



water & sanitation

Department:
Water and Sanitation
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DAM SAFETY OFFICE 2013/2014 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 2013 to 31 March 2014.

A total of 198 dams were registered during the year bringing the **total number of dams registered to date in South Africa to 5 030**. 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 297 registered dams were classified, bringing the total number of existing dams now classified to 4 933, that is 98% of the 5 030 dams registered to date. There are only 97 registered dams left that have not been classified yet. If proposed dams are included, the technical and administrative staff finalised a total of 495 registration / classification cases this year, compared to 305 cases last year, in spite of the shortage in technical and administrative staff.

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 27 dam safety licences were issued i.e. 9 licences to construct, 6 to impound (commission) and 12 to alter/repair.

During the year a total of approximately 1 297 letters were sent to dam owners to ensure compliance with dam safety legislation. This included a total of 89 dam safety evaluation instructions issued to dam owners. A total of 187 applications for approval as Approved Professional Persons for dam safety tasks were processed. In addition, a total of 123 dam safety evaluation reports for dams 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 2 157 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 189 dam safety evaluation reports were submitted by dam owners this year and a total of 123 reports, which include reports standing over from the previous year, were evaluated and accepted.

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 80% 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 R5 328 000 compared to R4 944 000 in the previous reporting year, i.e. an increase of 7,8%, mainly due to cost of living increases. Vacant technical and administrative posts remained vacant in the year, impacting 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 for most of the year.

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 which has been built in terms of the dam safety regulations (i.e. a licence to construct was issued and dam was built under supervision of an approved professional person according to the approved design), has failed since 1987 when the dam safety legislation came in force in South Africa.

Report compiled by Dam Safety Office team

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LIST OF ABBREVIATIONS

AAR	alkali-aggregate reaction
APP	Approved Professional Person
CMA	Catchment Management Agency
dse	dam safety evaluation
dsi	dam safety inspection
DSO	Dam Safety Office
DSP	Dam Safety Programme
DWA	Department of Water Affairs
DWS	Department of Water and Sanitation
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 2013 to 31 March 2014. The annual report also serves as an auditing tool to measure progress with the dam safety programme 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.

During the reporting year the name of the Department was "Department of Water Affairs" (DWA) and this name was used in the body of the report. At the time of publication of this report the Department's name has been changed to Department of Water and Sanitation (by proclamation signed by the President on 3 July 2014), and this name was used on the front page and will be used in future reports.

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 February 2014)
- One Deputy Director
- One Assistant Director
- One Senior Administrative Officer
- One Administrative Officer doing logistic duties
- One Senior Administrative Clerk
- Two Senior Administrative Clerks doing registry clerk duties
- One Senior Administrative Clerk doing data capturing
- One Graduate Trainee (Civil Engineer) for part of the year
- 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
- Two Senior Admin Clerks

During the year a total of approximately 1 297 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 2012 – 31 March 2013)

TASK	Region									Total
	GA	FS	EC	NW	KZ	LI	MP	WC	NC	
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 of 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 definition"	0	0	2	0	0	4	1	8	0	15
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

Statistics for the current reporting year (1 April 2013 – 31 March 2014)

TASK	GA	FS	EC	NW	KZ	LI	MP	WC	NC	Total
Registration & classification of dams										
Classification of dams (new/proposed)	6	4	1	0	0	4	1	10	0	26
Registration of dams/ class and reg (existing)	22	27	51	1	14	37	27	92	6	277
Dam safety evaluation letters										
Dam safety evaluation instructions	5	6	16	0	3	2	6	50	1	89
Implementations of recommendations of reports	5	7	11	0	8	4	1	18	2	56
General letters and reminders/warnings	24	22	45	1	30	14	11	102	3	252
Letters re inspection, investigation	31	26	77	0	38	23	17	123	13	348
Approval of professional persons										
Approval of app's & prof teams Internally	24	6	18	3	13	7	16	80	2	169
Approval of app's & prof teams Externally	5	2	0	0	1	1	0	9	0	18
Owner information										
Verification of ownership	1	3	14	1	1	1	1	6	1	29
Deeds	0	1	1	0	1	0	1	3	0	7
Other										
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 safety risk "by definition"	0	0	2	0	0	1	0	0	0	3
Licences										
Licence to construct/alter	2	0	1	0	2	4	5	3	0	17
Licence to impound	2	0	0	0	0	0	2	2	0	6
Licence to abandon	0	0	0	0	0	0	0	0	0	0
Total for Period	127	104	237	6	111	98	88	498	28	*1297

*The two senior admin clerks dealing with mainly registry duties were utilised to assist with the admin letters during January to March 2014.

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)	
	2012/13	2013/14
Employee component	4 305	4 890
Goods & Services	612	371
Transfers	0	0
Machinery	27	67
Grand Totals	4 944	5 328

The total direct expenditure was R5 328 000 compared to R4 944 000 in the previous year, i.e. an increase of 7,8%, mainly due to cost of living increases.

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 m³) must be registered by dam owners. A total of 198 dams were registered during the year bringing the total number of dams registered to date in South Africa to 5 030. The figure of 198 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.

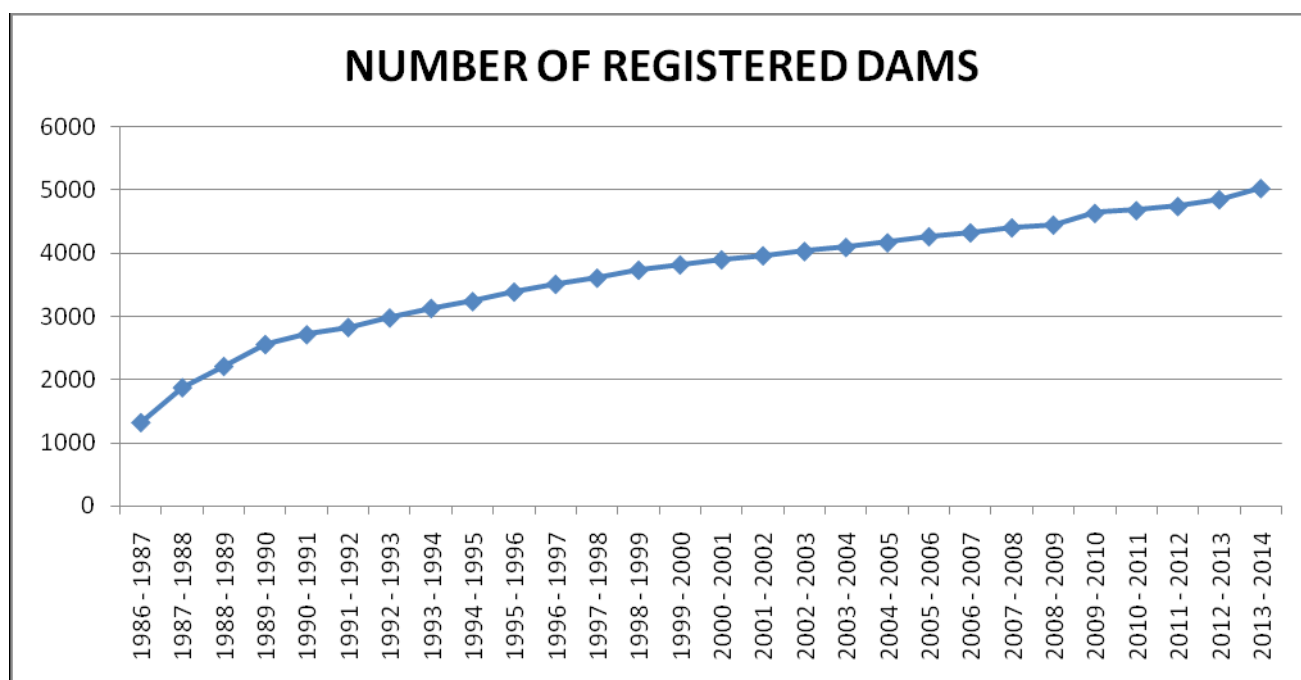


Figure 1: Progress with registration of dams

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)	3 775	75,0%
Medium (12 m – 30 m)	1 079	21,5%
Large (30 m and higher)	176	3,5%
Total	5 030	100

