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ENVIRONMENTAL AUTHORISATION OF LAND-BASED EFFLUENT DISCHARGES INTO THE COASTAL ENVIRONMENT: SYNCHRONISING ENGINEERING DESIGN, ENVIRONMENTAL IMPACT ASSESSMENT & REGULATORY APPROVAL PROCESSES TO MINIMISE THE RISK OF PROJECT DELAYS

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ABSTRACT

A significantly changed landscape with respect to environmental policy, legislation and the authorisation of land-based wastewater discharges into coastal environments, suggests that it is timeous to provide municipal authorities and coastal industries with a renewed insight into the requirements and likely timescales associated with infrastructure developments related to the disposal of land-based effluents to coastal environments.

A change in the regulatory authority responsible for the issuing of Coastal Water Discharge Permits and General Authorisations for land-based wastewater discharges into coastal environments has precipitated a sequence of events that has included a review the associated policy, legislation and operational guidelines and their implementation, as well as both recent and pending reviews of water and sediment quality guidelines. A concurrent change in the legislation governing the Environmental Impact Assessment process, together with trend of change in the type and nature of proposed wastewater discharges into coastal environments, has highlighted some existing and potential future challenges associated with the successful execution of infrastructure development projects related to the disposal of land-based effluents to coastal environments.

This paper addresses these challenges by providing a detailed description of the three key processes involved in such discharge infrastructure development projects (engineering design, environmental design/impact assessment and environmental authorisation/permitting processes), the information requirements for each of these processes and the most probable timelines for their execution based on past experience as well as the requirements of some of the recent regulatory changes. Highlighted are potential vulnerabilities (e.g. poor synchronisation of information flows between the processes) that could lead to significant project delays and/or increased costs. Also discussed is the role of improved assessment techniques and the potential use of novel construction methods in expediting and providing greater flexibility in the planning and execution of proposed wastewater management infrastructure development projects.

INTRODUCTION

Cost-effective processing, management and ultimate disposal of wastewater effluents is an important enabling factor in the delivery of municipal services related to water and sanitation, and in allowing appropriate industrial development and the associated socio-economic opportunities that this brings. One of the options in this regard is the disposal of partially treated or fully treated effluents through discharges into coastal environments. For such an option to be viable requires that the capital and operational costs are minimised while ensuring an environmentally sustainable solution. The engineering design process typically is focussed on ensuring a cost-effective and efficient processing, management and, if necessary, disposal of wastewater effluents, whereas it is the role of the regulatory authorities (supported by those undertaking the environmental design and impact assessment studies) to ensure the environmental acceptability and sustainability of the proposed wastewater management infrastructure.

In the recent past some significant changes have taken place with respect to the environmental policy, legislation and authorisation of proposed effluent discharges to the marine environment. This has included:

- changes in the regulatory authority responsible for the issuing of Coastal Water Discharge Permits and General Authorisations for land-based wastewater discharges into coastal environments;
- a review of the policy, legislation and operational guidelines associated with the discharge of land-based wastewater to the marine environment and the implementation thereof;
- recent and pending reviews of water and sediment quality guidelines;
- changes in the legislation governing the Environmental Impact Assessment process.

These changes, together with a changing landscape with respect to the type and nature of wastewater discharges, have highlighted some existing and potential future challenges. These include a need for a number of changes in the execution of effluent management infrastructure development projects, as well as the consideration of improved techniques for scientific and technical assessments and the use of novel construction methods to expedite and provide greater flexibility in the planning and execution of wastewater management infrastructure developments projects.

Environmental policy and authorisation processes

Prior to the promulgation of the Integrated Coastal Management Act, 2008 (Act No. 24 of 2008) (ICMA), the disposal of land-derived effluent into coastal environments through pipelines was controlled and regulated by the Department of Water Affairs (presently the Department of Water and Sanitation), under the National Water Act, 1998 (Act No. 36 of 1998) (NWA). Guidance on the regulation and management of such discharges was provided in a series of reports outlining the Operational policy for the disposal of land-derived water containing waste to the marine environment of South Africa (DWAF, 2004a-c). With the promulgation of the ICMA, the responsibility of controlling and regulating the disposal of land-derived effluent into the coastal environment through pipelines was transferred to the Department of Environmental Affairs (DEA). The ICMA seeks to regulate the discharge of effluent into the coastal waters from any source on land (Section 69) by requiring that such discharges are authorised under a Coastal Waters Discharge Permit (CWDP) or a General Discharge Authorisation (GDA), both authorisation processes and their requirements being outlined in a number of recent DEA documents (DEA, 2014a-c). In order to achieve this goal the DEA has adopted the principles contained in the 2004 version of the Operational Policy referred to above and has developed two key documents of relevance, namely:

- *A National Guideline for Coastal Effluent Discharges from Land-based Sources* (DEA, 2014a) that takes cognisance of legislation and principles developed post-2004. This guideline includes a hierarchy of decision-making which contains elements of the Receiving Water Quality Objectives approach, as well as the Precautionary Principle of Environmental Protection that includes the key elements of source reduction, waste minimisation and responsible disposal. Despite incorporating legislation and principles developed post-2004, this document is not significantly different in concept from the original 2004.
- Operational policy for the disposal of land-derived water containing waste to the marine environment of South Africa (DWAF, 2004a-c).
- *An Assessment Framework for the Management of Effluent from Land-based Sources* Discharged to the Marine Environment (Anchor Environmental, 2015) that has as its key objective the development of an assessment framework that includes an effluent classification scheme as well as an approach that can be used to inform specific levels of assessment for different types of effluent and also for determining discharge requirements/limits that should be applied in the different receiving environments. This document is in the process of being finalised, following a comprehensive public participation/ consultation process.

