



CapeNature

MAINTENANCE MANAGEMENT PLAN FOR THE
UULKRAAL ESTUARY MOUTH UNDER SPECIFIC
CONDITIONS

COMPILER: PIERRE DE VILLIERS

SENIOR MANAGER: MARINE AND COASTS OPERATIONS

STATEMENT OF THE PROBLEM

1. The Uilkraal estuary was historically a permanently open system with no known records of closure prior to 2008.
2. The estuary is currently experiencing anomalous periods of prolonged mouth closure attributable to:
 - Significant alien infestation in the catchment (which deplete base flow in summer and winter) as well as abstractions for irrigation and domestic and industrial use (which deplete medium and low flows in winter), and
 - Long-term variations in rainfall and runoff (drought cycles) and has recently entered a drought cycle (last 2 years only).
3. The Kraaibos Dam outlet is too small to release required base flows to the estuary.
4. Mouth closure is impacting on:
 - water quality, by exacerbated elevated levels of nutrients in the estuary originating from anthropogenic sources (WWTW and agriculture) and allowing hypersaline conditions to develop in the estuary when the mouth is closed and freshwater flow is very low;
 - movements of estuary associated fish and invertebrates and diadromous fish between the estuary and the sea and hence the nursery function of the system, which is of high regional importance due to most other systems in region being closed for much of the time;
 - salt marsh vegetation of the estuary, which has a high conservation importance due to the presence of genetically distinct species assemblages, by drowning (prolonged inundation with fresh for brackish water),
 - loss of intertidal habitat and associated invertebrate fauna, fish and birds through reduced tidal influence, desiccation (reduced frequency or absence of tidal inundation, and or drowning, and
 - infrastructure in, and use of, the holiday resort located adjacent to the mouth of the estuary (Uilenkraalsmond Holiday Resort).
5. Closed mouth status likely to be progressive or “self reinforcing” due to progressive sediment build up in the estuary particularly in the mouth region thereby increasing the likelihood of future closure
6. Removal of all alien vegetation from the catchment is a high priority and will go a long way towards restoring summer and winter base flows at the head of the estuary, but in itself may not be sufficient to keep the mouth of the estuary open.

OVERALL OBJECTIVE OF THE LOCAL MOUTH MANAGEMENT PROGRAMME

To manage the estuary mouth as an integral part of the Uilkraal Estuary Management Plan that will maintain the healthy functional ecological processes of the estuary. For the Uilkraal Estuary this means that its assessment rating should be consistent with a B Ecological Category defined as “*Largely natural with few modifications*” under the Department of Water and Sanitation’s (DWS) A to F rating system. (Clark et al. 2012).


The objectives of the mouth management intervention(s) are therefore as follows:

1. Enhance and maintain estuary health and ecosystem functions including:
 - Maintaining connectivity with the sea and hence protecting the nursery function of the estuary and its role as a passage for diadromous fish species;
 - Preventing further loss of and/or restoring conservation-worthy salt marsh vegetation in the estuary;
 - Preventing macro algae and/or benthic micro-algae from reaching unnatural densities in the estuary
 - Preventing further loss of, loss of and/or restoring intertidal habitat, invertebrate and bird communities in the estuary; and
 - Preventing further degradation in the water quality of the estuary and as far as possible restoring this to what it was like under reference conditions.
2. Reducing the risks of the closed mouth status becoming “*self-reinforcing*” (i.e. of sediment build up at the mouth) and thereby increasing likelihood of future closure.

DESCRIPTION OF THE UILKRAAL ESTUARY

Table 1. Description of the estuary and its importance.

Threat	Discussion
Location	<p>The Uilkraal Estuary is situated approximately 60 km northwest of Cape Agulhas and 11 km east of Danger Point on the south-west coast within the cool temperate biogeographic region of South Africa. The geographical boundaries for the study are defined as follows (Clark et al. 2012):</p> <ul style="list-style-type: none"> • Downstream boundary: Estuary mouth 34°36'23"S, 19°24'33"E • Upstream boundary: 34°35'38.03"S, 19°28'0.05"E • Lateral boundaries: 5 m contour above Mean Sea Level (MSL) as depicted by the Estuary Functional Zone below in light blue.