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

Capacity (x 10 ⁶ m ³)	Number	%
0,00 – 0,05	152	3.0%
0,05 – 0,10	1 296	25.8%
0,10 – 0,25	1 806	35.9%
0,25 – 1,00	1 164	23.1%
1,00 – 10,00	445	8.9%
10,00 – 100,00	114	2.3%
100 – 1 000	47	0.9%
1 000 – 10 000	6	0.1%
Total	5 030	100

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

Region	Total No. registered to date	%
Eastern Cape	739	15%
Free State	431	8%
Gauteng	333	7%
Northwest	154	3%
KwaZulu-Natal	975	19%
Limpopo	390	8%
Mpumalanga	501	10%
Northern Cape	82	2%
Western Cape	1 425	28%
Total	5 030	100%

The distribution of type of ownership of registered dams is indicated in Table 5 and the 20 largest dams in the RSA in terms of capacity, from large to small, are listed in Table 6.

Table 5: Distribution of type of ownership of registered dams

Ownership Sector	Total number of registered dams
DWA	321
Municipalities	322
Other State Departments	69
Water Boards	49
Mines, Industries, Business	332
Agriculture	3937
Total	5 030

Table 6: Largest dams in terms of storage capacity

Name of dam	Completion date	River or Watercourse	Wall height (m)	Capacity ('000 m ³)
Gariep	1971	Orange	73	5 342 932
Vanderkloof	1977	Orange	108	3 187 557
Sterkfontein	1980	Nuwejaar spruit	97	2 616 000
Vaal	1938	Vaal	63	2 536 000
Pongolapoort	1973	Phongolo	89	2 445 900
Bloemhof	1970	Vaal	34	1 269 000
Theewaterskloof	1980	Riviersonderend	35	480 406
Kwaggaskloof/ Brandvlei	1983	Breede	25	459 000
Heyshope	1986	Assegai	29	453 440
Woodstock	1982	Tugela	54	373 000
Loskop	1939	Olifants	49	361 000
Grootdraai	1981	Vaal	42	350 000
De Hoop	2013	Steelpoort	74	347 000
Goedertrouw	1982	Mhlatuze	88	301 000
Albert Falls	1976	Mgeni	30	289 100
Spioenkop	1973	Tugela	53	279 000
Kalkfontein	1938	Riet	36	258 274
Mtata	1977	Mtata	38	253 674
Inanda	1989	Mgeni	59	252 000
Driekoppies	1998	Lomati	50	251 000

5. CLASSIFICATION OF DAMS

The target for the number of classifications per year is set at 100 per year. Altogether 297 registered dams were classified, bringing the total number of registered existing dams now classified to 4 933, which is 98% of the 5 030 dams registered to date. In addition, about 13 proposed dams were also classified.

There are only 97 registered dams remaining that have not been classified yet. These 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 7 and 8.

Table 7: Classification of existing dams according to size class and hazard potential

Size class	Hazard potential rating			Total
	Low	Significant	High	
Small	2 764 (56%)	957 (19 %)	41 (1%)	3 762 (76%)
Medium	293 (6%)	582 (12%)	128 (3%)	1 003 (21%)
Large	1 (0%)	22 (0%)	145 (3%)	168 (3%)
Total	3 058 (62%)	1 561 (31%)	314 (7%)	4 933 (100%)

Table 8: Category classification of existing dams

Category classification	Number of dams	%
Category 1*	2 782	56 %
Category 2	1 855	38 %
Category 3	296	6%
Total	4 933	100 %

* 18 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

6.1 Licencing

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 27 dam safety licences were issued i.e. 9 licences to construct new dams, 6 to impound (to store water) and 12 to alter/repair existing dams. This is shown in the next Table.

Table 9: Licences issued by DSO in the year

Category	Licence to construct	Licence to impound	Licence to Abandon	Licence to Alter/Repair	Total
1	1	0	0	3	4
2	8	6	0	7	21
3	0	0	0	2	2
Total	9	6	0	12	27

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.

6.2 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 27 visits to dams during the year. Of these, 11 were to dams under construction whilst the remaining 16 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 27 visits could be made compared to 38 visits in the previous year.

6.3 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 compulsory dam safety evaluations

The main mechanism to promote the safety of existing dams is by means of compulsory dam safety evaluations that must be performed at intervals between 5 and 10 years (7,5 years average), taking into account the condition of a dam. Shortcomings at dams must be identified during these dam safety evaluations. The following table summarises the progress with compulsory dam safety evaluations for Category 2 and 3 dams:

Table 10: Progress with compulsory dam safety evaluations of Category 2 & 3 dams

Owner Sector	DWA	Municipalities	Industry Mines Businesses	Other State Dept's	Water Boards	Agri- culture	Total
Total number of Cat 2 & 3 dams	282	265	228	35	44	1 303	2 157
<u>Target</u> - Required number of evaluations per year based on an average 7,5 year interval	37	35	30	5	6	173	286
<u>Actual</u> number of evaluations submitted in year	20	38	24	1	4	102	189
Actual as % of Target (2013/14)	54%	109%	80%	20%	67%	59%	66%
(2012/13)	(95%)	(69%)	(55%)	(0%)	(16%)	(43%)	(53%)
(2011/12)	(100%)	(44%)	(50%)	(100%)	(17%)	(33%)	(47%)
Outstanding first evaluations	20	31	72	5	3	480	611
Total number done since 1987	730	478	311	50	65	1 218	2 852

The “Actual vs. Target” analysis shows slight improvement over time (on average). Nevertheless, it is clear that most owner sectors will have to commit more resources to submission of the compulsory dam safety evaluations in order to achieve the target (based on a 7,5 year interval). Performance seems to vary significantly from year to year.

The flow of dam safety inspection reports through the Dam Safety Office during the reporting year is shown below (with statistics of previous years in brackets):

Table 11: Flow of dam safety evaluations

	Number
Dam safety evaluation instruction letters issued	83 (155) (218)
Dam safety evaluation reports submitted / received	189 (144) (123)
Dam safety evaluation reports accepted	123 (145) (94)

The drop in the number of instruction letters issued by the DSO is due to administration posts that remained vacant in the year. Currently there are 2 157 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 288 dam safety evaluations per year.

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 123 reports were evaluated and accepted compared to the 189 that were received. 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 288 dam safety evaluations per year.

7.2 Progress with rectification of deficiencies at category II and III 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 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 656 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 1 386 (2012/13) to 1 426 (2013/14). 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 B. 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 B 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 decreased by 19% from 5 284 (2012/13) to 4 259 (2013/14), partly due to completed dam safety betterment work and partly 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 decreased by 38% from 3 678 (2012/13) to 2 270 (2013/14), 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, B2 and B3 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 B2.

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	31
• Deficient structural stability	24
• Total number of dams not complying with basic safety standards	50

*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 B2 and B3 in order to highlight shortcomings at dams that need to be addressed in the short term.

