water affairs

Department:
Water Affairs
REPUBLIC OF SOUTH AFRICA

DAM SAFETY OFFICE
2012/2013 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 carried out in terms of 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 2012 to 31 March 2013.

A total of 107 dams were registered during the year bringing the **total number of dams registered to date in South Africa to 4 832.** This includes the registration of new dams that were completed during the year, as well as of existing dams that were not registered previously. Some corrections were also made to the database. Altogether 198 registered dams were classified, bringing the total number of existing dams now classified to 4 636, that is 96% of the 4 832 dams registered to date.

Dam safety control over the construction of new dams and alterations to existing dams, involves the evaluation of design and other reports that form part of licence applications. A total of 26 dam safety licences were issued i.e. 6 licences to construct, 8 to impound (commission), 3 to abandon (decommission) and 9 to alter.

During the year a total of approximately 1 352 letters were sent to dam owners to ensure compliance with dam safety legislation. This included a total of 155 dam safety evaluation instructions issued to dam owners. A total of 201 applications for approval as Approved Professional Persons for dam safety tasks were processed. In addition, a total of 145 dam safety inspection reports and a total of 98 operation and maintenance manuals with emergency preparedness plans for dams that were considered and accepted.

The main mechanism to promote the safety of existing dams is compulsory dam safety evaluations that must be performed by Approved Professional Persons on behalf of dam owners. There are presently 2 033 category II and III dams in the country and the target is that these dams should be inspected at an average interval of about 7,5 years. A total of 144 dam safety evaluation reports were submitted by dam owners this year and a total of 145 reports, which include reports standing over from the previous year, were evaluated and accepted.

To date, 3 346 deficiencies at category 2 and 3 dams have been registered of which 997 (30%) have been rectified so far. Progress with the upgrading of the safety of dams is slow but steady. Personal finances and apathy on the part of some dam owners continue to be the most common stumbling blocks hampering progress with regard to the rectification of deficiencies at dams.

From statistics provided in the report, it is clear that **special attention should be focused on the first 100 to 200 dams on the DSO's priority list** as they have the greatest potential impact on the public. It is significant that 82% of the first 100 dams on the priority list belong to DWA and Municipalities. Ironically, in the past most incidents associated with loss of life or near misses have been caused by category 2 dams lower down on the priority list, indicating that these dams should not be neglected, even though they are not part of the first 100 to 200 dams.

Important recommendations are made in the report in order to maintain and preferably accelerate progress with the dam safety programme.

The total direct expenditure incurred in administration of the dam safety legislation at Head Office was R4 944 000 compared to R5 023 000 in the previous reporting year, i.e. a decrease of 1,6%, mainly due to vacant posts. Vacant technical posts remained vacant in the year and impacts negatively on the efficiency of the dam safety programme. Filling of vacant technical posts is an ongoing challenge. As an interim measure, two Graduate Trainees (one Civil Engineer and one Civil Engineering Technician) were seconded to the Dam Safety Office from the Learning Academy.

The direct cost of the Dam Safety Office is considered to be moderate compared to the benefits derived from the dam safety programme in South Africa. One of the significant benefits is that not a single new category 2 or 3 dam for which a licence to construct has been issued, has failed since 1987 when the dam safety legislation came in force.

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LIST OF ABBREVIATIONS

AAR	alkali-aggregate reaction
APP	Approved Professional Person
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^3	cubic metre
NOC	Non-overspill crest
NWA	National Water Act, 1998 (Act No. 36 of 1998)
O&M	Operation and maintenance
OMM	Operation and maintenance manual
R	Rand (South African)
RMF	Regional maximum flood peak
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
x 10^6 m^3	million cubic metres
<	This sign means “less than” (e.g. H < 12 m is pronounced as “H is less than 12 metres”)

1. INTRODUCTION

This annual report covers the activities of the Dam Safety Office within the Department of Water Affairs with regard to administration of the dam safety legislation in terms of Chapter 12 of the National Water Act, 1998 (Act 36 of 1998) read together with the relevant dam safety regulations, during the financial year 1 April 2012 to 31 March 2013. The annual report also serves as an auditing tool. Progress with the dam safety programme can be assessed by comparing the current statistics with those of previous years as well as with targets that were set in the strategic business plan enclosed in Appendix A.

The statistics included in this report reflect the position as for the current nine DWA regions, which are based on river drainage regions that differ from provincial boundaries.

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/Specialist Engineers
- One Engineering Technician (but became vacant on 1 October 2012)
- One Deputy Director
- One Assistant Director
- One Senior Administrative Officer (vacant for 9 months in year)
- One Administrative Officer (vacant for 9 months in year) doing logistic duties
- Three Senior Administrative Clerks
- Two Senior Administrative Clerks doing registry clerk duties
- One Senior Administrative Clerk doing data capturing
- One Senior Administrative Clerk (vacant for 3 months in year) doing logistic duties
- One Graduate Trainee (Civil Engineer)
- One Graduate Trainee (Civil Engineering Technician)

The following posts have been vacant for longer than a year:

- One Specialist Engineer
- Three Chief Engineers
- One Control Engineering Technician
- One Engineering Technician

The vacant posts impact negatively on the efficiency of the DSO and although re-advertised, it remains a challenge to fill vacant technical posts.

During the year a total of approximately 1 352 letters were compiled by the Dam Safety Administration officials. The statistics in this regard for the past two years are compared in the two Tables below:

Statistics for the previous reporting year (1 April 2011 – 31 March 2012)

TASK	GA	FS	EC	NW	KZ	LI	MP	WC	NC	Total
Classification of dams (new/proposed)	2	1	3	0	3	1	8	8	0	**26**
Registration & classification of dams	8	5	12	1	1	1	7	24	1	**60**
Licence to construct/alter	2	1	5	0	1	2	2	7	0	**20**
Licence to impound	3	1	0	0	1	0	1	0	0	**6**
Licence to abandon	0	1	0	0	0	0	0	0	0	**1**
Dam safety evaluation instructions	31	14	39	0	11	5	11	99	8	**218**
Implementation of recommendations	16	2	5	0	1	0	4	11	1	**40**
Approval of app's & prof teams (admin)										**222**
Approval of app's & prof teams (referred to ECSA for recommendation)										**13**
General letters and reminders/warnings	7	5	3	0	8	5	5	14	1	**48**
Legal Actions	0	0	0	0	0	0	0	0	0	**0**
Directives	0	0	0	0	0	0	0	0	0	**0**
Exemptions	0	0	0	0	0	0	0	0	0	**0**
Declarations of a dam with a safety risk	0	0	0	0	0	0	0	0	0	**0**
Dams not a safety risk "by definition"	2	4	2	0	0	0	4	2	0	**14**
Letters in connection with subsidies	0	0	0	0	0	0	0	0	0	**0**
Letters re inspection, investigation	36	46	45	0	42	0	20	74	2	**265**
Letters re licences to construct (design issues)	0	0	0	0	0	0	0	0	0	**0**
Miscellaneous letters (DSO)	0	0	0	0	0	0	0	0	0	**0**
No of Title Deeds searches	0	0	0	0	0	0	0	0	0	**0**
Total for Period	**107**	**80**	**114**	**1**	**68**	**14**	**62**	**239**	**13**	**933**

Statistics for the current reporting year (1 April 2012 – 31 March 2013)

TASK	Region									
	GA	FS	EC	NW	KZ	LI	MP	WC	NC	Total
Registration & classification of dams										**186**
Classification of dams (new/proposed)	0	3	4	3	4	1	5	6	1	27
Registration/classification of dams (existing)	10	26	27	8	7	12	17	43	9	159
Dam safety evaluation letters										**852**
Dam safety evaluation (inspection) instructions	22	14	40	0	10	2	8	59	0	155
Implementation of recommendations in reports	15	5	3	0	6	1	1	16	0	47
General letters and reminders/warnings	21	13	20	0	26	20	37	80	2	219
Letters l c w inspection, investigation	72	65	80	0	50	0	38	117	9	431
Approval of professional persons										**201**
Approval of app's & prof teams internally	6	2	4	0	6	3	16	24	0	193
Approval of app's & prof teams thro' ECSA	2	1	0	0	0	0	1	0	0	8
Owner information										**72**
Verification of ownership	7	13	11	0	5	3	5	15	0	59
Deeds	0	5	5	0	0	2	0	1	0	13
Other										**15**
Legal Actions	0	0	0	0	0	0	0	0	0	0
Exemptions	0	0	0	0	0	0	0	0	0	0
Declarations of a dam with a safety risk	0	0	0	0	0	0	0	0	0	0
Dams not a dam with safety risk "by	0	0	2	0	0	4	1	8	0	15

definition"										
Licences										**26**
Licence to construct/alter	3	1	4	0	3	0	2	2	0	15
Licence to impound	0	0	1	0	2	0	2	3	0	8
Licence to abandon	0	0	0	0	0	0	1	2	0	3
Total for year	158	148	201	11	119	48	134	376	21	**1352**

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

Item	Expenditure (R'000)	
	2011/12	**2012/13**
Employee component	4 352	4 305
Goods & Services	639	612
Transfers	0	0
Machinery	40	27
Grand Totals	5 023	4 944

The total direct expenditure was R4 944 000 compared to R5 023 000 in the previous year, i.e. a decrease of 1,6%. The reduction is mainly due to vacant posts.

Indirect costs (i.e. expenditure incurred by regional offices that assist the DSO and Head Office overhead cost) are not included in these amounts.

4. REGISTRATION OF DAMS

In terms of Section 120 of the NWA, all dams with a safety risk (i.e. if the wall height exceeds 5,0 m **and** if the storage capacity exceeds 50 000 m^3) must be registered by dam owners. A total of 107 dams were registered during the year bringing the total number of dams registered to date in South Africa to 4 832. The figure of 107 includes registration of new dams that were completed during the year, as well as of existing dams that were not registered previously. Some corrections were also made to the database. The progress with registration of dams is illustrated in figure 1.

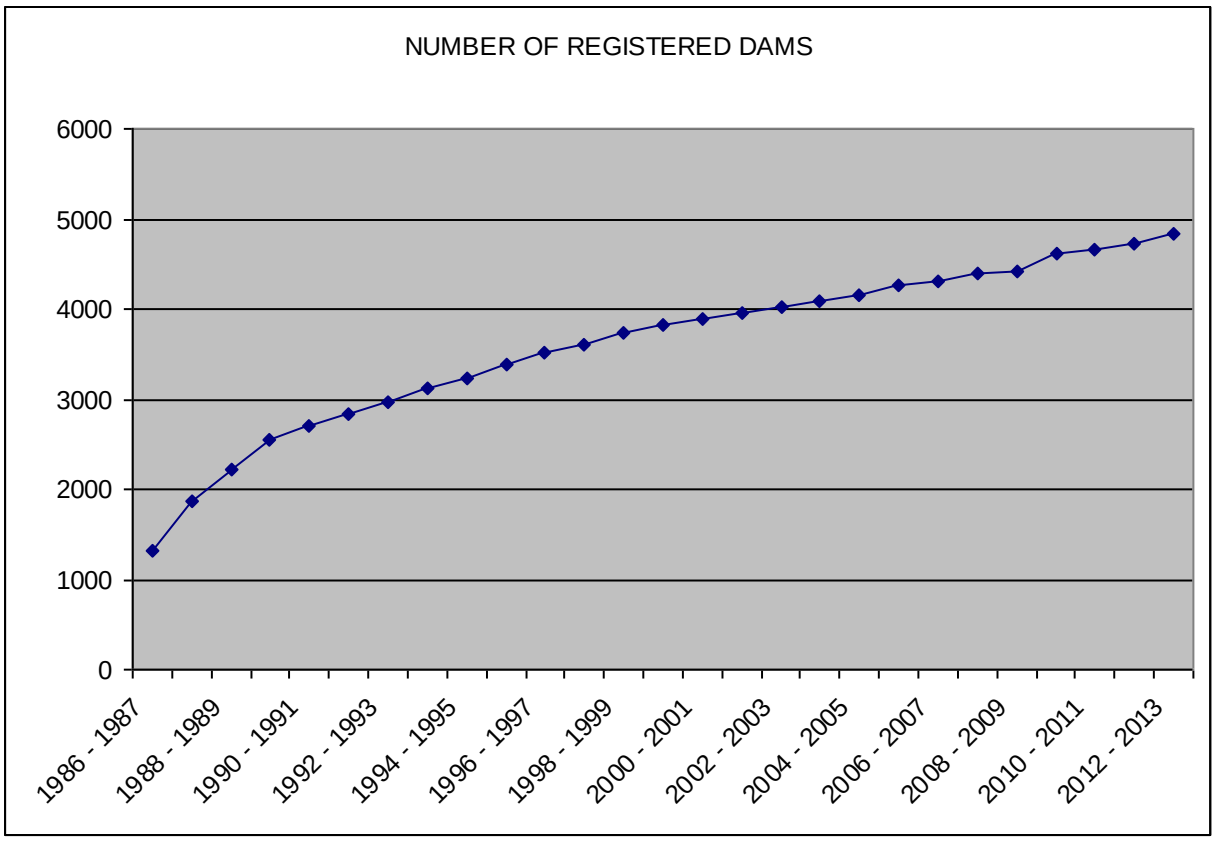


Figure 1: Progress with registration of dams

Distribution of registered dams according to size class, reservoir capacity and regional location is given in Tables 2 to 4.

