PROPOSED FLOOD CONTROL EMBANKMENTS FOR THE LOWER MGENI RIVER AT SPRINGFIELD PARK

PRELIMINARY BIODIVERSITY ASSESSMENT

REVISED CSIR REPORT

March 2013

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BACKGOUND

The CSIR conducted a preliminary biodiversity study of the area affected by the proposed widening and stabilisation of the Mgeni River bank in the region of Springfield Park in August 2005. The terms of that study were chiefly to undertake a botanical survey and to note fauna observed during the field survey. Further assessment of terrestrial and aquatic fauna potentially present in the area was to be based on current knowledge i.e. without any additional field surveys. As the proposed development was not implemented at the time the permission granted by the EIA has since expired. The CSIR was contacted by Gibb (Pty) Ltd to re-survey the area to determine if there were significant changes since 2005 and to make any further recommendations as necessary. The 2005 report is attached as Appendix 1 and should be read prior to the current re-assessment as the detailed information on the survey, impact assessment and mitigation measures are indicted in this previous report. The findings of the re-assessment of the proposed development site are detailed below. In addition, the recently completed Resource Directed Measures (RDM) for the estuary has been reviewed in order to determine if there could be any new information that may present fatal flaws to the proposed development.

BOTANICAL RE-ASSESSMENT OF THE DEVELOPMENT SITE

A field survey was conducted on 11th February 2013 to assess if there were any changes to the previous study conducted in 2005. No change in terms of the botanical species composition was recorded. However, a further recommendation is made that truncheons of a *Ficus sur* (see Figure 1) be taken for replanting above the banks after completion of the development. These truncheons can be potted while the development is in progress and transplanted thereafter.

The concern from a stakeholder for the *Ficus trichopoda* that might be lost is not relevant as this specimen was located directly behind NCP and just outside the development path. This was probably planted here sometime in the past as the natural distribution for this species is along the north coast.

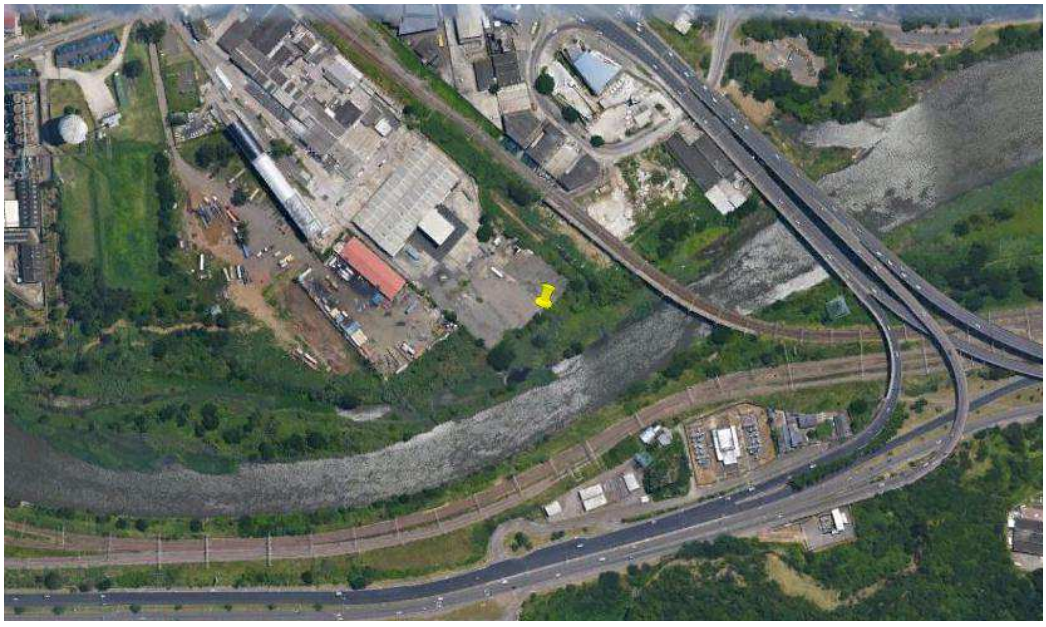

Figure 1. Yellow marker indicating position of the *Ficus sur*

TERRESTIAL FAUNA OF THE STUDY SITE

As previously stated there was no in-depth survey of fauna undertaken. Most terrestrial fauna are likely to move out of the area once the development disturbance commences. This is especially true for the more mobile fauna such as birds, small mammals and insects. The development area is also relatively small leaving sufficient (similar) adjacent environment for fauna to recruit to. There was some concern from stakeholders that the area may have one or more resident crocodiles but these are likely to move to adjacent less disturbed areas. This is also true for the Nile monitor (*Varanus niloticus*) which is likely to occur in habitats adjacent to water. The other concern was that the dwarf chameleon may be present in the area. This was not observed during the field study so its presence cannot be confirmed or refuted.