Table 13 shows that 80% 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	282	55
Municipal Dams	265	25
Other State Dams	35	2
Water Board Dams	44	1
Mines, Industries, Business	228	5
Agricultural Dams	1 303	12
TOTAL	2 157	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 (4 259), approximately 71% is caused by the first 100 dams or 82% 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.
- 80% 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 B2 and B3, the latter showing DWA dams only. There are 20 dams on the latter list, of which 9 dams are 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 187 applications for approval as approved professional persons (APPs) were approved during the year. A total of 18 applications were sent to the Engineering Council of South Africa (ECSA) for a recommendation and these were handled by its Committee on Professional Engineers for Dams. ECSA recommended all 18 as unconditional approvals.

A total of 169 applications were processed administratively on the strength of similar previous recommended approvals by ECSA and they were not again referred to ECSA for a recommendation. This task (administrative procedure) has now been largely replaced by the register of APPs, which provides for automatic approval on certain conditions. This register was implemented on 27 February 2014, after consultation with ECSA, in terms of section 123(1)(a) of the National Water Act, 1998 (Act 36 of 1998) and regulation 46 of the dam safety regulations as promulgated on 24 February 2012 (Government Notice R. 139). The register will reduce the administrative task of considering applications and writing letters of approval for each and every task at dams.

Since 1987, 160 persons have been approved as APPs for dam “tasks”. A total of 90 APPs are classified as still active, i.e. not emigrated, retired or deceased and approved for at least one task during the past 5 years, and their names appear on the Register of APPs.

9. UPGRADING OF EXISTING DAMS

The major rehabilitation programme by DWA’s Infrastructure Branch is continuing to make a significant contribution to upgrade the safety of existing DWA dams. Total annual expenditure during the last six years varied between R384 million and R228 million, following a downward trend. Reported challenges include the difficulty experienced by DWA’s construction unit to procure goods in time within the current supply chain management system, and the shortage of engineers. **Table 14** provides some statistics on progress showing that rehabilitation of roughly 50% of dams earmarked for major rehabilitation work, have been completed. However, it should be borne in mind that the relatively easier projects have been completed first, as the more difficult ones require longer lead times of investigation, planning and design. The Infrastructure Branch is in the process to appoint PSP’s to assist with the rehabilitation of 16 dams and it is expected that expenditure will start to follow an upward trend.

Table 14: Upgrading of safety of existing DWA dams

Description	Number of dams
Rehabilitated during last 9 years (w r t dam safety betterments) (mechanical refurbishment still continuing at some dams)	39
Current rate of completion of rehabilitation (per year)	4 to 5
Major outstanding rehabilitation work	41

10. INCIDENTS AT DAMS

The DSO is keeping record of all major incidents at dams that are reported to the DSO by means of an incident catalogue. The catalogue provides valuable statistics and details of the causes of dam incidents (including failures) that have occurred in South Africa. From the catalogue the major causes of dam failures are:

- Inadequate spillway capacity (46%)
- Piping through earthfill walls (19%)
- Failure through erosion of spillways and outflanking of weirs (14%)

The following significant incidents at dams were reported to the DSO during 2013/14:

Table 15: Incidents at Dams

NAME OF DAM	LOCALITY NUMBER	HEIGHT (m)	CAPACITY ('000 m ³)	CAT	INCIDENT OR DAMAGE
Rietspruit Dam	A211/60	7	51	II	Breached during a flood, Feb 2014.
Waterstone Dam	A213/60	7	66	II	Breached during a flood, Feb 2014.
Thaba Monate	A233/36	12	53	II	Breached during flood, March 2014.
Windhoek	Not registered, small weirs on Mokolo River near Lephalale	6	1 760	I	Earthfill flank wall overtopped and breached during flood, March 2014.
Wolmunster		8	868	I	Earthfill flank wall overtopped and breached during flood, March 2014.
Klipfontein	H700/90	10	300	II	Earthfill wall overtopped and breached during flood, Jan 2014.

11. IMPLEMENTATION OF THE NEW DAM SAFETY REGULATIONS

Good progress has been made with implementation of the new provisions of the 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):

- A register of approved professional persons (APPs) for tasks at dams with a safety risk was implemented on 27 February 2014, after consultation with ECSA, in terms of section 123(1)(a) of the National Water Act, 1998 (Act 36 of 1998) and regulation 46 of the dam safety regulations. The register will significantly reduce the administrative task

of considering applications and writing letters of approval for each and every task at dams.

- The requirements (and thereby the standard) for licence applications to construct/ alter/ enlarge/ repair category I dams were raised in the 2012-regulations. Prospective dam owners are effectively forced to obtain adequate technical help in order to compile the design report and engineering drawings, and this will have a positive impact on the safety of new category I dams.

12. 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 estimate of 97%.
- 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 2 157 category 2 and 3 dams, 1 546 (72%) dams have already undergone the first round of evaluations (including 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 51% 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 60% of the first 400 category II and III dams on the priority list comply with basic dam safety standards.** Although this is an improvement on the corresponding statistic of 57% 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 (4 259), approximately 71% is due to the first 100 dams or 82% 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.

- 80% 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 B2 (and of DWA dams only in Appendix B3).**
- The total direct expenditure incurred in administration of the dam safety legislation at Head Office was R5 328 000 compared to R4 944 000 in the previous reporting year, i.e. an increase of 7,8%, mainly due to cost of living increases. The total direct expenditure is considered modest compared to the benefits derived from the dam safety programme.
- **The filling of especially vacant technical posts remains 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**]), Enforcement (**E**), thirdly Disaster Management Structures [**DM**] and also SANCOLD.

Key Performance Area / Objectives	Short Term Targets	Current Status*	Possible action plan to attain objectives (+Responsible Role Player, apart from DSO, where applicable)
That all dams* are <ul style="list-style-type: none"> registered classified 	<ul style="list-style-type: none"> 99% dams* registered by 2015. 99% of reg. dams classified by 2015. 	<ul style="list-style-type: none"> 5 030 ($\pm 97\%$ -estimate) 4 933 (98% of 5 030) 	<ul style="list-style-type: none"> Register dams from WARMS database plus advertising campaign. (RO) Check by Google-Earth (RO) Introduce fines to owners for late registration? (LS/E)
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)	$\pm 95\%$ for cat 2&3 (estimate allows for deficient quality of illegal dams) $\pm 50\%$ for cat 1 dams	<ul style="list-style-type: none"> Prevent illegal construction by e.g. air and road reconnaissance. (RO) Introduce fines? (LS/E) Training courses for APPs/contractors/ clerks of works? (SANCOLD) Improve control over cat I dams. (RO)
3. That all Cat II & III dams are inspected and evaluated by APPs* according to schedule and to current dam engineering standards.	1 550 1 st evaluations by 2015. 80% of follow-up evaluations to follow at required intervals by 2020.	1 st 1 546 Only $\pm 50\%$ of follow-up evaluations received at required interval in reporting year.	<ul style="list-style-type: none"> Accelerate instructions. Improve system of reminders, warnings, legal action, etc. (E) Implement financial assistance scheme. Inspection of some DWA dams should be contracted out. (DWA-IB) Training of APPs (SANCOLD)
4. That all dams* are operated & maintained in accordance with appropriate safety standards and that effective OMMs* and EPPs* are in place.	1 100 OMMs & EPPs compiled for Cat II and III by 2015. Standard OMM & EPP issued for all Cat I dams by 2015.	$\pm 1 106$ OMMs, most with EPPs compiled for Cat II and III dams so far.	<ul style="list-style-type: none"> Improve system of instructions, reminders, warnings, etc. Ensure that all Cat II and III dams have OMMs & EPPs. (Owners) Compile a standard OMM & EPP for Cat I dams and issue. Motivate dam owners to keep up O&M by annual circular/letter. 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> <ul style="list-style-type: none"> 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> <ul style="list-style-type: none"> 1st 100 dams 50% (54%) 2nd 100 dams 60% (48%) 3rd 100 dams 68% (64%) 4th 100 dams 61% (62%) Average (1st 400) 60% (57%) (previous year in brackets) 	<ul style="list-style-type: none"> Upgrade dams on prioritized basis. Focus on first 100-200 dams on priority list. (Owners) Improve system of reminders, warnings, legal action, etc. (E) Implement financial assistance scheme. Training courses for APPs/contractors/ clerks of works? (APPs, SANCOLD) Budget R400 M+ per year for upgrading DWA dams. (DWA-IB)