Table 2: Distribution of registered dams according to size class

Size class	Number	%
Small (less than 12 m)	3 597	74%
Medium (12 m – 30 m)	1 060	22%
Large (30 m and higher)	175	4%
Total	**4 832**	**100**

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

Capacity (x 10^6 m^3)	Number	%
0,00 – 0,05	147	3.0%
0,05 – 0,10	1 225	25.3%
0,10 – 0,25	1 738	36%
0,25 – 1,00	1 120	23.2%
1,00 – 10,00	434	9.0%
10,00 – 100,00	115	2.4%
100 – 1 000	47	1.0%
1 000 – 10 000	6	0.2%
Total	**4 832**	**100**

Table 4: Regional distribution of registered dams with a safety risk

Region	Total No. registered to date	%
Eastern Cape	702	15%
Free State	414	9%
Gauteng	331	7%
Northwest	152	3%
KwaZulu-Natal	935	19%
Limpopo	326	7%
Mpumalanga	496	10%
Northern Cape	82	2%
Western Cape	1 394	29%
Total	**4 832**	**100%**

5. CLASSIFICATION OF DAMS

The target for the number of classifications per year is set at 100 per year.

Altogether 198 registered dams were classified (including re-classifications of some pollution control dams), bringing the total number of registered existing dams now classified to 4 636, which is 96% of the 4 832 dams registered to date. In addition, about 12 proposed dams were also classified. A special effort was made in the last quarter of the year and about double the target has been achieved mainly due to the increased use of geographical information systems like Google Earth and ArcMap for classifications.

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

Region	Total No. registered to date	Total No. classified to date	% Classified to date	Number not classified yet
Eastern Cape	702	675	96%	27
Free State	414	392	95%	22
Gauteng	331	323	98%	8
Northwest	152	151	99%	1
KwaZulu-Natal	935	908	97**%**	27
Limpopo	326	314	96%	12
Mpumalanga	496	466	94%	30
Northern Cape	82	76	93%	6
Western Cape	1394	1331	95%	63
Total	**4 832**	**4 636**	**96%**	**196**

The percentage classified for the country as a whole increased to 96% due to the 198 dams that were classified during the year. It will take about 2 years to classify most of the unclassified registered dams on the list if the target rate of 100 classifications per year can be maintained.

It should be noted that the outstanding classifications generally represent small dams and their hazard potential would mostly be low.

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

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

Size class	Hazard potential rating			Total
	Low	Significant	High	
Small	2 589 (56%)	875 (19 %)	39 (1%)	**3 503 (76%)**
Medium	286 (6%)	556 (12%)	128 (3%)	**970 (21%)**
Large	1 (0%)	21 (0%)	141 (3%)	**163 (4%)**
Total	**2 876 (62%)**	**1 452 (31%)**	**308 (7%)**	**4 636 (100%)**

Table 7: Category classification of existing dams

Category classification	Number of dams	%
Category 1*	2 603	56 %
Category 2	1 745	38 %
Category 3	288	6%
Total	**4 636**	**100 %**

* 14 of these dams are actually medium size dams that have been classified as indicated below, in terms of regulation 3.2 of the old 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 impound	Licence to Abandon	Licence to Alter	Total
1	1	0	0	2	3
2	5	7	3	5	20
3	0	1	0	2	3
Total	**6**	**8**	**3**	**9**	**26**

Dam safety control over the construction of new dams, including alterations to existing dams, involves the evaluation of design and other reports that form part of a licence application. A total of 26 dam safety licences were issued i.e. 6 licences to construct, 8 to impound (commission), 3 to abandon (decommission) and 9 to alter.

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, except in the Eastern Cape Region.

6.1 Site visits to dams

Response from APPs with regard to the submission of reports after site visits during construction work at dams varied from very good to fair.

Members of the DSO technical staff made a total of 38 visits to dams during the year. Of these, 16 were to dams under construction whilst the remaining 22 were to existing dams. Where possible, contact was made with APPs to discuss design issues, general problems and quality control. Due to personnel shortages, only 38 visits could be made compared to 83 visits in the previous year.

6.2 Evasion of the dam safety legislation

A few cases of dams having been built without licences to construct have been brought to the attention of the Dam Safety Office in the year. Possible prosecution is being handled by Regions in consultation with the Directorate Compliance Monitoring & Enforcement. In the majority of cases the DSO and Regions only find out when construction is near completion (or completed), and it is not always possible to stop construction at an early stage. If a water use licence would not be granted, then, in terms of section 53 of the NWA, 1988, the contravention must be rectified (which could include removing of the dam wall in its entirety). If a water use licence would be granted, then, following a dam safety evaluation, the dam would have to be upgraded to acceptable safety standards before any water may be stored in the dam.

7. CONTROL OVER THE SAFETY OF EXISTING DAMS

7.1 Progress with the five-yearly dam safety evaluations

The main mechanism to promote the safety of existing dams is compulsory dam safety evaluations that must be performed at an interval of between 5 an 10 years (7,5 years average). The following table show the status of the dams with respect to the number of dam safety evaluations submitted by dam owners for Category 2 and 3 dams:

Table 9: Progress with 5-yearly dam safety evaluations of Category 2 and 3 dams

Sector	DWA	Muni-cipal	Industry Mines Business	Other State Dams	Water Boards	Agri-cultural	Total
Total number of Cat 2 & 3 dams	276	263	219	35	44	1 196	2 033
Required number of evaluations per year (7,5 year interval)	37	35	29	5	6	159	271
Actual number of evaluations submitted this year	35	24	16	0	1	68	144
% (Actual vs required)	95%	69%	55%	0%	16%	43	53%
Outstanding first evaluations	17	33	68	5	2	408	533
Total number done since 1987	703	446	285	49	62	1 137	2 682

The analysis shows that al the sectors will have to commit more resources to the 5-yearly dam safety evaluations in order to achieve the target of an average 7.5 years interval. DWA Infrastructure Branch, the Municipal Sector and the Industries, Mines and Business Sector performed better than the average while “Other State Dams” and the Agricultural Sector performed below average. Although Water Boards did not evaluate many dams during the year, they have inspected most of their dams during the last 5 years.

In the case of the Industries, Mines and Business Sector, it should be mentioned that in terms of the new dam safety regulations promulgated in February 2012, pollution control dams with a safety risk are now automatically classified as category 2. Some of these dams have only recently been reclassified and must still be evaluated for the first time.

The flow of dam safety inspection reports through the Dam Safety Office 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 Instruction Letters Issued	155 (218)
Dam Safety Inspection Reports Submitted	144 (123)
Dam Safety Inspection Reports Accepted	145 (94)

Presently there are 2 033 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 long term target should be set at 271 evaluations per year. The actual target for instruction letters to dam owners is set at 250 per annum because instructions are not issued for dams under control of the DWA Infrastructure Branch as they follow a programme accepted by the DSO. Their dams are however included in the number of reports submitted and accepted.

The current capacity of the Dam Safety Office to perform an in-depth evaluation of the quality of each report submitted is limited. A total of 145 reports were evaluated and accepted. More technical capacity to evaluate the reports is essential to ensure that APPs submit reports of adequate quality. As long as the number of engineers in the DSO is not increased, the DSO will only be able to do an in-depth evaluation of a small sample of the evaluation reports submitted, for example only for dams with a high hazard potential, or for dams with a history of unsatisfactory behaviour, or those reports submitted by less experienced APPs. The technical capacity of both the Dam Safety Office and the pool of APPs will have to be increased to meet the ideal long term target of 271 dam safety evaluations per year.

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	743	167
Leakage Problems	239	65
Structural Problems	276	78
Material Problems	38	8
Operation And Maintenance Problems	2 021	674
Other Problems	29	5
TOTAL	**3 346**	**997**

A total of 3 346 deficiencies have been registered of which 997 (29%) have been rectified since 1986. Rectification of a deficiency can also means 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 98 operation and maintenance manuals (OMM) including emergency preparedness plans (EPP) were formally accepted during the financial year. Approximately 1 094 dams now have both a OMM and EPP, 32 has only an EPP and 56 has only an OMM.

Where possible, owners of existing dams were visited, discussing shortcomings requiring rectification. 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”. Nevertheless, some 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 (ideally every 6 months) all cases where instructions have been issued and where important recommendations of 5 yearly dam safety evaluation reports have not been implemented. This objective has however not been achieved in all cases due to the shortage of technical and administrative staff. A total of 697 follow-up letters were compiled in this regard.

7.3 Prioritisation of existing dams

Updating of the priority list of dams is an ongoing activity and takes place after receipt of dam safety evaluation reports, compiled by APPs. The total number of dams on the full list has increased from 1 334 (2011/12) to 1 386 (2012/13). The goal is to eventually reflect all category II and III dams (private as well as State dams) on the list. The list of the first 100 dams (thus including the most important outstanding dam safety work in South Africa) is appended in Appendix C. A simplified risk-based assessment is done to determine the relative risk and ranking of a dam on the list, based on information provided in dam safety inspection reports. The relative risk is based on the “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 (failure probabilities due to different causes at one dam are combined by using de Morgan's rule to prevent double-counting).
- 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 all dams on the list, and also just for the first 50 dams on an annual basis.

It was found that the total relative risk or "possible loss of life" for all dams on the list increased by 2,2% from 5 170 (2011/12) to 5 284 (2012/13), as a result of new entries to the list and due to different assessments of risks in new dam safety evaluation reports. The total "possible loss of life" for the first 50 dams on the list increased by 0,4% from 3 662 (2011/12) to 3 678 (2012/13), due to the same reasons as given above. It should also be noted that there is a time lag before recent betterment work is reflected on the priority list, as the list is only updated after receipt of the next dam safety evaluation report following completion of rehabilitation work. Thus the list is not yet adequately “stable” and responsive to be used as an accurate short term monitoring tool to measure progress with the dam safety programme. Nevertheless, some useful information can be extracted from the priority list as shown in the following paragraphs.

The information and statistics in Table 12 and in Appendices A, C2 and C3 have been corrected to take recently completed rehabilitation work into account. Table 12 shows the two main shortcomings under the first 100 dams on the priority list that require urgent attention. The relevant dams are listed in Appendix C2.

Table 12: Main shortcomings under the first 100 dams on priority list

Shortcoming (not complying with basic safety standards)*	**No. of dams**
• Deficient flood handling capacity	26
• Deficient structural stability	25
• Total number of dams not complying with basic safety standards	46

***For the purposes of this Table, "compliance with basic safety standards"** means the probability of failure of a dam is estimated to be less than 0,05% (1/2000) or 0,5% (1/200) per year for category 3 and 2 dams respectively.

An aspect that must be borne in mind is that 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 at 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. These dams have been removed from the lists provided in Appendices C2 and C3 in order to highlight shortcomings at dams that need to be addressed in the short term.

Table 13 shows that 82% of the top 100 dams on the priority list belong to DWA and the Municipalities. Most of the large dams in the country fall within these two sectors.

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

Sector	Total number of registered category 2 and 3 dams	Number of dams within first 100 dams as ranked on priority list (%)
DWA Dams	276	58
Municipal Dams	263	24
Other State Dams	35	2
Water Board Dams	44	1
Mines, Industries, Business	219	4
Agricultural Dams	1 196	11
TOTAL	2 033	100

The following useful information has been extracted from the priority list:

- Of the total "possible loss of life" for all dams on the list (5 284), approximately 78% is caused by the first 100 dams or 86% by the first 200 dams. It is clear that special attention should be given to the first 100 to 200 dams on the priority list as they have the greatest potential impact on the public. Ironically, in the past most incidents associated with loss of life or near misses have been caused by category 2 dams lower down on the priority list, indicating that these dams should not be neglected, even though they are not part of the first 100 to 200 priority dams.
- 82% of the top 100 dams on the priority list belong to DWA and the Municipalities as shown in Table 13. It should be possible for these major dam owners to obtain and budget adequate funds to upgrade and/or maintain these dams in pristine condition
- The most important shortcomings at dams that need to be addressed in the short term are listed in Appendices C2 and C3, the latter showing DWA dams only. There

are 18 dams on the latter list, of which 10 dams are already in the planning, tender, design or construction phase.

- The priority list also serves as a tool to help assess the current state of dam safety in South Africa and this is summarised under item 5 of the strategic business plan in Appendix A. It is clear 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 in South Africa is slow but steady. As reflected in Table 14, the current rehabilitation programme by DWA is making an important contribution in this regard.

7.4 Legal/criminal proceedings

Several cases of dams having been built without a licence to construct are being handled by the Regional Offices in collaboration with the Directorate Compliance Monitoring & Enforcement (CME) for possible prosecution.

8. APPROVAL OF PROFESSIONAL PERSONS FOR TASKS

A total of 201 applications for approval were approved during the year. A total of 8 applications were submitted to the Engineering Council of South Africa (ECSA) and handled by its Committee on Professional Engineers for Dams. ECSA recommended all 8 as unconditional approvals.

A total of 193 applications were processed on the strength of similar previous recommended approvals by ECSA and they were not again referred to ECSA for a recommendation.

Since 1987 155 persons have been approved as APPs for dam “tasks”. A total of about 78 APPs are classified as still active, i.e. not emigrated, retired or deceased and approved for at least 1 task during the past 5 years. Of the number of 78 APPs, 30 are 65 years or older.

9. UPGRADING OF EXISTING DAMS

The major rehabilitation programme by the DWA: Infrastructure Branch is continuing to make a significant contribution to upgrade the safety of existing dams. Total annual expenditure during the last five years varied between R384 million and R184 million, following a downward trend, caused by a delay in procuring PSPs. **Table 14** provides some relevant statistics.