REVIEW OF THE RDM REPORT

The author was able to obtain a copy of the final report of the recently completed Mgeni RDM from Ms Nicolette Forbes of Marine and Estuarine Research (MER) at the request of Ethekweni Municipality. Should stakeholders require access to this report, or any of the component specialist reports, requests will have to be submitted to the municipality who may seek permission for release of the document from the Department of Water Affairs. The author cannot attached any specific sections of the RDM report to this report as the official status in terms of release of the RDM document is unknown at this stage.

The RDM process relies on the inputs of several specialist ecologists who finalise the categorisation of the present state of the estuary and make relevant recommendations on elevating this current state through a standard methodology published by the Department of Water Affairs. The Mgeni RDM was done at the "Rapid" level i.e. based on existing knowledge and expert opinion rather than any significant additional field studies. Available data on the estuary varied widely amongst the different disciplines, and this together with many unknowns about the 'pristine' condition of the estuary, resulted in low confidence scoring throughout most of the report. However for certain components (such as birds) good data was able and relatively high confidence could be attached to the assessment.

The Estuarine Importance Score (EIS) was determined to be 81 which translates to a highly important system that should be left in a natural state and hence implies protection and conservation. However the Estuarine Health Index (EHI) which assesses the present condition of the estuary using several abiotic and biotic characteristics, resulted in a score of 38. This score indicates a highly degraded state and places the estuary in category E for assessment of the present ecological state (PES). However, due to the high importance rating achieved by the Mgeni Estuary, the RDM methodology requires that the ecological state be increased to Category A (natural, unmodified) or Best Attainable State. The team of specialists agreed that the former was not achievable given the surrounding developments and the estuary could only be elevated to Category D with practical interventions such as wetland habitat creation and removal of alien vegetation. This was thus proposed as the Estuarine Reserve Category for this system. It is thus critical that any future developments in the surrounding areas do not have any adverse impact on the estuary.

The specialist reports within the RDM indicated that the most important estuarine habitats (vegetation communities, tidally influenced substrates and waters) that support estuarine fauna, essentially occurred downstream of the Connaught Bridge although salinity penetration may, on occasion, occur

upstream of this area under certain conditions. The locations of the important estuarine habitat types is confirmed by author's detailed field study and GIS mapping of the area up to the Connaught bridge some eight years ago (Figure 2). One of the main findings of the RDM was a significant increase in sedimentation, and hence the development of more mesic areas and consequent loss of aquatic habitats, due to absence of large floods in recent years. The proposed bank widening development is not envisaged to impact on the important estuarine habitats as long as the mitigation measures (as detailed in the previous report- Appendix 1) are implemented. One of the more important of these is obviously to avoid any sediment input into the stream by removing all excess sand that is excavated when the new banks are constructed. It is extremely important to avoid exacerbation of the siltation problem in the estuary as this would lead to overall loss of certain estuarine habitats.