Presently there are some substantive changes in the detail of the *Assessment Framework for the Management of Effluent from Land-based Sources Discharged to the Marine Environment* (Anchor Environmental, 2015) compared to Operational policy for the disposal of land-derived water containing waste to the marine environment of South Africa (DWAF, 2004a-c). The key changes are related to the categorisation of the types of marine discharges, more stringent restrictions on surf-zone discharges and the proposed compliance assessment with respect to the initial mixing zone that, in turn, has consequences of potential concern with respect to the scope and practicality of the required monitoring activities. Key changes relate to:

- *Categorisation of outfalls:* Discharges into coastal environments in the 2004 Operational Policy were categorised as deep water outfalls, surf-zone discharges and estuarine discharges, whereas the new 2015 Assessment Framework identifies an additional type of discharge categorised as a nearshore outfall. Such a nearshore outfall is considered to comprise a discharge just seawards of the characteristically highly retentive and sensitive surf-zone. Typically this would imply outfall lengths of between 250 m and 500 m discharging into water depths of approximately -10 m to -15 m relative to Chart Datum. While such an outfall clearly constitutes and environmentally distinct option, the distinction in terms of other decision-making factors such as engineering design, capital cost and operational costs is less well-defined.
- *Surf-zone discharges:* The proposed 2015 Assessment Framework (Anchor Environmental, 2015) states an unequivocal requirement for discharges into the surf-zone to meet receiving water quality guidelines at the point of discharge (i.e. at the end of pipe). This is a more stringent requirement than suggested by the more pragmatic assessment approach for surf-zone discharges outlined in both the old 2004 Policy (DWAF, 2004a-c) as well as new 2014 *National Guideline for Coastal Effluent Discharges from Land-based Sources* (DEA, 2014a). The stated requirement in the 2015 Assessment Framework for discharges into the surf-zone to meet receiving water quality guidelines at the point of discharge, in principle, places fairly onerous requirements on smaller, more benign discharges into the surf-zone such as those from small-scale desalination and mariculture facilities, as well as secondary treated effluents from land-based wastewater treatment works (WWTW).
- *Compliance assessment and associated monitoring:* In addition to potentially burdensome requirements on smaller, more benign discharges into the surf-zone, the compliance criteria for deep water outfalls also are likely to be particularly onerous for any planned future discharges of primary treated effluents in terms of the allowed extent of the initial mixing zone, a zone within which it is accepted that there will not be compliance with the relevant receiving water quality guidelines. Furthermore compliance monitoring activities associated with these requirements, in their present form, could prove to be both excessive and potentially risky to implement.

It is however anticipated that these issues will be satisfactorily addressed prior to the promulgation of the relevant legislation and regulations associated with the CWDP or GDA authorisation process.

It also is planned by the DEA to comprehensively review existing receiving water quality guidelines for the marine environment. While the review of the guidelines for recreational use of the marine environment have been recently reviewed (DEA, 2012), the review of receiving water quality guidelines for the natural environment, industrial use and mariculture remains to be undertaken. In addition to being subject to the requirements of the CWDP or GDA process, most discharges of land-based sources of effluents also will need to undergo a full Environmental Authorisation Process (i.e. both a Scoping and detailed Environmental Assessment process). An understanding of the interaction and synergies between the Environmental Impact Assessment (EIA) and CWDP processes (Figure 1), as outlined in DEA (2014a,b), is important in appreciating the likely complexity and duration of the environmental authorisation processes and the effect that this is likely to have on the overall duration of wastewater management infrastructure development projects. Key interdependencies of the CWDP and EIA processes and therefore determinants of potential project timelines are:

- ACWDP reference number needs to be obtained before commencement of the Public Participation phase of the EIA process which presumably includes any public participation undertaken during the scoping phase of the EIA. Such a reference number may take up to 30 days to receive after the initial application is made for a CWDP;
- The detailed assessment phase of the CWDP permit process can only substantively commence once the EIA and any associated Appeal process has been completed, i.e. an Environmental Authorisation (EA) has been received after the conclusion of any Appeal of the initial EA.

Taking these interdependencies into account, the likely timelines associated with environmental authorisation processes related to

