



**water affairs**

Department:  
Water Affairs  
**REPUBLIC OF SOUTH AFRICA**

## **Dam Safety Office**

# **2009-2010 Annual Report**



**ADMINISTRATION OF THE DAM SAFETY  
LEGISLATION IN TERMS OF  
CHAPTER 12 OF THE NATIONAL WATER ACT,  
1998 (ACT № 36 OF 1998)**

## EXECUTIVE SUMMARY

The mission of the Dam Safety Office (DSO) is to promote the safety of new and existing dams with a safety risk so as to reduce the potential harm to the public, damage to property and to resource quality. The work of the DSO is enabled by Chapter 12 of the National Water Act, 1998 (Act No. 36 of 1998). This report covers the activities of the Dam Safety Office for the period 1 April 2009 to 31 March 2010.

A total of 229 dams were registered during the year bringing the total number of dams registered to date in South Africa to 4700. This includes the registration of new dams that were completed during the year as well as existing dams that were not registered previously.

Altogether 77 registered dams were classified, bringing the total number of registered existing dams now classified to 4286, which is 91,2 % of the 4700 dams registered to date. In addition, about 55 proposed dams have also been classified, bringing the total number of classifications to 132.

Dam safety control over the construction of new dams, including alterations to existing dams, involves the evaluation of design and other reports that forms part of a licence application. A total of 23 dam safety licences were issued i.e. 3 licences to construct, 13 to alter, 7 licences to impound (commission) and 0 to abandon (decommission).

During the year a total of approximately 1426 letters were sent to dam owners to ensure compliance with dam safety legislation.

A total of 286 dam safety inspection directives were issued to dam owners and a total of 134 dam safety inspection reports were evaluated and accepted.

A total of 85 operation and maintenance manuals with emergency preparedness plans for dams were considered and accepted.

A total of 217 applications to be approved as the Approved Professional Person for a dam safety task were considered.

To date, 3091 deficiencies at category 2 and 3 dams have been registered of which 900 (29%) have been rectified so far. Slow but steady progress was made with the upgrading of dams. Personal finances and apathy on the part of dam owners continue to be the most common stumbling blocks hampering progress with regard to the rectification of deficiencies at dams. Much time and effort were spent with owners and approved professional persons on addressing the entire spectrum of dam safety issues.

The total direct expenditure incurred in administration of the dam safety legislation at Head Office was R 5 444 000 compared to R 4 344 000 in the previous reporting year, i.e. an increase of 25%. Because of the small size of the DSO, expenditure is very sensitive to personnel fluctuations. It is believed that the benefits of the dam safety programme far outweigh the total direct expenditure.

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## LIST OF ABBREVIATIONS

AAR	alkali-aggregate reaction
APP	Approved Professional Person (this has the same meaning as Approved Professional Engineer)
CMA	Catchment management agency
DSO	Dam Safety Office
DSP	Dam Safety Programme
DWA	Department of Water Affairs
ECSA	Engineering Council of South Africa
EPP	Emergency preparedness plan
H	maximum dam wall height in metres
m	metre
m <sup>3</sup>	cubic metres
NOC	non-overspill crest
NWA	National Water Act (Act No. 36 of 1998)
O&M	Operation and maintenance
OMM	Operation and maintenance manual
R	Rand (South African)
RMF	Regional maximum flood
SANCOLD	South African National Committee on Large Dams
V	storage capacity of dam in cubic metres
WARMS	Water Authorisation & Registration Management System
WMA	Water management area
WRFMC	Water Resources Functional Management Committee of DWAF
x 10 <sup>6</sup> m <sup>3</sup>	million cubic metres
<	This sign means “less than” (e.g. H < 12 m is pronounced as “H is less than 12 metres”)

## **1. INTRODUCTION**

The annual report covers the activities of the Department with regard to administration of the dam safety legislation (Chapter 12 of the National Water Act, 1998 (Act 36 of 1998) read together with the dam safety regulations, R .1560 of 25 July 1986) during the financial year 1 April 2009 to 31 March 2010. The annual report also serves as an auditing tool and progress with the dam safety programme can be assessed by comparing the relevant statistics with those of previous years and with targets that were set in the business plans enclosed in Appendices A and B.

The statistics included in this report reflect the position as for the current nine regions of DWAF.

## **2. ADMINISTRATION**

Administration of the dam safety legislation is carried out jointly by the DSO and selected personnel from the regional offices.

The personnel listed below were employed by the Dam Safety Office at Head Office during the reporting year.

- Two Chief Engineers;
- One Control Industrial Technician;
- Two Chief Industrial Technicians;
- One Deputy Director;
- One Assistant Director;
- One Senior Administrative Officer;
- One Administrative Officer;
- Three Senior Administrative Clerks
- A Senior Admin Clerk doing registry clerk duties;
- One Senior Admin Clerk doing data capturing; and
- One Senior Admin Clerk doing Logistic duties.

During the year a total of approximately 1426 letters were compiled by Dam Safety Administration officials. The letters are categorised as follows:

NUMBER OF ADMIN LETTERS Task	Region									Total
	GA	FS	EC	NW	KZ	LI	MP	WC	NC	
Classification of dams (new/proposed)	5	10	2	10	5	2	5	13	3	<b>55</b>
Registration and classification of dams (existing or recently completed)	27	25	115	18	29	8	7	13	1	<b>243</b>
Licence to construct/alter	1	1	6	0	0	1	7	4	0	<b>20</b>
Licence to impound	0	0	1	0	2	0	2	4	0	<b>9</b>
Licence to abandon	0	0	0	0	0	0	0	0	0	<b>0</b>
Dam safety inspection instructions	31	30	34	16	112	7	37	19	0	<b>286</b>
Implementations of rec in dsi reports	11	17	14	3	2	7	6	26	0	<b>86</b>
Approval of APPs & prof teams (admin)	28	16	19	2	45	9	31	48	2	<b>200</b>
Approval of APPs & prof teams (ECSA)	2	0	4	0	6	0	0	5	0	<b>17</b>
General letters and reminders/warnings	23	10	21	1	24	37	18	71	3	<b>208</b>
Legal Actions	0	0	0	0	0	0	0	0	0	<b>0</b>
Directions	0	0	0	0	0	0	0	0	0	<b>0</b>
Exemptions	0	0	0	0	0	0	0	0	0	<b>0</b>
Declarations of a dam with a safety risk	0	0	0	0	0	0	0	1	0	<b>1</b>
Dams not a safety risk "by definition"	4	2	3	0	0	1	1	1	0	<b>12</b>
Letters in connection with subsidies	0	0	0	0	0	0	0	0	0	<b>0</b>
Letters re inspections, investigations	84	49	25	4	44	3	15	60	5	<b>289</b>
<b>Total for year</b>	<b>216</b>	<b>160</b>	<b>244</b>	<b>54</b>	<b>269</b>	<b>75</b>	<b>129</b>	<b>265</b>	<b>14</b>	<b>1426</b>

### 3. DIRECT COST OF DAM SAFETY ADMINISTRATION

The direct expenditure incurred in administration of the legislation at Head Office is shown in Table 1 below.

**Table 1: DSO Direct expenditure (Thousand Rand)**

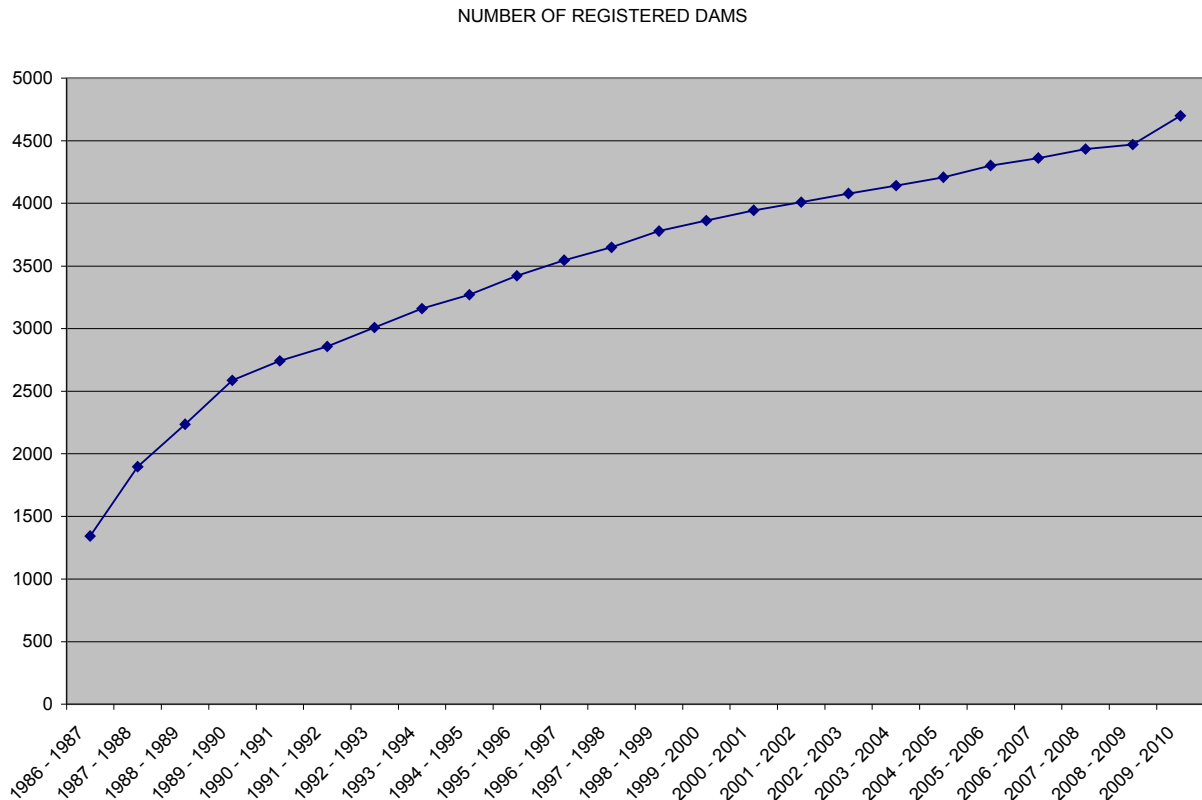
Item	Expenditure	
	2008/09	2009/10
Comp.of Employees	3 869 000	4 383
Goods & Services	449 000	668
Transfers		122
Machinery		271
<b>Grand Totals</b>	<b>4 344 000</b>	<b>5 444</b>

The total direct expenditure was R 5 444 000 compared to R4 344 000 in the previous year, i.e. an increase of 25%. Because of the small size of the DSO, expenditure is very sensitive to personnel fluctuations.

Indirect cost (i.e. expenditure incurred by regional offices for the DSO and Head Office overhead cost) is not included in this figure.

#### 4. REGISTRATION OF DAMS

A new programme was initiated during the year to register dams from the WARMS database onto the Dam Safety Office database making use of ArcMap and GoogleEarth to verify the positions of the dams. A total of 229 dams were registered during the year bringing the total number of dams registered to date in South Africa to 4700. This is a significant improvement on the previous year when only 28 dams were registered. The total figure includes registration of new dams that were completed during the year. The progress with registration of dams is illustrated in figure 1. There are currently 35 mine and industrial residue deposits registered as dams with a safety risk.



**Figure 1: Progress with registration of dams**

Distribution of registered dams according to size class and reservoir capacity, and progress with registration of dams on a regional basis is given in Tables 2 to 4.

