2,186,308.80	1,944,000	2.19	44.52	3,479,328.00	4,837,536.00	3,973,536.00
Jul-03	0.00	1,953,037.44	214,272.00	0.00	2,167,309.44	2,008,800	2.17	46.00	4,061,664.00	5,082,048.00	4,075,488.00
Aug-03	0.00	1,932,180.48	494,208.00	0.00	2,426,388.48	2,008,800	2.43	46.00	4,033,152.00	5,073,408.00	4,225,824.00
Sep-03	0.00	1,742,480.64	613,440.00	0.00	2,355,920.64	1,944,000	2.36	44.52	3,829,248.00	4,479,840.00	3,703,968.00
Volume in MCM	**11.241**	**11.543**	**1.951**	**0.00**	**24.735**	**11.858**	**24.735**	**271.56**	**32.589**	**43.300**	**27.971**
	Comp + Mini =	**13.494**									
Total water released downstream of Katse					**24.735**	**MCM**					
IFR Target Release over the same Period					**11.858**	**MCM**					

Figure 1: The Historic Monthly Flow Releases from the Katse Dam.

Figure 1 gives the Historic Monthly Flow Releases from the Katse Dam. It also shows the Hydrometric station on Malibamatšo River at Paray, the Hydrometric Station at Katse Bridge just downstream of the Katse Dam and the Weir flows of the Malibamatšo River at Paray as compared with all the releases from the Dam. These indicate that the flows at the above recording stations had always been higher than the releases from the Katse Dam. This is clearly seen at the Hydrometric Station immediately downstream of the Dam, near the Katse Bridge.

1.3 Chronology of Events of the 'Muela Dam

The volume of water released downstream of the 'Muela Reservoir into the Hololo River from the 1st April to the 30th September 2003 amounts to 2.372 MCM and converts to an average flow rate of 0.15 m^3/s. This amount, which is equivalent to the long term Nqoe catchment MAR, was released through the compensation pipe. There is no IFR at the 'Muela Dam since the Nqoe River Flows are not part of the Treaty Flows, hence the Mean Annual Runoff is being released continuously at 'Muela (The LLO was not used at 'Muela during the period under consideration. There was no spill flow either).

1.4 Flow Releases from 'Muela Dam

Table 3 below gives the monthly volumes of water released downstream of 'Muela Dam from the 1st April to the 30th September 2003.

TABLE 3: Monthly Flow Releases from 'Muela Dam

Months Since April 2003	Low – level Outlet (Radial Gates) Volume in Cubic Metres (m^3)	Compensation Volume in Cubic Metres (m^3)	Spillway Volume in Cubic Metres (m^3)	Monthly Total Downstream Flow in Cubic Metres (m^3)	Nqoe Hydrometric Station Flows in Cubic Metres (m^3)
Apr-03	0.00	388,800.00	0.00	388,800.00	145,152.00
May-03	0.00	401,760.00	0.00	401,760.00	70,848.00
Jun-03	0.00	388,800.00	0.00	388,800.00	51,840.00
Jul-03	0.00	401,760.00	0.00	401,760.00	38,016.00
Aug-03	0.00	401,760.00	0.00	401,760.00	30,240.00
Sep-03	0.00	388,800.00	0.00	388,800.00	864.00
	-	2,371,680			336,960
Volume in MCM	**0.00**	**2.371**	**0.00**	**2.371**	**0.337**
Total water released downstream of 'Muela Dam				**2.371**	

Figure 2: 'Muela Dam Releases from the Compensation Pipe and Mean Annual Runoff (MAR) of Nqoe River

Figure 2 shows the flows from the 'Muela Dam outlets as compared with those from the Nqoe River. The annual averages of these two flows are also shown on this figure. It is observed that the Nqoe Annual Average Flows are far less than the 'Muela Dam Outflows. The Nqoe flows decreased in magnitude from 0.145 MCM in April 2003 to 0.000864 MCM in September 2003. Thus the April to September 2003 period was a severely dry season.