*Notes: **APP** means approved professional person. **Basic compliance** means the probability of failure of a dam is estimated to be less than 0,05% (1/2000) and 0,5% (1/200) per year for category 3 and 2 dams respectively. **Dams** in this Table mean dams with a safety risk. **EPP** means emergency preparedness plan. **OMM** means O&M manual. **Current status** is the status as on 31 March 2014.

APPENDIX B: PRIORITISATION OF DAMS WITH A SAFETY RISK

APPENDIX B1: 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 next dam safety evaluation is only done 3-5 years thereafter. There are currently 1 426 dams on the full list.

APPENDIX B2: Dams under first 100 on list requiring urgent attention (50 dams)

As Appendix B1 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 B1 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 B2. **Dams on this list should receive urgent attention because their annual probability of failure is considered to be too high.**

APPENDIX B3: As Appendix B2 but only for DWA dams (20 dams)

Of the 20 dams on this list, 9 dams are already in the planning, tender, design or construction phase for upgrading work.

LEGEND FOR PRIORITY LIST:

PF	<i>Probability of failure during lifespan of dam</i>
LL	<i>Hazard potential in terms of loss of life</i>
EL	<i>Possible loss of life during lifespan of dam based on worst case scenario (e.g. failure during night and slow evacuation)</i>
AL	<i>Reduction factor for good O&MM and EPP</i>
N	<i>Lifespan of dam (100 years)</i>
T	<i>Average "recurrence period (years) between failures"</i>
1/T	<i>Annual probability of failure</i>
EPP	<i>Emergency preparedness plan</i>
Sector	<i>A (Agriculture), M (Municipal), W (DWA), S (State departments excluding DWA), O (Industry, Mines, Business)</i>

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

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 B 1

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 (PREVIOUSL	3							5
Structural Stability			Feasibility study to rehabilitate	0	0.000	0	0	310.5			
				200	0.394	1125	0.7			DWA to take over Dam	
2	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	
3	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. Concrete	1000	0.095	350	1			Programmed for...?	
Poor O&MM			Improve O&MM	1000	0.095	350	1			Programmed for...?	
4	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	
5	W	H800/03	DUIVENHOKS DAM	3					Y		5
Spillway capacity			None necessary	2000	0.049	100	1	126.8		Adequate	
Structural stability			(a) Investigate stability.(b) Stabilize left abutment	100	0.634	200	1				
6	W	C300/02	WENTZEL DAM	2					N		5
Spillway			*Detailed investigation and improve	133	0.530	312	0.7	125.5		Upgraded but completion report outstanding	
Structure			None, but monitoring essential	1000	0.095	312	0.7			Adequate	
7	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	
8	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	
9	W	A210/01	ROODEKOPJES DAM	3					N		5
Spillway gate malfunction			Regular Mechanical Maintenance	1000	0.095	500	1	80.1			
Structure				2000	0.049	900	0.8				
10	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	

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)	
11	W	C801/10	STERKFONTEIN	3					Y		5	
	Spillway Structure			2000	0.049	1350	0.5	58.8				
				5000	0.020	2700	0.5					
12	W	U200/04	INANDA DAM	3					Y		5	
	Spillway Structure - foundation		None	10000	0.010	1000	0.5	57.7		Adequate		
	Erosion emergency spillway		RF Foundation jointed with weathering of joints	8000	0.012	1000	0.5			Adequate		
			*Investigate erosion protection	1000	0.095	1000	0.5			Programmed for 2007/8		
13	W	C120/01	VAAL DAM	3					Y		5	
	Spillway Structure		None	2000	0.049	1600	0.6	55.9		Adequate		
			None	10000	0.010	1600	0.6			Adequate		
14	W	C520/02	KRUGERSDRIFT	3					Y		5	
	Spillway Structure		None	2000	0.049	930	0.6	53.1		Adequate		
			None	2000	0.049	930	0.6			Adequate		
15	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					
16	W	U200/01	ALBERTFALLS DAM	3					Y		6	
	Spillway Structure		* Improve the spillway capacity	1500	0.065	1200	0.5	49.8		Programmed for 2007/8		
			Monitor seepage	5000	0.020	1200	0.5			Adequate		
17	W	N230/01	DARLINGTON DAM	3					Y		6	
	Spillway Structure - stability		Investigate and improve	250	0.330	60	1	44.5				
				2000	0.049	608	0.9					
18	W	E100/02	CLANWILLIAM DAM	3					Y		6	
	Spillway Structure		None	10000	0.010	76	0.8	40.8		Adequate		
	No O&MM and EPP		Rehabilitation	1000	0.095	76	0.8			Inadequate. Programmed for 2015		
	Spillway gate operation (human error)		Compile and improve EPP	0	0.000	0	0			Programmed for 2016		
			Remove spillway gates - rehabilitation.	100	0.634	76	0.8			Programmed for 2015		
19	W	A300/03	KLEIN MARICOPOORT DAM	3					N		6	
	Spillway Structure		*Improve spillway	500	0.181	126	1	39.8		Programmed for 2007/8 & 2008/9		
	No O&MM and EPP		None, except monitoring	1000	0.095	206	1			Adequate		
			Compile							Programmed for 2007/8		
20	W	R300/01	NAHOON DAM	3					Y		6	
	Spillway Structure		None	2000	0.049	400	0.7	39.0		Adequate		
			None	1000	0.095	400	0.7			Adequate		

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	C520/04	GROOTHOEK DAM (MOUTLI)	3					Y		6	
	Spillway Structure		None	5000	0.020	1870	0.7	38.7		Adequate		
			None	10000	0.010	1870	0.7			Adequate		
22	M	C221/45	ORLANDO POWER STATIO 2						Y		6	
	Spillway Structure			200	0.394	9	1	35.8				
			Rehabilitate NOC & Slopes	20	0.994	9	4					
23	S	X103/50	MBAMBISO DAM-WAS BOSKOP	3					Y		6	
	Spillway Structure		Confirm / analyse spillway discharge capacity.	5000	0.020	40	1	34.9		Adequate		
			Maintenance must be done.	5000	0.020	40	1			Adequate		
			Relocate water supply pressure pipeline on dam. Investigate and relocate.	50	0.867	40	1			Programmed for ...?		
24	W	B200/01	BRONKHORSTSPRUIT DAM	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...?		
25	W	A900/03	ALBASINI DAM	3					Y		6	
	Spillway Structure		Must be improved.	200	0.394	100	0.8	33.9		Programmed for 2012		
			Post-stressed cables must be monitored,investigated.	2000	0.049	100	0.8			Programmed for ...?		
26	W	R101/01	CATA DAM	3					N		6	
	Spillway Structure			6000	0.017	750	0.7	33.9				
				2000	0.049	750	0.7					
27	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											
28	M	C601/01	BLOEMHOEK DAM	3					Y		6	
	Spillway Piping		Monitor drainage system.	6000	0.017	300	0.9	29.7				
				1000	0.095	300	0.9					
29	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		
30	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		