**Table 2: Distribution of dams registered according to size class**

Size class	Number	%
Small (5 m – 12 m)	3447	73%
Medium (12 m – 30 m)	1058	23%
Large (30 m and higher)	195	4%
<b>Total</b>	<b>4700</b>	<b>100</b>

**Table 3: Distribution of registered dams according to reservoir storage capacity**

Capacity (x 10 <sup>6</sup> m <sup>3</sup> )	Number	%
0,00 – 0,05	143	3.0%
0,05 – 0,10	1174	25.0%
0,10 – 0,25	1690	36.0%
0,25 – 1,00	1055	22.4%
1,00 – 10,00	429	9.1%
10,00 – 100,00	138	2.9%
100 – 1 000	62	1.3%
1 000 – 10 000	9	0.2%
<b>Total</b>	<b>4700</b>	<b>100</b>

**Table 4: Registration of dams on a regional office basis**

Region	Total No. registered to date	%
Eastern Cape	704	15%
Free State	409	8%
Gauteng	336	7%
Northwest	148	3%
KwaZulu-Natal	922	20%
Limpopo	309	7%
Mpumalanga	476	10%
Northern Cape	81	2%
Western Cape	1315	28%
<b>Total</b>	<b>4700</b>	<b>100%</b>

## 5. CLASSIFICATION OF DAMS

Altogether 77 registered dams were classified, bringing the total number of registered existing dams now classified to 4286, which is 91,2 % of the 4700 dams registered to date. In addition, about 55 proposed dams have also been classified.

Progress with the classification of registered dams in the regions is given in Table 5.



**Table 5: Progress with classification of dams on a regional office basis**

<b>Region</b>	<b>Total no. registered to date</b>	<b>Total no. classified to date</b>	<b>% Classified to date</b>
Eastern Cape	704	592	84%
Free State	409	360	88%
Gauteng	336	303	90%
Northwest	148	134	90%
KwaZulu-Natal	922	890	97%
Limpopo	309	289	94%
Mpumalanga	476	432	91%
Northern Cape	81	67	83%
Western Cape	1315	1219	93%
<b>Total</b>	<b>4700</b>	<b>4286</b>	<b>91%</b>

From Table 5 it can be seen that only KZN has classified more than 95 % of their registered dams. The total percentage classified has fallen from 94% in the previous year to 91 % at the end of this year due to the large number of dams that were registered during the year, but which must still be classified. The Dam Safety Office currently has 3 technicians who spend about 40% of their time on classifications. It will take about 6 years to classify all the unclassified registered dams on the list if we can maintain the current rate of 77 classifications per year. However the list is growing as we register more dams and it can be assumed that it will take at least 10 years before all the registered dams are classified.

It should be noted that the outstanding classifications generally represent small dams and their hazard potential would mostly be low. There may also be some errors on the DSO database or incomplete information.

The distribution of existing dams classified according to hazard potential rating and category are given in tables 6 and 7.

**Table 6: Classification of existing dams according to size class and hazard potential rating**

<b>Size class</b>	<b>Hazard potential rating</b>			<b>Total</b>
	<b>Low</b>	<b>Significant</b>	<b>High</b>	
Small	2350 (55%)	793 (18 %)	40 (1%)	<b>3183 (74%)</b>
Medium	293 (7%)	519 (12%)	134 (3%)	<b>946 (22%)</b>
Large	1 (0%)	21 (0.5%)	135 (3%)	<b>157 (4%)</b>
<b>Total</b>	<b>2644 (62%)</b>	<b>1333 (31%)</b>	<b>309 (7%)</b>	<b>4286 (100%)</b>

**Table 7: Category classification of existing dams**

Category classification	Number of dams	%
Category 1*	2385	56 %
Category 2	1614	38 %
Category 3	287	7 %
<b>Total</b>	<b>4286</b>	<b>100 %</b>

\* 35 of these dams are actually medium size dams that have been classified as indicated below, in terms of regulation 3.2 of the dam safety regulations.

Size class : Medium  
Hazard potential rating : Low  
Category classification : 1

## 6. CONTROL OVER THE CONSTRUCTION & ALTERATIONS OF DAMS

**Table 8: Licences issued by DSO**

Category	Licence to construct	Licence to alter	Licence to impound	Licence to Abandon	Total
1	1	0	1	0	2
2	1	7	5	0	13
3	1	6	1	0	8
Total	3	13	7	0	23

Dam safety control over the construction of new dams, including alterations to existing dams, involves the evaluation of design and other reports that forms part of a licence application. A total of 23 dam safety licences were issued, i.e. 3 licences to construct, 13 to alter, 7 to impound and 0 to abandon (decommission).

Provision has been made for inspections by personnel of the regional offices during construction of category I and II dams, but very little success has been achieved in most of the regions because of the lack of human resources.

Response from APPs with regard to the submission of reports after site visits varied from very good to fair.

### 6.1 Site visits to dams

The DSO made a total of 91 visits to dams during the year. Of these, 27 were to dams under construction whilst the remaining 64 were to existing dams. Where possible, contact was made with APPs to discuss design issues, general problems and quality control. A special effort was made to discuss dam safety and dam engineering issues with owners with respect to operation and maintenance (including contingency plans), as well as the dam safety legislation itself.

### 6.2 Evasion of the dam safety legislation

The following dams were identified during the year as having been built/enlarged/alterd without a licence to construct.

- Wolfgat Dam near Warden (H = 6m, V = 0,35 million m<sup>3</sup>, Cat 1)
- Leeukop Dam near Warden (H = 7m, V = 0,2 million m<sup>3</sup>, Cat 1)
- Brakwal Dam near Warden (H = 11m, V = 0,5 million m<sup>3</sup>, Cat 1)

The three dams near Warden belong to one owner and no licence applications were made to the DSO. Water use licences had also not been issued and the Gauteng Region who issued a directive to the owner that he may not store any water until the applications for water use licences have been considered. The owner will have to apply for a licence to abandon if it is decided that the dams must be removed.

In the majority of cases the DSO and regions only find out when construction is near completion (or completed), therefore it is not always possible to stop construction.

## 7. CONTROL OVER THE SAFETY OF EXISTING DAMS

### 7.1 Progress with the five-yearly inspections

The following table show the status of the dams with respect to the number of inspections performed to date for Category 2 and 3 dams only:

**Table 9: Progress with 5-yearly inspections of Category 2 and 3 dams**

Number of inspections performed to date	DWA	Municipal	Industry Mines Business	State	Water Boards	Agricultural	Other	Number of Dams (Cat 2 & 3)
0*	17 (8)**	21 (36)	34 (37)	1 (3)	4	324 (349)	96 (85)	497 (518)
1	59 (73)	103 (122)	54 (71)	14 (18)	25	566 (564)	30 (27)	851 (875)
2	98 (115)	69 (61)	48 (46)	9 (7)	4	143 (132)	5 (5)	376 (366)
3	86 (56)	30 (23)	16 (9)	3	5	19 (15)		159 (103)
4	9 (3)	6 (2)	1 (1)					16 (6)
5	1 (1)		1					2 (1)
Total number of Cat 2 & 3 dams	270 (256)	229 (244)	154 (164)	27 (28)	38	1052 (1060)	131 (117)	1901 (1869)
Total number of inspections done	554 (488)	355 (321)	207 (194)	41 (32)	48	909 (873)	40 (37)	2154 (1945)

\*The first row in the Table includes new dams not yet 5 years old.

\*\*Statistics of previous year are indicated in brackets.

The analysis shows that there are a large number of dam owners who are not complying with the target inspection intervals of between 5 and 10 years (average 7,5 years) between inspections. In addition a large number of Category 2 and 3 dams have not been inspected

yet. The Table also shows that DWA (Infrastructure Branch) has performed better than any other sector.

The flow of dam safety inspection reports through the directorate during the reporting year was as follows (statistics of previous year are indicated in brackets):

**Table 10: Flow of dam safety evaluations**

	Number
Dam Safety Inspection Instructions Issued*	286 (215)
Dam Safety Inspection Reports Received	148 (136)
Dam Safety Inspection Reports Accepted	134 (126)
Reports received but not evaluated or accepted at end of reporting period	88 (82)

\* Instructions are currently not issued for dams under control of the DWA Infrastructure Branch because they follow a programme accepted by the DSO and their dams are therefore not included in this figure. Their dams are however included in the number of reports received and accepted.

Recently the Dam Safety Office started to issue instructions for Category I dams belonging to the Municipalities in the Eastern Cape.

Presently there are 1901 category II and III dams in the country and these dams should be inspected at an average interval of about 7,5 years. To achieve this, the ideal target should be set at 250 inspections submitted and accepted per year. The ideal target for instructions is set at 200 per year as DWA dams are excluded.

The current capacity of the Dam Safety Office to evaluate and accept these reports are limited and only 134 were accepted and the year ended with a backlog of 88 reports that must still be finalised. More technical capacity is therefore essential.

## 7.2 Progress with rectification of deficiencies at category II and III dams

The deficiencies listed in Table 11 have been registered on the DSO database with regard to dams for which dam safety inspection reports have been formally accepted since implementation of the dam safety legislation in 1987.

**Table 11: Deficiencies/shortcomings at dams**

Description	Number of Deficiencies	Number rectified
Hydraulic Problems	706	151
Leakage Problems	218	58
Structural Problems	270	74
Material Problems	35	8
Operation And Maintenance Problems	1835	604
Other Problems	25	5
<b>TOTAL</b>	<b>3091</b>	<b>900</b>

A total of 3091 deficiencies have been registered of which 900 (29%) have been rectified since 1986. Rectification of a deficiency can also mean that a subsequent investigation into the matter proved that a deficiency previously recorded is no longer considered a

problem because of better information. A more detailed breakdown of the deficiencies is included in Appendix B.

A total of 85 operation and maintenance manuals (OMM) including emergency preparedness plans (EPP) were formally accepted during the financial year. According to the database, a total of 936 dams now have both an OMM and EPP, 33 have only an EPP and 42 only an OMM.

As in previous years much time and effort were spent on visiting owners, discussing shortcomings requiring rectification and associated problems. It is again reported that limited success has been achieved and where progress has been made, much personal input has been required. This is only possible for selected (more important) case studies. Financial circumstances and the state of the economy are still the most common “stumbling blocks”. However, in some cases dam owners have put a lot of effort into the upgrading and maintenance of their dams.

The Dam Safety Office tries to follow up in writing (every 6 months) all cases where important recommendations of 5 yearly dam safety inspection reports have not been implemented. This objective has however not been achieved in all cases due to the shortage of technical and administrative staff. Nevertheless, a total of 375 follow-up letters were compiled in this regard.

### **7.3 Prioritisation of existing dams**

The DSO continued with the upkeep of the priority list of dams and the first eleven pages (which include the most important outstanding dam safety work in South Africa) are appended in Appendix C. The total number of dams on the list has increased to 1290. The goal is to eventually reflect all category II and III dams (private as well as State dams) on the list. A simplified risk-based assessment is done to determine the ranking of a dam on the list, based on information provided in dam safety inspection reports that were compiled by APPs. The relative risk is expressed in terms of “possible loss of life during the life-span of a dam” (assumed as 100 years on average) and is calculated by using the following parameters:

- The estimated probability of failure of a dam.
- The consequences of such a failure (hazard potential in terms of loss of life during a worst case scenario).
- A reduction factor determined from the standard of operation, maintenance, monitoring programme, emergency preparedness and general condition of a dam.

The priority list serves as a management tool for the DSO to:

- Identify priorities for the DSO.
- Determine appropriate inspection frequencies for dams. The proposed frequency as indicated in the last column of the list in Appendix C is one of the parameters used for the determination of intervals (years) between inspections.
- Monitor progress with the dam safety programme e.g. by comparing the total expected loss of life for the first 50 dams on an annual basis.

It was found that the total expected/possible loss of life for the first 50 dams on the list reduced by 9,1% from 3 844 (2008/09) to 3 494 (2009/10). The total possible loss of life for all dams on the list also reduced by 9,1% from 5 282 (2008/09) to 4 800 (2009/10). Some of the afore-mentioned reductions are due to better assessments of risks following evaluations of new dam safety inspection reports, and not because of actual improvement on the ground. The list is not yet adequately “stable” to be used as an accurate short term

monitoring tool to measure progress with the dam safety programme. However, it is clear that attention should be focused on the first 50 to 200 dams on the list as they have the greatest potential impact on the public.