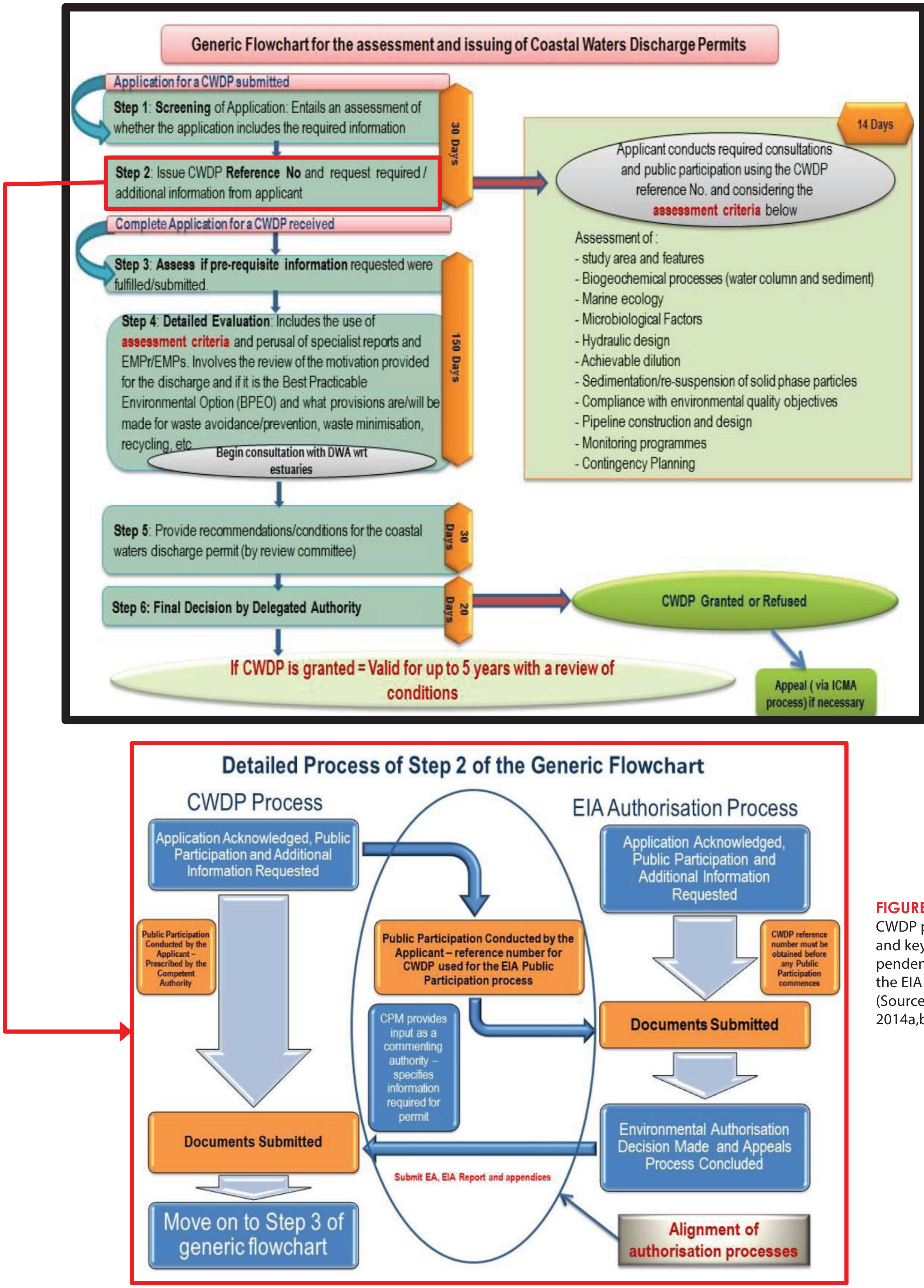


FIGURE 1 The CWDP process and key interdependencies with the EIA process (Source: DEA, 2014a,b)

TABLE 1 Indicative timelines for the Environmental Authorisation for wastewater management infrastructure development projects

Activity	Duration (Days)				
CWDP Process Initiation	**30**				
CWDP Application Screening & Issuing of Reference No.	30				
CWDP - Public Participation		**70**			
Preparation of documentation for comment		14			
Public comment		40			
Finalisation of CWDP submission		16			
EIA Process		**300 – 350**			
Preparation of Scoping Report		14			
Public Participation		30			
Acceptance of Scoping Report		43			
EIA Specialist Studies and final EIA Report		76			
Public Participation		30			
EIA Specialist Studies and final EIA Report (if extended)		20			
Public Participation		30			
Environmental Decision and Issuing of EA		107			
Appeal Process			**42**		
Submission of Appeal			20		
Appointment of Specialist Reviewer(s)			10		
Feedback/Recommendations of Specialist Reviewer(s)			10		
Inform Appellant of Decision			2		
Lodge of Appeal of Decision by Appellant			12		
Engineering Design				**0-60**	
Finalise EMP &Engineering Information for CWDP				**0-60**	
Finalisation of CDWP Process					**60 - 200**
Assessment of data adequacy & final assessment					150
Assessment and Recommendations by Review Committee					30
Final CWDP Decision by DEA					20
Cumulative Duration (No Appeal)	30	330 - 380	-	330-440	390 - 640
Cumulative Duration (With Appeal)	30	330 - 380	372 – 422	372-472	432 - 672

wastewater management infrastructure development projects are summarised in Table 1. From Table 1 it is clear that the EA should become available in less than one year and the full environmental authorisation process (including issuing of a CWDP) completed in little more than a year (~ 13 months) if it is assumed that i) the EIA studies be completed without the requirement for any extension to the duration of the EIA process; ii) the engineering design information required for the CWDP applications will be available at the conclusion of the EIA process, and iii) there is no appeal of the EA. Under a worst case scenario the full environmental authorisation process (receipt of both the requisite EA and CWDP) could take up to almost 2 years or possibly even longer should any Appeal of the initial EA prove to be a protracted process. Such a worst case scenario assumes that i) the EIA studies will need to be extended; ii) the engineering design information required for the CWDP applications will only be generated after the completion of the EIA process (e.g. due to there being an unwillingness to undertake further design until the EA has been received or due to the EIA process substantively influencing engineering design or the EMP), and iii) the that the initial EA is appealed.