Threat	Discussion
	
Estuary Importance	<p>The Uilkraal River Estuary was until recently a permanently open estuary. The estuary is rated as “Important” based on its Estuary Importance Score (EIS) of 74 (Clark et al. 2012). The EIS takes size, the rarity of the estuary type within its biographical zone, habitat, biodiversity and functional importance of the estuary into account.</p>
Conservation status	<p>The Uilkraal Estuary does not have any statutory protection status at present but is included in the subset of estuaries identified as requiring protection in order to conserve South Africa’s estuarine biodiversity in the National Estuary Biodiversity Plan (Turpie et al. 2012) and is listed in the WCPAES.</p>
Important vegetation	<p>The Uilkraal Estuary is important from a vegetation perspective. An important study by Mucina et al. (2003) on the salt marsh of the Uilkraal Estuary indicated a number of unique characteristics. The Uilkraal Estuary lies in the Cape Agulhas region that is considered as a phylogeographic break or transitioning zone between the cool temperate and warm-temperate zone (Teske et al., 2011). At these sites, several species have phylogeographic breaks, with distinct lineages that are endemic to this transition zone. This could explain the high species richness and number of endemic macrophytes found in the Uilkraal Estuary (Adams et al., 2010). Approximately 60 different macrophyte species are distributed in five different estuarine habitats: Intertidal and Supratidal salt marsh, Macro algae, Submerged macrophytes, Reeds and Sedges. The estuary is therefore important in biodiversity conservation.</p>
Important fish nursery	<p>The Uilkraal is of medium to high importance as a fish nursery area (DFFE, unpublished information). A few surveys have been undertaken of fish of the Uilkraal Estuary in the last two decades (1994, 1996 and 2011), and some anecdotal reports exist on the fish fauna of the estuary prior to this time. Harrison (1999) sampled the estuary using beach-seine and gill nets in 1994 and reported the presence of only four species in the system. Clark & Turpie (Unpublished) reported 12 species in 1996. Clark et al. (2012) recorded 12 species in April 2011 and four species in August 2011 (after a flood at low water levels).</p>
Important Bird site	<p>The Uilkraal Estuary has been ranked 14th in terms of water bird abundance in a conservation priority analysis study (Turpie 1995). Regionally, it was ranked 11th out of 65 coastal wetland systems in the south-western Cape in terms of total bird numbers.</p>
Estuary Condition w.r.t breaching	<p>The Uilkraal Estuary is negatively impacted by flow reduction (abstraction / impoundment for irrigation and alien invasive plant infestation in the catchment and riparian areas) leading to mouth closure, increased nutrient loading (agricultural return flow and effluent), riparian development and road infrastructure, and disturbance of birds by residents.</p> <p>The Uilkraal River Estuary has therefore been relegated to the D category in terms of its current estuarine health, but it is considered worthy of rehabilitation and a priority for conservation (Clark et al. 2012, Van Niekerk & Turpie 2012).</p>

Threat	Discussion
Recommended Ecological Condition	The estuary is rated as “ <i>Highly important</i> ”, and forms part of the core set of priority estuaries in need of formal protection to achieve biodiversity targets the National Estuary Biodiversity Plan (NBA 2011, Turpie et al. 2012). National biodiversity targets include, for example, the formal protection of 20% of estuarine ecosystem types. Thus the Recommended Ecological Category for the estuary is its “ <i>Best Attainable State</i> ” i.e. a B Ecological Category (Clark et al. 2012). A number of initiatives are in progress to address the pressures on the Uilkraal Estuary, including this Mouth Management Plan.

MOTIVATION FOR ARTIFICIAL BREACHING

Anecdotal records of the Uilkraal Estuary mouth state indicate that the estuary has closed five times since 2008 (Table 2). No record exists of any closures before this time. The mouth first closed on 22-23 December 2008, for a few days. It then closed in January 2009 for about six months before being breached illegally. By December (2009) it closed again, and it was not until 23 October 2010 that it was opened again, this time by the Overberg District Municipality. It closed soon after, in December 2010, and was illegally opened several months later on 5 July 2011. It closed again on 12 October 2011, and was closed till 8 August 2012. The mouth has breached naturally at high levels to the present day. There may be interference by members of the public at these high levels.

Table 2. Anecdotal records of mouth status.

Year	Date	Anecdotal information on mouth conditions
2008	22-23 December 2008	Closed for first time for a few days
2009	January 2009	Mouth closed
	July 2009	Open artificially (illegally)
	December 2009	Mouth closed
2010	23 October 2010	Opened artificially by Overberg District Municipality
	11 December 2010	Mouth closed
2011	5 July 2011	Open artificially (Illegally)
	12 October 2011	Mouth closed
2012	8 August 2012	Open artificially

Superimposing the mouth state observational data on the present state simulated monthly flows (Table 3) indicates a high sensitivity to low flows, but as no continuous water level data exists for the period of mouth closure, it is not clear at which flow ranges the estuary closes. What is clear is that the current base flow allocation is not sufficient to maintain an open mouth. The Kraaibos Dam outlet is also too small to release required baseflows to the estuary. In addition, artificial breaching of the system prevents accurate assessment of the duration of mouth closure. For this study it is assumed that the estuary mouth will be breached as soon as water levels become high enough to facilitate a breaching.

Table 3: Simulated monthly flows versus mouth condition (Clark et al. 2012)

YEAR	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
2007/8	0.295	1.609	0.127	0.004	0.004	0.004	0.004	0.007	0.054	0.459	0.250	0.791
2008/9	0.250	2.431	0.396	0.004	0.004	0.004	0.004	0.011	1.350	1.837	0.620	0.100
2009/10	2.106	0.374	0.004	0.004	0.004	0.004	0.004	0.037	0.316	0.325	0.082	0.012
2010/11	0.007	0.004	0.004	0.004	0.004	0.004	0.004	0.086	0.185	0.101	0.269	0.073

The Uilkraal mouth is relatively sheltered and measurements under taken by Ed Lucas and Sue Mathews indicate a berm height 1.91 to 1.98 m msl on 9 October 2010.