The priority list also provides a tool to assess the current state of dam safety in South Africa. This is reflected in the bottom portion (item 5) of the Table in Appendix A. The deductions that could be made from the first 100 dams on the priority list are shown in Table 12. It appears that progress is rather slow, but a number of dams are currently being rehabilitated or earmarked for rehabilitation, especially by the DWA Infrastructure Branch and this should make an impact on the statistics in the near future.

**Table 12: Serious deficiencies under the first 100 dams on priority list requiring immediate attention**

Item	No. of dams
<ul style="list-style-type: none"> <li>• Serious structural deficiency (estimated probability of failure more than 0,5% per year or more than 39% during dam's life)</li> </ul>	16 (15)
<ul style="list-style-type: none"> <li>• Serious deficient flood handling capacity (probability of failure more than 0,5% per year)</li> </ul>	15 (14)
<ul style="list-style-type: none"> <li>• Total number of dams with probability of failure of more than 0.5% per year</li> </ul>	26 (24)

*Note: Numbers in brackets are those for the 2008/09 report year*

An asterisk in the action column of the priority list marks urgent actions that should be undertaken in the short term (probability of failure estimated at more than 0,05% and 0,5% per year for category 3 and 2 dams respectively). **For these dams the probability of failure is considered to be unacceptably high.** Some dams appear high on the list on the basis of their massive size and high theoretical hazard potential. Although no betterment work may be required for these dams because they comply with appropriate dam safety standards, it is important that adequate maintenance, monitoring, emergency preparedness and security measures are in place at these dams.

**It can be concluded that a lot of work must still be done by several role players to bring the state of dam safety in South Africa to satisfactory levels.** The current rate of dam safety betterment work as reflected in Table 14 is slow but steady. It is important that the top 100 to 200 dams on the priority list are provided with emergency preparedness plans.

Table 13: Number of dams per sector within first 100 dams as ranked on priority list

Sector	Total number of dams registered	Number of dams within first 100 dams as ranked on priority list
DWAF Dams	311	61
Municipal Dams	268	20
Other State Dams	46	2
Water Board Dams	45	2
Mines, Industries, Business	271	3
Agricultural Dams	3085	12
Other	674	0
TOTAL	4700	100

#### 7.4 Legal/criminal proceedings

No new cases were handed to Directorate Legal Services for starting with legal procedures against dam owners during the past financial year.

### 8. APPROVAL OF PROFESSIONAL PERSONS FOR TASKS

A total of 217 applications for approval were received during the year. Of these 17 applications were submitted to the Engineering Council of South Africa (ECSA) and handled by its Committee on Professional Engineers for Dams. ECSA recommended 9 unconditional approvals, 2 conditional approval and 2 non approvals.

The 200 other applications were processed on the strength of previous recommendations and approvals i.e. not again referred to ECSA for a recommendation.

To date 214 persons have applied to be approved as APPs for dam “tasks” and 148 have been approved to date. A total of about 71 APPs are currently still active (not emigrated or deceased and approved for at least 1 task during the past 5 years).

### 9. UPGRADING OF EXISTING DAMS

Work to upgrade existing dams (completed or under construction during the year) are listed in **Table 14**. The amounts shown represent estimates of the total cost of the work.

**Table 14: Upgrading of safety of existing dams**

<b>Name of dam</b>	<b>Description</b>	<b>Cost (R)</b>
Rietvlei	Strengthen outlet tower by carbon fibre reinforcement polymer strips and rehabilitate joints in spillway chute slabs.	R 11 million
Bospoort	Dam Safety Rehabilitation Works – Replace crest gates with an uncontrolled labyrinth spillway on the crest and add a spillway on the right flank.	R 114 million
Kromellenboog	Dam Safety Rehabilitation Works – Increase spillway capacity.	R 52 million
Klein Maricopoort	Dam Safety Rehabilitation Works – Increase spillway capacity.	R 11 million
Nsami	Dam Safety Rehabilitation Works – Increase spillway capacity, new spillway & bridge and stabilise dam wall.	R 75 million
Lakeside	Dam Safety Rehabilitation Works - Increase spillway capacity by raising of the embankment.	R 30 million
Molepo	Improve stability and increase spillway capacity.	R 74 million
Acornhoek	Improve stability and increase spillway capacity.	R 26 million
Elandsdrift	Dam Safety Rehabilitation Works – Increase spillway capacity.	R 67 million
Grassridge	Dam Safety Rehabilitation Works – Increase spillway capacity.	R 25 million
Laing	Dam Safety Rehabilitation Works – Refurbish outlet works.	R 10 million
Toleni	Dam Safety Rehabilitation Works - Increase spillway capacity by raising of the embankment.	R 25 million
Gcuwa	Dam Safety Rehabilitation Works – Increase spillway capacity by raising of the embankment.	R 17 million
Belfort	Dam Safety Rehabilitation Works – Increase spillway capacity and strengthen multiple arch structure.	R 15 million
Magwa	Dam Safety Rehabilitation Works – Stabilise and drain downstream slope	R11 million
Albert Falls	Raise NOC level by crest wall	R 10 million
Chuniespoort	Dam Safety Rehabilitation Works – Increase spillway capacity, raising and stabilising dam wall.	R 32 million
Kabokweni	Abandonment/decommissioning.	R 9 million
Mogoto	Upgrade outlet tunnel and replace outlet valve.	R 2 million
Taung	Refurbish mechanical equipment and reduce leakage in drainage gallery.	R 8 million
Dap Naude	Conversion of buttress wall to partial concrete gravity wall to counter loss of pre-stressing provided by cables in buttress heads.	R 17 million
Rust de Winter	Dam Safety Rehabilitation Works – Increase spillway capacity, raising and stabilising dam wall.	R 33 million
Glen Brock	Dam Safety Rehabilitation Works – Upstream and downstream slopes of dam wall, spillway , outlets and roads.	R 33 million
Salani	Upgrading of spillway & outlet, levelling NOC and install toe drain.	R1 million
Bush	Upgrading of spillway & outlet, levelling NOC and install toe drain.	R1 million
German	Upgrading of spillway & outlet, levelling NOC and install toe drain.	R1 million
Mac	Upgrading of spillway & outlet, levelling NOC and install toe drain.	R1 million
Mbuzini	Upgrading of spillway, raising of NOC and installation of toe drain.	R4 million

A representative indication of betterments to some dams can be seen in the “photo series” in Appendix D.



## 10. INCIDENTS AT DAMS

**Table 14: Incidents at Dams**

The following incidents at dams were reported to the DSO:

NAME OF DAM (TYPE)	LOCALITY AND NUMBER OF DAM	HEIGHT (m)	CAPACITY (m <sup>3</sup> )	CAT	INCIDENT OR DAMAGE
Rust de Winter (Rockfill with u/s concrete membrane)	Pienaarsrivier, north of Tshwane. B310/01	31	28 million	3	Superficial downstream slope failure of rockfill dam when contractor undermined toe when constructing temporary access road.

## 11. REVISION OF THE DAM SAFETY REGULATIONS

In terms of section 163(4) of the NWA the current dam safety regulations (i.e. Government Notice R. 1560 of 25 July 1986) are still in force and have been used effectively in conjunction with the new Act since 1 October 1998. It has however been decided to revise the regulations for the following reasons:

- To better align the regulations with the objectives of the National Water Act of 1998.
- To build on experience since 1986.
- To implement the establishment of a register of approved professional persons for tasks for dams with a safety risk as provided for by section 123(1)(a) of the NWA.

The draft Dam Safety Regulations were drafted by the Dam Safety Office after consultation with Directorates in DWA involved with dam safety as well as senior officials in the National Water Resources Infrastructure Branch, and after consultation with members of the ECSA Committee on Professional Engineers for Dams.

The Chief State Law Advisers of the Department of Justice has reviewed the draft revised Dam Safety Regulations and their comments have been addressed.

The draft regulations were published in the Government Gazette on 1 September 2009 inviting comment from the public by 30 November 2009. The public comments have been received and have been considered by the end of the financial year.

## 12. PROPOSED REGULATIONS ON FINANCIAL ASSISTANCE

Until 1 October 1998, subsidies were paid out for dam safety related work in accordance with conditions published in Government Notice No. 1854 dated 10 August 1990 (hereafter G.N. 1854), which were published in terms of section 9C (9A) of the previous Water Act, 1956. The National Water Act, 1998, came into effect on 1 October 1998. Since 1 October 1998, new subsidy applications could not be considered, as the previous subsidy conditions were not compatible with the new set of criteria specified in section 61 of the NWA.

The objective of the proposed financial assistance scheme is to help dam owners who cannot afford it, to comply with requirements of the dam safety legislation to execute tasks such as dam safety evaluations, dam safety investigations and dam safety betterment work in order to upgrade the safety of category II and III dams to appropriate standards. It should be borne in mind that the proposed regulations can only be finalised once the new dam safety regulations (see section 11 above) have been promulgated, due to the many cross references to specific clauses of the dam safety regulations.

## 13. COURSES/TRAINING/LECTURES AND SYMPOSIUMS

<u>Event attended</u>	<u>Institution</u>	<u>Number of officials</u>	<u>Date</u>
Effective Document & Information Management	NKUFU	2	16 – 17 March 2010
Certificate in Public Management	Regenesys	1	One year Course
Business Management (own expense)	Tswane South College	1	One year Course
Information & Record Management	Document Warehouse	1	28 Sept. – 2 Oct 09
Program in HRM	UNISA	2	One year
Excell 1, Excell 2, Excell 3	Siyabonga	1	12 Oct 2009 16 Oct 2009 4 Nov. 2009
Innovation Conference	CPSI	3	27 – 28 August 09
<u>Introduction to Geographic Information Systems</u>	<u>GIMS Educational Services</u>	<u>2</u>	<u>September 2009</u>
<u>Conference on Sustainable Development of Dams in Southern Africa</u>	<u>SANCOLD</u>	<u>3</u>	<u>November 2009</u>

## 14. CONCLUSIONS AND RECOMMENDATIONS

A summary of the current state of dam safety in South Africa is given in the strategic business plan for the dam safety programme (DSP), attached as Appendix A. This strategic business plan also gives an indication of progress made since commencement with the DSP in 1987. In addition, possible steps to attain all the objectives of DSP by different key role players (not only the DSO) are included. The salient points of the current state of dam safety in South are as follows:

- It is expected that most category 2 and 3 dams have been registered, but there may still be a significant number of category 1 dams that have not been registered. Steps to improve on this statistic are proposed in the business plan and recently a number of category I dams had been registered from the WARMS database.
- Most new category 2 and 3 dams with a safety risk are being built in accordance with appropriate safety standards. Proposed steps to further improve quality of design and construction include training of the important role players.
- Of the total of 1901 category 2 and 3 dams, 1404 dams have already undergone the first round of inspections by approved professional persons/engineers. Most of the larger and more important dams have been inspected. Steps to ensure that all category 2 and 3 dams are inspected at regular intervals are proposed in the business plan.
- It will be a requirement in the new dam safety regulations that all category 2 and 3 dam owners must have updated O&M manuals and emergency preparedness plans. At present only about 49% of these dam owners comply with this objective. In the business plan steps to improve the standard of O&M at all dams with a safety risk are proposed.
- **Only an estimated 57% of the first 400 category II and III dams on the priority list comply with basic dam safety standards.** Upgrading of the remaining dams to appropriate safety standards will be a long-term task (until 2020 or later) and provisional targets are set on a prioritised basis in the business plan. DWA as a major dam owner has embarked on an aggressive dam safety rehabilitation programme, which should make a significant impact on the dam safety statistics during the next few years.
- It can be concluded that reasonable progress has been made since 1987. However, it is also clear that a lot of work by several role players still needs to be done to attain the set targets in order to improve the state of dam safety in South Africa to acceptable standards by 2020.
- The total direct expenditure incurred in administration of the dam safety legislation at Head Office was R 5 444 000 compared to R 4 344 000 in the previous reporting year, i.e. an increase of 25%. Because of the small size of the DSO, expenditure is very sensitive to personnel fluctuations. It is believed that the benefits of the dam safety programme far outweigh the total direct expenditure.