Table 14: Upgrading of safety of existing DWA dams

Description	Number of dams
Dams rehabilitated in full during last 8 years	21
Dams rehabilitated in full with regard to civil works, but mechanical refurbishment outstanding	14
Dams in tender, design or construction stage	41

10. INCIDENTS AT DAMS

The DSO has started with the upkeep of an incident database which will be pasted on the DSO webpage. This list provides valuable statistics and details of dam incidents that have occurred in South Africa. From the list the major causes of dam failures are:

- Inadequate spillway capacity (41%)
- Piping through earthfill walls (21%)
- Failure through erosion of spillways and outflanking of weirs (17%)

The following significant incidents at dams were reported to the DSO during 2012/13:

Table 15: Incidents at Dams

NAME OF DAM (TYPE)	LOCALITY AND NUMBER OF DAM	HEIGHT (m)	CAPACITY ('000 m^3)	CAT	INCIDENT OR DAMAGE
Border	A705/43	11,8	1 200	I	Breached thro' overtopping, Jan 2013.
Molodzwi	A901/25	11,6	613	I	Slip formed on d/s slope, but dam did not fail, Jan 2013.
Kanniedood	B902/04	8	2 563	I	Earthfill flank breached thro' overtopping, Jan 2013. Dam in Shingwedzi River, Kruger Park.
Lorna Dawn	B800/25	21	4 900	II	Spillway channel eroded, encroaching towards earthfill dam wall, Jan 2013.
Machimana	B801/FC	7	294	I	Dam failed through spillway erosion, Jan 2011
Mark Scott 2	B801/FA	7	60	I	Dam failed through spillway erosion, Jan 2011
Lukana	B801/EI	5	61	I	Spillway damaged, Jan 2011

It is interesting to note that localised floods occurred in different parts of Limpopo/ Mpumalanga during the month of January in the successive years of 2011, 2012 and 2013. A number of dams also failed in January 2012 as reported in previous annual report.

11. IMPLEMENTATION OF THE NEW DAM SAFETY REGULATIONS

Good progress has been made to implement the new aspects of the new dam safety regulations that were promulgated on 24 February 2012 (published in Government Notice R. 139 in English and in Government Notice R. 138 in Sepedi, both dated 24 February 2012):

- Re-classification of Category I pollution control dams as Category II dams in line with the new regulations, requiring that the impact on water resource quality must also be considered in the classification process.
- A project was initiated to establish a register of approved professional persons for tasks at dams with a safety risk (section 123(1)(a) of the NWA). This should reduce the administrative burden of considering applications and writing letters for each and every task at dams. It is expected that the register will be implemented by the end of 2013.
- All Dam Safety Office forms have been revised in line with the new regulations.
- The standard of licence applications to construct/ alter/ enlarge/ repair category I dams has been raised significantly. Prospective dam owners are effectively forced to obtain adequate technical help in order to compile a proper design report and engineering drawings, without which it is generally not possible to build an adequately safe dam.

12. COURSES, LECTURES & SYMPOSIUMS RE DAM SAFETY ENGINEERING

Event attended	Institution	Number of officials	Date
Workshop on research needs re flood determination methods	WRC	1	16 May 2012
Dams in changing world (also made presentation on extreme design floods for dams)	ICOLD	1	4-8 June 2012
Dam management & rehabilitation (also presented lectures)	Intelligent Transfer	1	24-25 July 2012
Geosynthetics for earth reinforcement and filtration	GIGSA / SAICE	1	5-6 Nov 2011
O&M, Management and Safety of Dams	Amabushi	1	26-27 March 2013

13. 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, recommendations to achieve the objectives of DSP by different key role players (not only the DSO) are included in the last column. The salient points of the current state of dam safety in South Africa are as follows:

- It is expected that most category 2 and 3 dams have been registered, but there may still be a number of category 1 dams that have not been registered. Steps to improve on this statistic are proposed in the business plan. The DSO has started to use the WARMS database to identify unregistered dams. At the current rate, 99% of all registered dams should be classified by 2015 compared to the current 96%.
- 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 on the quality of design and construction include training of the important role players. SANCOLD through its annual courses and/or conferences is assisting in this regard.
- Of the total of 2 033 category 2 and 3 dams, 1 499 (74%) 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 is a requirement of the new dam safety regulations that all category 2 and 3 dam owners must have an O&M manual and emergency preparedness plan compiled by an APP when so instructed by the Director-General. At present only about 54% 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.** Although this is a notable improvement on the corresponding statistic of 50% of the previous year, this is still far from satisfactory. Steps to improve this statistic are proposed in the business plan. Upgrading of the non-complying dams to appropriate safety standards remains a long-term task (until 2020 or later) and provisional targets are set on a prioritised basis in the business plan.
- **It is clear 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 is slow but steady. The rehabilitation programme by

DWA for DWA dams (see Table 14) is making an important contribution in this regard.

- Of the total "possible loss of life" for all dams on the list (5 284), approximately 78% is due to the first 100 dams or 86% due to the first 200 dams. It is clear that **special attention should be focused on the first 100 to 200 dams on the priority list** as they have the greatest potential impact on the public. Ironically, in the past most incidents associated with loss of life or near misses have been caused by category 2 dams lower down on the priority list, indicating that these dams should not be neglected.
- 82% of the top 100 dams on the priority list belong to DWA and the Municipalities as shown in Table 13. It should be possible for these major dam owners to obtain and budget adequate funds to upgrade and/or maintain these dams in pristine condition.
- **The most important shortcomings under the first 100 dams that need to be addressed in the short term are listed in Appendix C2 (and of DWA dams only in Appendix C3).**
- The total direct expenditure incurred in administration of the dam safety legislation at Head Office was R4 944 000 compared to R5 023 000 in the previous reporting year, i.e. a decrease of 1,6%, mainly due to vacant posts. 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 filling of especially vacant technical posts continuous to be a challenge and impacts negatively on the efficiency of the dam safety programme.**

The following specific recommendations are made in order 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 5 years ago. The DSO has also been unable to fill three vacant Chief Engineer posts over a long period of time.
- A detailed action plan to achieve the objectives of the dam safety programme is proposed in the last column of the strategic business plan in Appendix A.

APPENDIX A: STRATEGIC BUSINESS PLAN FOR DAM SAFETY PROGRAM

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 by several role players: Firstly dam* ***owners*** *(including Infrastructure Branch within DWA [**DWA-IB**]), secondly various components within DWA (Dam Safety Office [**DSO**], Regional Offices [**RO**], Legal Services [**LS**]), Compliance Monitoring & Enforcement (**CME**), thirdly Disaster Management Structures [**DM**] and also SANCOLD.*

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.	**99**% dams* registered by 2015. • **99**% of reg. dams classified by 2015.	• **4 832** (±**95%** -estimate) • **4 636** (**96**% of 4 832)	• Register dams from WARMS database plus advertising campaign. (RO) • Check by Google-Earth (RO, DSO) • Introduce fines to owners for late registration? (LS/CME)
2. That all new dams* are designed/ built / altered in accordance with appropriate standards.	**95**% by 2015 (measurement of quality of construction subjective, especially of Cat I dams)	**±95%** for cat 2&3 (estimate allows for deficient quality of illegal dams) **±50%** for cat 1 dams	• Prevent illegal construction by e.g. air and road reconnaissance. (RO) • Introduce fines? (LS/CME) • Training courses for APPs/contractors/ clerks of works? (DSO, SANCOLD) • Improve control over cat I dams. (RO, DSO)
3. That all Cat II & III dams are inspected and evaluated by APPs* according to schedule and to current dam engineering standards.	**1550** 1st inspections by 2015. Then 2nd and 3rd inspections to follow at required intervals.	1st **1499** 2nd **753** 3rd **329** inspection reports received so far.	• Accelerate instructions. (DSO) • Improve system of reminders, warnings, legal action, etc. (DSO, CME) • Implement financial assistance scheme. (DSO, DWA) • Inspection of some DWA dams should be contracted out. (DWA-IB) • Training of APPs (SANCOLD, DSO)
4. That all dams* are operated & maintained in accordance with appropriate safety standards and that effective OMMs* and EPPs* are in place.	**1100** OMMs & EPPs compiled for Cat II and III by 2015. Standard OMM & EPP issued for all Cat I dams by 2015.	**1 094** OMMs with EPPs compiled for Cat II and III dams so far.	• Improve system of instructions, reminders, warnings, etc. (DSO, CME) • Ensure that all Cat II and III dams have OMMs & EPPs. (DSO + owners) • Compile a standard OMM & EPP for Cat I dams and issue. (DSO) • Motivate dam owners to keep up O&M by annual circular/letter. (DSO) • Implement Disaster Management Act. (DM)
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>: • 1st 100 dams **80**% by 2020 • 2nd 100 dams **70**% by 2020 • 3rd 100 dams **70**% by 2020 • 4th 100 dams **70**% by 2020 • 80% of all Cat II & III dams by 2030	<u>Basic* compliance</u>: • 1st 100 dams **54%** (55%) • 2nd 100 dams **48%** (44%) • 3rd 100 dams **64%** (42%) • 4th 100 dams **62%** (60%) Average (1st 400) **57%** (50%) (previous year in brackets)	• Upgrade dams on prioritized basis. Focus on first 100-200 dams on priority list. (Owners, DSO) • Improve system of reminders, warnings, legal action, etc. (DSO, CME) • Implement financial assistance scheme. (DSO, DWA) • Training courses for APPs/contractors/ clerks of works? (APPs, DSO, SANCOLD) • Budget R400 M+ per year for upgrading DWA dams. (DWA-IB)

*<u>Notes</u>: **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 2013.

APPENDIX B: DEFICIENCIES AT DAMS WITH A SAFETY RISK

		Previous year		This Year	
Code	**Description**	**Number**	**Rectified**	**Number**	**Rectified**
H01	Spillway capacity less than requirements of current criteria	456	94	462	97
H02	Erosion of toe of dam or downstream thereof	46	8	49	9
H03	Damage to spillway lining (e.g. erosion or cavitation	80	22	80	22
H04	Damage to outlet works (e.g. cavitation)	15	4	15	4
H05	Mechanical equipment or outlet works out of order	42	10	43	10
H06	Spillway or gate vibration	2	1	2	1
H08	Erosion due to wave action (damage to upstream slope protection)	67	15	70	15
H09	Inadequate surface drainage or damage by "rainfall" erosion	22	8	21	8
H11	Hazard to human life upstream of dam during floods ("backwater" effects also)	1	1	1	1
	HYDRAULIC PROBLEMS	**731**	**163**	**743**	**167**
L01	Excessive loss of water	133	31	136	33
L02	High pore pressures, uplift forces, blocked drains	30	8	30	8
L03	Internal erosion, piping	20	3	21	3
L04	Wet patches observed	47	21	51	21
L05	Leakage along outlet / other pipe			1	0
	LEAKAGE PROBLEMS	**230**	**63**	**239**	**65**
S01	Stability (gravity and buttress dams)	63	18	61	18
S02	Slope stability (earth and rockfill dams)	76	19	78	19
S03	Structural design criteria exceeded (arch dams)	10	3	11	3
S04	Foundation movement observed	3		3	0
S05	Upstream "slip circle movement" observed	2	1	2	1
S06	Downstream "slip circle movement" observed	13	4	13	4
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	77	23	77	23
S11	Formation and development of cracks in earth dams	12	5	13	5
	STRUCTURAL PROBLEMS	**274**	**78**	**276**	**78**
M01	Weakening of concrete due to alkali-aggregate reaction or swelling/shrinking aggregate	18	4	18	4
M02	Chemical attack, leaching, weathering, bacteriological attack	4	1	4	1
M03	Break up of upstream membrane	1		2	0
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	0
	MATERIAL PROBLEMS	**37**	**8**	**38**	**8**

	APPENDIX B (continued)	Previous year		This Year	
Code	**Description**	**Number**	**Rectified**	**Number**	**Rectified**
B01	Flood control: Lack of personnel, untrained personnel	3		3	8
B02	Operation and Maintenance Manual (OMM) must be compiled / updated	1 156	423	1 156	441
B03	Deficiencies in monitoring (instrumentation)	68	24	71	25
B04	Deficiencies in monitoring (routine inspections)	6	3	6	3
B05	Emergency Preparedness Plan (EPP) must be compiled / updated	421	63	450	75
B07	Trees and vegetation that must be removed	204	86	206	88
B08	Burrowing animals that must be exterminated	69	21	67	23
B09	Instruments not read/processed/evaluated	2		2	0
B10	Flood control gates out of order	8	4	8	4
B11	Outlet works out of order	24	5	23	5
B12	Maintenance of slope protection	23	10	24	10
B13	Increase non overspill crest width	1		2	0
B14	Inadequate freeboard	1		3	0
	OPERATION AND MAINTENANCE PROBLEMS	**1 986**	**639**	**2 021**	**674**
A01	Sabotage	2		2	0
A02	Earthquake Damage	2	1	2	1
A04	Problems in dam basin (unstable slopes, sedimentation)	1		1	0
A05	Problems in the river downstream of a dam	1		1	0
A06	Further investigations required	19	4	23	4
	OTHER PROBLEMS	**25**	**5**	29	5
	TOTAL	**3 283**	**956**	**3 346**	**997**

APPENDIX C: PRIORITY LIST OF DAM SAFETY OFFICE

APPENDIX C1: First 100 dams on list (10 pages)

Upon receipt of dam safety evaluation reports on category 2 and 3 dams, a basic risk assessment is done and the priority of a dam is determined on the basis of its "possible loss of life during the lifespan of the dam", taken as 100 years. There is a time lag before the list is updated after completion of dam safety betterment work, as the dam safety evaluation is done 3-5 years thereafter. There are currently 1 386 dams on the full list.