1.5 Chronology of Events of Matsoku Diversion Weir

The construction of Matsoku Diversion Weir and Tunnel was completed and commissioned before any flow measuring instruments and/or devices could be installed. Some of the recording devices have since been installed, however, there is no software to read and download the Matsoku Diversion Weir and Tunnel records. The record cards that are used to capture the flow records at the Matsoku Weir are usually exchanged and carried to TCTA in RSA to be downloaded. The process to acquire the software for downloading, processing and analyzing the records is in progress. The flows of Matsoku River Hydrometric Station downstream of the Weir at Ha - Seshote are therefore used and transferred to the Matsoku Weir by using the weighting factor of the catchment areas at the Hydrometric Station at Ha – Seshote and at the Matsoku Weir. It seems that the total flow downstream of the Matsoku Diversion Weir and Tunnel for the period April to September 2003 is 5.703 MCM, which converts to 0.36 m^3/s. This amount seems to be less than the average flow of 0.60 m^3/s, which is the flow that the weir has to release downstream whilst transferring excess water into Katse Reservoir. Obviously flows into the Matsoku Diversion Weir and Tunnel were less than 0.60m^3/s for most of the time during the period April to September 2003 due to the drought that prevailed over the entire region of the Southern Africa.

The Matsoku Diversion Weir and Tunnel is actually a none storage facility and there are no IFR requirements implied for this Weir, however, the targeted flow volume if the flow rate of 0.6 m^3/s was constantly released downstream amounts to 9.487 MCM for the period April to September 2003.

The Matsoku River Hydrometric station at Ha – Seshote was used to evaluate the performance of the Matsoku Weir. This station recorded the volume amounting to 7.936 MCM, the flow rate of 0.5 m^3/s for the same period.

1.6 Flow Releases from Matsoku Diversion Weir:

The Table 4 below shows the Matsoku Diversion Weir and Tunnel estimated flows against the Matsoku River at Ha – Seshote Hydrometric Station for the period April to September 2003.

Table 4: Estimated Monthly Flow Releases from Matsoku Weir.

Months Since April 2003	Matsoku Weir Compensation Volume in Cubic Metres (m^3)	Spillway Volume in Cubic Metres (m^3)	Transfers To Katse In Cubic Metres (m^3)	Monthly Total Downstream Flow in Cubic Metres (m^3)	Target Releases in cubic metres (m^3)	Matsoku Hydrometric Station Flows in Cubic Metres (m^3)
Apr-03	1,555,200	0.00	1,283,818	1,555,200	1,555,200.00	3,154,464
May-03	1,468,627	0.00	102,125	1,468,627	1,607,040.00	1,745,280
Jun-03	1,011,658	0.00	0	1,011,658	1,555,200.00	1,124,064
Jul-03	678,067	0.00	0	678,067	1,607,040.00	753,408
Aug-03	250,128	0.00	28,253	250,128	1,607,040.00	309,312
Sep-03	739,498	0.00	24,883	739,498	1,555,200.00	849,312
	5,703,177.60	0.00	1,439,078.40	5,703,177.60	9,486,720.00	7,935,840.00
Volume in MCM	**5.703**	**0.00**	**1.439**	**5.703**	**9.487**	**7.936**
Total water released downstream of Matsoku Weir				**5.703**		
Target released downstream of Matsoku Weir over the same period April to September 2003				**9.487**		

Figure 3: Matsoku Diversion Weir and Tunnel Flows and Transfers.

Figure 3 shows the downstream flows from the Matsoku Diversion Weir and Tunnel as compared with the Targeted releases and the Transfers into the Katse Dam. The estimated Matsoku Weir Inflow and the Matsoku Hydrometric Station at Ha – Seshote flows are also shown on this figure.