The following specific recommendations are made to maintain and preferably accelerate progress with the dam safety programme:

- The technical personnel component within the DSO should be strengthened. Significant momentum was lost when one Chief Engineer resigned. The DSO has been unable to fill three vacant Chief Engineer posts over a long period of time.
- A financial assistance scheme should be implemented as soon as possible after promulgation of “new” dam safety regulations. Previously it was found that financial assistance acted as a moderate incentive for dam owners to implement dam safety betterment work. Dam safety is in public interest.

## APPENDIX A: STRATEGIC BUSINESS PLAN FOR THE DAM SAFETY PROGRAMME

**Vision:** That all dams with a safety risk shall comply with appropriate safety standards in order to minimize loss of life, damage to property and harm to the environment.

**Responsibilities:** The success of the dam safety programme depends on action and commitment by several role players: Firstly dam **owners** (including Infrastructure Branch within DWA [**DWA-IB**]), secondly various other components within DWA (Dam Safety Office [**DSO**], Regional Offices [**RO**] and Legal Services [**LS**]) and thirdly Disaster Management Structures [**DM**].

Key Performance Area / Objectives	Short Term Targets	Current Status*	Possible Plan of Action to Attain Objectives (+Responsible Role Player)
1. That all dams* are registered and classified.	<b>99%</b> cat II & III and <b>90%</b> cat I registered by 2012. <b>95%</b> of reg. dams classified by 2012.	<b>1901</b> <b>2385</b>  <b>91,2%</b> (of <b>4700</b> )	<ul style="list-style-type: none"> <li>Register dams from WARMS database plus advertising campaign. (RO)</li> <li>Obtain services of consultants to assist some Regional Offices. (RO)</li> <li>Introduce fines to owners? (LS)</li> </ul>
2. That all new dams* are designed/ built / altered in accordance with appropriate standards.	<b>90%</b> by 2012 (measurement of quality of construction subjective, especially at Cat I dams)	<b>≈82%</b> (estimate allows for deficient quality at category I dams)	<ul style="list-style-type: none"> <li>Prevent illegal construction by e.g. air and road reconnaissance. (RO)</li> <li>Introduce fines? (LS)</li> <li>Training courses for APPs/contractors/ clerks of works? (APPs, DSO)</li> <li>Improve control over cat I dams. (RO, DSO)</li> </ul>
3. That all Cat II & III dams are inspected and evaluated by APPs* according to schedule and in accordance with current dam engineering standards.	<b>1450</b> 1st inspections by 2012. Then 2 <sup>nd</sup> and 3 <sup>rd</sup> inspections to follow schedule.	1 <sup>st</sup> <b>1404</b> 2 <sup>nd</sup> 553 3 <sup>rd</sup> 177 inspection reports received so far.	<ul style="list-style-type: none"> <li>Accelerate instructions. (DSO)</li> <li>Improve system of reminders, warnings, legal action, etc. (DSO, LS)</li> <li>Implement financial assistance scheme. (DSO)</li> <li>Inspection of some DWAF dams should be contracted out. (DWAF-IB)</li> <li>Training courses for APPs? (APPs, DSO)</li> </ul>
4. That all dams* are operated & maintained in accordance with appropriate safety standards and that effective OMMs* and EPPs* are in place.	<b>1000</b> OMMs and EPPs for Cat II and III by 2012. Standard OMM & EPP issued for all Cat I dams by 2012. Effective Disaster Management Structures by 2012.	<b>936</b> OMMs and EPPs for Cat II and III dams compiled so far.	<ul style="list-style-type: none"> <li>Improve system of reminders, warnings, legal action, etc. (DSO, LS)</li> <li>Implement financial assistance scheme. (DSO)</li> <li>Ensure that all Cat II and III dams have OMMs and EPPs. (DSO + owners)</li> <li>Compile a standard OMM &amp; EPP for Cat I dams and issue. (DSO)</li> <li>Motivate dam owners to keep up O&amp;M by two-yearly circulars. (DSO)</li> <li>Implement Disaster Management Act. (DM)</li> </ul>
5. That all dams* shall comply with appropriate safety standards (e.g. SANCOLD guidelines).  Where necessary, dams must be upgraded to acceptable standards.	<u>According to order of priority list:</u> <ul style="list-style-type: none"> <li>1<sup>st</sup> 100 dams <b>75%</b> by 2012</li> <li>2<sup>nd</sup> 100 dams <b>70%</b> by 2012</li> <li>3<sup>rd</sup> 100 dams <b>70%</b> by 2012</li> <li>4<sup>th</sup> 100 dams <b>70%</b> by 2012</li> <li>All Cat II &amp; III dams by 2020</li> </ul>	<u>Basic* compliance:</u> <ul style="list-style-type: none"> <li><b>48</b> dams</li> <li><b>59</b> dams</li> <li><b>52</b> dams</li> <li><b>70</b> dams</li> </ul>	<ul style="list-style-type: none"> <li>Upgrade dams on prioritized basis. (Owners+DSO)</li> <li>Improve system of reminders, warnings, legal action, etc. (DSO, LS)</li> <li>Implement financial assistance scheme. (DSO)</li> <li>Training courses for APPs/contractors/ clerks of works? (APPs, DSO)</li> <li>Give special attention to high priority cases and report on progress annually (DSO)</li> <li>Budget R500 M+ per year. (DWAF-IB)</li> </ul>

\*Notes: **APP** means approved professional person. **Basic compliance** means the probability of failure of a dam is estimated to be less than 0,05% (1/2000) and 0,5% (1/200) per year for category 3 and 2 dams respectively. **Dams** in this Table mean dams with a safety risk. **EPP** means emergency preparedness plan. **OMM** means O&M manual. **Current status** is the status as on 31 March 2010.

**APPENDIX B: DEFICIENCIES AT DAMS WITH A SAFETY RISK**

Code	Description	Previous year		This Year	
		Number	Rectified	Number	Rectified
H01	Spillway capacity less than requirements of current criteria	402	79	428	82
H02	Erosion of toe of dam or downstream thereof	45	8	47	8
H03	Damage to spillway lining (e.g. erosion or cavitation)	80	22	80	22
H04	Damage to outlet works (e.g. cavitation)	16	3	16	4
H05	Mechanical equipment or outlet works out of order	1	10	42	10
H06	Spillway or gate vibration	2	1	2	1
H08	Erosion due to wave action (damage to upstream slope protection)	69	15	68	15
H09	Inadequate surface drainage or damage by "rainfall" erosion	22	7	22	8
H11	Hazard to human life upstream of dam during floods ("backwater" effects also)	1	1	1	1
	<b>HYDRAULIC PROBLEMS</b>	<b>678</b>	<b>146</b>	<b>706</b>	<b>15</b>
L01	Excessive loss of water	120	29	125	30
L02	High pore pressures, uplift forces, blocked drains	29	5	29	6
L03	Internal erosion, piping	16	2	19	2
L04	Wet patches observed	45	21	45	20
	<b>LEAKAGE PROBLEMS</b>	<b>210</b>	<b>57</b>	<b>218</b>	<b>58</b>
S01	Stability (gravity and buttress dams)	60	19	62	19
S02	Slope stability (earth and rockfill dams)	70	14	74	17
S03	Structural design criteria exceeded (arch dams)	10	3	10	3
S04	Foundation movement observed	3		3	
S05	Upstream "slip circle movement" observed	2	1	2	1
S06	Downstream "slip circle movement" observed	13	3	13	3
S07	"Flow slide" observed	3	1	3	1
S09	Excessive cracking or differential movement observed in mass concrete	15	4	15	4
S10	Excessive settlement of earth or rockfill dams	75	22	77	22
S11	Formation and development of cracks in earth dams	11	4	11	4
	<b>STRUCTURAL PROBLEMS</b>	<b>262</b>	<b>71</b>	<b>270</b>	<b>74</b>
M01	Weakening of concrete due to alkali-aggregate reaction or swelling/shrinking aggregate	18	4	18	4
M02	Chemical attack, leaching, weathering, bacteriological attack	2	1	2	1
M03	Break up of upstream membrane	1		1	
M06	"Foundation/ abutment material breakdown"(chemical)	1	1	1	1
M07	Corrosion ( mechanical equipment)	4	1	4	1
M09	Dispersive soils identified	8	1	8	1
M11	Crumbling/weathering/slaking of rock	1		1	
	<b>MATERIAL PROBLEMS</b>	<b>35</b>	<b>8</b>	<b>35</b>	<b>8</b>
B01	Flood control: Lack of personnel, untrained personnel	2		3	

B02	Operation and Maintenance Manual (OMM) must be compiled / updated	1057	400	1097	408
B03	Deficiencies in monitoring (instrumentation)	72	24	69	24
B04	Deficiencies in monitoring (routine inspections)	6	3	6	3
B05	Emergency Preparedness Plan (EPP) must be compiled / updated	261	37	329	49
B07	Trees and vegetation that must be removed	202	80	204	81
B08	Burrowing animals that must be exterminated	70	21	70	21
B09	Instruments not read/processed/evaluated	2		2	
B10	Flood control gates out of order	6	3	7	4
B11	Outlet works out of order	22	5	24	5
B12	Maintenance of slope protection	25	11	24	9
<b>B13</b>	<b>Increase non overspill crest width</b>			<b>1</b>	
<b>B14</b>	<b>Inadequate freeboard</b>			<b>1</b>	
	<b>OPERATION AND MAINTENANCE PROBLEMS</b>	<b>1725</b>	<b>584</b>	<b>1835</b>	<b>604</b>
A01	Sabotage	2		2	
A02	Earthquake Damage	2	1	2	1
A04	Problems in dam basin (unstable slopes, sedimentation)	1		1	
A05	Problems in the river downstream of a dam	1		1	
A06	Further investigations required	20	4	19	4
	<b>OTHER PROBLEMS</b>	<b>26</b>	<b>5</b>	<b>25</b>	<b>5</b>
	<b>TOTAL</b>	<b>2936</b>	<b>871</b>	<b>3091</b>	<b>900</b>

## APPENDIX C: PRIORITISATION OF DAMS

**PRIORITY LIST OF DAM SAFETY OFFICE (No. of dams on list: 1290)**

**LEGEND:**

**PF - Probability of failure during lifespan of dam**

**LL - Hazard potential in terms of loss of life**

**EL - Possible loss of life during lifespan of dam based on worst scenario (e.g. failure during night, slow evacuation)**

**AL - Reduction factor for good O&MM and EPP**

**N - Lifespan of dam (100 years)**

**T - Average "recurrence period (years) between failures"**

**1/T - Annual probability of failure**

**EPP - Emergency preparedness plan**

**Sector (owner) - A (Agriculture), M (Municipal), W (DWA), S (Other state departments), O (other e.g. industry)**

Expected loss of life	Guide for DSI interval in years
< 0.5	10
0.5 - 2	9
2 - 10	8
10 - 20	7
20 - 50	6
> 50	5