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	B800/01	TZANEEN	3					Y		6	
	Spillway Structure		None Improved monitoring required	10000 5000	0.010 0.020	2000 2000	0.5 0.5	29.6		Adequate Adequate		
32	W	B402/35	DER BROCHEN DAM	3					Y		6	
	Spillway capacity: Cavities beneath spillway or Structural stability		Improve spillwal against erosion Monitoring essential	50 2000	0.867 0.049	30 30	1 1	26.2		Programmed for ...? Adequate		
33	W	A210/02	HARTBEESPOORT DAM	3					Y		6	
	Spillway Structure		Routed flood that can be handled by channel before over None	1000 10000	0.095 0.010	323 323	0.7 0.7	23.6		Programmed for ...? Adequate		
34	M	D200/18	SMITHFIELD DAM	3							6	
	Spillway Capacity Structural Stability O & MM			200 0	0.394 0.000	60 0	0.9 0	21.3				
35	M	A600/06	DONKERPOORT DAM	3					Y		6	
	Spillway capacity Structural stability		Investigate + improve Investigate	200 2000	0.394 0.049	100 100	0.5 0.5	21.2		Programmed for ...? Programme for...?		
36	W	K100/09	KLIPHEUWEL DAM	3					Y		6	
	Spillway capacity Structural stability: Dispersive soil		None Inspect outlet pipe by vedio camera	5000 50	0.020 0.867	30 30	0.5 0.8	20.8		Adequate Programmed for?...		
37	W	B800/02	EBENEZER DAM	3					Y		6	
	Spillway Structure Potential clogging of shaft spillway.		*Investigate further. *Install safe seepage monitoring system. *Install structure to prevent clogging.	200 1000 50	0.394 0.095 0.867	43 43 43	0.5 0.5 0.5	20.6		Programmed for ...? Programmed for ...? Programmed for ...?		
38	W	A601/42	VAALKOP NO.II-DAM	2					N		7	
	Spillway Structure		*Improve *Improve	100 20	0.634 0.994	20 20	1 1	20.0		Programmed for ...? Programmed for ...?		
39	A	G401/65	GEELBOS DAM	2					Y		7	
	Spillway Structure		None None	50 100	0.867 0.634	20 20	1 1	19.0		Adequate Adequate		
40	W	B800/29	MIDDEL LETABA DAM	3					N		7	
	Spillway capacity Structural stability		Investigate by model study Re-evaluate stability and improve monitoring	1000 500	0.095 0.181	100 100	0.7 0.7	18.2		Programmed for ??? Programmed for ???		

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)	
41	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		
42	M	A211/58	RIETVLEI DAM (was A210/02)	3					Y		7	
	Spillway		None	10000	0.010	500	0.6	17.5		Adequate		
	Structure		None	2000	0.049	500	0.6			Adequate		
43	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					
44	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		
45	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		
46	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		
47	W	S300/16	THRIFT DAM (MOUNTHOPE)	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		
48	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		
49	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		
50	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		

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	W	J340/02	KAMMANASSIE DAM	3					Y		7	
	Spillway Structure		None	1000	0.095	30	0.7	14.6		Adequate		
			* Unblock/ clean pressure relief holes	200	0.394	50	0.7					
52	M	U401/08	LAKE MERTHLEV	2					N		7	
	Spillway Structure		Investigate & wall stability	1000	0.095	21	1	14.0		Programmed for ???		
			* Investigate integrity of post stressed bables	100	0.634	21	1			Programmed for ???		
53	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		
54	W	H200/07	ROODE ELSBERG DAM	3					N		7	
	Spillway Structure		None	10000	0.010	50	0.6	12.9		Adequate		
			Structural analysis & risk analysis	2000	0.049	50	0.6			Programmed for 2010		
	Internal erosion. Leaching sand from foundation		Monitor	200	0.394	50	0.6			Ongoing		
55	W	L300/01	BEERVLEI DAM	3					N		7	
	Spillway Structure		None	200	0.394	41	0.7	12.2		Adequate		
			None	2000	0.049	41	0.7			Adequate		
56	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		
57	W	D310/01	VANDERKLOOF DAM	3					N		7	
	Spillway Structure		Monitoring	10000	0.010	1500	0.7	11.7		Adequate		
			Monitoring	80000	0.001	1500	0.7			Adequate		
	No O&MM and EPP		Compile							Programmed for 2007		
58	A	J250/02	CALITZDORP DAM	3					Y		7	
	Spillway Structure		None necessary	2000	0.049	50	1	11.6				
			Investigate stability	1000	0.095	100	1					
59	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		
60	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		

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	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		
62	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		
63	M	G204/65	DRIFTSANDS STORMWATE	2					Y		7	
	Spillway		None	1000	0.095	106	1	10.1		Adequate		
	Structure		None	10000	0.010	5	1			Adequate		
64	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					
65	A	B401/33	LEEUKLIP 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							Programmed for 2004 Outstanding		
66	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		
67	A	C240/05	JOHAN NESER DAM (KLERK	2					Y		8	
	Spillway		Cost Benefit / Risk Analysis	200	0.394	30	0.8	9.6				
	Structure			10000	0.010	30	0.8					
68	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					
69	W	Q940/01	KATRIVIER DAM	3					Y		8	
	Spillway Capacity		Can take RIVF + 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					
70	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		

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	M	H402/66	MCGREGOR-NUWE DAM NK	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		
72	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		
73	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		
74	M	Q800/13	BESTERSHOEK DAM	2							8	
	Spillway Capacity			2000	0.049	10	1	8.7				
	Structural Stability			50	0.867	10	1					
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					
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 (flood) s	1000	0.095	100	0.8					
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		
78	W	C230/07	LAKESIDE DAM (POTCHEFS	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					
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		
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...?		

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		
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...?		
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		
84	M	C221/26	HAMBERG	2					Y		8	
	Spillway Capacity		Raise crest by 300mm	50	0.867	9	1	7.8				
				0	0.000	0	0					
85	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					
86	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		
87	O	A215/61	EASTERN PLATINUM MINE I	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		
88	W	L820/01	KOUGA DAM (PAUL SAUER	3					Y		8	
	Spillway		None	10000	0.010	100	0.7	7.3		Adequate		
	Structure		None	1000	0.095	100	0.7			Ongoing monitoring		
89	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 buried in damwall		*Relocate / monitor	50	0.867	8	1			Programmed for 2006 - 2008		
90	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 ...?		