APPENDIX C2: Dams under first 100 on the list needing urgent attention (45 dams)

As Appendix C1 but without dams that have been rehabilitated recently and without dams that are considered to comply with basic safety standards (annual probability of failure less than 1/200 for category 2 dams and less than 1/2000 for category 3 dams). Some dams in Appendix C1 appear high on the list because of their massive size and high theoretical hazard potential although they comply with appropriate safety standards. These dams have been omitted in Appendix C2. **Dams on this list should receive urgent attention because their annual probability of failure is considered to be too high.**

APPENDIX C3: As Appendix C2 but only for DWA dams (18 dams)

Of the 18 dams on this list, 12 dams are already in the planning, tender, design or construction phase for upgrading work.

LEGEND FOR PRIORITY LIST:

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 case scenario (e.g. failure during night and 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	*A (Agriculture), M (Municipal), W (DWA), S (State departments excluding DWA), O (Industry, Mines, Business)*

The following guideline is used to determine intervals between dam safety evaluations *(shown in the last column of Appendix C):*

EL	***Intervals between dam safety evaluations (years)***
<0,5	10
0,5 to 2	9
2 to 10	8
10 to 20	7
20 to 50	6
>50	5

APPENDIX C1

No.	Sector	Loc. No.	Name of dam	Category					EPP		DSI Interval
	Major risk aspect		Action to be taken	T(years)	PF	LL	AL	EL(total)	(Y/N)	Status/Progress	(years)
1	M	N120/01	NQWEBA DAM (PREVIOU	3					Y		5
	Spillway		*Investigate further	100	0.634	10	0.5	634.0		Programmed for 2007/8	
	Structure		*Investigate further and improve	100	0.634	2000	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				
2	M	C601/01	BLOEMHOEK DAM	3					Y		5
	Spillway		None	2000	0.049	2140	0.6	284.2		Adequate	
	Structure		Adequate	500	0.181	2140	0.6			Adequate	
				0	0.000	0	0				
				0	0.000	0	0				
3	W	A210/01	ROODEKOPJES DAM	3					N		5
	Spillway		None	2000	0.049	500	0.7	271.6		Adequate	
	Structure		None	2000	0.049	900	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	
4	W	N230/01	DARLINGTON DAM	3					Y		5
	Spillway		*Investigate and improve	200	0.394	608	0.9	231.9		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				
5	W	W440/01	PONGOLAPOORT DAM	3					N		5
	Spillway Capacity		Investigate further.Operate at reduced FSC(66%).	5000	0.020	6600	0.7	181.2		Programmed for 2009	
	Structural Stability		Investigate	5000	0.020	6600	0.7			Programmed for 2010	
					0.000						
					0.000						
6	M	B100/04	WITBANK DAM	3					Y		5
	Spillway		* Investigate and improve (gated spillway)	200	0.394	350	1	177.7		Programmed for...?	
	Structure		Pendulums and cracking should be monitored. Conc	1000	0.095	350	1			Programmed for...?	
	Poor O&MM		Improve O&MM	1000	0.095	350	1			Programmed for...?	
					0.000						
7	W	C801/10	STERKFONTEIN	3					Y		5
	Spillway		None except correct operation	2000	0.049	2500	0.5	155.9		Adequate	
	Structure - filters not comprehensive		None except permanent monitoring and EP	5000	0.020	5000	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				
8	M	B100/13	MIDDELBURG DAM	3					Y		5
	Spillway		Investigate options (overtopping spillway)	3000	0.033	6000	0.5	127.2		Ongoing	
	Structure		None except when overtopping	10000	0.010	6000	0.5			Adequate	
				0	0.000	0	0				
				0	0.000	0	0				
9	W	H800/03	DUIVENHOKS DAM	3					Y		5
	Spillway capacity		None necessary	2000	0.049	100	1	126.8		Adequate	
	Structural stability		(a) Investigate stab (b) Stabalise left abutment	100	0.634	200	1			Programmed for 2007/8 & 2008/9 & 2010/1	
					0.000						
					0.000						
10	W	C300/02	WENTZEL DAM	2					N		5
	Spillway		*Detailed investigation and improve	133	0.530	312	0.7	125.5		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				

No.	Sector / Major risk aspect	Loc. No.	Name of dam / Action to be taken	Category / T(years)	PF	LL	AL	EL(total)	EPP (Y/N)	Status/Progress	DSI Interval (years)
11	W	R101/01	CATA DAM	3					N		5
	Spillway		*Investigate and improve	500	0.181	750	0.7	116.2		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				
12	W	J330/01	STOMPDRIFT DAM	3					Y		5
	Spillway		* Increase spillway capacity	111	0.595	100	0.8	96.5		Programmed for 2009/10	
	Structure		* Improve structural adequacy	200	0.394	200	1			Programmed for 2009/10	
				0	0.000	0	0				
				0	0.000	0	0				
13	W	B310/05	RHENOSTERKOP DAM	3					N		5
	Spillway		Investigate further	5000	0.020	4000	0.7	82.8		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						
14	M	M100/01	GROENDAL DAM	3					Y		5
	Spillway		None	2000	0.049	1000	0.7	66.6		Adequate	
	Structure		None	2000	0.049	1000	0.7			Adequate	
					0.000						
					0.000						
15	W	U200/04	INANDA DAM	3					Y		5
	Spillway		None	10000	0.010	1000	0.5	57.7		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	W	C120/01	VAAL DAM	3					Y		5
	Spillway		None	2000	0.049	1600	0.6	55.9		Adequate	
	Structure		None	10000	0.010	1600	0.6			Adequate	
					0.000						
					0.000						
17	W	C520/02	KRUGERSDRIFT	3					Y		5
	Spillway		None	2000	0.049	930	0.6	53.1		Adequate	
	Structure		None	2000	0.049	930	0.6			Adequate	
					0.000						
					0.000						
18	A	G401/AM	SPIOENKOP	3					Y		5
	Spillway Capacity		None necessary	10000	0.010	20	0.8	52.0		Adequate	
	Structural Stability		* Repair cracking	50	0.867	40	0.9			Programmed for...?	
	Piping		Permanent monitoring	50	0.867	60	1				
				0	0.000	0	0				
19	W	U200/01	ALBERTFALLS DAM	3					Y		6
	Spillway		* Improve the spillway capacity	1500	0.065	1200	0.5	49.8		Programmed for 2007/8	
	Structure		Monitor seepage	5000	0.020	1200	0.5			Adequate	
					0.000						
					0.000						
20	W	E100/02	CLANWILLIAM DAM	3					Y		6
	Spillway		None	10000	0.010	76	0.8	40.8		Adequate	
	Structure		Rehabilitation	1000	0.095	76	0.8			Inadequate.Programmed for 2006/7 & 2007/8 & 2008/	
	No O&MM and EPP		Compile and improve EPP	0	0.000	0	0			Programmed for ???	
	Spillway gate operation (human error)		Remove spillway gates - rehabilitation.	100	0.634	76	0.8			Programmed for 2006	

No.	Sector	Loc. No.	Name of dam	Category					EPP		DSI Interval
	Major risk aspect		Action to be taken		T(years)	PF	LL	AL	EL(total)	(Y/N)	Status/Progress	(years)
21	W	A300/03	KLEIN MARICOPOORT DA	3						N		6
	Spillway		*Improve spillway		500	0.181	126	1	39.8		Programmed for 2007/8 & 2008/9	
	Structure		None, except monitoring		1000	0.095	206	1			Adequate	
	No O&MM and EPP		Compile		0	0.000	0	0			Programmed for 2007/8	
					0	0.000	0	0				
22	W	R300/01	NAHOON DAM	3						Y		6
	Spillway		None		2000	0.049	400	0.7	39.0		Adequate	
	Structure		None		1000	0.095	400	0.7			Adequate	
					0	0.000	0	0				
					0	0.000	0	0				
23	W	C520/04	GROOTHOEK DAM (MOU	3						Y		6
	Spillway		None		5000	0.020	1870	0.7	38.7		Adequate	
	Structure		None		10000	0.010	1870	0.7			Adequate	
						0.000						
						0.000						
24	S	X103/50	MBAMBISO DAM-WAS BO	3						Y		6
	Spillway		Confirm / analyse spillway discharge capacity.		5000	0.020	40	1	34.9		Adequate	
	Structure		Maintenance must be done.		5000	0.020	40	1			Adequate	
	Relocate water supply pressure pipeline or		Investigate and relocate.		50	0.867	40	1			Programmed for ...?	
					0	0.000	0	0				
25	W	B200/01	BRONKHORSTSPRUIT DA	3						N		6
	Spillway capacity		Inspect apron area		10000	0.010	1740	1	34.5		Programmed for...?	
	Structural stability		Carry out FEA		10000	0.010	1740	1			Programmed for...?	
						0.000						
						0.000						
26	W	R101/03	MNYAMENI DAM	3								6
	Spillway Capacity		* Improve		200	0.394	80	1	31.5			
	Structural Stability				0	0.000	0	0				
	O & MM				0	0.000	0	0				
					0	0.000	0	0				
27	W	C230/04	BOSKOP DAM	3						Y		6
	Spillway capacity				2000	0.049	519	0.6	29.6		Adequate	
	Structural capacity		Low due to poor maintenance + sinkholes.		2000	0.049	519	0.6			Adequate	
						0.000						
						0.000						
28	B	X100/22	DRIEKOPPIES DAM	3						Y		6
	Spillway Capacity		None		10000	0.010	2000	0.5	29.6		Adequate	
	Structural Stability - piping potential		Monitoring		5000	0.020	2000	0.5			Adequate	
					0	0.000	0	0				
					0	0.000	0	0				
29	W	B800/01	TZANEEN	3						Y		6
	Spillway		None		10000	0.010	2000	0.5	29.6		Adequate	
	Structure		Improved monitoring required		5000	0.020	2000	0.5			Adequate	
						0.000						
						0.000						
30	W	B402/35	DER BROCHEN DAM	3						Y		6
	Spillway capacity: Cavities beneath spillwa		Improve spillwal against erosion		50	0.867	30	1	26.2		Programmed for...?	
	Structural stability		Monitoring essential		2000	0.049	30	1			Adequate	
						0.000						
						0.000						

No.	Sector	Loc. No.	Name of dam	Category						EPP		DSI Interval
	Major risk aspect		Action to be taken		T(years)	PF	LL	AL	EL(total)	(Y/N)	Status/Progress	(years)
31	W	A210/02	HARTBEESPOORT DAM	3						N		6
	Spillway		Routed flood that can be handled by channel before		1000	0.095	323	0.7	23.6		Programmed for ...?	
	Structure		None		10000	0.010	323	0.7			Adequate	
					0	0.000	0	0				
						0.000						
32	M	D200/18	SMITHFIELD DAM	3								6
	Spillway Capacity				200	0.394	60	0.9	21.3			
	Structural Stability				0	0.000	0	0				
	O & MM				0	0.000	0	0				
					0	0.000	0	0				
33	M	A600/06	DONKERPOORT DAM	3						Y		6
	Spillway capacity		Investigate + improve		200	0.394	100	0.5	21.2		Programmed for ...?	
	Structural stability		Investigate		2000	0.049	100	0.5			Programme for...?	
					0	0.000	0	0				
					0	0.000	0	0				
34	W	K100/09	KLIPHEUWEL DAM	3						Y		6
	Spillway capacity		None		5000	0.020	30	0.5	20.8		Adequate	
	Structural stability: Dispersive soil		Inspect outlet pipe by vedio camera		50	0.867	30	0.8			Programmed for?...	
						0.000						
						0.000						
35	W	B800/02	EBENEZER DAM	3						N		6
	Spillway		*Investigate further.		200	0.394	43	0.5	20.6		Programmed for ...?	
	Structure		*Install safe seepage monitoring system.		1000	0.095	43	0.5			Programmed for ...?	
	Potential clogging of shaft spillway.		*Install structure to prevent clogging.		50	0.867	43	0.5			Programmed for ...?	
						0.000						
36	W	A601/42	VAALKOP NO.II-DAM	2						N		7
	Spillway		*Improve		100	0.634	20	1	20.0		Programmed for ...?	
	Structure		*Improve		20	0.994	20	1			Programmed for ...?	
						0.000						
						0.000						
37	W	A900/03	ALBASINI DAM	3						N		7
	Spillway		Must be improved.		500	0.181	100	1	19.8		Programmed for 2012	
	Structure		Post-stressed cables must be monitored,investigate		5000	0.020	100	1			Programmed for ...?	
					0	0.000	0	0				
						0.000						
38	W	B800/29	MIDDEL LETABA DAM	3						N		7
	Spillway capacity		Investigate by model study		1000	0.095	100	0.7	18.2		Programmed for ???	
	Structural stability		Re-evaluate stability and improve monitoring		500	0.181	100	0.7			Programmed for ???	
						0.000						
						0.000						
39	M	S300/10	BONGOLO DAM	3						Y		7
	Spillway capacity				2000	0.049	600	0.6	17.9		Adequate	
	Structural stability				100000	0.001	600	0.6			Adequate	
					0	0.000	0	0				
					0	0.000	0	0				
40	M	A211/58	RIETVLEI DAM (was A210	3						Y		7
	Spillway		None		10000	0.010	500	0.6	17.5		Adequate	
	Structure		None		2000	0.049	500	0.6			Adequate	
					0	0.000	0	0				
					0	0.000	0	0				