FIGURE 2 Deep water and nearshore outfalls constructed or approved prior to 2005

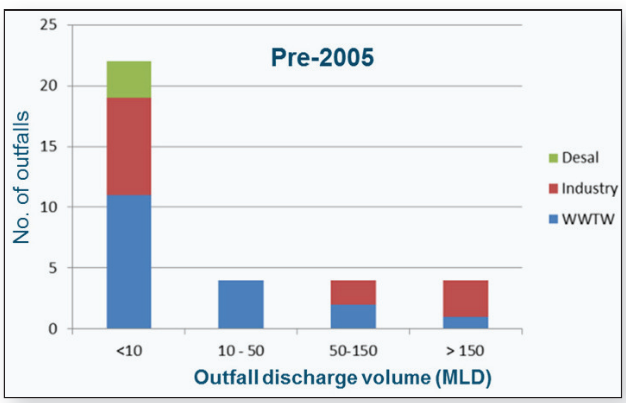
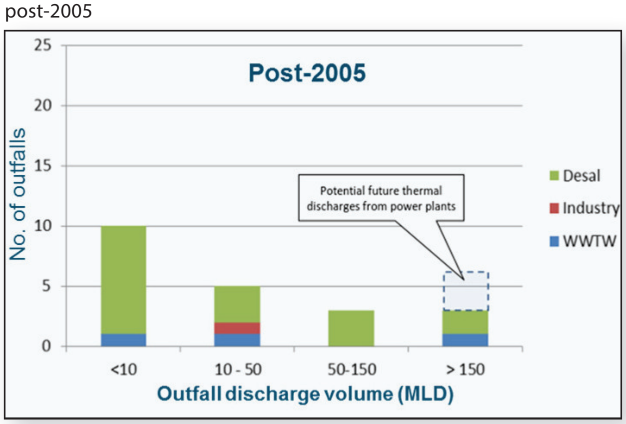


FIGURE 3 Deep water and nearshore outfalls constructed or planned post-2005



Trends in types of outfalls installed and under development

A wide range of outfalls have been developed along the South African coastline, many of the major outfalls being located along the Kwazulu-Natal coastline where the proximity of the fast-flowing Agulhas Current plays a significant role in the dispersion of the effluents being discharged. These comprise both industrial and sewage outfall or combinations thereof. Other larger outfalls are clustered around the larger metros and comprise primarily medium to large sewage outfalls. A comprehensive summary of the existing outfalls and their relative risk profiles is contained in a recent review of all outfalls along the South African coastline undertaken by WSP | Parsons Brinckerhoff for the Department of Environmental Affairs (WSP|PB, 2016).

The original 2004 *Operational policy and associated guidelines for the disposal of land-derived water containing waste to the marine environment of South Africa* (DWAF, 2004a-c) was focussed on the type of outfalls predominating at that time which comprised mainly WWTW outfalls (deep water outfalls discharging preliminary or primary treated WWTW effluents and smaller discharges of secondary treated effluents), industrial outfalls (mainly large deep water outfalls) and numerous smaller fish processing or mariculture effluent discharges (see Figure 2).

This observation remains largely true for the new National Guideline for Coastal Effluent Discharges from Land-based Sources (DEA, 2014a) which has asimilar focus. However trends of proposed and commissioned outfalls since 2005 (Figure 3), suggest a perceptible shift in the nature and type of effluent discharges to the marine environment. Few new large deep water outfalls discharging WWTW or potentially harmful industrial effluents are presently under consideration. Rather there exists a trend towards small to medium (and