No. Sector	Major risk aspect	DAM NO.	NAME OF DAM	Category	T (Years)	PF	LL	AL	EL (Total)	EPP (Y/N)	STATUS	DSI interval / PROGRESS
1N120-01		NQWEBA DAM	(PREVIOUSLY VANRYNEVELD'S PASS)	3						Y		5
	Spillway		*Investigate further	100	0.634	2000	0.5		633.968		Programmed for 2007/8	
	Structure		*Investigate further and improve	100	0.634	10	0.5				Programmed for 2007/8	
	EPP out of date		EPP to be updated	0	0.000	0	0				Programmed for 2006/7	
				0	0.000	0	0					
2C601-01		BLOEMHOEK DAM	3	Y						5		
	Spillway		None	2000	0.049	2140	0.6		284.233		Adequate	
	Structure		Adequate	500	0.181	2140	0.6				Adequate	
				0	0.000	0	0					
				0	0.000	0	0					
3A210-01		ROODEKOPJES DAM	3	N						5		
	Spillway		None	2000	0.049	900	0.7		271.575		Adequate	
	Structure		None	2000	0.049	500	0.7				Adequate	
	No O&MM and EPP		Revise existing O&MM and compile EPP	0	0.000	0	0				Programmed for 2007/8	
	Spillway gate malfunction		*Investigate	200	0.394	900	0.7				Ongoing	
4N230-01		DARLINGTON DAM	(LAKE MENTZ)	3						Y		5
	Spillway		*Investigate and improve	200	0.394	608	0.9		231.893		Programmed for 2010/1 & 2011/2	
	Structure - stability		None	2000	0.049	608	0.9				Adequate	
				0	0.000	0	0					
				0	0.000	0	0					
5W440-01		PONGOLAPOORT DAM	3	N						5		
	Spillway Capacity		Investigate further. Operate at reduced FSC(66%).	5000	0.020	6600	0.7		181.171		Programmed for 2009	
	Structural Stability		Investigate	5000	0.020	6600	0.7				Programmed for 2010	
					0.000							
					0.000							
6B100-04		WITBANK DAM	3	Y						5		
	Spillway		* Investigate and improve (gated spillway)	200	0.394	350	1		177.681		Programmed for...?	
	Structure		Pendulums and cracking should be monitored. Concrete corrosion	1000	0.095	350	1				Programmed for...?	
	Poor O&MM		Improve O&MM	1000	0.095	350	1				Programmed for...?	





<i>interval</i>	<i>Sector</i>	<i>Major risk aspect</i>	<i>Action to be taken (*urgent)</i>	<i>T (Years)</i>	<i>No.</i>	<i>DAM NO.</i>	<i>NAME OF DAM</i>	<i>Category</i>	<i>EPP</i>	<i>DSI</i>
<i>(years)</i>					<i>PF</i>	<i>LL</i>	<i>AL</i>	<i>EL (Total)</i>	<i>(Y/N)</i>	<i>STATUS / PROGRESS</i>
7C801-10		STERKFORTEIN	3	Y					5	
	Spillway	None except correct operation		2000	0.049	5000	0.5	155.857		Adequate
	Structure - filters not comprehensive	None except permanent monitoring and EP		5000	0.020	2500	0.5			Adequate
	Material parameters not fully known	Investigate further (design report)		5000	0.020	5000	0.5			Programmed for 2010
				0	0.000	0	0			
8B100-13		MIDDELBURGDAM	3	Y					5	
	Spillway	Investigate options (overtopping spillway)		3000	0.033	6000	0.5	127.241		Ongoing
	Structure	None except when overtopping		10000	0.010	6000	0.5			Adequate
				0	0.000	0	0			
				0	0.000	0	0			
9C300-02		WENTZEL DAM	2	N					5	
	Spillway	*Detailed investigation and improve		133	0.530	312	0.7	125.497		Programmed for 2007/8 & 2008/9
	Structure	None, but monitoring essential		1000	0.095	312	0.7			Adequate
	No O&MM and EPP	Compile		0	0.000	0	0			Programmed for 2008/9
				0	0.000	0	0			
10		R101-01	CATA DAM	3					N	
	Spillway	*Investigate and improve		500	0.181	750	0.7	116.217		Programmed for 2007/8 & 2008/9
	Structure	None		2000	0.049	750	0.7			Adequate
	No O&MM and EPP	Compile		0	0.000	0	0			Programmed for 2008
				0	0.000	0	0			
11		J330-01	STOMPDRIFT DAM	3					Y	
	Spillway	* Increase spillway capacity		111	0.595	200	0.8	96.481		Programmed for 2009/10
	Structure	* Improve structural adequacy		200	0.394	100	1			Programmed for 2009/10
				0	0.000	0	0			
				0	0.000	0	0			
12		B310-05	RHENOSTERKOP DAM	3					N	
	Spillway	Investigate further		5000	0.020	4000	0.7	82.759		Adequate
	Structure	Do survey of saddle dam		10000	0.010	4000	0.7			Programmed for 3/97. Outstanding
	No O&MM and EPP	Compile		0	0.000	0	0			Programmed for 3/98. Outstanding
					0.000					
13		H800-03	DUIVENHOKS	3					Y	
	Spillway	None		2000	0.049	200	1	80.090		Adequate
	Structure	*Investigate stability. Stabilize left abutment		200	0.394	100	1			Programmed for 2007/8 & 2008/9 & 2010/1
					0.000					
					0.000					
14		M100-01	GROENDAL DAM	3					Y	
	Spillway	None		2000	0.049	1000	0.7	66.630		Adequate
	Structure	None		2000	0.049	1000	0.7			Adequate
					0.000					
					0.000					
15		U200-04	INANDA DAM	3					Y	
	Spillway	None		10000	0.010	1000	0.5	57.676		Adequate
	Structure - foundation	RF Foundation jointed with weathering of joints		8000	0.012	1000	0.5			Adequate
	Erosion emergency spillway	*Investigate erosion protection		1000	0.095	1000	0.5			Programmed for 2007/8
					0.000					
16		C120-01	VAAL DAM	3					Y	
	Spillway	None		2000	0.049	1600	0.6	55.918		Adequate
	Structure	None		10000	0.010	1600	0.6			Adequate
					0.000					

<i>interval</i>	<i>Sector</i>	<i>Major risk aspect</i>	<i>Action to be taken (*urgent)</i>	<i>T (Years)</i>	<i>No. PF</i>	<i>DAM NO. LL</i>	<i>AL</i>	<i>NAME OF DAM EL (Total)</i>	<i>Category (Y/N)</i>	<i>EPP STATUS</i>	<i>DSI / PROGRESS</i>	
17	Spillway Structure		C520-02 KRUGERSDRIFT None None	3	2000 2000	0.049 0.049	930 930	0.6 0.6	53.113	Y	Adequate Adequate	5
18	Spillway Capacity Structural Stability Piping		G401-AM SPIOENKOP None necessary * Repair cracking Permanent monitoring	3	10000 50 50 0	0.010 0.867 0.867 0.000	40 20 60 0	0.8 0.9 1 0	52.043	Y	Adequate Programmed for...?	5
19	Spillway Structure		U200-01 ALBERTFALLS DAM * Improve the spillway capacity Monitor seepage	3	1500 5000	0.065 0.020	1200 1200	0.5 0.5	49.824	Y	Programmed for 2007/8 Adequate	6
20	Spillway Structure No O&MM and EPP		A300-03 KLEIN MARICOPOORT DAM *Improve spillway None, except monitoring Compile	3	500 1000 0 0	0.181 0.095 0.000 0.000	206 126 0 0	1 1 0 0	39.821	N	Programmed for 2007/8 & 2008/9 Adequate Programmed for 2007/8	6
21	Spillway Structure		R300-01 NAHOON DAM None None	3	2000 1000 0 0	0.049 0.095 0.000 0.000	400 400 0 0	0.7 0.7 0 0	39.017	Y	Adequate Adequate	6
22	Spillway Structure		C520-04 MOUTLOATSISETLOGELO (GROOTHOEK) None None	3	5000 10000	0.020 0.010	1870 1870	0.7 0.7	38.690	Y	Adequate Adequate	6
23	Spillway Structure Relocate water supply pressure pipeline on dam crest.		X103-50 MBAMBISO DAM- WASBOSCHFONTEINDAM(M'ZINTIRIVER) Confirm / analyse spillway discharge capacity. Maintenance must be done. Investigate and relocate.	3	5000 5000 50 0	0.020 0.020 0.867 0.000	40 40 40 0	1 1 1 0	34.917	Y	Adequate Adequate 1 Programmed for ...?	6
24	Spillway Capacity Structural Stability O & MM		R101-03 MNYAMENI DAM * Improve	3	200 0 0 0	0.394 0.000 0.000 0.000	0 80 0 0	1 0 0 0	31.538			6
25	Spillway Structure		C230-04 BOSKOP DAM None None	3	2000 2000	0.049 0.049	519 519	0.6 0.6	29.641	Y	Adequate Adequate	6
26	Spillway Structure - piping potential		X100-22 DRIEKOPPIES DAM None None except monitoring	3	10000 5000 0 0	0.010 0.020 0.000 0.000	2000 2000 0 0	0.5 0.5 0 0	29.557	Y	Adequate Adequate	6

<b>No.</b>	<b>Sector</b>	<b>Major risk aspect</b>	<b>DAM NO.</b>	<b>NAME OF DAM</b>	<b>Category</b>	<b>PF</b>	<b>LL</b>	<b>AL</b>	<b>EL (Total)</b>	<b>EPP (Y/N)</b>	<b>STATUS</b>	<b>DSI interval</b>	
<b>(years)</b>			<b>Action to be taken (*urgent)</b>	<b>T (Years)</b>							<b>/</b>	<b>PROGRESS</b>	
27	Spillway Structure		B800-01	TZANEEN DAM (FANIEBOTH)	3	10000 5000	0.010 0.020 0.000 0.000	2000 2000	0.5 0.5	29.557	Y	Adequate Adequate	6
28	Spillway Structure No EPP		B200-01	BRONKHORSTSPRUIT DAM	3	3000 4000 0	0.033 0.025 0.000	600 600 0	0.8 0.8 0	27.203	N	Programmed for 2008 Programmed for 2008 Outstanding	6
29	Spillway Structure		A210-02	HARTBEESPOORT DAM	3	1000 10000 0	0.095 0.010 0.000 0.000	323 323 0	0.7 0.7 0	23.562	N	Programmed for ...? Adequate	6
30	Spillway Capacity Structural Stability O & MM		D200-18	SMITHFIELD DAM	3	200 0 0 0	0.394 0.000 0.000 0.000	0 60 0 0	0.9 0 0 0	21.288			6
31	Spillway Structure Potential clogging of shaft spillway.		B800-02	EBENEZER DAM	3	200 1000 50	0.394 0.095 0.867 0.000	43 43 43	0.5 0.5 0.5	20.637	N	Programmed for ...? Programmed for ...? Programmed for ...?	6
32	Spillway Structure		A601-42	VAALKOP NO.II-DAM	2	100 20	0.634 0.994 0.000 0.000	20 20	1 1	19.957	N	Programmed for ...? Programmed for ...?	7
33	Spillway Structure		A900-03	ALBASINI DAM	3	500 5000 0	0.181 0.020 0.000 0.000	100 100 0	1 1 0	19.764	N	Programmed for 2012 Programmed for ...?	7
34	Spillway Capacity Structural Stability		S300-10	BONGOLO DAM	3	2000 100000 0 0	0.049 0.001 0.000 0.000	600 600 0 0	0.6 0.6 0 0	17.904	Y	Adequate Adequate	7
35	Spillway capacity . Structure stability. Lack of maintenance.		C212-44	MIDDLE LAKE	2	150 1000 100 0	0.488 0.095 0.634 0.000	20 20 20 0	1 1 1 0	17.196	Y		7
36	Spillway Structure		A220-02	OLIFANTSNEK DAM	3	2000 2000 0 0	0.049 0.049 0.000 0.000	292 292 0 0	0.6 0.6 0 0	16.676	Y	Adequate Adequate	7