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)
91	A	E201/CL	KLOOF DAM	2							8
	Spillway Capacity		Remove sandbags	10	1.000	7	1	7.0			
	Structural Stability			0	0.000	0	0				
	O & MM			0	0.000	0	0				
92	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	
93	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	
94	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	
95	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 ???	
96	W	B501/11	FLAG BOSHELLO - WAS AR/	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	
97	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				
98	O	A231/35	PREMIER MINE NO.7 SLIME	3					N		8
	Spillway		Overall estimate	1000	0.095	70	1	6.7			
	Structure		None	0	0.000	0	0				
99	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	
100	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	

APPENDIX B 2 (Update of Appendix B 1 and only dams not complying with basic standards)

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 (PREVIOUSL	3	0	0.000	0	0	310.5			5
	Structural Stability		Feasibility study to rehabilitate		200	0.394	1125	0.7			DWA to take over Dam	
3	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. Concrete		1000	0.095	350	1			Programmed for...?	
	Poor O&MM		Improve O&MM		1000	0.095	350	1			Programmed for...?	
5	W	H800/03	DUIVENHOKS DAM	3						Y		5
	Spillway capacity		None necessary		2000	0.049	100	1	126.8		Adequate	
	Structural stability		(a) Investigate stability.(b) Stabilize left abutment		100	0.634	200	1				
9	W	A210/01	ROODEKOPJES DAM	3						N		5
	Spillway gate malfunction		Regular Mechanical Maintenance		1000	0.095	500	1	80.1			
	Structure				2000	0.049	900	0.8				
15	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				
17	W	N230/01	DARLINGTON DAM	3						Y		6
	Spillway		Investigate and improve		250	0.330	60	1	44.5			
	Structure - stability				2000	0.049	608	0.9				
18	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 2015	
	No O&MM and EPP		Compile and improve EPP		0	0.000	0	0			Programmed for 2016	
	Spillway gate operation (human error)		Remove spillway gates - rehabilitation.		100	0.634	76	0.8			Programmed for 2015	
20	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	
22	M	C221/45	ORLANDO POWER STATIO 2							Y		6
	Spillway				200	0.394	9	1	35.8			
	Structure		Rehabilitate NOC & Slopes		20	0.994	9	4				
23	S	X103/50	MBAMBISO DAM-WAS BOSK	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 on dai		Investigate and relocate.		50	0.867	40	1			Being investigated	

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)	
25	W	A900/03	ALBASINI DAM	3					Y		6	
	Spillway Structure		Must be improved. Post-stressed cables must be monitored,investigated.	200 2000	0.394 0.049	100 100	0.8 0.8	33.9		Programmed for 2012 Programmed for ...?		
27	W	R101/03	MINYAMENI DAM	3							6	
	Spillway Capacity Structural Stability O & MM		* Improve	200 0	0.394 0.000	80 0	1 0	31.5				
28	M	C601/01	BLOEMHOEK DAM	3					Y		6	
	Spillway Piping		Monitor drainage system.	6000 1000	0.017 0.095	300 300	0.9 0.9	29.7				
32	W	B402/35	DER BROCHEN DAM	3					Y		6	
	Spillway capacity: Cavities beneath spillway or Structural stability		Improve spillwal against erosion Monitoring essential	50 2000	0.867 0.049	30 30	1 1	26.2		Programmed for...? Adequate		
33	W	A210/02	HARTBEESPOORT DAM	3					Y		6	
	Spillway Structure		Routed flood that can be handled by channel before over None	1000 10000	0.095 0.010	323 323	0.7 0.7	23.6		Programmed for ...? Adequate		
34	M	D200/18	SMITHFIELD DAM	3							6	
	Spillway Capacity Structural Stability O & MM			200 0 0	0.394 0.000 0.000	60 0 0	0.9 0 0	21.3				
35	M	A600/06	DONKERPOORT DAM	3					Y		6	
	Spillway capacity Structural stability		Investigate + improve Investigate	200 2000	0.394 0.049	100 100	0.5 0.5	21.2		Programmed for ...? Programme for...?		
37	W	B800/02	EBENEZER DAM	3					Y		6	
	Spillway Structure Potential clogging of shaft spillway.		*Investigate further. *Install safe seepage monitoring system. *Install structure to prevent clogging.	200 1000 50	0.394 0.095 0.867	43 43 43	0.5 0.5 0.5	20.6		Programmed for ...? Programmed for ...? Programmed for ...?		
38	W	A601/42	VAALKOP NO.II-DAM	2					N		7	
	Spillway Structure		*Improve *Improve	100 20	0.634 0.994	20 20	1 1	20.0		Programmed for ...? Programmed for ...?		
39	A	G401/65	GEELBOS DAM	2					Y		7	
	Spillway Structure		None None	50 100	0.867 0.634	20 20	1 1	19.0		Adequate Adequate		

No.	Sector	Loc. No.	Name of dam	Category	Major risk aspect					EPP (Y/N)	Status/Progress	DSI Interval (years)	
					T(years)	PF	LL	AL	EL(total)				
40	W	B800/29	MIDDEL LETABA DAM	3	Spillway capacity	1000	0.095	100	0.7	18.2	N	Programmed for ???	7
					Structural stability	500	0.181	100	0.7		Programmed for ???		
43	M	C212/44	MIDDLE LAKE DAM	2	Spillway capacity	150	0.488	20	1	17.2	Y		7
					Structure stability	1000	0.095	20	1				
					Lack of maintenance	100	0.634	20	1				
52	M	U401/08	LAKE MERTHLEV	2	Spillway	1000	0.095	21	1	14.0	N	Programmed for ???	7
					Structure	100	0.634	21	1		Programmed for ???		
54	W	H200/07	ROODE ELSBERG DAM	3	Spillway	10000	0.010	50	0.6	12.9	N	Adequate	7
					Structure	2000	0.049	50	0.6		Programmed for 2010		
					Internal erosion. Leaching sand from foundation	200	0.394	50	0.6		Ongoing		
55	W	L300/01	BEERVLEI DAM	3	Spillway	200	0.394	41	0.7	12.2	N	Adequate	7
					Structure	2000	0.049	41	0.7		Adequate		
58	A	J250/02	CALITZDORP DAM	3	Spillway	2000	0.049	50	1	11.6	Y		7
					Structure	1000	0.095	100	1				
59	A	G101/AH	PARYS DAM	2	Spillway Capacity	500	0.181	20	0.8	11.3	Y	Adequate	7
					Structural Stability	10000	0.010	30	0.8		Adequate		
					O & MM	0	0.000	0	0				
					Erosion of spillway lining (reo mattresses)	100	0.634	20	0.8		Programmed for 2006/7		
61	W	A901/42	DAMANI DAM	3	Spillway	1000	0.095	60	1	10.9	N	Adequate	7
					Structure	1000	0.095	60	1		Adequate		
					No O&MM and EPP	0	0.000	0	0		Outstanding		
62	A	U700/11	BEAULIEU DAM	3	Spillway capacity	500	0.181	62	0.5	10.2	N	Programmed for ...?	7
					Structural stability	500	0.181	62	0.5		Adequate		
64	M	Q920/04	ANDREW TURPIN DAM	2	Spillway	20	0.994	10	1	9.9	Y		8
					Structure	10000	0.010	6	0.9				