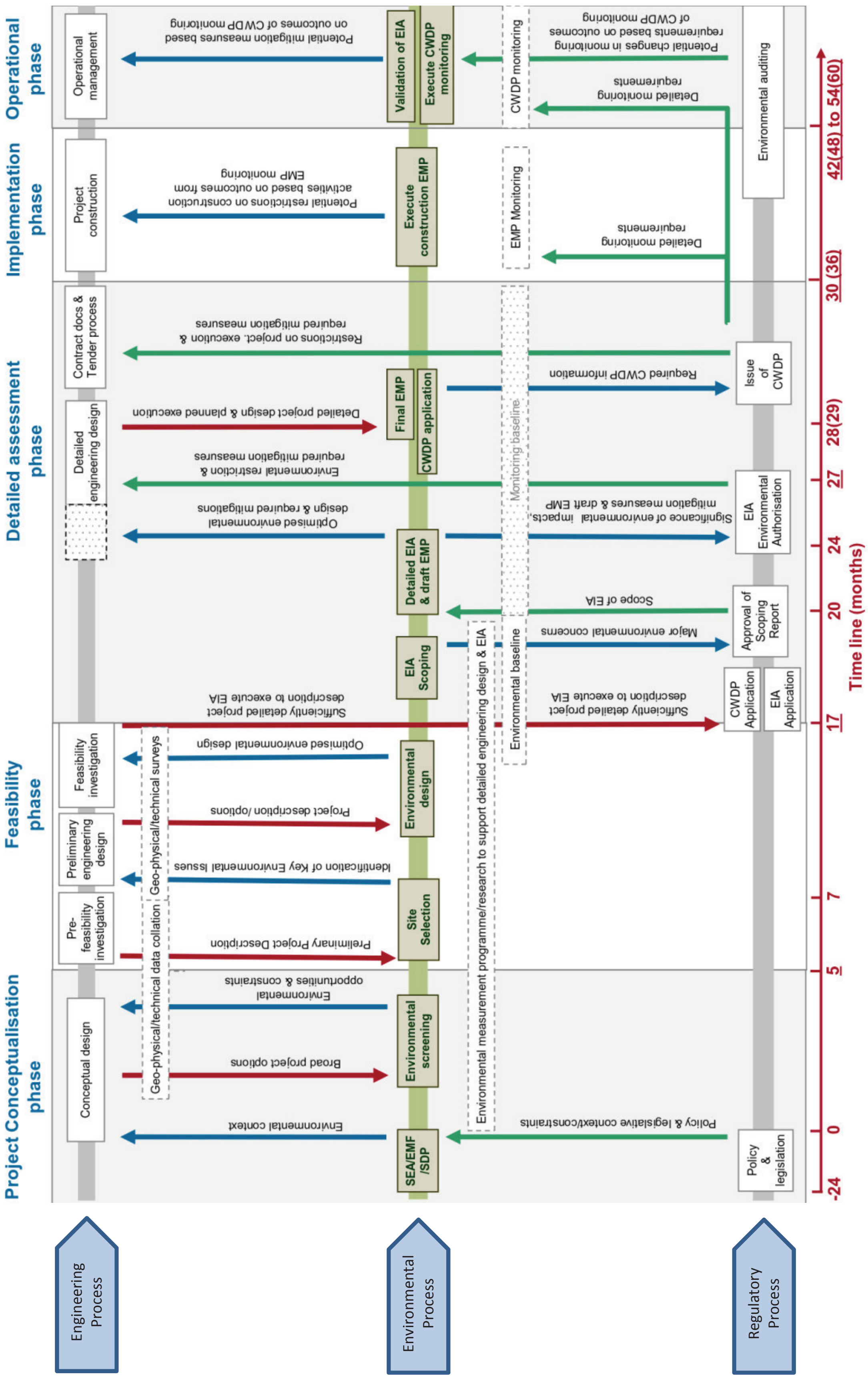


FIGURE 4
Development phases and estimated "best case" timelines for a typical effluent discharge infrastructure (outfall) development process as indicated by the non-bracketed durations. The durations in brackets indicate potential "worst case" project timelines assuming no appeal of the initial EA

some large) brine discharges from desalination plants and more modest effluent discharges from mariculture facilities (the latter not included in Figures 2 and 3). A significant unknown remains the likelihood of thermal discharges from proposed LNG or nuclear power plants that typically comprise high volume discharges.

The trend therefore is towards effluent discharges comprising more modest volumes of generally more benign effluents (i.e. brine and mariculture wastes compared to preliminary or primary treated WWTW effluents and the earlier industrial effluents). The only exception to this is potential future thermal effluent discharges from proposed power plants. While typically high volume discharges, the main constituent of such thermal effluents is elevated seawater temperature that requires relatively modest dilution of the effluent to meet receiving water quality guidelines, i.e. comprises a fairly benign effluent compared to preliminary or primary treated WWTW effluents and most industrial effluents. As noted earlier the present restrictions on particularly the smaller volume brine, mariculture and even secondary treated WWTW effluent discharges as outlined in the Assessment Framework for the Management of Effluent from Land-based Sources Discharged to the Marine Environment (Anchor Environmental, 2015), seemingly are more restrictive than is likely to be necessary.

The trend towards more benign effluents and significantly improved capabilities in predicting and assessing flows and effluent dispersion in nearshore and surf-zone environments, together with the ability of novel construction techniques such as directional drilling to provide the flexibility to more effectively deal with site-specific engineering challenges and environmental constraints, suggest that a greater degree of pragmatism may be possible when planning future outfalls of this nature. As can be seen from the recent large Australian desalination plants, micro-tunnelling has become a viable alternative construction method (Baudish, 2015). This is however only considered feasible for large projects in less benign conditions, due to the high establishment costs. For small projects, i.e. projects with appropriately small pipe sizes, horizontal directional drilling may be viable. These novel construction techniques will reduce environmental impacts, and potentially shorten the construction programme, when compared to conventional trenched installation methods. What is interesting however, is that for small to medium sized projects, depending on site specific conditions, the presently considered novel techniques are generally less viable for South Africa.

KEY ROLE-PLAYERS IN WASTEWATER MANAGEMENT INFRASTRUCTURE DEVELOPMENT PROJECTS

The key role-players in almost all infrastructure development projects are:

- the parties focused on the engineering feasibility and design process;
- the parties focused on environmental design and impact assessments process;
- the regulatory authorities providing the environmental authorisations and associated permits.

There is a strong interdependency between the engineering design, environmental assessment and regulatory processes, particularly in terms of the nature and timing of required information flows.

EFFLUENT DISCHARGE INFRASTRUCTURE DEVELOPMENT PHASES

The typical infrastructure development project, in this case the development of infrastructure for the disposal of land-based effluents, can be broken down into five phases, namely a:

- Project Conceptualization Phase;
- Feasibility Phase;
- Detailed Assessment Phase;
- Implementation Phase, and;
- Operational or Management Phase.