No. Sector	Major risk aspect	DAM NO.	NAME OF DAM	Category T (Years)	PF	LL	AL	EL (Total)	EPP (Y/N)	STATUS	DSI interval / PROGRESS	
37	Spillway Structure	J250-02	CALITZDORP DAM	3	2000 500 0 0	0.049 0.181 0.000 0.000	100 50 0 0	0.8 0.8 0 0	15.833	Y	Adequate Programmed for ...?	7
38	Spillway Structure	H300-02	PIETERSFONTEIN DAM	3	1000 10000	0.095 0.010 0.000 0.000	280 210	0.7 0.7	15.802	Y	Adequate Adequate	7
39	Spillway Structure	S300-16	THRIFT DAM (MOUNTHOPE)-CISKEI	2	500 10000 0	0.181 0.010 0.000	100 100	0.8 0.8	15.166	Y	Outstanding Adequate	7
40	Spillway Structure	J250-01	GAMKAPOORT DAM	3	10000 3333 0 0	0.010 0.030 0.000 0.000	543 300	0.8 0.8	15.116	Y	Adequate Adequate	7
41	Spillway Structure	X201-68	NGODWANA DAM	3	10000 5000 0 0	0.010 0.020 0.000 0.000	1000 1000	0.5 0.5	14.778	N	Adequate Adequate	7
42	Spillway Structure	G100-13	WEMMERSHOEK DAM	3	18182 10000	0.005 0.010 0.000 0.000	1000 2000	0.7 0.7	14.593	N	Adequate Adequate	7
43	Spillway Structure	J340-02	KAMMANASSIEDAM	3	1000 200	0.095 0.394 0.000 0.000	50 30	0.7 0.7	14.586	Y	Adequate	7
44	Spillway Structure	U401-08	LAKE MERTHLEV	2	1000 100 0 0	0.095 0.634 0.000 0.000	21 21	1 1 0 0	14.045	N	Programmed for ??? Programmed for ???	7
45	Spillway Capacity Structural Stability	H300-01	POORTJIESKLOOF DAM	3	1000 2000	0.095 0.049 0.000 0.000	400 40	0.6 0.6	13.541	Y	Adequate	7
46	Spillway Structure Internal erosion.Leaching sand from foundation	H200-07	ROODE ELSBERG DAM	3	10000 2000 200	0.010 0.049 0.394	50 50 50	0.6 0.6 0.6	12.891	N	Adequate Programmed for 2010 Ongoing	7

<i>interval</i>	<i>Sector</i>	<i>Major risk aspect</i>	<i>Action to be taken (*urgent)</i>	<i>T (Years)</i>	<i>No. PF</i>	<i>DAM NO. LL</i>	<i>AL</i>	<i>NAME OF DAM EL (Total)</i>	<i>Category (Y/N)</i>	<i>EPP STATUS</i>	<i>DSI / PROGRESS</i>
47	Spillway Structure	L300-01	BEERVLEI DAM None None	3 200 2000	0.394 0.049 0.000 0.000	41 41	0.7 0.7	12.163	N	Adequate Adequate	7
48	Spillway Capacity Structural Stability	V700-01	WAGENDRIFTDAM Check freeboard and spillway length Install monitoring instruments	3 2000 2000	0.049 0.049 0.000 0.000	250 250	0.5 0.5	11.898	Y	Programmed for 2008 Programmed for 2008	7
49	Spillway Capacity Structural Stability O & MM Erosion of spillway lining (reo mattresses)	G101-AH	PARYS DAM None None * Repair	2 500 10000 0 100	0.181 0.010 0.000 0.634	30 20 0 20	0.8 0.8 0 0.8	11.303	Y	Adequate Adequate Programmed for 2006/7	7
50	Spillway Capacity Structural Stability	S302-33	GLENBROCK DAM * Improve None	3 100 1000	0.634 0.095 0.000 0.000	21 21	0.8 0.8	11.236	Y	Programmed for 2008 Programmed for 2008	7
51	Spillway Structure No O&MM and EPP	A901-42	DAMANI DAM Adequate Adequate Compile	3 1000 1000 0	0.095 0.095 0.000 0.000	60 60 0	1 1 0 0	10.881	N	Adequate Adequate Outstanding	7
52	Spillway Structure - slope stability	G400-49	ROCKVIEWDAM *Construct a spillway None	3 50 10000 0 0	0.867 0.010 0.000 0.000	6 20 0 0	0.6 0.5 0 0	10.409	N	Programmed for 2007/8 & 2008/9 Adequate	7
53	Spillway Structure	B501-11	FLAG BOSHIELO DAM - WAS ARABIE DAM (MOKGOMOMATLALA) None Monitor	3 10000 5000	0.010 0.020 0.000 0.000	500 500	0.7 0.7	10.345	Y	Adequate Adequate	7
54	Spillway Structure No O&MM and EPP	A800-01	NZHELELE DAM(NJELELE) Investigate spillway capacity None Compile	3 2000 10000 0	0.049 0.010 0.000 0.000	250 250 0	0.7 0.7 0	10.193	N	Programmed for 2007/8 Adequate Outstanding	7
55	Spillway Structure No O&MM and EPP	S302-35	SHILOH DAM-CISKEI None None Compile	3 2000 10000 0	0.049 0.010 0.000 0.000	250 250 0	0.7 0.7 0	10.193	N	Adequate Adequate Programmed for 2007/8	7
56	Spillway Structure	G204-65	DRIFTSANDS STORMWATER RETENTION DAM None None	2 1000 10000 0 0	0.095 0.010 0.000 0.000	5 106 0 0	1 1 0 0	10.092	Y	Adequate Adequate	7

No. Sector	Major risk aspect	DAM NO.	NAME OF DAM Action to be taken (*urgent)	Category T (Years)	PF	LL	AL	EL (Total)	EPP (Y/N)	STATUS /	DSI interval PROGRESS	
57	Spillway Structure No O&MM and EPP	B401-33	LEEUEWKLIPDAM *Enlarge / abandon *Improve / abandon Compile	2	50 50 0 0	0.867 0.867 0.000 0.000	10 10 0 0	1 1 0 0	9.824	N	Programmed for 2004 Outstanding Programmed for 2004 Outstanding Programmed for 2004 Outstanding	8
58	Spillway Structure Outletpipe O&M Manual	B502-23	CHUNIESPOORT DAM Investigate and improve No drain - investigate dispersiveness *Investigate founding conditions Compile	2	200 200 50 0	0.394 0.394 0.867 0.000	9 9 9 0	1 1 1 0	9.775	N	Programmed for 2007 - 2008 Programmed for 2007 - 2008 Programmed for 2007 - 2008 Outstanding	8
59	Spillway Structure	C240-05	JOHAN NESER DAM (KLERKSDORP DAM) Investigate betterments None	2	200 10000	0.394 0.010 0.000 0.000	30 30	0.8 0.8	9.606	Y	Programmed for 2007/8 Adequate	8
60	Spillway Capacity Structural Stability O & MM	D120-02	KLOOF DAM	3	100 0 0 0	0.634 0.000 0.000 0.000	0 15 0 0	1 0 0 0	9.510			8
61	Spillway Structure	A600-06	DONKERPOORTDAM *Investigate further - then improve None	3	500 10000 0 0	0.181 0.010 0.000 0.000	100 100 0 0	0.5 0.5 0 0	9.479	Y	Programmed for ??? Adequate	8
62	Spillway Capacity Structural Stability O & MM	Q940-01	KATRIVIER DAM Can take RMF + no apron protection * Improve stability	3	2000 1000 0 0	0.049 0.095 0.000 0.000	82 82 0 0	0.8 0.8 0 0	9.141	Y	Adequate Programmed for 2012/3 & 2013/4	8
63	Spillway - radial gates Structure O&MM and EPP not to standard	A220-07	BOSPOORT DAM *Inadequate. Enlarge spillway capacity None Compile O&MM and update EPP	3	200 1000 0 0	0.394 0.095 0.000 0.000	20 20 0 0	1 1 0 0	9.038	Y	Programmed for 2008/9 & 2010/1 Programmed for 2008/9 & 2010/1 Programmed for 2007/8	8
64	Spillway Structure	B402-35	DER BROCHEN DAM * Cavities beneath Spillway Crest to be grouted Significant settlement should be monitored.	3	200 1000	0.394 0.095 0.000 0.000	20 20	1 1	9.038	Y	Programmed for...??? Adequate for now	8
65	Spillway Capacity Structural Stability Piping	H402-66	MCGREGOR-NUWE DAM NO.1 None None Monitoring	2	10000 500 50 0	0.010 0.181 0.867 0.000	10 8 10 0	1 1 1 0	8.924	Y	Adequate Adequate Ongoing	8
66	Spillway Structure	J340-08	EZELJACHTDAM None *Investigation to determine "safe operating level"	3	100000 100 0 0	0.001 0.634 0.000 0.000	20 5 0 0	0.6 0.7 0 0	8.876	Y	Adequate Programmed for 2006/7 & 2007/8	8

No. Sector	Major risk aspect	DAM NO.	NAME OF DAM	Category T (Years)	PF	LL	AL	EL (Total)	EPP (Y/N)	STATUS	DSI interval / PROGRESS
67	Spillway Structure No O&MM and EPP	B320-01	LOSKOP DAM	3	10000	0.010	500	0.6	8.867	N	Adequate
					5000	0.020	500	0.6			
					0	0.000	0	0			
68	Spillway Structure	G200-12	KLEINPLAAS DAM	3	1177	0.081	120	0.8	8.758	N	Adequate
					1818	0.054	60	0.8			
					0	0.000	0	0			
69	Spillway Capacity Structural Stability	Q800-13	BESTERSHOEK DAM	2	2000	0.049	10	1	8.738	N	Adequate
					50	0.867	10	1			
					0	0.000	0	0			
70	Spillway capacity Structural Stability	A213-52	HIPPO DAM	2	50	0.867	0	1	8.674	N	Adequate
					0	0.000	10	0			
					0	0.000	0	0			
71	Spillway Structure	U700-11	BEAULIEUDAM	3	1000	0.095	125	0.5	8.478	Y	Adequate
					1000	0.095	62	0.5			
					0	0.000	0	0			
72	Spillway Structure Flood control	C900-07	BLOEMHOF DAM	3	10000	0.010	50	0.8	8.268	N	Adequate
					10000	0.010	50	0.8			
					1000	0.095	100	0.8			
73	Spillway Structure	S401-05	KOCH DAM	2	20	0.994	9	0.9	8.057	Y	Still need to be verified
					1000	0.095	9	0.9			
					0	0.000	0	0			
74	Spillway Structure O&MM and EPP	C230-07	LAKESIDE DAM (POTCHEFSTROOM DAM)	2	100	0.634	18	0.7	8.034	Y	Programmed for 2012
					10000	0.010	18	0.7			
					0	0.000	0	0			
75	Spillway Capacity Structural Stability Piping due to animal burrows.	D540-01	VANWYKSVLEI	2	2000	0.049	10	0.8	7.994	Y	Adequate
					1000	0.095	5	0.9			
					100	0.634	14	0.9			
76	Spillway Structure Strong leak at RF	B800-25	LORNA DAWN DAM	2	2000	0.049	9	1	7.939	Y	Adequate
					2000	0.049	9	1			
					50	0.867	9	1			