No.	Sector	Loc. No.	Name of dam	Category						EPP (Y/N)	Status/Progress	DSI Interval (years)		
					Major risk aspect	Action to be taken	T(years)	PF	LL				AL	EL(total)
65	A	B401/33	LEEUEWKLIP DAM	2						N	Programmed for 2004 Outstanding Programmed for 2004 Outstanding Programmed for 2004 Outstanding	8		
					Spillway	*Enlarge / abandon	50	0.867	10				1	9.8
					Structure	*Improve / abandon	50	0.867	10				1	9.8
					No O&MM and EPP	Compile	0	0.000	0	0				
68	M	D120/02	KLOOF DAM	3								8		
					Spillway Capacity		100	0.634	15				1	9.5
					Structural Stability		0	0.000	0				0	9.5
					O & MM		0	0.000	0	0				
69	W	Q940/01	KATRIVIER DAM	3						Y	Adequate Programmed for 2012/3 & 2013/4	8		
					Spillway Capacity	Can take RIMF + no apron protection	2000	0.049	82				0.8	9.1
					Structural Stability	* Improve stability	1000	0.095	82				0.8	9.1
					O & MM		0	0.000	0	0				
72	A	J340/08	EZELJACHT DAM	3						Y	Adequate Programmed for 2006/7 & 2007/8	8		
					Spillway	None	100000	0.001	5				0.6	8.9
					Structure	*Investigation to determine "safe operating level"	100	0.634	20				0.7	8.9
74	M	Q800/13	BESTERSHOEK DAM	2								8		
					Spillway Capacity		2000	0.049	10				1	8.7
					Structural Stability		50	0.867	10				1	8.7
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	8.7
77	M	S401/05	KOCH DAM	2						Y	Still need to be verified Adequate	8		
					Spillway	*Recently improved	20	0.994	9				0.9	8.1
					Structure	None	1000	0.095	9				0.9	8.1
80	S	B800/25	LORNA DAWN DAM	2						Y	Ongoing Ongoing Programmed for...?	8		
					Spillway capacity	Monitor erosion	2000	0.049	9				1	7.9
					Structural stability	Monitor seepage	2000	0.049	9				1	7.9
					Strong leak at RF	Repair	50	0.867	9	1				
81	A	B501/17	UPPER GOMPIES DAM	2						N	Programmed for 2007 Adequate Outstanding	8		
					Spillway	*Investigate / improve	50	0.867	9				1	7.9
					Structure	None	2000	0.049	9				1	7.9
					No O&MM and EPP	Compile	0	0.000	0	0				
82	M	B100/16	KRUGER DAM	2						Y	Programmed for...? Programmed for...?	8		
					Spillway Capacity	Improve	50	0.867	8				1	7.9
					Structural Stability (Toe are wet)	Berm + subsurface toe drain	50	0.867	8				1	7.9

No.	Sector	Loc. No.	Name of dam	Category						EPP (Y/N)	Status/Progress	DSI Interval (years)
					Major risk aspect	Action to be taken	T(years)	PF	LL			
84	M	C221/26	HAMBERG	2						Y		8
	Spillway Capacity		Raise crest by 300mm		50	0.867	9	1	7.8			
					0	0.000	0	0				
85	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				
86	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	
88	W	L820/01	KOUGA DAM (PAUL SAUER	3						Y		8
	Spillway		None		10000	0.010	100	0.7	7.3		Adequate	
	Structure		None		1000	0.095	100	0.7			Ongoing monitoring	
89	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 buried in damwall		*Relocate / monitor		50	0.867	8	1			Programmed for 2006 - 2008	
90	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 ...?	
91	A	E201/CL	KLOOF DAM	2								8
	Spillway Capacity		Remove sandbags		10	1.000	7	1	7.0			
	Structural Stability				0	0.000	0	0				
	O & MM				0	0.000	0	0				
93	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	
95	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 ???	
98	O	A231/35	PREMIER MINE NO.7 SLIME	3						N		8
	Spillway		Overall estimate		1000	0.095	70	1	6.7			
	Structure		None		0	0.000	0	0				

APPENDIX B3 (As Appendix B2 but showing only DWA dams)

No.	Sector	Loc. No.	Name of dam	Category	EPP					Status/Progress	DSI Interval (years)			
					T(years)	PF	LL	AL	EL(total)			(Y/N)		
Major risk aspect		Action to be taken												
5	W	H800/03	DUIVENHOKS DAM	3	Spillway capacity	None necessary	2000	0.049	100	1	126.8	Y	Adequate	5
					Structural stability	(a) Investigate stability.(b) Stabilize left abutment	100	0.634	200	1				
9	W	A210/01	ROODEKOPJES DAM	3	Spillway gate malfunction	Regular Mechanical Maintenance	1000	0.095	500	1	80.1	N	Adequate	5
					Structure		2000	0.049	900	0.8				
17	W	N230/01	DARLINGTON DAM	3	Spillway	Investigate and improve	250	0.330	60	1	44.5	Y	Adequate	6
					Structure - stability		2000	0.049	608	0.9				
18	W	E100/02	CLANWILLIAM DAM	3	Spillway	None	10000	0.010	76	0.8	40.8	Y	Adequate	6
					Structure	Rehabilitation	1000	0.095	76	0.8		Inadequate.Programmed for 2015		
					No O&MM and EPP	Compile and improve EPP	0	0.000	0	0		Programmed for 2016		
					Spillway gate operation (human error)	Remove spillway gates - rehabilitation.	100	0.634	76	0.8		Programmed for 2015		
20	W	R300/01	NAHOON DAM	3	Spillway	None	2000	0.049	400	0.7	39.0	Y	Adequate	6
					Structure	None	1000	0.095	400	0.7		Adequate		
25	W	A900/03	ALBASINI DAM	3	Spillway	Must be improved.	200	0.394	100	0.8	33.9	Y	Programmed for 2012	6
					Structure	Post-stressed cables must be monitored,investigated.	2000	0.049	100	0.8		Programmed for ...?		
27	W	R101/03	MNYAMENI DAM	3	Spillway Capacity	* Improve	200	0.394	80	1	31.5		Adequate	6
					Structural Stability		0	0.000	0	0				
					O & MM		0	0.000	0	0				
32	W	B402/35	DER BROCHEN DAM	3	Spillway capacity: Cavities beneath spillway cre	Improve spillwal against erosion	50	0.867	30	1	26.2	Y	Programmed for ...?	6
					Structural stability	Monitoring essential	2000	0.049	30	1		Adequate		
33	W	A210/02	HARTBEESPOORT DAM	3	Spillway	Routed flood that can be handled by channel before overf	1000	0.095	323	0.7	23.6	Y	Programmed for ...?	6
					Structure	None	10000	0.010	323	0.7		Adequate		
37	W	B800/02	EBENEZER DAM	3	Spillway	*Investigate further.	200	0.394	43	0.5	20.6	Y	Programmed for ...?	6
					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 ...?		

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)	
38	W	A601/42	VAALKOP NO.II-DAM	2					N		7	
	Spillway Structure		*Improve *Improve	100 20	0.634 0.994	20 20	1 1	20.0		Being upgraded Being upgraded		
40	W	B800/29	MIDDEL LETABA DAM	3					N		7	
	Spillway capacity Structural stability		Investigate by model study Re-evaluate stability and improve monitoring	1000 500	0.095 0.181	100 100	0.7 0.7	18.2		Programmed for ??? Programmed for ???		
54	W	H200/07	ROODE ELSBERG DAM	3					N		7	
	Spillway Structure Internal erosion. Leaching sand from foundation		None Structural analysis & risk analysis Monitor	10000 2000 200	0.010 0.049 0.394	50 50 50	0.6 0.6 0.6	12.9		Adequate Programmed for 2010 Ongoing		
55	W	L300/01	BEERVLEI DAM	3					N		7	
	Spillway Structure		None None	200 2000	0.394 0.049	41 41	0.7 0.7	12.2		Adequate Adequate		
61	W	A901/42	DAMANI DAM	3					N		7	
	Spillway Structure No O&MM and EPP		Adequate Adequate Compile	1000 1000 0	0.095 0.095 0.000	60 60 0	1 1 0	10.9		Adequate Adequate Outstanding		
69	W	Q940/01	KATRIVIER DAM	3					Y		8	
	Spillway Capacity Structural Stability O & MM		Can take RMF + no apron protection * Improve stability	2000 1000 0	0.049 0.095 0.000	82 82 0	0.8 0.8 0	9.1		Adequate Programmed for 2012/3 & 2013/4		
88	W	L820/01	KOUGA DAM (PAUL SAUER	3					Y		8	
	Spillway Structure		None None	10000 1000	0.010 0.095	100 100	0.7 0.7	7.3		Adequate Ongoing monitoring		
89	W	B501/14	MAHLANGU DAM	2					N		8	
	Spillway Structure Pipeline buried in damwall		None Monitor *Relocate / monitor	2000 1000 50	0.049 0.095 0.867	8 8 8	1 1 1	7.1		Adequate Adequate Programmed for 2006 - 2008		
90	W	C700/05	WELTEVREDE DAM	2					N		8	
	Spillway Structure No O&MM and EPP		*Investigate *Leakage along RHS pipe Compile	50 50 0	0.867 0.867 0.000	9 9 0	0.8 0.8 0	7.1		Programmed for ...? Programmed for ...? Programmed for ...?		
93	W	A804/04	NWANEDZI	3					N		8	
	Spillway Structure No O&MM and EPP		Investigate erosion potetial during overtopping *Do structural and foundation analysis Compile	2000 1000 0	0.049 0.095 0.000	50 50 0	1 1 0	7.0		Programmed for 2007/8 Programmed for 2007/8 Outstanding		