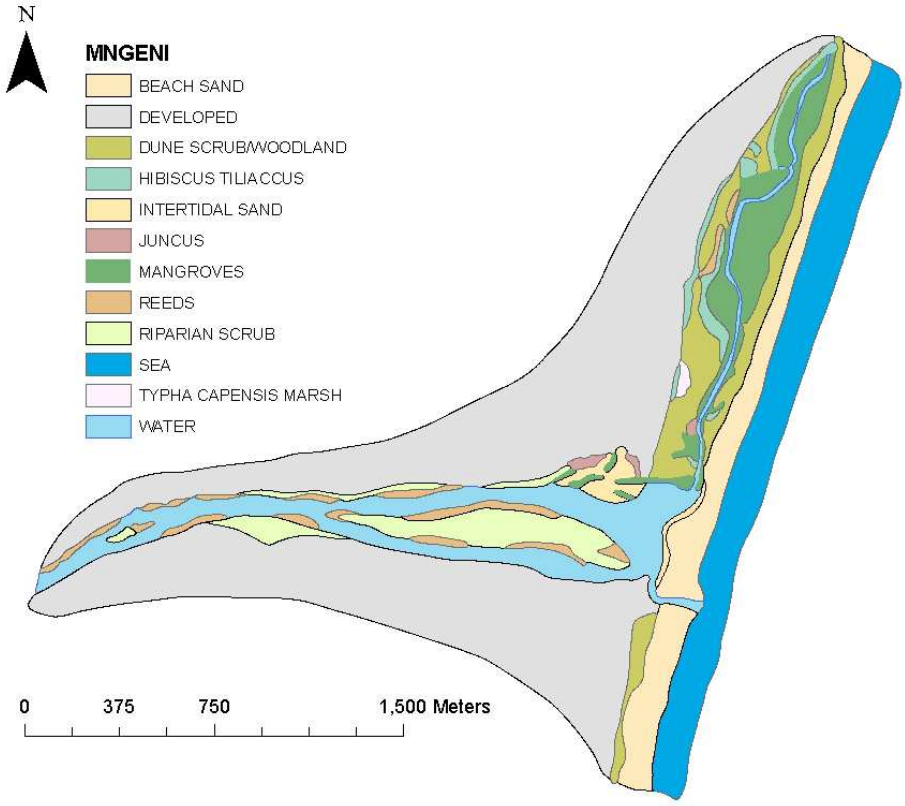

Figure 2. Habitat map of the Mgeni Estuary (*Shamilla Pillay, CSIR, unpublished*)

While the RDM does provide the most recent update of the condition (abiotic and biotic) and functioning of the estuary, perhaps the most important consideration for this proposed bank widening project is the estuarine flow requirement assessment. The study determined that prior to 1981 the estuary mouth remained permanently open, but currently with the development of the Inanda Dam, the mouth closes periodically depending on flow rates and tidal conditions. Based on volumetric data the RDM study approximated that the following conditions would result in mouth closure:

- At a flow rate of 5 $m^3.s^{-1}$ the estuary would only remain closed for 1 – 3 days;
- At a flow rate of 3 $m^3.s^{-1}$ the estuary would only remain closed for 2 – 5 days;
- At a flow rate of 1 $m^3.s^{-1}$ the estuary would remain closed for 2 – 4 weeks

One of the aims of the RDM study is to ensure that no changes to current mouth dynamics are made unless the trajectory of such change is towards states existing during 'pristine conditions'. Theoretically, any increase in channel width can reduce flow rate though the estuary. However, in this case, such an effect is only expected to happen during significant flood events. No impact on base flows and small storm events is envisaged as the lower banks will not be modified during the development. During flood conditions the high flow rate would result in open mouth conditions and any reduction in flow rate is unlikely to be significant enough to alter mouth dynamics. The author is however not a hydrologist and therefore strongly recommends that this be confirmed by the hydrologists/engineers overseeing the proposed development.

CONCLUSION

No significant changes to the previous survey within the terrestrial environment of the development area were noted. Given this, the previous impact assessment together with all recommendations and mitigation measures hold true if the bank widening and stabilisation is to be implemented as proposed. The only further recommendation emanating from the re-survey was the possible harvesting of truncheons from the *F. sur* for replanting in appropriate areas above the banks. If there are any confirmed sightings of the dwarf chameleon within the development area then capture and relocation of these animals to adjacent areas is recommended.

There is also an opportunity for the development to contribute to improvement of the estuarine condition as recommended by the RDM study. Some interventions to consider include:-

- Removal of alien species on the banks and in-stream islands adjacent to the north bank
- Replace aliens with swamp forest/riparian species on the in-stream islands and at the landward edge of the lower banks (species: *Ficus sur, Rauvolfia caffra, Voacanga thouarsii, Syzygium cordatum, Barringtonia racemosa, Hibiscus tiliaceus*)