There is a strong interdependency between the engineering design, environmental assessment and regulatory processes, particularly in terms of the nature and timing of the required information flows. These dependencies and the resultant estimated timelines for the completion of a typical large wastewater management infrastructure development project are outlined in Figure 4. Associated with each of the above phases and role-players are a series of design and assessment activities (comprehensively outlined in DWAF, 2004b) that all need to be completed with the requisite degree of rigour at the conclusion of the effluent discharge infrastructure development process. However, the rigour with which these activities need to be completed at the end of each of these phases may vary somewhat depending on the development context, ambient environmental conditions, the type of infrastructure (outfall) and proposed construction methods envisaged for the project. While some of the earlier design and assessment activities (such as the initial conceptual design, environmental screening, etc.) will need to be undertaken with roughly equal rigour no matter what the scale of proposed infrastructure development (i.e. a major deep water outfall, a nearshore outfall or typically more modest surf-zone discharges), the scope and cost of most activities will change significantly with the scale and complexity of the proposed infrastructure development.

Project conceptualisation phase

In this initial conceptualization phase a broad range of options are assessed (e.g. estuarine discharges versus a marine outfall, preliminary treated versus secondary treated effluents, etc.). The context for this assessment is provided by socio-economic considerations, strategic plans for the region(s) of interest (e.g. Strategic Environmental Assessments, Estuarine Management Plans, Spatial Development Plans and Environmental Management Frameworks) and relevant policy and legislation (e.g. specific restrictions on the types of allowable discharge into various environments). It is important for any party that intends to discharge wastewater to the coastal environments to ensure appropriate engagement with consultation processes surrounding the development of policy, legislation and the various strategic planning initiatives in the region(s) of interest, so as to ensure that cognizance is taken of the potential future discharges and that they are included in these strategic planning initiatives to the extent appropriate.

In this initial conceptualization phase a broad range of concepts are considered in terms of inter alia engineering/technical, cost and environmental considerations. The approach usually is to develop initial concepts based primarily on economic and technical/engineering considerations and then screen these in terms of their environmental suitability. The idea is to identify potential fatal flaws in the proposed wastewater discharge infrastructure development options. The studies undertaken during this conceptualization phase are essentially desktop and are likely to comprise:

- Development of engineering concepts (e.g. engineering constraints determining site selection, etc.) which also typically includes economic considerations;
- Environmental screening (which typically includes socio-economic considerations) for potential fatal flaws.

It is important that the environmental screening process is well documented as this is likely to form an important part of the documentation required as proof of due diligence in the EIA process. The scope and costs associated with this initial phase can be quite variable depending on the regional context, the nature of the discharge, the range of wastewater management options that are considered, sensitivity of the proposed development to cost and the required completion timelines, etc. The ultimate goal of this phase is to develop a limited range of potentially viable options to take forward into the feasibility phase.

Feasibility phase

Part of the feasibility phase is the engineering pre-feasibility study that typically includes consideration of a number of possible sites and a level of engineering design that takes local site conditions into account. The pre-feasibility study, upon its conclusion, should provide the project proponent with confidence that the proposed conceptual designs (outfall location and type) indeed are feasible and that the cost and effort of proceeding to a more detailed feasibility study is justified.

It is at the conclusion of the pre-feasibility study that the costly field measurement programmes typically are commissioned as this allows for a sufficient duration of environmental data to be collected for use in the feasibility assessment study (which often is completed on a less than ideal data set). The requisite one year of environmental measurements typically only becomes available in time for the completion of the EIA specialist assessments and detailed engineering design undertaken during the Detailed Assessment phase. These data also are required for the planning and design of the construction methods/procedures and the scheduling of construction activities. However for "greenfield" sites where little or no such data exists, such field measurement programmes may need to be started earlier under the understanding that there exists a risk that such data may prove to be insufficiently representative of the site that is ultimately selected and thus require the execution of a supplementary measurement programme that, in turn, may lead to project delays.

The conclusion of the pre-feasibility study is intended to provide a project description that is sufficiently detailed to inform an initial informal scoping exercise (with specifically identified I&AP's) and which can be used for environmental design purposes (or directly in EIA Scoping process or specialist studies should the requirement for environmental optimization be limited).

A more detailed Feasibility Study typically follows the initial pre-feasibility study. It is at this stage that the environmental design aspects of the project typically are optimized. With the changes in the EIA regulations and the presently limited time allowed for the EIA process, it has now become critical that significant effort is undertaken during the detailed feasibility phase to optimize the design (environmentally and otherwise) of the proposed effluent discharge infrastructure. This should lead to a "stable" project description comprising a limited, but environmentally optimized, number of options that can be taken forward into the EIA process (or any similar CWDP assessment process should for some reason a full EIA process not be required). The detailed feasibility assessment requires that detailed water quality (and where relevant sediment quality) near- and far-field modelling be undertaken at this stage. This provides the iterative feedbacks that allow for the optimization of the engineering design. This modelling can be included as a specialist study in the EIA or can be considered to constitute an engineering/environmental design study that informs the EIA specialist assessments studies (e.g. ecological & health assessments).