ASSESSMENT OF RISKS, THREATS, OPPORTUNITIES ASSOCIATED WITH MOUTH MANAGEMENT DECISIONS

Table 4: Summary of artificial breaching motivation

Potential Threat	Relevance
Threat to human life (as a result of high water levels)	No threats to human life
Threat to immovable property and infrastructure (as a result of high water levels)	The high water levels associated with the closed mouth conditions result in flooding to the adjacent Uilenkraalsmond Caravan Park & Resort. The resort is an important tourist destination, especially over the summer months and large numbers of people come to the resort to enjoy the beach and estuary (swimming, fishing, paddling etc.). High water levels result in a loss of revenue, for example, in December 2010 bookings amounted to R900 000 but a third of the holiday makers delayed paying their deposits due to their knowledge of the deterioration in the estuary condition and the possible flooding of some sites. There were also mosquitoes reported from the estuary.
Human health impact (e.g. flooding of sewage pump station, septic tanks, chemical storage yards, etc.)	Swimming was not recommended in the estuary under the closed mouth conditions as a result of poor water quality.
Potential loss of agricultural resources (as a result of high water levels)	At water levels of 2.6m there is minimal impact on agriculture practices within the estuary functional zone. In most cases properties are used for recreational use as well as grazing stock.
Potential impact on nearshore environment if breached (e.g. aquaculture facilities)	Not a significant consideration.
Loss/impaired access (e.g. roads, footpaths, cattle crossings)	Not a significant consideration.
Harmful / Noxious algal blooms	During long closed phases algal blooms develop along the banks in the shallow warm water. Some residents found the decaying matter to be offensive in 2010.
Impact(s) on recreational use (e.g. increase depth / surface area when mouth is closed, reduce fishing).	This is not a high use recreational system from a boating/yachting/wind surfing perspective as it is very shallow under normal conditions. The estuary is an important swimming area.
	Impact of artificial breaching Open mouth condition ensure good tidal flushing and improved circulation beneficial for recreational activities.
	Impact of NOT breaching This is not a high use recreational system as it in a very remote area. Closed mouth conditions result in a stagnant water body that is associated with algal blooms and bad smells.

Ecosystem requirements	Impact on avifauna abundance, species richness/ community composition	Important bird habitat	The system is not a significant bird area.
		Impact of artificial breaching	Expose intertidal areas similar to natural conditions that favour waders and migrants similar to natural conditions.
		Impact of NOT breaching	The avifauna in this system is historically representative of open mouth conditions.
		Occurrence of avian botulism	No information available on this aspect, but not deemed a critical issue.
	Impact on estuarine fish abundance, species richness/ community composition	Important fish nursery	Open mouth conditions are necessary to maintain the ecological functioning of the estuary and its value as a nursery area for fish. The mouth needs to be open to ensure recruitment and emigration during the peak recruitment period during spring – early summer (August –November).
		Impact of artificial breaching	Positive impacts are recruitment of larval and juvenile fish and return of adolescents and reproductively active fish to the sea to spawn. Aggregations of fish at the mouth just prior to and during breaching are particularly vulnerable to exploitation especially by illegal methods such as gaffing and snagging with treble-hooks. Draft legislation (in terms of the Marine Living Resources Act) has existed for the past decade that prohibits fishing of any kind in a temporarily open closed (TOC) estuary the two days before, during and one day after a breaching event albeit artificial or natural.
		Impact of NOT breaching	Nursery area not available to juvenile fish on the Cape south coast and eventual drop in recruitment or available biomass of exploited species to marine fisheries.
		Occurrence of fish kills	No major fish kills recorded for this system.

Estuarine Macrophytes (plants)	Impact of artificial breaching	Open mouth conditions create intertidal habitat for salt marsh and reeds and sedges. Fluctuating water levels would decrease submerged macrophyte biomass and extent. Strong tidal flows could limit the establishment of submerged macrophytes in lower reaches.
	Impact of NOT breaching (i.e. die-back of saltmarsh)	The closing of the estuary mouth may possibly alter the macrophyte species composition and habitats in the estuary and must be carefully monitored. The diversity of macrophytes in the upper floodplain reaches and the relationship with topographical gradients and substrate type needs further investigation. According to Mucina et al. (2003) the estuary's sand flats consist of greyish-white sands that are derived from the nutrient poor sandstones and lime rich sand deposits. An opposing impact to that of closed mouth high water level conditions is that decreased base flow may cause large areas of this marsh to desiccate and die. The middle-upper reaches also appear to become disconnected during low flow conditions partially attributable to bridge construction, sedimentation and decrease in tidal flows.
Water quality (Thresholds of concern that would compromise estuarine ecosystem or ecosystem services)	Salinity thresholds of concern (high or low) that would compromise ecosystem or ecosystem services	Less than 6ppt for extended periods due to closed mouth will impact negatively on salt marsh
	Dissolve Oxygen levels	< 4 mg/l
	Ammonia levels	Not applicable.
	Toxic substance in the context of breaching	Not applicable.
	Pollution source include sewage, septic tanks.	