Appendix 1: Previous Report 2005

PROPOSED FLOOD CONTROL EMBANKMENTS FOR THE LOWER MGENI RIVER AT SPRINGFIELD PARK

PRELIMINARY BIODIVERSITY ASSESSMENT

CSIR REPORT

August 2005

PROPOSED FLOOD CONTROL EMBANKMENTS FOR THE LOWER MGENI RIVER AT SPRINGFIELD PARK

PRELIMINARY BIODIVERSITY ASSESSMENT

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TABLE OF CONTENTS

BACKGROUND

During the severe floods experienced in the 1980's, properties alongside the lower Mgeni River at the Springfield Industrial Park were subjected to severe flooding with consequent damage to property and financial losses. In order to reduce this risk of flooding, the eThekwini Municipality has proposed a widening of the present channel for a distance of approximately 1km (see fig. 1 at end of document,) though excavation along the north bank of the river in the vicinity of Connaught Bridge (some 4km upstream of the mouth). The newly created banks are to be stabilized by gabions and the use of hard engineering structures (concrete) will be minimised. The opposite bank of the river has previously been "re-engineered" in this manner.

The envisaged primary impact of this project is the loss of land area through excavation and there is thus a need to understand the impact on biodiversity due to this loss. This purpose of this study is to undertake a preliminary survey of vegetation communities in this area and to assess the significance of the loss these habitats in terms of biodiversity.

While the eThekwini Municipality has indicated that construction activities will remain outside of the present flow channel, there is nonetheless a potential for impacts on in-stream biota during storm events. This may occur during the construction phases of this project and possibly in the medium term thereafter if mitigation measures are inadequate. This type of impact is indicated through an understanding of the species/communities that are likely to occur in this habitat and no actual surveys of biodiversity in the river or the estuary downstream have be conducted at as part of this assessment. Thus this part of the assessment is one of specialist "opinion" rather than one based on actual records to determine the present state of in-stream biodiversity.

TERMS OF REFERENCE

Study Description

- Identify the presence of undeveloped land area within the study site using recent aerial/ortho-photographs.
- Describe the vegetation communities (cover of dominant species) based on a once off field survey.

- Provide a preliminary list of species noted in this "reconnaissance level" survey and list any rare or endangered species.
- Indicate any fauna that are incidentally noted during the survey.
- From the information gained in this survey and any relevant literature assess the potential impact that will result from the loss of these undeveloped areas.
- Assess any risks to in-stream biota that may potentially occur as a result of the development
- Provide relevant recommendations to reduce the risks of potential impacts

Limitations and Assumptions

- The assessment is for stream-bank and surrounding communities of the affected area and does not include in-stream biota (i.e. algae, fish, aquatic invertebrates)
- The assessment is based on vegetation communities that are present as this provides an indication of the habitats available to faunal communities.
- This is a preliminary assessment based on desk top data and one rapid qualitative field assessment i.e. quantitative surveys along transects or within quadrants are not included as part of the survey

METHODS

A vegetation survey was undertaken on 2nd August 2005. The types of vegetation communities present were noted in the field and lists of species were recorded in the affected area and in areas immediately above and below this. The new position of the embankment was noted in order to assess the significance of the quantity of materials that may need to be excavated to achieve channel widening.

RESULTS

Site Description

The present banks of the river in the study area forms two distinct zones. These are:

a) An outer (landward) vertical or near vertical slope (70^{o}-90^{o}) descending for approximately 5-7 metres

b) A gently sloping inner bank extending from the base of the outer bank to the waters edge. The width of this varied from 4-10 metres.

Above these banks, the affected area is essentially flat and the land is either undeveloped or in some instances support buildings or paved industrial areas.

Vegetation Description

The vegetation above the banks of the river consisted of a mixture of exotic weedy species (e.g. *Riccinus communis, Chromolaena odorata, Cardiospermum grandiflorum)* and few indigenous species generally characteristic of highly disturbed secondary habitats. This habitat may best be described as open scrub consisting of secondary grasses (e.g. *Cynodon nlemfuensis, Sporobolus africanus, Panicum maximum*), with shrubs (e.g. *Abutilon sonneratianum, R. communis, C. odorata, Lantana camara, Solanum mauritianum*) and occasional trees (e.g. *Erythina lysistemon, Trema orientalis, Ficus natalensis, Melia azedarach*). The exotic creepers, *Ipomoea purpurea* and *C. grandiflorum*, were also prolific in this habitat. At the lower section of the study area (Riverside Road end) part of this area had previously been developed into a grassed recreational area.