No.	Sector / Major risk aspect	Loc. No.	Name of dam / Action to be taken	Category	T(years)	PF	LL	AL	EL(total)	EPP (Y/N)	Status/Progress	DSI Interval (years)
41	M	C212/44	MIDDLE LAKE DAM	2						Y		7
	Spillway capacity .				150	0.488	20	1	17.2			
	Structure stability.				1000	0.095	20	1				
	Lack of maintenance.				100	0.634	20	1				
					0	0.000	0	0				
42	A	A220/02	OLIFANTSNEK DAM	3						Y		7
	Spillway		None		2000	0.049	292	0.6	16.7		Adequate	
	Structure		None		2000	0.049	292	0.6			Adequate	
					0	0.000	0	0				
					0	0.000	0	0				
43	W	S302/35	SHILOH DAM-CISKEI	3						N		7
	Spillway		None		2000	0.049	250	0.7	16.7		Adequate	
	Structure		None		2000	0.049	250	0.7			Adequate	
	No O&MM and EPP		Compile		0	0.000	0	0			Programmed for 2007/8	
						0.000						
44	A	J250/02	CALITZDORP DAM	3						Y		7
	Spillway		None necessary		2000	0.049	50	0.8	15.8		Adequate	
	Structure		Investigate stability		500	0.181	100	0.8			Programmed for ...?	
					0	0.000	0	0				
					0	0.000	0	0				
45	W	H300/02	PIETERSFONTEIN DAM	3						Y		7
	Spillway		None necessary		1000	0.095	210	0.7	15.8		Adequate	
	Structure		None necessary		10000	0.010	280	0.7			Adequate	
						0.000						
						0.000						
46	W	S300/16	THRIFT DAM (MOUNTHOI	2						Y		7
	Spillway		Investigate and improve		500	0.181	100	0.8	15.2		Outstanding	
	Structure		None		10000	0.010	100	0.8			Adequate	
						0.000						
					0	0.000	0	0				
47	W	J250/01	GAMKAPOORT DAM	3						Y		7
	Spillway		None		10000	0.010	300	0.8	15.1		Adequate	
	Structure		None		3333	0.030	543	0.8			Adequate	
					0	0.000	0	0				
					0	0.000	0	0				
48	O	X201/68	NGODWANA DAM	3						N		7
	Spillway		Adequate, but erosion should be monitored		10000	0.010	1000	0.5	14.8		Adequate	
	Structure		Adequate, but monitoring essential		5000	0.020	1000	0.5			Adequate	
					0	0.000	0	0				
					0	0.000	0	0				
49	M	G100/13	WEMMERSHOEK DAM	3						N		7
	Spillway		None		18182	0.005	2000	0.7	14.6		Adequate	
	Structure		None		10000	0.010	1000	0.7			Adequate	
						0.000						
						0.000						
50	W	J340/02	KAMMANASSIE DAM	3						Y		7
	Spillway		None		1000	0.095	30	0.7	14.6		Adequate	
	Structure		* Unblock/ clean pressure relief holes		200	0.394	50	0.7				
						0.000						
						0.000						

No.	Sector	Loc. No.	Name of dam	Category					EPP		DSI Interval
	Major risk aspect		Action to be taken		T(years)	PF	LL	AL	EL(total)	(Y/N)	Status/Progress	(years)
51	M	U401/08	LAKE MERTHLEV	2						N		7
	Spillway		Investigate & wall stability		1000	0.095	21	1	14.0		Programmed for ???	
	Structure		* Investigate integrity of post stressed bables		100	0.634	21	1			Programmed for ???	
					0	0.000	0	0				
					0	0.000	0	0				
52	W	H300/01	POORTJIESKLOOF DAM	3						Y		7
	Spillway Capacity		None		1000	0.095	40	0.6	13.5			
	Structural Stability		None		2000	0.049	400	0.6			Adequate	
						0.000						
						0.000						
53	W	H200/07	ROODE ELSBERG DAM	3						N		7
	Spillway		None		10000	0.010	50	0.6	12.9		Adequate	
	Structure		Structural analysis & risk analysis		2000	0.049	50	0.6			Programmed for 2010	
	Internal erosion.Leaching sand from found		Monitor		200	0.394	50	0.6			Ongoing	
						0.000						
54	W	L300/01	BEERVLEI DAM	3						N		7
	Spillway		None		200	0.394	41	0.7	12.2		Adequate	
	Structure		None		2000	0.049	41	0.7			Adequate	
						0.000						
						0.000						
55	W	V700/01	WAGENDRIFT DAM	3						Y		7
	Spillway Capacity		Check freeboard and spillway length		2000	0.049	250	0.5	11.9		Programmed for 2008	
	Structural Stability		Install monitoring instruments		2000	0.049	250	0.5			Programmed for 2008	
						0.000						
						0.000						
56	W	D310/01	VANDERKLOOF DAM	3						N		7
	Spillway		Monitoring		10000	0.010	1500	0.7	11.7		Adequate	
	Structure		Monitoring		80000	0.001	1500	0.7			Adequate	
	No O&MM and EPP		Compile		0	0.000	0	0			Programmed for 2007	
						0.000						
57	A	G101/AH	PARYS DAM	2						Y		7
	Spillway Capacity		None		500	0.181	20	0.8	11.3		Adequate	
	Structural Stability		None		10000	0.010	30	0.8			Adequate	
	O & MM				0	0.000	0	0				
	Erosion of spillway lining (reo mattresses)		* Repair		100	0.634	20	0.8			Programmed for 2006/7	
58	W	S302/33	GLENBROCK DAM	3						Y		7
	Spillway Capacity		* Improve		100	0.634	21	0.8	11.2		Programmed for 2008	
	Structural Stability		None		1000	0.095	21	0.8			Programmed for 2008	
						0.000						
						0.000						
59	W	A901/42	DAMANI DAM	3						N		7
	Spillway		Adequate		1000	0.095	60	1	10.9		Adequate	
	Structure		Adequate		1000	0.095	60	1			Adequate	
	No O&MM and EPP		Compile		0	0.000	0	0			Outstanding	
						0.000						
60	A	U700/11	BEAULIEU DAM	3						N		7
	Spillway capacity		Reinstate NOCL		500	0.181	62	0.5	10.2		Programmed for...?	
	Structural stability		Monitoring essential		500	0.181	62	0.5			Adequate	
					0	0.000	0	0				
					0	0.000	0	0				

No.	Sector	Loc. No.	Name of dam	Category					EPP		DSI Interval
	Major risk aspect		Action to be taken		T(years)	PF	LL	AL	EL(total)	(Y/N)	Status/Progress	(years)
61	W	A800/01	NZHELELE DAM(NJELELE	3						N		7
	Spillway		Investigate spillway capacity		2000	0.049	250	0.7	10.2		Programmed for 2007/8	
	Structure		None		10000	0.010	250	0.7			Adequate	
	No O&MM and EPP		Compile		0	0.000	0	0			Outstanding	
						0.000						
62	M	G204/65	DRIFTSANDS STORMWA	2						Y		7
	Spillway		None		1000	0.095	106	1	10.1		Adequate	
	Structure		None		10000	0.010	5	1			Adequate	
					0	0.000	0	0				
					0	0.000	0	0				
63	M	Q920/04	ANDREW TURPIN DAM	2						Y		8
	Spillway		Investigate and Increase.		20	0.994	10	1	9.9			
	Structure				10000	0.010	6	0.9				
					0	0.000	0	0				
					0	0.000	0	0				
64	A	B401/33	LEEUWKLIP DAM	2						N		8
	Spillway		*Enlarge / abandon		50	0.867	10	1	9.8		Programmed for 2004 Outstanding	
	Structure		*Improve / abandon		50	0.867	10	1			Programmed for 2004 Outstanding	
	No O&MM and EPP		Compile		0	0.000	0	0			Programmed for 2004 Outstanding	
					0	0.000	0	0				
65	W	B502/23	CHUNIESPOORT DAM	2						N		8
	Spillway		Investigate and improve		200	0.394	9	1	9.8		Programmed for 2007 - 2008	
	Structure		No drain - investigate dispersiveness		200	0.394	9	1			Programmed for 2007 - 2008	
	Outletpipe		*Investigate founding conditions		50	0.867	9	1			Programmed for 2007 - 2008	
	O&M Manual		Compile		0	0.000	0	0			Outstanding	
66	A	C240/05	JOHAN NESER DAM (KLE	2						Y		8
	Spillway		Investigate betterments		200	0.394	30	0.8	9.6		Programmed for 2007/8	
	Structure		None		10000	0.010	30	0.8			Adequate	
						0.000						
						0.000						
67	M	D120/02	KLOOF DAM	3								8
	Spillway Capacity				100	0.634	15	1	9.5			
	Structural Stability				0	0.000	0	0				
	O & MM				0	0.000	0	0				
					0	0.000	0	0				
68	W	Q940/01	KATRIVIER DAM	3						Y		8
	Spillway Capacity		Can take RMF + no apron protection		2000	0.049	82	0.8	9.1		Adequate	
	Structural Stability		* Improve stability		1000	0.095	82	0.8			Programmed for 2012/3 & 2013/4	
	O & MM				0	0.000	0	0				
					0	0.000	0	0				
69	W	A220/07	BOSPOORT	3						Y		8
	Spillway - radial gates		*Inadequate. Enlarge spillway capacity		200	0.394	20	1	9.0		Programmed for 2008/9 & 2010/1	
	Structure		None		1000	0.095	20	1			Programmed for 2008/9 & 2010/1	
	O&MM and EPP not to standard		Compile O&MM and update EPP		0	0.000	0	0			Programmed for 2007/8	
					0	0.000	0	0				
70	M	H402/66	MCGREGOR-NUWE DAM	2						Y		8
	Spillway Capacity		None		10000	0.010	8	1	8.9		Adequate	
	Structural Stability		None		500	0.181	10	1			Adequate	
	Piping		Monitoring		50	0.867	10	1			Ongoing	
					0	0.000	0	0				

No.	Sector	Loc. No.	Name of dam	Category						EPP		DSI Interval
	Major risk aspect		Action to be taken		T(years)	PF	LL	AL	EL(total)	(Y/N)	Status/Progress	(years)
71	A	J340/08	EZELJACHT DAM	3						Y		8
	Spillway		None		100000	0.001	5	0.6	8.9		Adequate	
	Structure		*Investigation to determine "safe operating level"		100	0.634	20	0.7			Programmed for 2006/7 & 2007/8	
					0	0.000	0	0				
					0	0.000	0	0				
72	W	B320/01	LOSKOP DAM	3						N		8
	Spillway		None		10000	0.010	500	0.6	8.9		Adequate	
	Structure		*Monitoring essential / Improve drainage		5000	0.020	500	0.6			Adequate	
	No O&MM and EPP		Compile		0	0.000	0	0			Outstanding	
						0.000						
73	W	G200/12	KLEINPLAAS DAM	3						N		8
	Spillway		None		1177	0.081	60	0.8	8.8		Adequate	
	Structure		None		1818	0.054	120	0.8			Adequate	
					0	0.000	0	0				
					0	0.000	0	0				
74	M	Q800/13	BESTERSHOEK DAM	2								8
	Spillway Capacity				2000	0.049	10	1	8.7			
	Structural Stability				50	0.867	10	1				
						0.000						
						0.000						
75	A	A213/52	HIPPO DAM	2						N		8
	Spillway capacity				50	0.867	10	1	8.7			
	Structural Stability				0	0.000	0	0				
					0	0.000	0	0				
					0	0.000	0	0				
76	W	C900/07	BLOEMHOF DAM	3						N		8
	Spillway		None necessary		10000	0.010	50	0.8	8.3		Adequate	
	Structure		None necessary		10000	0.010	50	0.8			Adequate	
	Flood control		Improve skills and knowledge during emergency (flo		1000	0.095	100	0.8				
						0.000						
77	M	S401/05	KOCH DAM	2						Y		8
	Spillway		*Recently improved		20	0.994	9	0.9	8.1		Still need to be verified	
	Structure		None		1000	0.095	9	0.9			Adequate	
					0	0.000	0	0				
					0	0.000	0	0				
78	W	C230/07	LAKESIDE DAM (POTCHE	2						Y		8
	Spillway		* Upgrade		100	0.634	18	0.7	8.0		Programmed for 2012	
	Structure		None		10000	0.010	18	0.7			Adequate	
	O&MM and EPP				0	0.000	0	0				
					0	0.000	0	0				
79	M	D540/01	VANWYKSVLEI	2						Y		8
	Spillway Capacity		None		2000	0.049	5	0.8	8.0		Adequate	
	Structural Stability		None		1000	0.095	10	0.9			Adequate	
	Piping due to animal burrows.		* Maintenance and monitoring		100	0.634	14	0.9			Ongoing	
					0	0.000	0	0				
80	S	B800/25	LORNA DAWN DAM	2						Y		8
	Spillway capacity		Monitor erosion		2000	0.049	9	1	7.9		Ongoing	
	Structural stability		Monitor seepage		2000	0.049	9	1			Ongoing	
	Strong leak at RF		Repair		50	0.867	9	1			Programmed for...?	
						0.000						