Eutrophication	Excessive reed growth	Not a significant consideration.
	Macrophyte blooms	Not a significant consideration.
	Harmful algal blooms	During long closed phases algal blooms develop along the banks in the shallow warm water. Some residents found the decaying matter to be offensive in 2010.
Sedimentation	On-going sedimentation	No information on this aspect as no recent bathymetric surveys have been carried out in the estuary.
Type	Yes/No	Motivation
Major flood events associated with severe flood damage	Yes	It is an emergency if estuary water level is high and a severe flood is eminent (i.e. cut-off low/1:20 year flood).
Poor water quality	Yes	Low oxygen levels throughout the system may be considered an emergency (must be verified through regular monitoring and estuarine specialist consultation) Salinity levels are not a consideration because the system is characteristically saline. Artificial breaching will not be considered to flush polluted water out of the estuary.
Fish kills	Yes	DFFE to determine cause of fish kill and then establish if major fish kill can be remedied by breaching. Written findings to be provided to breaching committee.
Hazardous spill	Yes	Breaching will only be considered if hazardous substance holds no risk to the nearshore environment and is registered as a disaster. In the event of an oil spill at sea, the mouth of the Uilkraals Estuary can temporarily be closed to prevent oil from entering the system. Spillage of organic waste should be addressed using standard biological control measures.

INTEGRATED ASSESSMENT

The following breaching specifications need to be met before artificial breaching of the Uilkraal Estuary can be considered (Table 5):

Table 5: Uilkraal Estuary Breaching Specifications

Breaching considerations	Details		
Minimum breaching level (water level should be as high as possible before breaching)	>2.0 m msl	Y	Level to MSL
Optimum breaching period (if applicable)	Historically the Uilkraal Estuary was permanently open, there is thus no optimum breaching period, but if closure should occur it is preferred that the estuary be open during spring and summer to facilitate ecological processes.		
Neap-spring breaching considerations	Preferably 3-4 days before spring tide, but consideration should be given to wave conditions and water levels. Local observation is required on the degree to which waves will hinder during the planned breaching. The higher the berm, the more the system is buffered against the effects of high waves from the ocean. A calm period of 1 to 2 days is preferred. Higher water levels generate greater outflow so this recommendation can be over ruled to prevent significant seepage and evaporation losses as a result of its large surface area (Clark et al. 2012).		
Timing of breaching	Breach 2 hrs before high tide, or just after high tide (to prevent high waves from reclosing the opening), to maximize the outflow.		
Consider safety of public during breaching	Breaching at the Uilkraal Estuary hold a risk to public safety, e.g. surfers wanting to body surf standing waves, children and dogs falling in outflow channel. Care should be taken with the general public to ensure their safety. Cordon the area off with the aid of red and white emergency tape to keep the public out of the area were breaching will take place. Ideally an official or security person must man the area in question. Temporarily close the designated area in circumstances that could pose a danger to the human life or property. This must be accompanied by appropriate signage.		
Breaching trench to maximize outflow	Excavate a 2m deep and 4m wide trench before breaching to maximize outflow.		
Location of the breaching position.	At the lowest position of the berm, opposite the previous year's channel (these mostly coincide) to assist with the efficient removal of sediment during the breaching. However, allow enough space for separate ebb and flood tidal channels to develop. Breaching too far to the sides often result in a single confined channel for both the ebb and the flood tidal flows. If possible, artificial breaching should line up with historical channels to assist with the removal of sediment during the breaching. Significant scouring potential is lost if the system has to cut new channels in the lower reaches during a breaching. This consideration may require the alignment of the breaching channel with an older historical channel configuration.		

Propose area of breaching position	<p>Uilkraal River estuary</p> <p>Coordinates: -34.6055 ; 19.408E</p> <p>Winter Winds</p> <p>Summer Winds</p> <p>Scale: 0, 50, 100, 150, 200 m</p> <p>Critical Biodiversity Areas</p> <ul style="list-style-type: none"> CBA: River CBA: Terrestrial CBA: Wetland CBA: Estuary Uilkraal estuary - breaching site Uilkraal estuary - access road <p>Sensitive areas</p> <ul style="list-style-type: none"> 1 2 3 4 5 <p>Provincial reserves</p>
Estimate amount of sediment to be moved during breaching	Not applicable, as amounts vary significantly between breachings. It cannot be determined in advance.
Disposal of sediment removed during excavation	The sand excavated from the trench should be stored on the banks adjacent to the trench.
Mobilizing machinery and equipment on site during breaching	<p>Equipment and machinery to be utilized in a breaching must be in be in a good state. Oil leaks are not to cause additional pollution.</p> <p>Care should be taken to ensure that earth moving equipment do not disturb indigenous vegetation of conservation worthiness on route to the excavation site. Bird nesting areas are to be avoided. Where possible existing access roads / tracks should be used.</p> <p>Once it has been established that a clear outflow channel has formed and breaching is progressing on its own momentum the earth moving equipment may be removed from the beach.</p> <p>Implement an appropriate control mechanism, such as erecting comprehensive signage with information of the launching areas and the associated dangers.</p> <p>Allow DFFE officials access to the designated area for the purpose of assessing and/or monitoring compliance with the conditions contained in the MMP, at all reasonable times.</p> <p>Be responsible for all costs necessary to comply with these conditions unless otherwise specified</p> <p>The municipality retains the management responsibility of the designated area, even though the applicant may grant permission to manage the designated area, on their behalf, to any competent contractor /service provider. Ensure that all users adhere to the local authority By-Laws relating to the designated areas at all times.</p> <p>The legal requirements associated with the use of the designated area must be brought to the attention of all persons that are granted access to the designated area by the applicant (licensee) in terms of the conditions of this license and the applicant shall take measures necessary to bind such persons to these requirements.</p>
Noise & light pollution	Noise on during a breaching should be kept to a minimum and within the relevant noise control by-laws/regulations of the municipality.
	Salinity: Low salinities due to mouth closure for extended periods (two months)

Water Quality considerations related to breaching	Oxygen: < 4 mg/l
	Toxic substances: Currently not a consideration for breaching of this system
Ecological considerations	Birds: Open mouth conditions per natural conditions.
	Fish: Open mouth conditions per natural conditions.
	Invertebrates: Open mouth conditions per natural conditions.
	Plants: Open mouth conditions per natural conditions.