Of the outer banks those that were vertical were essentially devoid of vegetation except for occasional tufts of grasses such as *S. Africanus.* Sloping banks were better vegetated with with taller grasses (e.g. *Phragmites maurtianus, Arundo donax, Digitaria eriantha*), weedy shrubs such as *C. odorata* and occasional trees (e.g. *F. natalensis, M. azedarach, P guajava, T. orientalis*).

The inner gently sloping banks were characterized by more hygrophilous vegetation. The landward section and raised islands within this habitat were characterized by tall stands of *P. mauritianus* and *A. donax*. Occasional trees such as *Ficus sur, T. orientalis* and *F. natalensis* had also colonized these areas since the last major flood. Closer to the channel *Phragmites australi*s dominated while at the waters edges and on islands within the channel the grass *Echinochloa crusgalli* was the dominant species.

During this survey the vegetation upstream and downstream of the affected area was also briefly surveyed and was found to have an essentially similar community structure and species composition to that of study area. The plant species list for the study area is recorded in Table 1 below.

Table 1. Plant list for the study area

TAXON	COMMON NAME	GROWTH FORM	LOCALITY
Typhaceae:			
Typha capensis	Bulrush	Herb	Inner bank, waters edge
Poaceae:			
Phragmites aurtralis	Common reed	Robust grass	Inner bank, waters edge
Phragmites mauritianus		Tall reed	Outer/inner bank, above banks, islands
*Arundo donax**	Giant reed	Tall reed	Outer/inner bank, above banks, islands
Panicum maximum	Guinea grass	Tufted grass	Above banks
Eragrostis curvula	Weeping love grass	Tufted grass	Above banks
Cynodon dactylon	Couch grass	Creeping grass	Above banks
*Cynodon nlemfuensis**	Star grass	Creeping grass	Above banks
Echinochloa crusgalli	Barnyard millet	Branched grass	Waters edge, islands
Digitaria eriantha	Finger grass	Tufted grass	Outer banks, above banks
*Paspalum urvillei**	Giant paspalum	Tufted grass	Inner bank
Sporobolus africanus	Ratstail dropseed	Tufted grass	Outer banks, above banks
Cyperaceae:			
Cyperus dives	Giant sedge	Robust sedge	Waters edge
Lemnaceae:			
Spirodela punctata	Duckweed	Tiny floating herb	In channel backwaters
Commelinaceae:			
Commelina erecta	Blue commelina	Spreading herb	Lower bank, waters edge
Aneilema dregeanum	Blue aneilema	Trailing herb	Above banks
Pontederiaceae:			
*Eichhornia crassipes **	Water hyacinth	Floating herb	In channel backwaters
Ulmaceae:			
Trema orientalis	Pigeonwood	Tree	Inner/outer banks, above banks
Moraceae:			
Ficus natalensis	Natal fig	Tree	Inner/outer banks, above banks
Ficus sur	Cape fig	tree	Inner bank
Polygonaceae:			
Persicaria sengalensis	Silver polygonum	Robust herb	Inner bank
*Persicaria lapathifolia**	Spotted knotweed	Herb	Inner bank
Chenopodiaceae:			
*Chenopodium album**	Fat hen	Herb	Above banks
Amaranthaceae:			
*Amaranthus hybridus**	Common pigweed	Robust herb	Above banks
*Amaranthus spinosus**	Thorny Pigweed	Herb	Above banks

Lauraceae:			
*Litsea glutinosa**	Indian laurel	Tree	Above banks
Fabaceae:			
Acacia karoo	Sweet thorn	Tree	Outer banks, above banks
Erythrina lysistemon	Coral tree	Tree	Above banks
*Senna didymobotria**	Peanut cassia	Shrub	Above banks
Oxalidaceae:			
*Oxalis latifolia**	Pink garden sorrel	Herb	Above banks
Meliaceae:			
*Melia azedarach**	Indian lilac	Tree	Outer Banks, above banks
Euphorbiaceae:			
*Ricinis communis**	Castor oil bean	Shrub	Above banks
Sapindaceae:			
*Cardiospermum grandiflorum**	Ballon vine	Shrub	Inner/outer banks, above banks
Malvaceae:			
Abutilon sonneratianum	Forest abutilon	Shrub	Above banks
Sida cordifolia	Flannel weed	Herb	Above banks
Myrtaceae:			
*Psidium guajava**	Guava	Shrub/tree	Outer banks, above banks
Convolulaceae:			
*Ipomoea purpurea**	Common morning glory	Herb- creeper	Outer/inner banks, above banks
Ipomoea cairica	Common ipomoea	Herb- creeper	Above banks
Verbenaceae:			
Lantana camara	Tickberry	Shrub	Outer banks, above banks
Solanceae:			
*Solannum mauritianum**	Bugweed	Shrub	Outer banks, above banks
*Nicandra physalodes**	Apple of Peru	Herb	Above banks
*Cestrum laevigatum**	Inkberry	Robust shrub	Outer banks
Acanthaceae:			
Asystasia gangetica	Asystasia	Spreading herb	Outer banks, above banks
Asteraceae:			
*Ageratum houstonianum**	Blue weed	Herb	Inner banks
*Chromolaena odorata**	Triffid weed	Shrub	Outer banks, above banks
Tithonia diversifolia	Mexican sunflower	Shrub	Above banks