No.	Sector	Loc. No.	Name of dam	Category					EPP		DSI Interval
	Major risk aspect		Action to be taken		T(years)	PF	LL	AL	EL(total)	(Y/N)	Status/Progress	(years)
81	A	B501/17	UPPER GOMPIES DAM	2						N		8
	Spillway		*Investigate / improve		50	0.867	9	1	7.9		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						
82	M	B100/16	KRUGER DAM	2						Y		8
	Spillway Capacity		Improve		50	0.867	8	1	7.9		Programmed for...?	
	Structural Stability (Toe are wet)		Berm + subsurface toe drain		50	0.867	8	1			Programmed for...?	
						0.000						
						0.000						
83	W	W120/01	GOEDERTROUW DAM	3						Y		8
	Spillway capacity		Monitor erosion		5000	0.020	400	0.5	7.8		Adequate	
	Structural stability				5000	0.020	400	0.5			Adequate	
						0.000						
					0	0.000	0	0				
84	O	C221/70	FLEURHOF DAM	2								8
	Spillway Capacity				100000	0.001	12	1	7.6			
	Structural Stability		* Investigate and improve		100	0.634	12	1				
	O & MM				0	0.000	0	0				
					0	0.000	0	0				
85	M	G400/21	MOSSEL RIVER DAM	3						Y		8
	Spillway		*Increase spillway capacity		500	0.181	50	0.8	7.6		Investigation to start 6/2000	
	Structure		None		3000	0.033	20	0.8			Adequate	
					0	0.000	0	0				
					0	0.000	0	0				
86	O	A215/61	EASTERN PLATINUM MIN	2						N		8
	Spillway Capacity		None		200	0.394	31	0.6	7.3		Adequate	
	Structural Stability		None		10000	0.010	6	0.6			Adequate	
	O & MM		Compile		0	0.000	0	0			Programmed for 2006	
					0	0.000	0	0				
87	W	L820/01	KOUGA DAM (PAUL SAUI	3						Y		8
	Spillway		None		10000	0.010	100	0.7	7.3		Adequate	
	Structure		None		1000	0.095	100	0.7			Ongoing monitoring	
						0.000						
						0.000						
88	W	B501/14	MAHLANGU DAM	2						N		8
	Spillway		None		2000	0.049	8	1	7.1		Adequate	
	Structure		Monitor		1000	0.095	8	1			Adequate	
	Pipeline burried in damwall		*Relocate / monitor		50	0.867	8	1			Programmed for 2006 - 2008	
						0.000						
89	W	C700/05	WELTEVREDE DAM	2						N		8
	Spillway		*Investigate		50	0.867	9	0.8	7.1		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				
90	W	D350/02	GARIEP DAM	3						Y		8
	Spillway		Monitoring		100000	0.001	5000	0.7	7.0		Adequate	
	Structure		Monitoring		100000	0.001	5000	0.7			Adequate	
						0.000						
						0.000						

No.	Sector / Major risk aspect	Loc. No.	Name of dam / Action to be taken	Category	T(years)	PF	LL	AL	EL(total)	EPP (Y/N)	Status/Progress	DSI Interval (years)
91	W	A804/04	NWANEDZI	3						N		8
	Spillway		Investigate erosion potetial during overtopping		2000	0.049	50	1	7.0		Programmed for 2007/8	
	Structure		*Do structural and foundation analysis		1000	0.095	50	1			Programmed for 2007/8	
	No O&MM and EPP		Compile		0	0.000	0	0			Outstanding	
						0.000						
92	A	G200/06	BLUEGUM DAM	3						Y		8
	Spillway		None necessary		5000	0.020	100	0.6	6.9		Adequate	
	Structure		None necessary		2000	0.049	200	0.6			Adequate	
					0	0.000	0	0				
					0	0.000	0	0				
93	M	C212/46	KLEINFONTEIN DAM	2						N		8
	Spillway		None		50	0.867	8	1	6.9		Adequate	
	Structure		None		2000	0.049	2	0.6			Adequate	
	No O&MM and EPP		Compile		0	0.000	0	0			Programmed for ???	
					0	0.000	0	0				
94	W	B501/11	FLAG BOSHIELO - WAS A	3						Y		8
	Spillway capacity		None		10000	0.010	500	0.7	6.9		Adequate	
	Structura stability		None		10000	0.010	500	0.7			Adequate	
						0.000						
						0.000						
95	W	A210/03	BUFFELSPOORT DAM	3						N		8
	Spillway Capacity		None		2000	0.049	20	0.8	6.8		Adequate	
	Structural Stability		* Investigate (AAR + GEODETIC SURVEYS)		200	0.394	20	0.8				
						0.000						
						0.000						
96	O	A231/35	PREMIER MINE NO.7 SLIM	3						N		8
	Spillway		Overall estimate		1000	0.095	70	1	6.7			
	Structure		None		0	0.000	0	0				
					0	0.000	0	0				
					0	0.000	0	0				
97	M	H402/74	DASSIESHOEK DAM	3						Y		8
	Spillway Capacity		None		100000	0.001	30	0.8	6.5		Adequate	
	Structural Stability		None		500	0.181	40	0.9			Adequate	
					0	0.000	0	0				
					0	0.000	0	0				
98	W	S200/02	LUBISI DAM	3						N		8
	Spillway		None		2000	0.049	102	1	6.5		Adequate	
	Structure		None		10000	0.010	158	1			Adequate	
						0.000						
					0	0.000	0	0				
99	M	E400/01	KAREE DAM	3						Y		8
	Spillway		None necessary		20000	0.005	12	0.7	6.4		Adequate	
	Structure		None necessary		2000	0.049	12	0.7			Adequate	
	Retaining wall/embankment transition.		Monitor leakage(L03)		200	0.394	20	0.8			Programmed for...?	
					0	0.000	0	0				
100	W	V100/01	SPIOENKOP DAM	3						Y		8
	Spillway capacity				10000	0.010	650	0.5	6.4		Adequate	
	Structural stability				10000	0.010	650	0.5			Adequate	
						0.000						
						0.000						

No.	Sector / Major risk aspect	Loc. No.	Name of dam / Action to be taken	Category	T(years)	PF	LL	AL	EL(total)	EPP (Y/N)	Status/Progress	DSI Interval (years)
1	M	N120/01	NQWEBA DAM (PREVIOU	3						Y		5
	Spillway		*Investigate further		100	0.634	10	0.5	634.0		Programmed for 2007/8	
	Structure		*Investigate further and improve		100	0.634	2000	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				
2	M	C601/01	BLOEMHOEK DAM	3						Y		5
	Spillway		None		2000	0.049	2140	0.6	284.2		Adequate	
	Structure		Adequate		500	0.181	2140	0.6			Adequate	
					0	0.000	0	0				
					0	0.000	0	0				
4	W	N230/01	DARLINGTON DAM	3						Y		5
	Spillway		*Investigate and improve		200	0.394	608	0.9	231.9		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				
6	M	B100/04	WITBANK DAM	3						Y		5
	Spillway		* Investigate and improve (gated spillway)		200	0.394	350	1	177.7		Programmed for...?	
	Structure		Pendulums and cracking should be monitored. Conc		1000	0.095	350	1			Programmed for...?	
	Poor O&MM		Improve O&MM		1000	0.095	350	1			Programmed for...?	
						0.000						
9	W	H800/03	DUIVENHOKS DAM	3						Y		5
	Spillway capacity		None necessary		2000	0.049	100	1	126.8		Adequate	
	Structural stability		(a) Investigate stab (b) Stabalise left abutment		100	0.634	200	1			Programmed for 2013/15	
						0.000						
						0.000						
11	W	R101/01	CATA DAM	3						N		5
	Spillway		*Investigate and improve		500	0.181	750	0.7	116.2		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				
15	W	U200/04	INANDA DAM	3						Y		5
	Spillway		None		10000	0.010	1000	0.5	57.7		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						
18	A	G401/AM	SPIOENKOP	3						Y		5
	Spillway Capacity		None necessary		10000	0.010	20	0.8	52.0		Adequate	
	Structural Stability		* Repair cracking		50	0.867	40	0.9			Programmed for...?	
	Piping		Permanent monitoring		50	0.867	60	1				
					0	0.000	0	0				
20	W	E100/02	CLANWILLIAM DAM	3						Y		6
	Spillway		None		10000	0.010	76	0.8	40.8		Adequate	
	Structure		Rehabilitation		1000	0.095	76	0.8			Programmed for 2013/15	
	No O&MM and EPP		Compile and improve EPP		0	0.000	0	0			Programmed for ???	
	Spillway gate operation (human error)		Remove spillway gates - rehabilitation.		100	0.634	76	0.8			Programmed for 2006	
24	S	X103/50	MBAMBISO DAM-WAS BO	3						Y		6
	Spillway		Confirm / analyse spillway discharge capacity.		5000	0.020	40	1	34.9		Adequate	
	Structure		Maintenance must be done.		5000	0.020	40	1			Adequate	
	Relocate water supply pressure pipeline or		Investigate and relocate.		50	0.867	40	1			Programmed for ...?	
					0	0.000	0	0				

No.	Sector	Loc. No.	Name of dam	Category					EPP		DSI Interval
	Major risk aspect		Action to be taken		T(years)	PF	LL	AL	EL(total)	(Y/N)	Status/Progress	(years)
26	W	R101/03	MNYAMENI DAM	3								6
	Spillway Capacity		* Improve		200	0.394	80	1	31.5			
	Structural Stability				0	0.000	0	0				
	O & MM				0	0.000	0	0				
					0	0.000	0	0				
30	W	B402/35	DER BROCHEN DAM	3						Y		6
	Spillway capacity: Cavities beneath spillwa		Improve spillwal against erosion		50	0.867	30	1	26.2		Programmed for...?	
	Structural stability		Monitoring essential		2000	0.049	30	1			Adequate	
						0.000						
						0.000						
32	M	D200/18	SMITHFIELD DAM	3								6
	Spillway Capacity				200	0.394	60	0.9	21.3			
	Structural Stability				0	0.000	0	0				
	O & MM				0	0.000	0	0				
					0	0.000	0	0				
33	M	A600/06	DONKERPOORT DAM	3						Y		6
	Spillway capacity		Investigate + improve		200	0.394	100	0.5	21.2		Programmed for ...?	
	Structural stability		Investigate		2000	0.049	100	0.5			Programme for...?	
					0	0.000	0	0				
					0	0.000	0	0				
34	W	K100/09	KLIPHEUWEL DAM	3						Y		6
	Spillway capacity		None		5000	0.020	30	0.5	20.8		Adequate	
	Structural stability: Dispersive soil		Inspect outlet pipe by vedio camera		50	0.867	30	0.8			Programmed for?...	
						0.000						
						0.000						
35	W	B800/02	EBENEZER DAM	3						N		6
	Spillway		*Investigate further.		200	0.394	43	0.5	20.6		Programmed for ...?	
	Structure		*Install safe seepage monitoring system.		1000	0.095	43	0.5			Programmed for ...?	
	Potential clogging of shaft spillway.		*Install structure to prevent clogging.		50	0.867	43	0.5			Programmed for ...?	
						0.000						
36	W	A601/42	VAALKOP NO.II-DAM	2						N		7
	Spillway		*Improve		100	0.634	20	1	20.0		Programmed for ...?	
	Structure		*Improve		20	0.994	20	1			Programmed for ...?	
						0.000						
						0.000						
37	W	A900/03	ALBASINI DAM	3						N		7
	Spillway		Must be improved.		500	0.181	100	1	19.8		Programmed for 2012	
	Structure		Post-stressed cables must be monitored,investigate		5000	0.020	100	1			Programmed for ...?	
					0	0.000	0	0				
						0.000						
38	W	B800/29	MIDDEL LETABA DAM	3						N		7
	Spillway capacity		Investigate by model study		1000	0.095	100	0.7	18.2		Programmed for ???	
	Structural stability		Re-evaluate stability and improve monitoring		500	0.181	100	0.7			Programmed for ???	
						0.000						
						0.000						
41	M	C212/44	MIDDLE LAKE DAM	2						Y		7
	Spillway capacity .				150	0.488	20	1	17.2			
	Structure stability.				1000	0.095	20	1				
	Lack of maintenance.				100	0.634	20	1				
					0	0.000	0	0				

No.	Sector	Loc. No.	Name of dam	Category					EPP		DSI Interval
	Major risk aspect		Action to be taken		T(years)	PF	LL	AL	EL(total)	(Y/N)	Status/Progress	(years)
44	A	J250/02	CALITZDORP DAM	3						Y		7
	Spillway		None necessary		2000	0.049	50	0.8	15.8		Adequate	
	Structure		Investigate stability		500	0.181	100	0.8			Programmed for ...?	
					0	0.000	0	0				
					0	0.000	0	0				
51	M	U401/08	LAKE MERTHLEV	2						N		7
	Spillway		Investigate & wall stability		1000	0.095	21	1	14.0		Programmed for ???	
	Structure		* Investigate integrity of post stressed bables		100	0.634	21	1			Programmed for ???	
					0	0.000	0	0				
					0	0.000	0	0				
57	A	G101/AH	PARYS DAM	2						Y		7
	Spillway Capacity		None		500	0.181	20	0.8	11.3		Adequate	
	Structural Stability		None		10000	0.010	30	0.8			Adequate	
	O & MM				0	0.000	0	0				
	Erosion of spillway lining (reo mattresses)		* Repair		100	0.634	20	0.8			Programmed for 2006/7	
59	W	A901/42	DAMANI DAM	3						N		7
	Spillway		Adequate		1000	0.095	60	1	10.9		Adequate	
	Structure		Adequate		1000	0.095	60	1			Adequate	
	No O&MM and EPP		Compile		0	0.000	0	0			Outstanding	
						0.000						
60	A	U700/11	BEAULIEU DAM	3						N		7
	Spillway capacity		Reinstate NOCL		500	0.181	62	0.5	10.2		Programmed for...?	
	Structural stability		Monitoring essential		500	0.181	62	0.5			Adequate	
					0	0.000	0	0				
					0	0.000	0	0				
63	M	Q920/04	ANDREW TURPIN DAM	2						Y		8
	Spillway		Investigate and Increase.		20	0.994	10	1	9.9			
	Structure				10000	0.010	6	0.9				
					0	0.000	0	0				
					0	0.000	0	0				
64	A	B401/33	LEEUWKLIP DAM	2						N		8
	Spillway		*Enlarge / abandon		50	0.867	10	1	9.8		Programmed for 2004 Outstanding	
	Structure		*Improve / abandon		50	0.867	10	1			Programmed for 2004 Outstanding	
	No O&MM and EPP		Compile		0	0.000	0	0			Programmed for 2004 Outstanding	
					0	0.000	0	0				
67	M	D120/02	KLOOF DAM	3								8
	Spillway Capacity				100	0.634	15	1	9.5			
	Structural Stability				0	0.000	0	0				
	O & MM				0	0.000	0	0				
					0	0.000	0	0				
68	W	Q940/01	KATRIVIER DAM	3						Y		8
	Spillway Capacity		Can take RMF + no apron protection		2000	0.049	82	0.8	9.1		Adequate	
	Structural Stability		* Improve stability		1000	0.095	82	0.8			Programmed for 2012/3 & 2013/4	
	O & MM				0	0.000	0	0				
					0	0.000	0	0				
71	A	J340/08	EZELJACHT DAM	3						Y		8
	Spillway		None		100000	0.001	5	0.6	8.9		Adequate	
	Structure		*Investigation to determine "safe operating level"		100	0.634	20	0.7			Programmed for 2006/7 & 2007/8	
					0	0.000	0	0				
					0	0.000	0	0				