According to the new Environmental Impact Assessment (EIA) Regulations promulgated on 18 June 2010 in terms of the National Environmental Management Act 1998, the artificial mouth breaching may not commence without an environmental authorisation from the competent authority:

The infilling or depositing of any material of more than 5 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock from:

- I. a watercourse;
- II. the sea;
- III. the seashore;
- IV. the littoral active zone, an estuary or a distance of 100 metres inland of the high-water mark of the sea or an estuary, whichever distance is the greater

but excluding where such infilling, depositing, dredging, excavation, removal or moving

- I. is for maintenance purposes undertaken in accordance with a management plan agreed to by the relevant environmental authority; or
- II. occurs behind the development setback line.

[Listing Notice 1, Activity Number 18]

Application for a special dispensation to implement the mouth management plan for a period of five years (at which time it will be subject to specialist review) is therefore required from DFFE in terms of the need for ecosystem maintenance.

RELEVANT AUTHORITIES

Table 6 lists the Key lead authorities involved in artificial breaching at the Uilkraals Estuary.

Table 6: Key lead authority involved in artificial breaching

Management authority	CapeNature	
Advisory Committee	Uilkraal River Estuary Advisory Forum	
Authorisation (breaching / emergency)	DFFE	
Lead authority	Breaching sub-committee	Minimum consultation In case of Emergency
Overstrand Municipality (Environmental Management and Disaster Management sections)	✓	✓
District Municipality (Environmental Management and Disaster Management sections)	✓	✓
DEA&DP	✓	✓
Department of Forestry Fisheries and Environmental Affairs	✓	✓
Department of Water and Sanitation	✗	✗
Department of Agriculture	✓	✓
CapeNature	✓	✓
SANParks	✗	✗
Research organisation with recognised estuarine expertise (e.g. CSIR)	✓	✗
NGOs	✓	✗
<p>The decision to artificially breach will be made by a Breaching sub-committee comprising the Overstrand Municipality's Environmental Manager, the Overberg District Municipality, the estuary Forum Chair, CapeNature: Landscape Manager and marine and Coasts Manager following consultation with at least two estuarine ecological specialists (e.g. from the CSIR and DFFE: Inshore Fisheries Research and Estuaries Management). These lead authorities are important role players with respect to emergency situations and administer their relevant empowering provisions (Disaster Management Act 2002, NEMA 1998, and the Integrated Coastal Management Act 2008).</p> <p>Data on water level, berm height, salinity, as well as water quality parameters where feasible, will be collated by CapeNature and any specialists team.</p> <p>Once the Breaching sub-committee has decided that an artificial breach must occur, CapeNature in association with the Disaster Management unit of the Overberg District Municipality and Overstrand Municipality shall be responsible for overseeing the breaching activities.</p>		
Disaster Management	Authority/Organisation	Status
Early warning system	South African Weather Services (weather)	No
	DWS warning system (flow/water levels/dam safety)	No
Disaster Management Plan	Municipality	Yes
Approved Maintenance Management Plan	CapeNature	Yes, in process of update

Planned mouth breaching procedures

CapeNature is responsible for the operational aspects of the Uilkraal Estuary MMP. They can delegate this function, but ultimately they have oversight over the functioning of the Breaching Sub-committee. It is therefore recommended that the Breaching Sub-committee be established as a formal structure under the Municipal Coastal Committee. CapeNature (or its delegated structure) is required to co-ordinate the Breaching Sub-committee, which include:

- Convening Breaching Sub-committee meetings (when listed specifications are triggered or are expected to be triggered in the near future due to inclement weather);
- Recording the minutes of the Breaching Sub-committee meetings;
- Distributing relevant information to the Breaching Sub-committee members; and
- Sharing the post-breaching incident report of the Breaching Sub-committee;
- Sharing process followed with Estuary Advisory Forum (if time permits).

CapeNature is also responsible for continuous monitoring of the conditions in the catchment when water levels become elevated (>1.5 m MSL). Communication between the different role players, i.e. the local municipality, CapeNature and key authorities (stipulated in Table 6), should take place at a regular basis. This can be done at an advisory committee/ forum meeting or as email communications summarising critical aspects. The day-to-day monitoring should include the following aspects:

- The actual and expected rainfall in the catchment;
- The water level in the estuary and its rate of increase;
- The height and width of the sand berm at the mouth;
- The actual and predicted wave conditions;
- The availability of equipment to breach the mouth;
- Water quality conditions (if applicable); and
- Biotic responses to elevated water levels (e.g. fish aggregations at mouth, formation of algal blooms, die-back of macrophytes, bird nesting behaviour).