* Denotes exotic species

Fauna

As noted above, this study did not include specific faunal surveys. In the terrestrial environment the only fauna incidentally noted were two pairs of Egyptian geese (*Alopochen aegyptiacus*). The habitat could however, support several species of small mammals (mice, moles), lizards (skinks, agamas) and snakes. The plant community that was present did not indicate any species-specific insect-plant relationships with the exception of those of the *Ficus* species with their species-specific pollinator relationship with Agaonid wasps. Trees of this species were however well represented outside the affected area.

At the waters edge, two Nile monitors (*Varanus niloticus*) were noted. In the open water a pair of ducks (South African Pochard - *Netta erythropthalma*) were noted in the deeper water of the channel. The lower banks and vegetated backwater areas are expected to support several frog species. The channel area with its marginal vegetation is also expected to support a very rich invertebrate fauna. This would include larger crustaceans such as the shrimps and crabs (e.g. *Caridina spp., Palaemon spp., Macrobrachium spp.,Varuna sp*.) as well as the much smaller amphipod, copepod, ostracod etc. species. The characteristics of this habitat especially the abundant marginal vegetation also suggest that it would support a rich diversity and abundance of aquatic insect fauna belonging to several different orders.

In the upper sections of the study site the most common freshwater fish species expected to occur are tilapia (*Oreochromis mossambicus*) and catfish (*Clarias gariepinus*). However, tidal influence is expected to reach the study area especially at spring highs and estuarine fish may thus occur within the habitat. Potential impacts from the proposed project, if correct mitigation measures are not executed, can nonetheless extend into the estuary and thus effect estuarine fish populations. The Mgeni estuary has a typical estuarine fish fauna and the system is functional as a nursery area for marine spawned fish species.

Fish species previously recorded in the system are listed in Table 2 below. This species list is based on very limited fieldwork (CSIR unpublished data; Harrison et al., 2000; Begg 1984) and should be regarded as incomplete. Harrison et al (2000) considered the ichthyofauna to be in a moderate condition. In prioritising South African estuaries based on their potential importance to estuarine associated fish species, Maree et al (2000) regarded the importance of the estuary as the 34th of 248 systems assessed. Several species are important in recreational

(estuarine and marine environments) and commercial fisheries (in marine environments). Several rare and endangered fish species, including sleepy goby *Glossogobius biocellatus* and checked goby *Redigobius dewaali*, are also expected to occur in the system although these have not been recorded in the limited surveys undertaken to date.

Table 2: Fish species list for Mgeni Estuary.

SCIENTIFIC NAME	COMMON NAME	ENDEMIC	CONSERVATION STATUS
Ambassis productus	Longspine glassy		
Ambassis natalensis	Slender glassy		
Ambassis gymnocephalus	Bald glassy		
Oligolepis acutipennis	Sharptail goby		
Oligolepis keiensis	Speartail goby		2003 IUCN Red List of Threatened Species
Periopthalmus sp.	Mudskipper		
Caffrogobius natalensis	Baldy	E	
Glossogobius callidus	River goby	E	
Argyrosomus japonicus	Dusky kob		
Elops machnata	Ladyfish		
Terapon jarbua	Thornfish		
Rhabdosargus holubi	Cape stumpnose	E	
Acanthopagrus berda	Estuarine bream		
Pomadasys commersonnii	Spotted grunter		
Valamugil robustus	Robust mullet		
Valamugil cunnesius	Longarm mullet		
Liza macrolepis	Largescale mullet		
Valamugil spp.	Mullet		
Mugil cephalus	Flathead mullet		
Liza spp.	Mullet		
Solea bleekeri	Blackhand sole	E	
Caranx sexfasciatus	Bigeye kingfish		
Leiognathus equula	Slimy		
Rhabdosargus sarba	Tropical stumpnose		
Liza alata	Diamond mullet		
Liza dumerilii	Groovy mullet		
Valamugil buchanani	Bluetail mullet		
Clarias gariepinus	Sharptooth catfish		
Oreochromis mossambicus	Mozambique tilapia		
Anguilla spp.	Freshwater eels		
Myxus capensis	Freshwater mullet	E	Rare