<i>interval</i>	<i>Sector</i>	<i>Major risk aspect</i>	<i>Action to be taken (*urgent)</i>	<i>T (Years)</i>	<i>No.</i>	<i>DAM NO.</i>	<i>NAME OF DAM</i>	<i>Category</i>	<i>EPP</i>	<i>DSI</i>
<i>(years)</i>					<i>PF</i>	<i>LL</i>	<i>AL</i>	<i>EL (Total)</i>	<i>(Y/N)</i>	<i>STATUS / PROGRESS</i>
77		B501-17	UPPER GOMPIES DAM	2					N	8
	Spillway		*Investigate / improve	50	0.867	9	1	7.865		Programmed for 2007
	Structure		None	2000	0.049	9	1			Adequate
	No O&MM and EPP		Compile	0	0.000	0	0			Outstanding
					0.000					
78		W120-01	GOEDERTROUW DAM	3					Y	8
	Spillway		Erosion must be monitored/repaired	5000	0.020	400	0.5	7.843		Adequate
	Structure		Monitoring	5000	0.020	400	0.5			Adequate
				0	0.000	0	0			
79		B800-29	MIDDELLETABA DAM	3					N	8
	Spillway		Investigate Further	500	0.181	30	1	7.781		Programmed for ???
	Structure		Investigate stability of embankment and piping potential	1000	0.095	30	1			Programmed for ???
					0.000					
					0.000					
80		C221-70	FLEURHOF DAM	3						8
	Spillway Capacity		* Investigate and improve	100000	0.001	12	1	7.612		
	Structural Stability			100	0.634	12	1			
	O & MM			0	0.000	0	0			
				0	0.000	0	0			
81		G400-21	MOSSELRIVIERDAM	3					Y	8
	Spillway		*Increase spillway capacity	500	0.181	20	0.8	7.566		Investigation to start 6/2000
	Structure		None	3000	0.033	50	0.8			Adequate
				0	0.000	0	0			
				0	0.000	0	0			
82		L820-01	KOUGA DAM (PAUL SAUER)	3					Y	8
	Spillway		None	10000	0.010	100	0.7	7.295		Adequate
	Structure		None	1000	0.095	100	0.7			Ongoing monitoring
					0.000					
					0.000					
83		B501-14	MAHLANGU DAM	2					N	8
	Spillway		None	2000	0.049	8	1	7.119		Adequate
	Structure		Monitor	1000	0.095	8	1			Adequate
	Pipeline buried in damwall		*Relocate / monitor	50	0.867	8	1			Programmed for 2006 - 2008
					0.000					
84		C700-05	WELTEVREDE DAM	2					N	8
	Spillway		*Investigate	50	0.867	9	0.8	7.073		Programmed for ...?
	Structure		*Leakage along RHS pipe	50	0.867	9	0.8			Programmed for ...?
	No O&MM and EPP		Compile	0	0.000	0	0			Programmed for ...?
				0	0.000	0	0			
85		D350-02	GARIEP DAM (HENDRIK VERWOERD)	3					Y	8
	Spillway		Monitoring	100000	0.001	5000	0.7	6.993		Adequate
	Structure		Monitoring	100000	0.001	5000	0.7			Adequate
					0.000					
					0.000					
86		D310-01	VAN DER KLOOF DAM (P.K.LEROUX)	3					N	8
	Spillway		Monitoring	80000	0.001	4000	0.7	6.991		Adequate
	Structure		Monitoring	80000	0.001	4000	0.7			Adequate
	No O&MM and EPP		Compile	0	0.000	0	0			Programmed for 2007



<i>interval</i>	<i>Sector</i>	<i>Major risk aspect</i>	<i>Action to be taken (*urgent)</i>	<i>T (Years)</i>	<i>No.</i>	<i>DAM NO.</i>	<i>NAME OF DAM</i>	<i>Category</i>	<i>EPP</i>	<i>DSI</i>	
<i>(years)</i>					<i>PF</i>	<i>LL</i>	<i>AL</i>	<i>EL (Total)</i>	<i>(Y/N)</i>	<i>STATUS / PROGRESS</i>	
87	Spillway Structure No O&MM and EPP	A804-04	NWANEDZI Investigate erosion potetial during overtopping *Do structural and foundation analysis Compile	3	2000 1000 0	0.049 0.095 0.000	50 50 0	1 1 0	6.967	N Programmed for 2007/8 Programmed for 2007/8 Outstanding	8
88	Spillway Structure	G200-06	BLUEGUM DAM None necessary None necessary	3	5000 2000 0	0.020 0.049 0.000	200 100 0	0.6 0.6 0	6.943	Y Adequate Adequate	8
89	Spillway Capacity Structural Stability	A210-03	BUFFELSPOORT DAM None * Investigate (AAR + GEODETIC SURVEYS)	3	2000 200	0.049 0.394 0.000	20 20	0.8 0.8	6.780	N Adequate	8
90	Spillway Structure	H200-06	LAKENVALLEI DAM None None	3	100000 33333	0.001 0.003 0.000	2600 2600	0.65 0.65	6.747	Y Adequate Adequate	8
91	Spillway - capacity Structure No O&MM and EPP	A220-01	VAALKOP DAM Investigate None Compile	3	5000 20000 0	0.020 0.005 0.000	386 386 0	0.7 0.7 0	6.672	N Programmed for 2007/8 Adequate Programmed for 2007/8	8
92	Spillway Structure	Q440-01	LAKE ARTHUR DAM None None	3	200 200	0.394 0.394 0.000	15 15	0.7 0.7	6.647	Y Adequate Adequate	8
93	Spillway Capacity Structural Stability	H402-74	DASSIESHOEK DAM None None	3	100000 500 0	0.001 0.181 0.000	40 30 0	0.8 0.9 0	6.549	Y Adequate Adequate	8
94	Spillway Structure Retaining wall/embankment transition.	E400-01	KAREE DAM None necessary None necessary Monitor leakage(L03)	3	20000 2000 200 0	0.005 0.049 0.394 0.000	12 12 20 0	0.7 0.7 0.8 0	6.439	Y Adequate Adequate Programmed for...?	8
95	Spillway capacity Structural stability	U202-45	DURBAN HEIGHTS RESERVOIR NO.3 None. *Investigate stability.	3	5000 100 0	0.020 0.634 0.000	20 20	0.5 0.5 0	6.412	N Adequate. Programmed for...?	8
96	Spillway Structure Piping	G402-57	BOTRIVIERRAILWAYS DAM Increase spillway capacity None *Remove antworks	2	200 500 100	0.394 0.181 0.634	9 4 9	1 1 1	6.367	Y Programmed for 2006/7 Adequate Programmed for 2006/7	8

<i>interval</i>	<i>Sector</i>	<i>Major risk aspect</i>	<i>Action to be taken (*urgent)</i>	<i>T (Years)</i>	<i>No.</i>	<i>DAM NO.</i>	<i>NAME OF DAM</i>	<i>Category</i>	<i>EPP</i>	<i>DSI</i>
<i>(years)</i>					<i>PF</i>	<i>LL</i>	<i>AL</i>	<i>EL (Total)</i>	<i>(Y/N)</i>	<i>STATUS / PROGRESS</i>
97		B310-01	RUSTDEWINTERDAM	3					N	8
	Spillway		*Improve		500	0.181	40	0.8		
	Structure		Monitor		5000	0.020	40	0.8		Programmed for 2006 - 2008
	No O&MM and EPP		Compile		0	0.000	0	0		Adequate
						0.000				Outstanding
98		S702-07	XILINXA DAM	3					Y	8
	Spillway		Spillway capacity to be checked by checking crest level of dam		1000	0.095	30	0.8		Adequate
	Structure		*Repair NOC to level. Investigation recommended.		500	0.181	30	0.8		Programmed for ???
						0.000				
						0.000				
99		S600-04	GUBU DAM	3					N	8
	Spillway		None		6000	0.017	30	0.7		Adequate
	Structure (Wet patch)		None		300	0.284	30	0.7		Adequate
	No O&MM and EPP		Compile		0	0.000	0	0		Programmed for ???
					0	0.000	0	0		
100		S302-36	OXKRAAL DAM-CISKEI	3					Y	8
	Spillway Capacity		None		5000	0.020	300	0.7		Adequate
	Structural Stability		None		10000	0.010	300	0.7		Adequate
						0.000				
						0.000				
101		C221-55	FOREST HILL NO 2 RESERVOIR	2						8
	Spillway Capacity		* Investigate and improve		50	0.867	0	0.7		6.072
	Structural Stability				0	0.000	10	0		
	O & MM				0	0.000	0	0		
					0	0.000	0	0		
102		X302-26	KASTEEL DAM	2					N	8
	Spillway		None		1000	0.095	4	1		6.072
	Structure - high phreatic surface		*Abandon / improve		50	0.867	7	1		Adequate
	Outlet works out of order		*Abandon / repair		50	0.867	7	1		Programmed for 2007
	Inlet tower and access bridge is a safety hazard		*Abandon / repair		20	0.994	1	1		Programmed for 2007
103		K100-02	HARTBEESKUIL DAM	3					Y	8
	Spillway		None		2000	0.049	42	0.7		6.048
	Structure		Investigate		500	0.181	28	0.7		Adequate
					0	0.000	0	0		Adequate
					0	0.000	0	0		
104		A210-05	RIETVLEI	3					Y	8
	Spillway		None		10000	0.010	500	0.6		5.941
	Structure		None		10000	0.010	500	0.6		Adequate
					0	0.000	0	0		Adequate
					0	0.000	0	0		
105		V100-01	SPIOENKOP DAM	3					Y	8
	Spillway Capacity		None		10000	0.010	600	0.5		5.941
	Structural Stability		Drainage system must be fuctional		10000	0.010	600	0.5		Adequate
	O & MM		Compile		0	0.000	0	0		Outstanding
						0.000				
106		B401-54	DREISELEN DAM	2					N	8
	Spillway		*Improve		100	0.634	7	1		5.913
	Structure - Toe wet, concentrated leak		Construct toe drain and berm		200	0.394	7	1		Programmed for 2007
	Condition of outlet pipe unknown		*Find and investigate condition		100	0.634	7	1		Programmed for 2007
	Spillway -failure through spillway erosion		Repair spillway erosion		200	0.394	1	1		Programmed for 2007

**APPENDIX D: PHOTOGRAPHS OF INTERESTING CASE STUDIES**



**Lakeside Dam near Potchefstroom in the Northwest Province.**

Department of Water Affairs

Dam Safety Rehabilitation Works nearing completion.



**Tierpoort Dam in the Free State Province south of Bloemfontein.**

Tierpoort Water Users Association

Rip rap protection around inlet tower need to be reinstated.





**Mockes Dam east of Bloemfontein**

Mangaung Municipality

View of siphon spillway structure from downstream side.



**Mazelspoort Dam east of Bloemfontein.**

Mangaung Municipality

View of spillway structure from downstream side.



**Petrus van der Merwe Haarhof Dam near Balfour.**

Dipaleseng Local Municipality.

Inspection by Dam Safety Office Staff of the downstream toe of the dam.



**Balfour/Siyathemb a Dam near Balfour.**

Dipaleseng Local Municipality.

Downstream face of the Rubble Masonry Concrete Dam.





**Balfour/Siyathemb  
a Dam near  
Balfour.**

Dipaleseng Local  
Municipality.

Inspection of  
contraction joins at  
upstream face of  
Rubble Masonry  
Concrete Dam by  
Dam Safety Office  
staff.



**Balfour/Siyathemb  
a Dam near  
Balfour.**

Dipaleseng Local  
Municipality

Inspection of  
downstream toe of  
Rubble Masonry  
Concrete Dam by  
Dam Safety Office  
staff.



**De Hoop Dam near Graaf Reinet.**

Agricultural Sector.

Photo sent in by owner to report progress with the implementation of the recommendations of a dam safety inspection report.



**Gibson Dam on top of the Platberg Mountain near Harrismith.**

Maluti-a-Phofung Local Municipality.

Rubble Masonry Concrete Arch Dam constructed in 1906.

Dam leaking but otherwise in good condition.





**Gibson Dam on top of the Platberg Mountain near Harrismith.**

Maluti-a-Phofung Local Municipality.

Rubble Masonry  
Concrete Arch Dam  
constructed in 1906.

Municipal worker  
opening the outlet  
pipe to release  
water to the two  
municipal dams  
below the dam.



**Gibson Dam on top of the Platberg Mountain near Harrismith.**

Maluti-a-Phofung Local Municipality.

View of Gibson Dam  
on top of Platberg in  
the foreground with  
the Sterkfontein  
Dam in the far right  
background.





**Klein Maricopoort Dam near Zeerust in North West Province.**

Department of Water Affairs.