Once the breaching criteria is met, the decision to artificially breach will be made by the Breaching Sub-committee comprising, at a minimum, the CapeNature Landscape Manager, Overstrand Municipality's Environmental Manager, Overberg District Municipality and the Estuary Advisory Forum Chairperson in consultation with at least two ecological specialists (e.g. CSIR, DFFE: Inshore Fisheries Research and Estuaries Management, Nelson Mandela University). Note, that while the Breaching Sub-committee is tasked with executing the approved MMP, it should be recognized that an estuary mouth is highly dynamic and unforeseen events may require special management actions. In such an event, additional verbal (followed by written) authorisation may be required from the authorising authority (i.e. DFFE) which needs to be supported by specialist comment and suggestions.). A flow chart for a planned mouth breaching procedures to be followed by the breaching committee is included in Figure 2.

Once the Breaching Sub-committee has established that the relevant criteria have been met and that artificial breach must occur, CapeNature and the Disaster Management Department of the Overberg District Municipality needs to be responsible for overseeing the breaching activities.

CapeNature is responsible for the following:

- Ensuring the availability of Earth moving equipment on day of breaching;
 - Establishing the exact location and time of the breaching channel;
 - Verifying that the sandberm at the mouth is high enough above the water line that there is no risk of “fluidization” of berm sediment (i.e. turns to quicksand) and associated risk to operator and equipment;
 - Deployment of flags and signage to warn public of risk to safety; and
 - Breaching of the estuary mouth (it should be noted that the excavations may take several hours).
- Finally, CapeNature is responsible for the compilation of a Breaching Incident Report to be provided to DFFE within 14 days of the actual breaching.

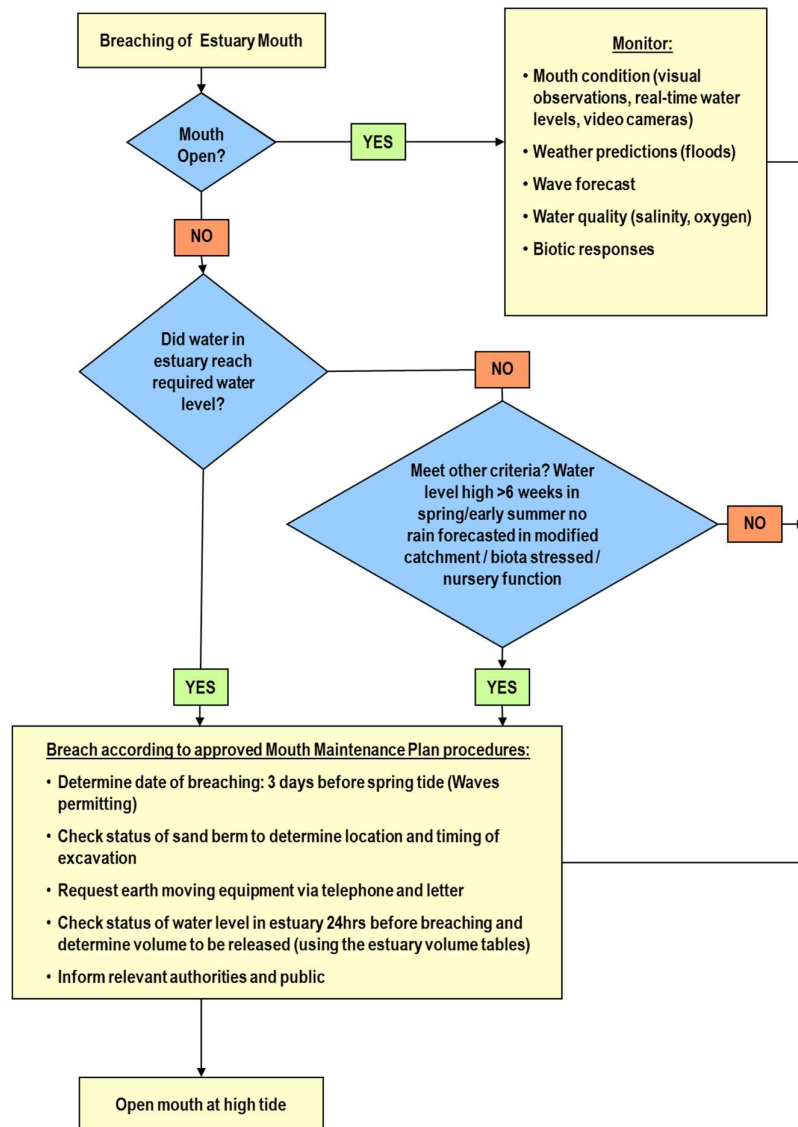


Figure 2: A flow chart of the procedures for a planned mouth breaching

Emergency

A flow chart for the undertaking of mouth breaching under emergency conditions is included in Figure 3. Breaching should be undertaken in the swiftest manner possible and in most cases the Disaster Management Department of the local municipality is responsible. While breaching should be conducted according to an approved Estuary Mouth Maintenance Plan, some of the general breaching principles may be waived under emergency conditions to ensure an expedient breaching.