IMPACT ASSESSMENT

The potential impacts from the proposed project are summarized in Table 3 below. In general the loss of terrestrial species (including hygrophilous species on the inner banks) due to actual disturbance and bank reconfiguration is not considered to be of major significance due to the following:

- These were essentially disturbed secondary habitats and in terms of the vegetation there were many opportunistic alien species
- From this preliminary survey this habitat is not expected to contain any rare or endangered species
- The relatively small affected area was very similar in habitat to areas above and below this section and species composition (terrestrial and aquatic) are thus expected to be similar

In addition the more mobile members of the faunal communities are likely to move out of the area into surrounding habitats once the activities and noise associated with construction becomes evident.

The construction activities however, are of greater concern in terms of potential impacts on the aquatic environments within and below the study area. The delivery of large amounts of sediment to the aquatic environment, especially if construction occurs during the rainy months, has the potential to have the following impacts:

- Reduced primary (algal) productivity due to compromised light penetration resulting from increased turbidity
- The clogging of gills of fish and feeding structures of planktonic filter feeders
- Decrease in visibility can affect feeding (prey capture) of fish, predatory invertebrates and zooplankton
- Settling of sediment can result in the smothering of benthic communities. Such sediment deposition is likely to occur when flow rates reduce in the wider estuarine area. These benthic communities are an integral part of the food web in estuarine ecosystems

The potential impacts described above may be exacerbated if there is an intention to leave most of the sediment between the present outer bank and the newly constructed bank in situ,

as has been proposed. While a large flood such as that of 1987 is likely to remove this sediment out to sea, most smaller storm events would only result in gradual erosion of the areas and the sediment is most likely to be deposited in the estuary. If such storm events are accompanied by high seas and outflow is compromised by simultaneous high tides such turbid waters could backup into the Beachwood Mangroves via the outflow creek close to the mouth of the Mgeni. Sediments deposited here would have impacts on the aerial roots of mangroves and the benthic communities in this habitat.

Table 3. Summary of Potential Impacts and Relevant Ratings

IMPACT	STATUS	EXTENT	INTENSITY	DURATION	PROBABILITY	SIGNIFICANCE	CONFIDENCE
1. Site specific loss of biodiversity	Negative	Site specific	Low	Long term	100%	Low/NS	High
2. Increased turbidity -Reduced primary productivity	Negative	Site specific and estuary	Medium	Short term	70%	Medium	Medium
3. Increased turbidity – clogging of gills and feeding structures	Negative	Site specific and estuary	Medium	Short term	70%	Medium	Medium
4. Increase turbidity – affecting prey capture	Negative	Site specific and estuary	Medium	Short term	70%	Medium	Medium
5. Smothering of benthic communities – especially in estuary	Negative	Site specific and estuary	Medium	Short term	60%	Medium	Medium
6. Medium/long term erosion of sediments left in situ- several resultant impacts similar to 2-5 above	Negative	Site specific and estuary including mangroves	Medium/ Long	Long term	80%	Medium/ High	Medium/ High

NB: Impacts 2-5 will only occur if storms events happen during the construction phase. NS = Not Significant

RECOMMENDATIONS/MITIGATION MEASURES

The following recommendations are made to address the potential impacts described above. The effects of implementing mitigation are summarized in Table 4 below.

- If at all possible, construction should occur during the dry season
- The area described as the inner bank and the river channel should largely remain undisturbed

- During excavation and construction activities any sediment delivery to the water as a result of storm events, should be avoided. A temporary dam to trap sediments should be built at the outer edge of the inner bank using sandbanks and bidim etc.
- All sediments between the present outer banks and the proposed new flood control bank should be excavated and removed from the area. The height of the substrate at the base of the new bank should not be higher than 0.5 metres above the outer edge of the present inner bank.