APPENDIX C: PHOTOGRAPHS OF SELECTED DAMS

**De Hoop Dam completed in 2013 (Owner: Department of Water Affairs)
Maximum Wall Height = 74 m. Capacity = 347 million m³.**



Mass concrete (rollcrete) gravity dam on Steelpoort River.



Outlet works on right flank (left hand side of picture).

**Kareerand Tailing Dam (Owner: - AngloGold Ashanti)
Photo provided by Knight Piésold. Planned maximum wall height = 80m**



Kareerand Tailings Dam in the operational phase

Cycloning operations at the Kareerand Tailings Dam near Stilfontein in the Northwest Province.



Kareerand Tailings Dam

Floating barge mounted pumps for return water from the Kareerand Tailings Dam near Stilfontein in the Northwest Province.

**Mndwaka Dam, Owner: Amathole District Municipality
Photos by ARQ Consulting Engineers**



Mndwaka Dam

25 m high Rubble Masonry Arch Dam under construction in the Eastern Cape

General overview of the site seen from the left flank



Mndwaka Dam

25 m high Rubble Masonry Arch Dam under construction in the Eastern Cape.

Construction of Rubble Masonry Concrete Side Walls on Gravity Section.

Rehabilitation of Elandsdrift Weir, Owner: Department of Water Affairs
Photos by AECOM



Elandsdrift Weir

Construction of a roller compacted concrete gravity spillway structure in the event of breaching of the earth embankment during a very large flood.



Elandsdrift Weir

Last exposed section of jet-grouted structure being covered during this lift.

**Stompdrift Dam, Owner: Department of Water Affairs
Photos by V. Schoeman**



Stompdrift Dam

Rehabilitation of a 37 m high multi arch dam.

View of block 34 to 39A from the dam wall



Stompdrift Dam

Rehabilitation of a 37 m high multi arch dam.

Construction of Splitter at buttress.

**Cengane Dam, Owner: OR Tambo District Municipality
Photos by HHO Africa**



Cengane Dam

17 m high
Earthfill Dam
completed in the
Eastern Cape.

Rip-rap on
upstream slope
and inlet tower.



Cengane Dam

17 m high
Earthfill Dam
completed in the
Eastern Cape

Bridge to Inlet
Tower under
construction.

**Mzintlava Off Channel Storage Dam, Owner: OR Tambo District Municipality
18 m High Earthfill Dam under construction in the Eastern Cape**



Mzintlava Off Channel Storage Dam

The installation of the membrane, consisting of a polyseal geoliner, was in progress in the bottom half of the dam basin.

The membrane is installed in two phases, first the bottom half then the top half.



Mzintlava Off Channel Storage Dam

Close up view of the installation of the polyseal geoliner.

**Egmont Dam, Owner: Department of Water Affairs
Photos by J van Zyl, DSO**



Downstream view of the 25m high Egmont Arch Dam near Wepener in the Free State from the left bank.



Downstream view of the Egmont Dam from the right bank.

**Laing Dam, Owner: Department of Water Affairs
Rehabilitation of Outlet Works
Photos by J. Venter, Eastern Cape Region**



Laing Dam

Rehabilitation of
Outlet Works

New Valve
Chamber and
Flow Meter
Chamber



Laing Dam

Rehabilitation of
Outlet Works

New outlet pipe
encase in
concrete below
the outlet gallery.

**Mnyameni Dam and Port St Johns Dam in Eastern Cape
Photos by J. Venter, Eastern Cape Region**



**Mnyameni Dam
Department of
Water Affairs**

31 m high
earthfill dam

Rehabilitation
showing new
steps on the
downstream
face.



**Port St Johns
Dam, OR
Tambo District
Municipality**

Construction of
new 26 m high
rubble masonry
arch dam

Grouting of the
foundation

Chintsa Dam, Amathole District Municipality and Cengane Dam, OR Tambo District Municipality
Photos by J. Venter, Eastern Cape Region



**Chintsa Dam
Amathole
District
Municipality**

Rehabilitation of
Spillway



**Cengane Dam,
Owner: OR
Tambo District
Municipality**

Recently
completed and
spilling for the first
time

**Cengane Dam, Owner: OR Tambo District Municipality
Photos by J. Venter, Eastern Cape Region**



**Cengane Dam,
Owner: OR
Tambo District
Municipality**

View of Spillway
from the
downstream side.



**Cengane Dam,
Owner: OR
Tambo District
Municipality**

Inlet Tower and
Bridge to Inlet
Tower

**Armenia Dam, Owner: Department of Water Affairs
Photos by M Letswalo, DSO**



Armenia Dam

View of the 20m high category III concrete arch dam on the Leeuw River North of Hobhouse, Free State



Armenia Dam

View of the 20m high category III concrete arch dam on the Leeuw River North of Hobhouse, Free State.

**Imvutshane Dam under construction near Stanger, Owner: Umgeni Water
(H = 28 m, V = 3,1 million m³, category 2)**



View on spillway.



Picture shows soil nails and drains underneath spillway lining.

**Imvutshane Dam under construction, Owner: Umgeni Water
(H = 28 m, V = 3,1 million m³, category 2)**



Dam wall under construction on left flank, and connection with spillway channel visible in background.



Picture shows cut-off consisting of jet grouting in river section where deep alluvial deposits would make conventional excavation expensive.

**Invutshane Dam under construction, Owner: Umgeni Water
(H = 28 m, V = 3,1 million m³, category 2)**



Base of inlet tower under construction.



Outlet tunnel is constructed by means of pipe-jacking to overcome expected weathered zones.

**Ludeke Dam near Bizane, Owner: Initially OR Tambo District Municipality, later Umgeni Water and finally DWA
(H = 40 m, V = 14 million m³, category 3)**



Dam wall nearing completion. Intake tower on left of picture and side-channel spillway in background.



View on side-channel spillway with ogee on RHS of picture.

**Ludeke Dam near Bizane, Owner: Initially OR Tambo District Municipality, later Umgeni Water and finally DWA
(H = 40 m, V = 14 million m³, category 3)**



View of intake tower and access bridge.



Picture shows line of pressure relief wells on LHS and conventional toe drain on RHS, at downstream embankment toe.

THE END