1.7 Chronology of Events of Mohale Dam

The Mohale Dam records show that water amounting to the volume of 1.18 MCM, an average flow rate of 0.80 m^3/s was released downstream through Tunnel 2 from the 1st April to the 17th April 2003. The reservoir level was 2024.69 masl on the 1st April 2003 and had risen to 2026.14 masl on the 17th April 2003. Water was then released through a 500mm diameter sleeve valve from the 18th April 2003 to the end of April. The valve was opened at 70% for two (2) days, 18th and 19th April 2003, releasing the flow rate of 3.27 m^3/s. It was then lowered to 62% from the 20th to the 30th April 2003 to release the flow rate of 3.00 m^3/s. The reservoir level had then risen to 2026.55 masl.

The reservoir level was still 2026.55 masl on the 1st May 2003 and then decreased until it reached 2024.70 masl on the 30th September 2003. Both the Inflow and the Outflow were balanced between the 30th April and the 1st May 2003. Thereafter the Inflow was below and less than the Outflow and hence the reduction in water level in the Mohale reservoir. Thus severe drought was prevailing during the period April to September 2003.

The percentage opening of the 500mm diameter sleeve valve at 62% continued into May 2003 and the flow release rate of 3.00 m^3/s was maintained until the 15th May when the percentage opening was reduced to 60% to release the flow rate of 2.90 m^3/s. The percentage opening of the same 500mm diameter sleeve valve was reduced to 57% to release the flow rate of 2.73 m^3/s from the 28th May to the 5th June 2003. The opening was then increased to 70% to release the flow rate of 3.25 m^3/s from the 6th to the 26th June 2003. The valve opening was reduced to 50% from the 27th June to the 8th July 2003. The flow rate released was 2.4 m^3/s.

A dramatic reduction of the percentage opening to 18% was done from the 9th July to the 12th July 2003. Flow rate released was 0.80 m^3/s. the

opening was then increased to 52% to release the flow rate of 2.56 m^3/s.

All the above – mentioned variations were done taking into consideration the release of 2.45 m^3/s, which was set as a condition to fulfill the downstream releases whilst Mohale Dam is also filling up.

The In – stream Flow Requirement (IFR) Policy and Procedures was implemented earlier in August on Mohale Dam. The 200mm diameter sleeve valve was opened at 70% on the 2nd August 2003, releasing the flow rate of 0.68 m^3/s. The opening was later reduced to 60% to release the flow rate of 0.55 m^3/s, which is the flow for a Plus 1 hydrological Class as 2003 was Hydrological classified as a Plus 1 year. It was, however, reclassified as an average year later. This flow rate was released from August through September and into the middle of October 2003.

The total amount of water released downstream of the Mohale Dam from 1st April to 30th September 2003 is 29.793 MCM, an average flow rate of 1.88 m^3/s, whilst the targeted IFR flow amounts to 27.298 MCM, an average flow rate of 1.73 m^3/s.

The average flow rate at Marakabei weir for the period April to September 2003 was 2.11 m^3/s and corresponds to a volume of 33.369 MCM.

1.8 Flow Releases from Mohale Dam

The Table 5 below shows the Mohale Dam flows against the flow records of the Hydrometric Station and the Weir on Senqunyane River for the period April to September 2003.

Table 5: Flow Monthly Releases from Mohale Dam

Months Since April 2003	Mohale Dam Compensation Volume in Cubic Metres (m^3)	Spillway Volume in Cubic Metres (m^3)	Low – level Outlet Volume in Cubic Metres (m^3)	Monthly Total Downstream Flow in Cubic Metres (m^3)	Target IFR Releases in cubic metres (m^3)	Marakabei Hydrometric station flows in Cubic Metres (m^3)	Marakabei Weir Station Flows in Cubic Metres (m^3)
Apr-03	4,624,128.00	0.00	0.00	4,624,128.00	6,350,400.00	5,614,272.00	6,260,544.00
May-03	7,606,600.26	0.00	0.00	7,606,600.26	6,562,080.00	8,389,440.00	8,157,888.00
Jun-03	7,905,600.00	0.00	0.00	7,905,600.00	6,350,400.00	8,592,480.00	9,160,128.00
Jul-03	6,135,264.00	0.00	0.00	6,135,264.00	6,562,080.00	6,537,024.00	6,941,376.00
Aug-03	2,095,884.00	0.00	0.00	2,095,884.00	1,473,120.00	2,491,776.00	2,849,472.00
Volume in MCM	**29.793**	**0.00**	**0.00**	**29.793**	**27.298**	**31.625**	**33.369**
Total water released downstream of Mohale Dam in MCM				**29.793**			
IFR Target Release over the same Period				**27.298**			