No.	Sector	Loc. No.	Name of dam	Category					EPP		DSI Interval
	Major risk aspect		Action to be taken		T(years)	PF	LL	AL	EL(total)	(Y/N)	Status/Progress	(years)
74	M	Q800/13	BESTERSHOEK DAM	2								8
	Spillway Capacity				2000	0.049	10	1	8.7			
	Structural Stability				50	0.867	10	1				
						0.000						
						0.000						
75	A	A213/52	HIPPO DAM	2						N		8
	Spillway capacity				50	0.867	10	1	8.7			
	Structural Stability				0	0.000	0	0				
					0	0.000	0	0				
					0	0.000	0	0				
77	M	S401/05	KOCH DAM	2						Y		8
	Spillway		*Recently improved		20	0.994	9	0.9	8.1		Still need to be verified	
	Structure		None		1000	0.095	9	0.9			Adequate	
					0	0.000	0	0				
					0	0.000	0	0				
80	S	B800/25	LORNA DAWN DAM	2						Y		8
	Spillway capacity		Monitor erosion		2000	0.049	9	1	7.9		Ongoing	
	Structural stability		Monitor seepage		2000	0.049	9	1			Ongoing	
	Strong leak at RF		Repair		50	0.867	9	1			Programmed for...?	
						0.000						
81	A	B501/17	UPPER GOMPIES DAM	2						N		8
	Spillway		*Investigate / improve		50	0.867	9	1	7.9		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						
82	M	B100/16	KRUGER DAM	2						Y		8
	Spillway Capacity		Improve		50	0.867	8	1	7.9		Programmed for...?	
	Structural Stability (Toe are wet)		Berm + subsurface toe drain		50	0.867	8	1			Programmed for...?	
						0.000						
						0.000						
84	O	C221/70	FLEURHOF DAM	2								8
	Spillway Capacity				100000	0.001	12	1	7.6			
	Structural Stability		* Investigate and improve		100	0.634	12	1				
	O & MM				0	0.000	0	0				
					0	0.000	0	0				
85	M	G400/21	MOSSEL RIVER DAM	3						Y		8
	Spillway		*Increase spillway capacity		500	0.181	50	0.8	7.6		Investigation to start 6/2000	
	Structure		None		3000	0.033	20	0.8			Adequate	
					0	0.000	0	0				
					0	0.000	0	0				
87	W	L820/01	KOUGA DAM (PAUL SAUI	3						Y		8
	Spillway		None		10000	0.010	100	0.7	7.3		Adequate	
	Structure		None		1000	0.095	100	0.7			Ongoing monitoring	
						0.000						
						0.000						
88	W	B501/14	MAHLANGU DAM	2						N		8
	Spillway		None		2000	0.049	8	1	7.1		Adequate	
	Structure		Monitor		1000	0.095	8	1			Adequate	
	Pipeline burried in damwall		*Relocate / monitor		50	0.867	8	1			Programmed for 2006 - 2008	
						0.000						

No.	Sector	Loc. No.	Name of dam	Category						EPP		DSI Interval
	Major risk aspect		Action to be taken		T(years)	PF	LL	AL	EL(total)	(Y/N)	Status/Progress	(years)
89	W	C700/05	WELTEVREDE DAM	2						N		8
	Spillway		*Investigate		50	0.867	9	0.8	7.1		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				
91	W	A804/04	NWANEDZI	3						N		8
	Spillway		Investigate erosion potetial during overtopping		2000	0.049	50	1	7.0		Programmed for 2007/8	
	Structure		*Do structural and foundation analysis		1000	0.095	50	1			Programmed for 2007/8	
	No O&MM and EPP		Compile		0	0.000	0	0			Outstanding	
						0.000						
93	M	C212/46	KLEINFONTEIN DAM	2						N		8
	Spillway		None		50	0.867	8	1	6.9		Adequate	
	Structure		None		2000	0.049	2	0.6			Adequate	
	No O&MM and EPP		Compile		0	0.000	0	0			Programmed for ???	
					0	0.000	0	0				
96	O	A231/35	PREMIER MINE NO.7 SLIM	3						N		8
	Spillway		Overall estimate		1000	0.095	70	1	6.7			
	Structure		None		0	0.000	0	0				
					0	0.000	0	0				
					0	0.000	0	0				
97	M	H402/74	DASSIESHOEK DAM	3						Y		8
	Spillway Capacity		None		100000	0.001	30	0.8	6.5		Adequate	
	Structural Stability		None		500	0.181	40	0.9			Adequate	
					0	0.000	0	0				
					0	0.000	0	0				
99	M	E400/01	KAREE DAM	3						Y		8
	Spillway		None necessary		20000	0.005	12	0.7	6.4		Adequate	
	Structure		None necessary		2000	0.049	12	0.7			Adequate	
	Retaining wall/embankment transition.		Monitor leakage(L03)		200	0.394	20	0.8			Programmed for...?	
					0	0.000	0	0				

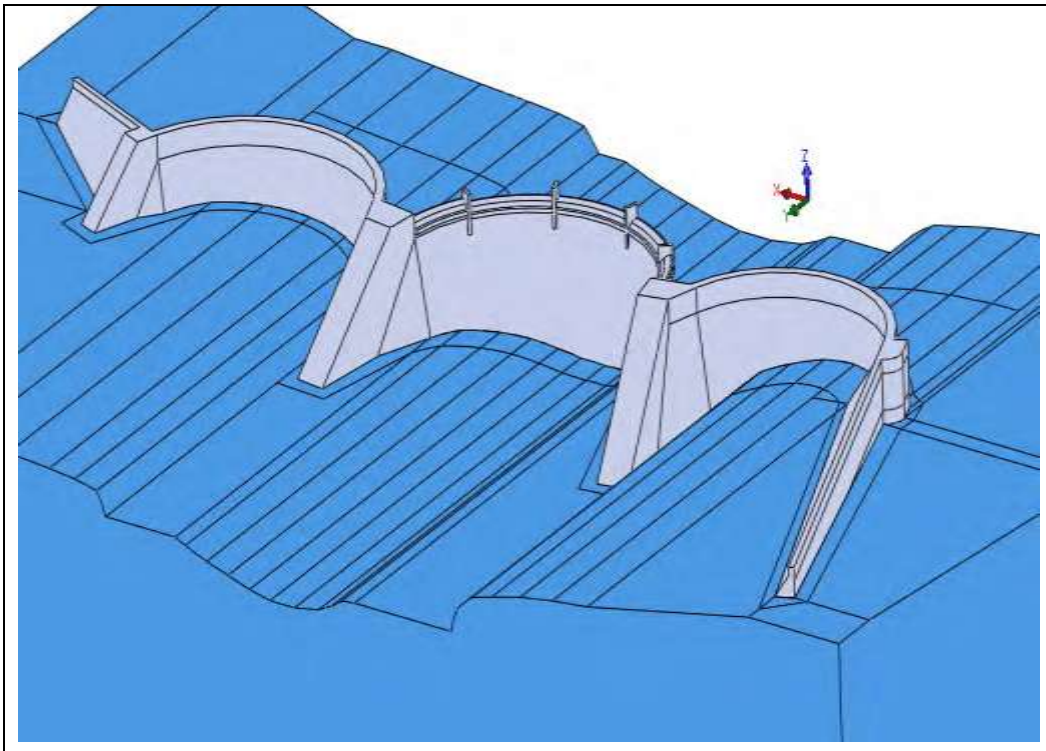
APPENDIX C3

No.	Sector	Loc. No.	Name of dam	Category						EPP		DSI Interval
	Major risk aspect		Action to be taken		T(years)	PF	LL	AL	EL(total)	(Y/N)	Status/Progress	(years)
4	W	N230/01	DARLINGTON DAM	3						Y		5
	Spillway		*Investigate and improve		200	0.394	608	0.9	231.9		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				
9	W	H800/03	DUIVENHOKS DAM	3						Y		5
	Spillway capacity		None necessary		2000	0.049	100	1	126.8		Adequate	
	Structural stability		(a) Investigate stab (b) Stabalise left abutment		100	0.634	200	1			Programmed for 2007/8 & 2008/9 & 2010/1	
						0.000						
						0.000						
11	W	R101/01	CATA DAM	3						N		5
	Spillway		*Investigate and improve		500	0.181	750	0.7	116.2		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				
15	W	U200/04	INANDA DAM	3						Y		5
	Spillway		None		10000	0.010	1000	0.5	57.7		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						
20	W	E100/02	CLANWILLIAM DAM	3						Y		6
	Spillway		None		10000	0.010	76	0.8	40.8		Adequate	
	Structure		Rehabilitation		1000	0.095	76	0.8			Inadequate.Programmed for 20012/15	
	No O&MM and EPP		Compile and improve EPP		0	0.000	0	0			Programmed for ???	
	Spillway gate operation (human error)		Remove spillway gates - rehabilitation.		100	0.634	76	0.8			Programmed for 2006	
26	W	R101/03	MNYAMENI DAM	3								6
	Spillway Capacity		* Improve		200	0.394	80	1	31.5			
	Structural Stability				0	0.000	0	0				
	O & MM				0	0.000	0	0				
					0	0.000	0	0				
30	W	B402/35	DER BROCHEN DAM	3						Y		6
	Spillway capacity: Cavities beneath spillwa		Improve spillwal against erosion		50	0.867	30	1	26.2		Programmed for...?	
	Structural stability		Monitoring essential		2000	0.049	30	1			Adequate	
						0.000						
						0.000						
34	W	K100/09	KLIPHEUWEL DAM	3						Y		6
	Spillway capacity		None		5000	0.020	30	0.5	20.8		Adequate	
	Structural stability: Dispersive soil		Inspect outlet pipe by vedio camera		50	0.867	30	0.8			Programmed for?...	
						0.000						
						0.000						
35	W	B800/02	EBENEZER DAM	3						N		6
	Spillway		*Investigate further.		200	0.394	43	0.5	20.6		Programmed for ...?	
	Structure		*Install safe seepage monitoring system.		1000	0.095	43	0.5			Programmed for ...?	
	Potential clogging of shaft spillway.		*Install structure to prevent clogging.		50	0.867	43	0.5			Programmed for ...?	
						0.000						
36	W	A601/42	VAALKOP NO.II-DAM	2						N		7
	Spillway		*Improve		100	0.634	20	1	20.0		Programmed for ...?	
	Structure		*Improve		20	0.994	20	1			Programmed for ...?	
						0.000						
						0.000						

No.	Sector / Major risk aspect	Loc. No.	Name of dam / Action to be taken	Category	T(years)	PF	LL	AL	EL(total)	EPP (Y/N)	Status/Progress	DSI Interval (years)
37	W	A900/03	ALBASINI DAM	3						N		7
	Spillway		Must be improved.		500	0.181	100	1	19.8		Programmed for 2012	
	Structure		Post-stressed cables must be monitored,investigate		5000	0.020	100	1			Programmed for ...?	
					0	0.000	0	0				
						0.000						
38	W	B800/29	MIDDEL LETABA DAM	3						N		7
	Spillway capacity		Investigate by model study		1000	0.095	100	0.7	18.2		Programmed for ???	
	Structural stability		Re-evaluate stability and improve monitoring		500	0.181	100	0.7			Programmed for ???	
						0.000						
						0.000						
59	W	A901/42	DAMANI DAM	3						N		7
	Spillway		Adequate		1000	0.095	60	1	10.9		Adequate	
	Structure		Adequate		1000	0.095	60	1			Adequate	
	No O&MM and EPP		Compile		0	0.000	0	0			Outstanding	
						0.000						
68	W	Q940/01	KATRIVIER DAM	3						Y		8
	Spillway Capacity		Can take RMF + no apron protection		2000	0.049	82	0.8	9.1		Adequate	
	Structural Stability		* Improve stability		1000	0.095	82	0.8			Programmed for 2012/3 & 2013/4	
	O & MM				0	0.000	0	0				
					0	0.000	0	0				
87	W	L820/01	KOUGA DAM (PAUL SAUI	3						Y		8
	Spillway		None		10000	0.010	100	0.7	7.3		Adequate	
	Structure		None		1000	0.095	100	0.7			Ongoing monitoring	
						0.000						
						0.000						
88	W	B501/14	MAHLANGU DAM	2						N		8
	Spillway		None		2000	0.049	8	1	7.1		Adequate	
	Structure		Monitor		1000	0.095	8	1			Adequate	
	Pipeline burried in damwall		*Relocate / monitor		50	0.867	8	1			Programmed for 2006 - 2008	
						0.000						
89	W	C700/05	WELTEVREDE DAM	2						N		8
	Spillway		*Investigate		50	0.867	9	0.8	7.1		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				
91	W	A804/04	NWANEDZI	3						N		8
	Spillway		Investigate erosion potetial during overtopping		2000	0.049	50	1	7.0		Programmed for 2007/8	
	Structure		*Do structural and foundation analysis		1000	0.095	50	1			Programmed for 2007/8	
	No O&MM and EPP		Compile		0	0.000	0	0			Outstanding	
						0.000						