Emergency conditions could develop when an estuary mouth is closed/constricted and severe rainfall occurs in the catchment causing a large flood. Alternatively, they could also develop at the (largely unlikely) event of a break of the dam wall. Constant monitoring of the conditions in the catchment is required when emergency conditions develop. Communication between the different role players, i.e. the local municipality, CapeNature and key authorities (DFFE) involved, should take place, if time is available, to monitor the situation. Included in the monitoring are:

- The actual and expected rainfall in the catchment.
- The water level in the estuary and its rate of increase.
- The height and width of the sand berm at the mouth.
- The actual and predicted wave conditions.
- The availability of equipment to breach the mouth on short notice.

While most emergency breachings relate to floods Section 3 lists some additional events that can constitute an emergency at the Uilkraal Estuary.

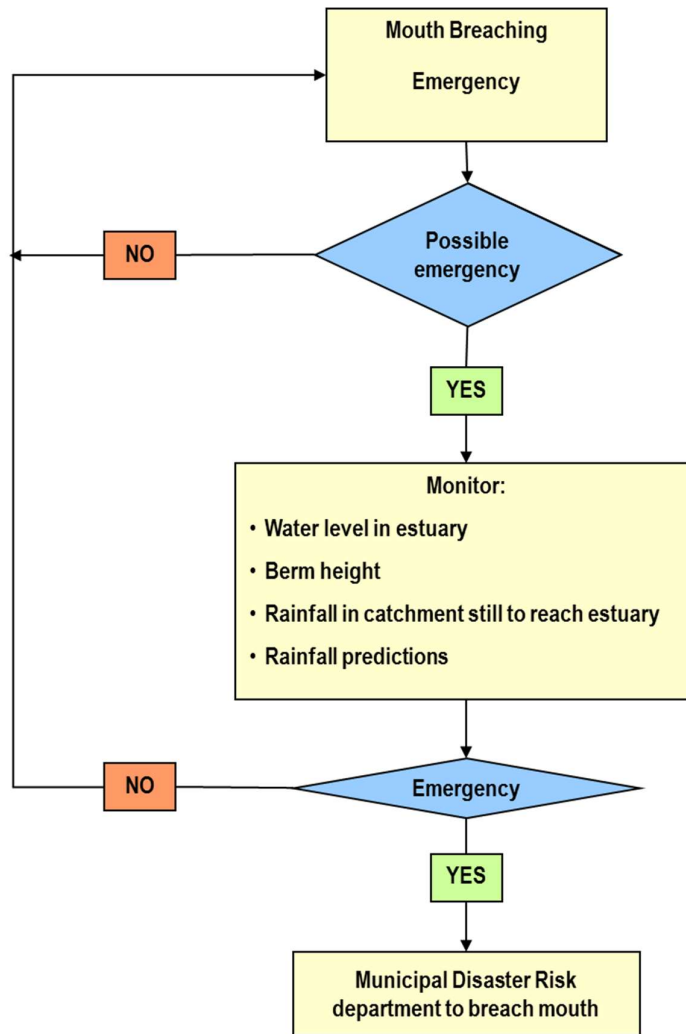


Figure 3: A flow chart of the procedures of an emergency breaching plan

MONITORING PROGRAMME

The following monitoring programme is required to be able to perform artificial breaching in a responsible and effective manner (Table 7):

Table 7: Monitoring programme for Uilkraal Estuary relating to artificial breaching

MONITORING ACTIONS	FREQUENCY	LOCAL REQUIREMENT - YES/NO	AGENCY RESPONSIBLE
Weather forecast (projected rainfall and waves)	Period leading up to breaching	Yes	SA Weather Services

Water levels	Continuous Ideally, automated daily monitoring of the mouth state of the estuary (e.g. using a web cam)	Yes	DWS G4R004 (1979-2016)
River inflow data	Daily Preferably, continuous monitoring of freshwater inflows at the head of the estuary	Yes	DWS gauge
Bathymetric surveys	Every 3 years	Yes	CapeNature
Salinity and Oxygen	Monthly Day before and after 5 to 10 days after a breaching	Yes	CapeNature/NGO
<i>In situ</i> water quality measurements (e.g. ecoli)	Monthly	Yes	BGCMA
Berm levels	Monthly (and just before breaching if breaching is planned)	Yes	CapeNature/OSM
Photographs	To be arranged between authorities before, during and after breaching	Yes	CapeNature/OSM/ODM
Observations on estuarine vegetation (e.g. inundation of salt marsh, reeds & sedges, occurrence of algal blooms)	Quarterly (and just before breaching)	Yes	CapeNature
Observations on Invertebrate behavior (e.g. invertebrate kills)	Quarterly (and just before breaching)	Yes	CapeNature
Fish surveys Distribution, abundance, movement and behavior (e.g. recruitment, aggregations, fish kills)	Bi-annually	Yes	DFFE
Co-ordinated Waterbird Counts (CWAC)	Bi-annually	Yes	CapeNature
Water quality parameters	Nutrients NOx and PO4 on an ad hoc basis when problems develop e.g. macro- or microalgal blooms); Dissolved oxygen (ad hoc as above); and Continuous monitoring of temperature and salinity below and above the bridge	No	CapeNature/ DWS

REPORTING

Following a breaching, a Breaching Incidence Report needs to be compiled by CapeNature and submitted to DFFE within 14 days of the activity. This report should contain as much as possible information on the motivation for breaching and the process followed.