Figure 4: The Historic Monthly Flow Releases from the Mohale Dam.

Figure 4 gives the Historic Monthly Flow Releases from the Mohale Dam. It also shows the Hydrometric station on Senqunyane River at Marakabei and the Weir flows of the Senqunyane River at Marakabei as compared with all the releases from the Dam.

2.0 CONCLUSIONS

There have been various discharges downstream of the Katse Dam, the Mohale Dam, the 'Muela Dam and the Matsoku Diversion Weir and Tunnel.

The flow release of 0.75 m^3/s ± 10% variation from the Katse Dam had been implemented since the 25th April 2002 and the Hydrometric station downstream of the Katse Dam, about 1Km from the dam wall, to monitor all the releases has been rehabilitated. This Station is awaiting the development of the new rating equations for the calculations of the flow rates from the Dam. The old rating equations were however used and the total flow recorded was 32.589MCM, an average flow rate of 2.06 m^3/s. The volume of the IFR target release for the period April to September 2003 was only 11.858 MCM, an average flow rate of 0.75 m^3/s. Thus the IFR was met and exceeded.

The flow downstream of the 'Muela Dam has been far higher than the annual average Inflow from the Nqoe River for the period April to September 2003. The Compensation valve at Muela is constantly set to release the long – term mean annual runoff of Nqoe River, which is estimated at 0.15 m^3/s. There is no IFR implied for 'Muela Dam.

The Hydrometric Station flows of Matsoku River at Ha Seshote have been used to estimate the Inflows into the Matsoku Weir and the Outflows that have been released downstream of Matsoku Weir whilst transferring excess water into the Katse reservoir. The volume of water transferred via the Diversion Tunnel into Katse reservoir equates to 1.439 MCM whilst the volume of water released downstream equates to 5.703 MCM, the equivalent of the flow rate of 0.36 m^3/s. The target flow rate of 0.6 m^3/s, which is equivalent to the volume of 9.487 MCM was not achieved at the Matsoku Weir, inflows into this Weir were themselves very low.

A volume of 29.793 MCM, an equivalent flow rate of 1.88 m^3/s, which is in excess of the IFR target release of 27.298 MCM (1.73 m^3/s) was released downstream of Mohale Dam from April to September 2003. A flow – measuring Weir (the Crump Weir) is now completed just downstream of the Mohale Dam Wall but the continuous recorder has not yet been installed to measure water level, which could then be converted into the corresponding discharge by the use of the calibrated Crump Weir rating equation.

3.0 RECOMMENDATIONS

In lieu of the monthly reports that are being produced and published it is recommended that the production of this report should only be done once in a year, at the end of each Hydrological Year to enable the analysis to be done with the records from other Hydrometric stations for hydrological publications.

It is also recommended that the process of recorders and measuring device installations must be speeded up to enable valuable data records to continue to be obtained. Thus there is an urgent need to construct Hydrometric Stations at IFR Sites so that the targeted flows at IFR Sites could be compared with the actual recorded flows. That is downstream of Matsoku Weir (IFR Site 1), at IFR Site 2 downstream of the Katse Bridge Hydrometric Station and Khohlontšo tributary.

The discrepancies between the Marakabei Weir, Marakabei Hydrometric Station and the IFR Site 7 records have been noted and it has been recommended that there is an urgent need to resurvey the Crump Weirs downstream of the Dams to properly calibrate them and then monitor the flows for some time to verify the IFR releases.