Table 4. Summary of Recommendations and Mitigation Measures

NO.	IMPACT	SIGNIFICANCE WITHOUT MITGATION	MITIGATION DESCRIPTION	SIGNIFICANCE WITH MITGATION
1.	Site specific loss of biodiversity	Low/NS	None required	NA
2.	Increased turbity -Reduced primary productivity	Medium/high	Appropriate dam for sediment trapping	Low/NS
3	Increased turbidity – clogging of gills and feeding structures	Medium/high	Appropriate dam for sediment trapping	Low/NS
4	Increased turbidity – affecting prey capture	Medium/high	Appropriate dam for sediment trapping	Low/NS
5.	Smothering of benthic communities –especially in estuary	Medium/High	Appropriate dam for sediment trapping	Low/NS
6.	Medium/long term erosion of sediments left in situ- several resultant impacts	High	Excavate and remove sediments between present outer bank and new flood control bank	NS

NA= not applicable NS = Not Significant

CONCLUSION

This survey has indicated that the proposed construction of a flood control bank in the study area is not expected have any significant impacts if the mitigation measures described above are adhered to.

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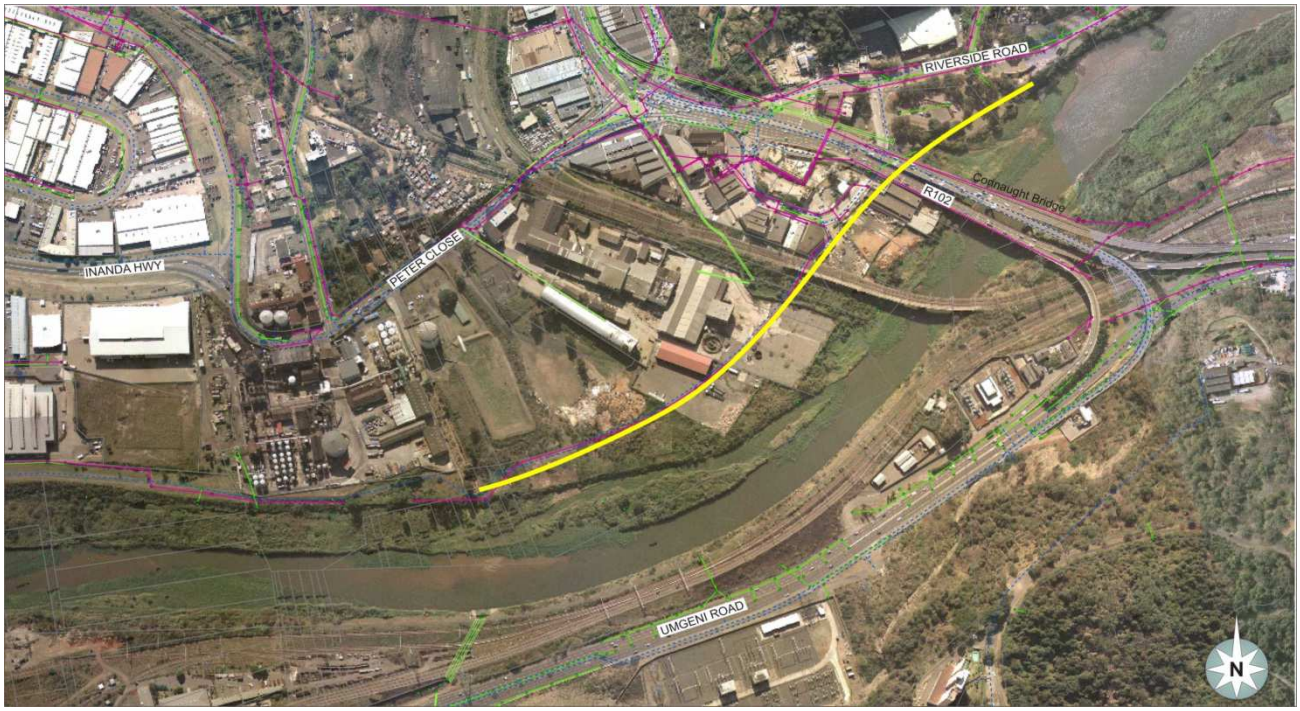

Figure 1. Location of New Flood Control Embankment (Yellow line)