APPENDIX D: PHOTOGRAPHS OF SELECTED DAMS

MNDWAKA DAM - AMATHOLE DISTRICT MUNICIPALITY (EASTERN CAPE)

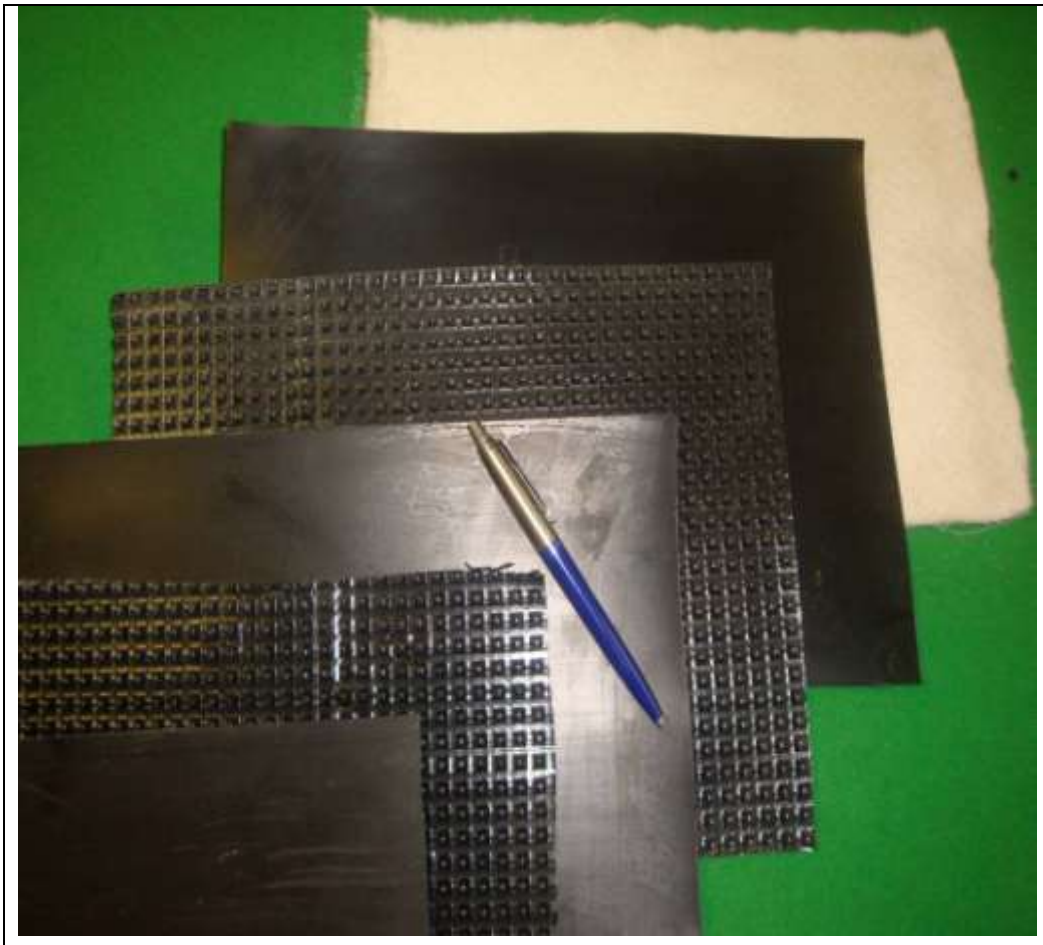
	Excavation for a new rubble masonry concrete arch dam. General Site Overview of the Dam. Viewed from the Cableway. Gross storage capacity : 1.917 x 106 m3 .
	Finite Element Model for the proposed 25 m high rubble masonry concrete Mndwaka Dam currently under construction in the Eastern Cape for the Amathole District Municipality.

	Concrete infill in progress in Arch No2.

	Pouring concréte on the tail pond toe in progress.

NEW DENMARK COLLIERY BRINE EVAPORATION PONDS - 26 MARCH 2013
OWNER : ANGLO AMERICAN THERMAL COAL

	Completed South Pond with the Tutuka Power Station in the background. The pond will be used to dispose brine from the desalination plant treating contaminated mine water at the New Denmark Colliery. The desalinated water is used in the Tutuka Power Station.
	The brine from the desalination have been disposed in the underground mine to date. The Gauteng Region of the Department of Water Affairs directed the mine to find an alternative method to dispose the brine because of the impact on groundwater and eventually the Vaal River. V = 820 000 m^3 H = 14m



The 6 geosynthetic liners used in the brine evaporation ponds from the top of picture: (i) Geosynthetic clay liner (ii) 1.5mm HDPE Geo-membrane (iii) 0,76 mm HDPE Cuspated Drain (iv) 1.5mm HDPE Geo-membrane (v) 0,76 mm HDPE Cuspated Drain (vi) 2mm HDPE Geo-membrane

The total estimated cost of the pond is about R 155 million.

Excavation at the second pond, the North Pond.

GRASSRIDGE DAM - 15 OCTOBER 2012

Grassridge Dam is near Cradock and Middelburg in the Eastern Cape. A license to rehabilitate the dam has recently been issued and the rehabilitation work is nearly completed. DWA is the owner.

	Rehabilitation of the upstream face showing the new rip rap already at crest level. A gravel layer at crest level is still outstanding.

	View of the rehabilitated downstream face. Only a small strip at crest level must still be done.

Rehabilitation of the main spillway.

The crest was cut down and rebuilt with a round shape to improve the discharge coefficient.

The buttresses were extended to the downstream side to improve stability.

The foundation rock between the buttresses were protected with a concrete slab.

Grassridge Dam

Originally built in 1924

Rehabilitation of the main spillway by extending buttresses to downstream side and rounding of the spillway crest.

SOL PLAATJIE DAM NEAR BETHLEHEM – 6&7 NOVEMBER 2012

The Sol Plaatjie Dam owned by the from Dihlabeng Local Municipality was inspected on 6 and 7 November 2012 making use of the fact that the dam was not spilling due to a scheduled shut down of the Lesotho Highlands Water Project. The more detailed inspection was done the next day on 7 November 2012 and is recorded separately.

	The dam water level was slightly below full supply level on 6 November and was not spilling.. View of the apron on the right bank of the river, with the Bethlehem Hydro Power Station in the background. The apron looks in an excellent condition from here.

	Although the water level was below full supply level, it was spilling slightly on 7 November 2012 due to windy conditions.

STOMPDRIFT DAM NEAR OUDTSHOORN - 18 OCTOBER 2012

Stompdrift Dam near Oudtshoorn and De Rust. This Category III DWA dam is being rehabilitated and a license to construct has already been issued.

	Photo showing two blocks towards the right buttress. (Left and right is defined looking downstream).

	Concrete delivery into a lift in the left buttress.

LANGFONTEIN DAM - 19 OCTOBER 2012

Langfontein Dam is a recently completed farm dam near Humansdorp in the Eastern Cape.

	Downstream face protected with rip-rap with spillway excavation in the background.

	Spillway in operation showing first sill on the upstream side..

CHLOORKOP NORTH&SOUTH DAMS - 19 SEPTEMBER 2012

Chloorkop North and South Dams are pollution control dams owned by NCP Chlorchem (PTY) LTD. Rehabilitation on the dams has been completed.

	Completion of rehabilitated wall on downstream face of Chloorkop North Dam.

	Balancing tank for all seepage water to be pumped back into the Chloorkop North dam.

Upstream view looking from North Dam to South Dam.

Construction work being done on Chloorkop South Dam. Comparison between the completed and uncompleted section of the wall.

JOHAN NESER DAM - 16 JANUARY 2013

Johan Neser Dam is located in Klerksdorp and owned by the Klerksdorp Irrigation Board.

Overview of Johan Nesser Dam

View of replaced rip rap on upstream slope from west side bank.

BLOEMHOEK DAM - 20 FEBRUARY 2013

Bloemhoek Dam located and owned by Moqhaka Local Municipality (Kroonstad). This dam is currently number 2 on the priority list with a high hazard potential.

	View along crest of damwall. There are trees that need to be cleared away urgently.

	View from crest of dam basin. The dam is currently at 50% below full capacity.

VIRGINIA DAM - 21 FEBRUARY 2013

Virginia Dam located and owned by Matjhabeng Local Municipality (Welkom). This dam wall has not been maintained on a regular basis.

	View of the dam wall from the downstream side.
	Erosion was detected by the APP in the last dam safety inspection report under the right side of the spillway downstream toe. The APP estimated the depth of the undercutting to 2m but needs a diver to measure its width. In the picture vegetation can be seen growing out the expanding construction joints on the dam wall. These expanding cracks could be a sign of the instability of the dam wall.

CHEMWES KAREERAND TAILINGS DAM - 22 FEBRUARY 2013

Chemwes Kareerand Tailings Dam located near Stilfontein. This tailings dam is currently under construction and estimated to be 80m high when completed

	About 1000m^3/hr of sludge is transported from exisiting/ decommissioned tailings dam to a pumpstation onto the Chemwes Kareerand Tailings Mega Dam and deposited via cyclones. Once the surface water has been removed a freeboard is created to build a level higher.
	Penstocks help to decant suface water on the Chemwes Kareerand Tailings Dam

	Canal carrying decanted water. About 2000m^3/hr is continually moving through this system.

	Return water dam. Filtered water is transported through pipes to existing tailings dams to make more sludge for gold processing.

MODDERFONTEIN FACTORY DAMS NO 1, 3 & 4

Modderfontein Factory Dams 1, 3, & 4 owned by Heartland Leasing Pty (Ltd). This is an example of feedback from the owner on progress made of implemented recommendations from the 5 yearly Dam Safety Inspection Report.

	BEFORE: Right Bank Spillway chute of Modderfontein Factory Dam No 1
	AFTER: Repair on chute and gabion basket retaining wall.

	BEFORE: Erosion hole in right bank spillway chute of Modderfontein Factory Dam No 3.
	AFTER: Hole backfilled in layers. (Soilcrete and well compacted)

BEFORE: Note the lush green colour of the reeds on the downstream slope of Modderfontein Factory Dam No 4.

AFTER: Seepage has reduced substantially due to the lowering of the dam water level.

HAZELMERE DAM NEAR VERILUM IN KZN
(OWNER: DWA)

Early hydraulic model of piano key weir (PKW) to be used for 7 m raising of spillway of Hazelmere Dam.

Tests carried out in DWA's hydraulic lab in Pretoria-West.

Testing of hydraulic model of PKW during extreme flood conditions (SEF).

FISH BARRIER WEIR NEAR MOOI RIVER IN KZN, MARCH 2013
(OWNER: DWA)

	Natural fish barrier or waterfall at upstream end of dam basin of the new Springgrove Dam. The waterfall will be partially inundated when Springgrove Dam is full.

	New Fish Barrier Weir being built just upstream of waterfall in Mooi River to replace natural fish barrier.

SPRINGGROVE DAM NEAR MOOI RIVER IN KZN, MARCH 2013
(OWNER: DWA)

Construction of dam in Mooi River nearing completion.

Outlet works can be seen on left of picture and stepped spillway in middle of picture. The concrete wall was constructed mainly by roller compacted concrete (RCC).

Maximum wall height is 39 m and storage capacity 140 million m^3.

This earthfill embankment forms part of the right flank of Springgrove Dam.

MOLODZWI DAM NEAR LEVUBU, LIMPOPO PROVINCE, JANUARY 2013

During local floods in Limpopo during January 2013 a number of category I farm dams were damaged or breached.

In this case a partial slip occured on the downstream slope due to the steep slope and wet conditions.

Close-up view of slip which is a typical form of slope failure.

The dam did not breach, but the downstream slope must be stabilized.

LUDEKE DAM NEAR BIZANE IN KZN
(OWNER: UMGENI WATER)

	Photo shows coffer wall upstream of main dam wall just before being overtopped. Note intake tower in background of picture.

	Coffer wall being overtopped by small flood, when discharge capacity of diversion pipe was exceeded.

LUDEKE DAM NEAR BIZANE IN KZN, MARCH 2013
(OWNER: UMGENI WATER)

Failure of coffer wall after being overtopped by a small flood.

Correct sizing of river diversion works is one of the challenges faced by contractors, and is typically based on balancing the cost of the diversion works against the risk cost of damage to the dam wall.

Construction of the rockfill dam with clay core underway, after repair of coffer wall.

Note side channel spillway in background, and outlet conduit just behind truck.

LUDEKE DAM NEAR BIZANE IN KZN, MARCH 2013
(OWNER: UMGENI WATER)

Side-channel spillway under construction.

Picture of downstream part of side-channel spillway. Soil nails were used to anchor side walls.

Note intake tower in left background.

LORNA DAWN DAM IN MIDDLE LETABA RIVER, LIMPOPO, JAN 2013

Erosion damage occurred in the spillway channel, encroaching towards the earthfill dam wall in the background.

This took place during isolated floods in Limpopo during January 2013.

A filter structure (at RHS of picture) to control a concentrated leak was also undermined.

This donga has progressed in an upstream direction towards the right flank of the earthfill wall.

The concentrated leak occurs at the upstream bottom of this donga and has the features of an erosion pipe, although it is possible that the leak is coming through the foundation.

It must be controlled by a filter and the leak must be sealed at the upstream end.