Upon conclusion of the detailed Feasibility Study it should be clear to the project proponent as to whether it is justified both to initiate a CWDP application process and proceed with a formal EIA process. The extent of the preliminary engineering design undertaken in the Feasibility Study will depend quite strongly on specific circumstances (nature of the outfall, effluent risk profile, client requirements, etc.) as it will need to be sufficient to confirm the feasibility of the proposed discharge infrastructure development. Substantive study components initiated and/or completed in this phase include the following:

- A measurement campaign to obtain environmental measurements (wind, wave, current water level, stratification) in support of engineering design and environmental impact assessments;
- Measurement of existing water, sediment and ecological status (i.e. the development of environmental baselines for predicting/assessing potential environmental impacts prior to project approval and impact assessment and monitoring during construction phase as well as during the life-time of the system);
- Geophysical and geotechnical studies informing the Feasibility Study where these offshore and inshore investigations are used to confirm the suitability of the selected pipeline route, type of backfill to be used, the structural design and the detailed planning of the construction methods and procedures. It is helpful if the hydrographic (bathymetry), seismic and side-scan surveys are undertaken as early as possible, however typically these studies only commence once the pre-feasibility studies have been completed and the project considered likely to be viable. Furthermore it is often very expensive to perform offshore geotechnical studies (as large marine plant is required) meaning that at this stage of the effluent discharge infrastructure development process, offshore geotechnical information often is inferred from land-based data.

While the engineering feasibility assessment undertaken during the Feasibility Phase is expected to be fairly detailed (i.e. includes engineering design of the outfall and an assessment of its environmental performance), the environmental aspects of the proposed project are only comprehensively addressed in the CWDP/EIA process undertaken during the Detailed Assessment phase. Historically a large portion of the more detailed engineering and environmental optimization has occurred at the same time as the execution of the EIA process (which was often of an extended duration). However as noted earlier, with the changes in the EIA regulations and the resultant limited time allowed for completion of the EIA process, it has now become critical that significant effort is undertaken during the Feasibility Phase (i.e. the detailed feasibility study) to optimize the engineering and environmental design of the proposed effluent discharge infrastructure and, in doing so, limit the number of options to be considered in the EIA.

Detailed assessment phase

The detailed assessment phase commences with the initiation of the CWDP and EIA application processes. The EIA commences with a formal Scoping process that includes a public participation exercise to ensure that all potential environmental issues have been identified. While there exists a possibility that new environmental concerns may be identified during this formal EIA scoping process, this is considered unlikely provided that there have been appropriate environmental inputs into the feasibility investigations and earlier screening studies. The risk of discovering such "new" environmental concerns at this stage can be significantly reduced by undertaking an early (informal) consultation with specific identified I&AP's during the Project Conceptualisation or Feasibility phases.

The EIA is expected to include a range of specialist studies, in addition to the near- and far-field modelling studies which typically would have been completed during the Feasibility Study. These EIA specialist studies together with a draft Environmental Monitoring Plan (EMP), after further public consultation, are submitted for environmental authorization. Should the potential environmental impacts be considered acceptable an EA will be issued that provides environmental authorization for the development. This decision may be subject to Appeal which would need to be resolved before the issuing of a final EA. The EA may stipulate mitigation measures or changes that would need to be incorporated into the final engineering design and construction plan, with any associated EMP being modified accordingly. Only once all Appeal processes have been resolved, the EMP finalized and a final EA issued, will the final CWDP assessment process commence. In principle, if there is good ongoing consultation with DEA, the finalization of the CWDP process could be quite short (~2 months) but could in principle take up to 7 months to complete (see Figure 4) after all requisite information becomes available.

The stage at which the detailed engineering design is commenced can be as early as mid-way through the EIA process, however there is the risk of fairly costly detailed engineering design being undertaken on a project that ultimately may not receive environmental authorization. More typical is the commencement of detailed engineering design after a final EA has been received after finalization of any Appeal process.

While at this stage the CWDP remains to be issued, the risk of not receiving a full environmental authorisation (EA and the CWDP) is considered minimal. In principle the preparations of contract documentation and execution of the tender process can commence immediate after the detailed engineering design is complete, however prudence would suggest that this be commenced only once the CWDP has been received or after there have been communication that there seem to be no impediments to the issuing of the requisite CWDP.

Implementation phase

The implementation phase comprises all construction and commissioning activities. Included in this phase is all required EMP monitoring during construction activities.

Operational phase

During the Operational Phase monitoring will need to be undertaken as per the CWDP (or equivalent) requirements. Typically such monitoring will include:

- Compliance (source) monitoring to determine the effectiveness of management strategies and actions to ensure compliance with license conditions, e.g. monitoring at source the limits set for the volume and composition of the wastewater;
- System performance monitoring to ensure performance in accordance with the design criteria (e.g. hydraulic performance of the discharge system). This typically this would include:
  - physical inspections to check pipeline stability, potential damage and operational efficiency of diffusers and ports, and
  - hydraulic inspections and relevant environmental measurements to determine/confirm pipeline performance. This should be undertaken after commissioning and at any stage in the lifetime of the pipeline when there are substantial changes to effluent quantity or composition;
- Environmental monitoring to determine the trends and status of changes in the receiving marine environment, in terms of the health of important ecosystems and designated beneficial uses.

The environmental monitoring typically will require the setting up of a monitoring baseline prior to commencement of the monitoring activities. This may require that additional measurements be made prior to the commissioning of the outfall and commencement of monitoring activities. This environmental monitoring will be subject to on-going audit by the DEA.