In addition to the Breaching Incidence Report, CapeNature needs to compile an Annual Breaching Report that summarises information on all mouth manipulation activities during a year, including a review of ecological responses and consequences to human well-being and safety. The Annual Breaching Report needs to be presented to all Interested and Affected Parties (I&AP) (relevant authorities and civil society) to communicate progress with the implementation of the MMP. Such feedback sessions provide the opportunity for a critical review of current breaching practises and discussions on possible future improvements to the MMP.

Breaching Report

Table 8 below summarises the minimum content of a Uilkraal Estuary Breaching Incidence Report. The initial report should be compiled within about 14 days of the breaching activity, with data gaps (e.g. duration open) addressed after mouth closure.

Table 8: Content of Uilkraal Estuary breaching report

ACTIONS	REQUIREMENT	AGENCY RESPONSIBLE
<u>Met-ocean information</u> <ul style="list-style-type: none"> State of the tide (spring-neap/ high-low tide) Sea conditions (calm/stormy) 	Yes	CapeNature
<u>Estuary Information</u> <ul style="list-style-type: none"> Water level from DWS (and volume) before breaching Maximum outflow rate during breaching calculated from water levels and surface area of system Outflow duration (from water level graph) Lowest water level achieved after breaching (from water level graph) Did flooding problems arise before or during the breaching? If so, quantify these problems. Could measures be taken to prevent such problems in the future? For example by protection of low laying properties. Distinguish between short-term and long-term measures. Could further problems arise by design of new developments at too low levels? Date since last reaching Estimated volume of sediment removed and indicate how sediment was disposed (e.g. left on berm at mouth). <p>Were there problems with septic tanks before the breaching? If so quantify</p>	Yes	DWS/CapeNature/ Overstrand Municipality and Overberg District Municipality
<u>Location of breaching channel</u>	Yes	CapeNature

ACTIONS	REQUIREMENT	AGENCY RESPONSIBLE
<ul style="list-style-type: none"> Align with historical position of channels Reduce channel length Estimated volume of sediment excavated during the breaching 		
Period the mouth stayed open	Yes	CapeNature
Bathymetric surveys before breaching events to establish erosion /deposition rates.	Yes	CapeNature
Salinity measurement before and after breaching	Yes	CapeNature
Macrophyte conditions	Yes	CapeNature
Fish recruitment survey	Yes, in summer after breaching	DFFE and CapeNature
Avifauna counts (CWAC)	Yes	CapeNature
Other		
<u>Assessment record compiled by:</u> Name: Organization: Date: Contact details:		

Feedback on breaching activities

Table 9 below summarises the minimum information required as evidence of feedback breaching activities to the relevant authorities and stakeholders. Such report back sessions should be held at least once a year to ensure that the correct breaching procedures are being followed and that additional interventions are not required.

Table 9: Minimum information to be captured at breaching feedback sessions

ACTIONS	REQUIREMENT -
Responsible agency /authority	CapeNature
Place & Workshop venue	
Date	
Meeting/committee/workshop participants (attached attendance register)	
Workshop chaired by	
Key lessons learned that could assist with future breaching	
Material presented at meeting (including copies of presentations)	

REFERENCES

- Adams, J.B., Snow, G.C. and Veldkornet, D.A. 2010. Updated estuary habitat and plant species data. National Spatial Biodiversity Assessment 2010: Estuaries Component. Report submitted to CSIR. 14 pp.
- Clark, B.M., Turpie, J.K., Mallory, S., van Niekerk, L., Taljaard, S, Adams, J.B., and Biccard, A. 2012. Determination of the Ecological Reserve for the Uilkraals Estuary.
- Harrison, T. D. 1999. A preliminary survey of Estuaries on the South-West Coast of South Africa, Cape Hangklip - Cape Agulhas, with particular references to the fish fauna. Transactions of the Royal Society of South Africa 54(2): 257-283.
- Heydorn, A.E.F. and Bickerton, I.B..1982. Report No. 9: Uilkraals (CSW 17). In: Estuaries of the Cape. Part 2. Synopses of available information on individual systems. Heydorn, A.E.F. & Grindley, J.R. (eds)., Report, Green Series,
- Mucina, L., Janssen, J. A. and O'Callaghan, M. 2003. Syntaxonomy and zonation patterns in the coastal salt marshes of the Uilkraals Estuary, Western Cape (South Africa). Phytocoenologia, 33: 309-334.
- Ryan, P.G., Underhill, L.G., Cooper, J. & Waltner, M. 1988. Waders (Charadrii) and other waterbirds on the coast, adjacent wetlands and offshore islands on the southwestern Cape Province, South Africa. Bontebok 6: 1-19.
- Summers, R.W., Pringle, J.S. & Cooper, J. 1976. The status of Coastal Waders in the south-western Cape, South Africa. Report on the summer 1975/76 ornithological survey of coastal wetlands and shorelines of the south-western Cape by the Western Cape Wader Study Group. Percy FitzPatrick Institute, University of Cape Town. 162pp.
- Teske, P.R., Von der Heyden, S., McQuaid, C.D. and Barker, N.P. 2011. A review of marine phylogeography in southern Africa. South African Journal of Science, 107 (5/6): 43-53.
- Turpie, J.K. 1995. Prioritising South African estuaries for conservation: a practical example using waterbirds. Biological Conservation 74: 175-185.