Dam Safety Rehabilitation Works.

Enlargement of Spillway to increase spillway capacity.



**Klein Maricopoort Dam near Zeerust in North West Province.**

Department of Water Affairs.

Dam Safety Rehabilitation Works.

Enlargement of Spillway to increase spillway capacity.



**Western Complex  
Stormwater Dam  
near Klerksdorp.**

Anglo Gold Ashanti  
Mining Company.

Construction of  
pollution control dam  
using sliming  
techniques.

Rip rap placement in  
progress on the  
upstream face.



**Knopjeslaagte  
Dam near Pretoria.**

Agricultural Dam.

Dam Safety Office  
staff taking  
measurements of a  
culvert at a busy  
road crossing  
downstream of the  
dam for  
classification  
purposes.





**Donaldson Dam in the Wonderfontein Spruit near Westonaria.**

West Rand District Municipality.

Dam Safety Inspection by Municipal staff and Dam Safety Office.

Note the vegetation on the dam wall.



**Donaldson Dam in the Wonderfontein Spruit near Westonaria.**

West Rand District Municipality.

Note the vegetation on the dam wall.





**Struben Dam in Pretoria**

Tshwane Metropolitan Municipality.

Crest, upstream side and downstream face of dam overgrown with trees.

It is standard practice in dam engineering not to allow any trees on embankment dams because they can fall over during storm events and form holes in the embankment that can lead to dam failure.



**Montagu Dam near Zastron**

Mohakare Local Municipality.

The roots of the trees will eventually die and rot and this can lead to piping failure of the embankment.

Unwanted vegetation on embankment dams also hampers the routine dam safety inspections that must be done regularly by the dam owner.





**Lady Grey Dam near Lady Grey in the Eastern Cape.**

Senqu Local Municipality.



**Magwa Dam in the Eastern Cape.**

Department of Water Affairs.

Dam Safety Rehabilitation Works.

Construction of a layer on the downstream face to improve drainage and stability.



**Magwa Dam  
in the Eastern  
Cape.**

Department of  
Water Affairs.

Dam Safety  
Rehabilitation  
Works.

Construction  
of a layer on  
the  
downstream  
face to  
improve  
drainage and  
stability.



**Ngqeleni Dam  
in the Eastern  
Cape – New  
municipal  
dam under  
construction.**

Oliver Tambo  
District  
Municipality.

Rip rap on  
upstream face  
must still be  
completed.





**Belfort Dam  
in the Eastern  
Cape.**

Department of  
Water Affairs.

Dam Safety  
Rehabilitation  
Works.

Mass concrete  
is added on  
the  
downstream  
side of the  
three arches to  
improve  
stability.



**Belfort Dam  
in the Eastern  
Cape.**

Department of  
Water Affairs.

Dam Safety  
Rehabilitation  
Works.

Mass concrete  
is added on  
the  
downstream  
side of the  
three arches to  
improve  
stability.



**Bedford Dam under construction near Harrismith in the Free State.**

ESKOM Ingula Hydro Power Station.

Compaction of different zones of the Clay Core Rockfill Section in progress.



**Bedford Dam under construction near Harrismith in the Free State.**

ESKOM Ingula Hydro Power Station.

Trimming of the downstream rockfill face using an excavator.





**Bedford Dam under construction near Harrismith in the Free State.**

ESKOM Ingula Hydro Power Station.

View of the inlet tower and the upstream face. The reinforced concrete slab on the upstream face must still be constructed.



**Bedford Dam under construction near Harrismith in the Free State.**

ESKOM Ingula Hydro Power Station.

Close up view of the inlet tower.



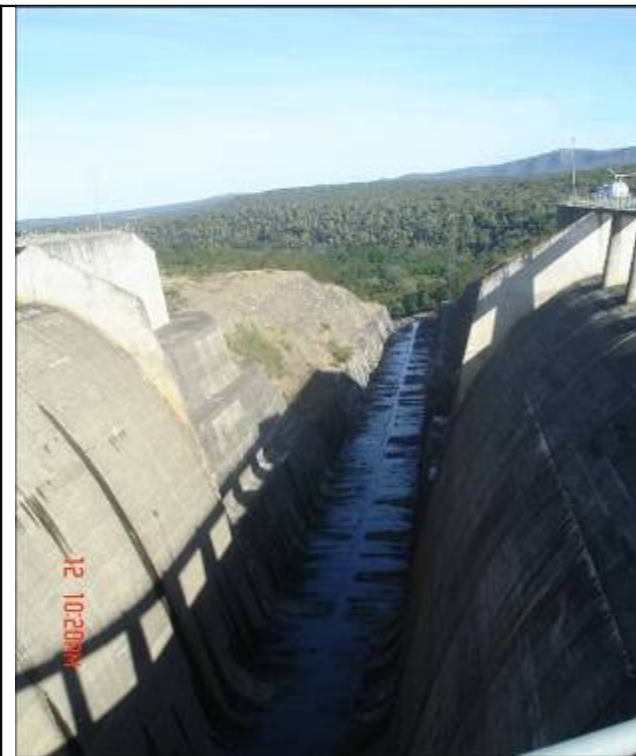
**Amabele Dam  
in Eastern  
Cape.**

Department of  
Water Affairs.

Dam safety  
Inspection  
in June 2009  
by Eastern  
Cape Regional  
Staff.

View of rip-  
rap on  
upstream side  
of dam wall.

No apparent  
shortcomings



**Binfield Dam  
in the Eastern  
Cape.**

Department of  
Water Affairs.

Dam safety  
Inspection  
in June 2009  
by Eastern  
Cape Regional  
Staff.

View of  
spillway  
channel  
showing  
drainage flow.





**Cata Dam in the Eastern Cape.**

Department of Water Affairs.

Dam safety Inspection in June 2009 by Eastern Cape Regional Staff.

View of upstream slope showing good condition of rip-rap



**Glen Brock Dam in the Eastern Cape.**

Department of Water Affairs.

Dam safety Inspection in June 2009 by Eastern Cape Regional Staff.

Picture shows the badly eroded downstream slope of embankment.



**Gubu Dam in the Eastern Cape.**

Department of Water Affairs.

Dam safety Inspection in June 2009 by Eastern Cape Regional Staff.

View showing good condition of pipes in outlet tunnel.



**Oxkraal Dam in the Eastern Cape.**

Department of Water Affairs.

Dam safety Inspection in June 2009 by Eastern Cape Regional Staff.

Walkway to inlet tower needs to be treated against weathering.



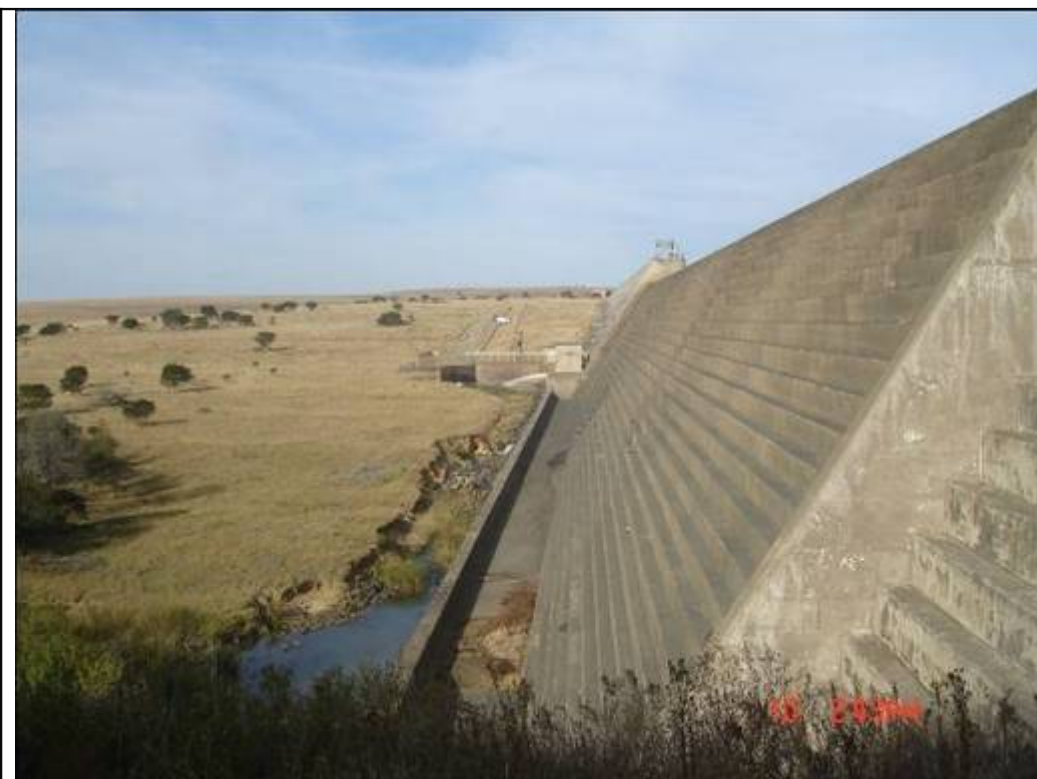


**Rooikrantz Dam in the Eastern Cape.**

Department of Water Affairs.

Dam safety Inspection in June 2009 by Eastern Cape Regional Staff.

Seepage through spillway joints of Spillway Structure.



**Wriggleswade Dam in the Eastern Cape.**

Department of Water Affairs.

Dam safety Inspection in June 2009 by Eastern Cape Regional Staff.

View of spillway taken from left flank



**Rust de Winter Dam near Pienaarsrivier north of Tshwane.**

Department of Water Affairs.

Rockfill dam with upstream concrete membrane, originally completed in 1934, and now being rehabilitated.



**Rust de Winter Dam**

Surficial downstream slope failure occurred during the rehabilitation work when construction of an access road at the toe of the wall slightly undermined the slope, demonstrating marginal stability of the existing slope.





**Rust de Winter Dam**

Another view of downstream slope failure which is on average 1,0 m deep.

The incident occurred during August 2009.



**Rust de Winter Dam**

A stabilising berm was constructed as a matter of urgency.





**Witbank Dam near Witbank.**

This concrete butress dam wall with heavily reinforced butress heads and provided with a radial gate spillway system was completed in 1972.



**Witbank Dam near Witbank.**

The water in the dam has a low pH level and a high sulphate level due to extensive opencast coal mining in the catchment of the dam.





**Witbank Dam near Witbank.**

The consequence of the poor water quality is significant concrete corrosion with possible corrosion of the steel reinforcement in the buttress heads, which may have an impact on the stability of the dam wall.



**Witbank Dam near Witbank.**

A further consequence of the poor water quality is significant corrosion of the steel radial gates, raising concerns about the safety of the spillway system. These matters have and are being investigated but it is clear that a long term solution must be found soon.





**Bramhoek Dam, (gravity arch) under construction near Ladysmith in KZN.**

ESKOM Ingula Hydro Power Pump Storage Scheme.

Placement of RCC or roller compacted concrete on left flank. Outlet works are in the centre of the picture.



**Bramhoek Dam.**

Placement of RCC on the right flank.





**Bramhoek Dam.**

Closer detail of placement of RCC on the right flank.



**Molepo Dam near Zion City in Limpopo.**

Department of Water Affairs.

Major rehabilitation work included raising and stabilising earthfill wall, provision of new spillway and provision of new outlet works. Note new rip-rap on upstream slope as wave protection measure.





### **Molepo Dam**

New downstream slope protection consists of coarse stone (crusher run). Note small "no fines' concrete" wall on left hand side of storm water drain at down- stream toe of dam wall.



### **Molepo Dam**

The new multi arch "rubble" masonry spillway structure is nearing completion. The "rubble" masonry concrete construction method is labour intensive and a further spin-off is that local people are taught basic masonry skills. The "rubble" was obtained from a quarry by blasting, but it could also consist of natural stone of reasonable size and quality.