KEY RISK FACTORS LEADING TO POTENTIAL PROJECT DELAYS

The key risk factors associated with project delays are i) the need to revisit studies or decisions due to deficiencies in these studies and/or associated decision-making, and ii) poor information flows whereby required information is not available timeously for inclusion into studies and/or for decision-making. Specific risk factors include:

- A lack of engagement during policy development and associated legislation and regulations which could result in unnecessarily restrictive constraints on wastewater infrastructure development options (e.g. proposed restrictions on smaller desalination, mariculture and secondary treated sewage effluent discharges);
- Inadequate documentation of particularly the environmental screening processes, resulting in a challenge of the sufficiency of the range of options assessed during the EIA process;
- Inadequate scoping of potential environmental issues in the early conceptualization phases leading to potential re-design and re-assessment requirements for issues assumed to have been resolved during the earlier project phases. Should such requirements only be identified during the EIA process, this can result in substantial risks to both the timeous completion of the EIA process and to the overall project timelines;
- A lack of sufficient environmental data (wind, waves, current) and geophysical and geotechnical data at the time required for engineering design and environmental assessment activities. This includes the lack timeous development of appropriate environmental baselines for the EIA specialist assessments. This could result in a lack of rigour in the engineering design and/or EIA specialist assessments that ultimately could lead to environmental authorisations being refused or an Appeal of the initial EA received. The project delays associated with such events are substantial and constitute a major project risk.

In summary, the above risks often are a consequence of poor information flows related to:

- insufficient understanding of the context within which the development is occurring (e.g. policy and legislative requirements),
- inadequate early scoping of environmental issues,
- inadequate inclusion of these issues in early screening studies and engineering design,
- insufficient environmental data being available at the time that decisions need to be made and
- inadequate consultation with the regulatory authorities during the project execution.

Key to addressing the risks related to potential re-design and re-assessment requirements that could lead to substantive project delays or even environmental authorisations being refused are:

- early and accurate identification of potential environmental issues,
- timeous commencement of environmental measurement programmes (including geophysical and geotechnical surveys) and
- the use of appropriately rigorous and detailed assessment techniques. Furthermore, the use of recently improved assessment techniques (e.g. related to assessment of effluent dispersion in surf-zones) and novel construction techniques such as directional drilling provides a significantly improved capacity to deal with specific engineering challenges and potential environmental constraints that may arise during such projects.

Perhaps the most significant observation to be made is that restriction on the duration of the EIA process resulting from recent changes to EIA policy and legislation, requires that a more rigorous screening, assessment and both engineering and environmental design of development options occurs, prior to the commencement of the EIA process.

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THE DANGERS OF INTERMITTENT SUPPLY AS A MEASURE TO SAVE WATER IN SOUTH AFRICA

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ABSTRACT

There are many countries around the world where intermittent supply is a way of life and residents often have to deal with a water supply which is only pressurised an hour per day or even an hour per week. Such intermittent water supplies cause huge problems in the long term viability of the water reticulation systems and pose significant health risks.

Here in South Africa, the issue of reducing water losses from municipal water supply systems is becoming a serious problem throughout the country, particularly in view of the current drought situation which is aggravating an already difficult balance between supply and demand. Municipalities throughout the country are being asked to cut their water usage but many of them have neither the expertise nor the funds to implement the appropriate interventions with the result that little progress is being made.

It has become clear that some water suppliers are resorting to the introduction of intermittent supply as a measure to reduce losses and normal water consumption. In some instances, there is clearly no alternative due to the fact that the supply reservoirs are at or near empty. In other cases, the practice of intermittent supply is being used as a quick and simple measure to reduce water losses.

This paper highlights the implications of intermittent supply and the fact that it can be introduced in a matter of hours but the damage caused to the reticulation system may take years to resolve. The paper shows that although some savings can initially be achieved through the introduction of intermittent water supply, in the long-term, such measures will often result in higher water use.

INTRODUCTION

Potable drinking water is becoming one of the most important issues in the 21st century. Growing world population, global warming, improved living standards in many areas and land use changes are among the many factors which exacerbate the impacts of the normal flood and drought events. Climate change is often highlighted as the key factor behind all droughts and floods which often appear more severe than any previously recorded events. While the cause of the more extreme events is often up for some debate, the fact remains that both floods and droughts are becoming more severe and causing huge stress on many regions throughout the world. The situation is unlikely to improve in the foreseeable future and may well deteriorate with the result that water supply managers and other government officials must prepare for more extreme events in future and ensure that the available resources are being used efficiently.

When considering potable water supply, South Africa has many different problem issues to deal with. By global standards, the country has relatively efficient reticulation systems in most of the metros and large municipalities where tap water is generally safe to drink and water is generally supplied at normal first world pressures 24 hours a day. While this is often taken for granted in many parts of South Africa, it is unusual in most parts of the developing world. In many of the rural areas in South Africa, safe drinking water cannot be taken for granted and such areas regularly experience severe supply problems during times of drought. Such local water supply schemes are extremely vulnerable to drought events due to the fact that they often rely on run-of-river flow or groundwater for their water supply. Such small local schemes lack the assurance of supply provided by the large integrated water supply systems used to supply the urban areas where reservoirs are often linked to each other across provincial boundaries to provide a reliable supply that can withstand droughts of 5 or even 10 years in duration. In effect, rural water supply schemes will tend to experience regular but shorter drought events while the large interbasin schemes will experience less frequent but potentially much longer drought events.

The above points are well illustrated by some facts and figures which were recently presented by the Department of Water and Sanitation (DWS, 2016) to highlight the water situation in the Vaal River System which supplies the main industrial heartland of South Africa including the whole of Gauteng, many mines, power stations, large industries etc. Figure 1 provides a graph showing the percentage storage in the major reservoirs which supply the Vaal River System (based on