

Hartbeespoort Dam Integrated Biological Remediation Programme

Crocodile West Reconciliation Strategy Steering Committee (SSC)
24 February 2011




PETRUS VENTER
Deputy Regional Director NW
Integrated Water Resource Management &
Catchment Strategies

www.dwa.gov.za/harties

Harties, metsi a me

North West with WMA



CWM-WMA generates ±
1/3 of RSA's Gross Domestic
Product (GDP)

Hartbeespoort Dam is
1 of 9 hypertrophic dams in
South Africa
7 in the Crocodile Marico WMA

Harties, metsi a me

Problem Statement (1): Upstream Catchment

- Storm water, litter and debris, erosion & sedimentation




Harties, metsi a me

Problem Statement (1): Upstream Catchment

- Storm water, litter and debris, erosion & sedimentation
- 700+ mega litres of purified sewage per day
- 280+ tons of ortho-phosphate (450 total P) / annum

Northern WWTW discharge to the Jukokob
Impact: Continuous high flow – 400 ml/day



Harties, metsi a me

Problem Statement (1): Upstream Catchment

- Storm water, litter and debris, erosion & sedimentation
- 700+ mega litres of purified sewage per day
- 280+ tons of phosphate per annum
- Shrinking wetlands
- Rivers – depleted riparian vegetation & in-stream habitat

Agricultural & urban Impact: Clayville Wetland



Harties, metsi a me

Destruction of riverbank & riparian vegetation Crocodile River – upstream & downstream of Hartbeespoort Dam



Harties, metsi a me

Problem Statement(2): Hartbeespoort Dam

- Toxic algal blooms



Harties, metsi a me

Problem Statement(2): Hartbeespoort Dam

- Toxic algal blooms
- Exotic water plants - hyacinths



Harties, metsi a me

Problem Statement(2): Hartbeespoort Dam

- Toxic algal blooms
- Exotic water plants – hyacinths
- Shoreline destruction



Harties, metsi a me

Project History

- Development of remediation plan: 8/2003 – 3/2005
- 2 Main reports
 - Action plan (volumes 1 & 2) Oct '04
 - Fish community study HBPD Feb '05
- Publish plan – NW: Env Man Series 5 Oct '05
- DWA appoint RW implementing agent Jun '06
- DG DWA instruct fast tracing May '07
- BP developed & implemented 2007 – 2010
 - Rand Water Contribution – R8.1 million
- Current BP implementation 2010 – 2015
 - RW – no implementation fee but cost recovery

Harties, metsi a me

Summary of implementation – Main Issues Identified

- 1) Water quality management (point & non-point sources: Land Management Practices and Water Use authorizations)
- 2) Fisheries management (bio-manipulation)
- 3) Balance reservoir ecosystems (shore land & wetlands)
- 4) Recreational Activity Control & Boating regulations (RMP)
- 5) Recreational access opportunities and control
- 6) Ecologically valuable areas & land management
- 7) On-going monitoring – interventions & pilot implementation
- 8) Intergovernmental liaison (HDSC)
- 9) Public awareness & education programs

Harties, metsi a me

Business Plan 2010-2015

- On-going dam basin activities (O & M)
 - Foodweb restructuring
 - Biomass, litter and debris removal
 - Biomass establishment (shoreline & floating wetlands)
- Development and operation of Information Communication Knowledge Centre (ICC)
 - Information Tent at Dam wall
 - Communication Centre at Tant Malie
 - Knowledge hubs (vermiculture, wetlands, stormwater, etc.)
- Fast track sediment management
- Implement water use authorization and integrated catchment management

Harties, metsi a me

Overall objectives of the HDRP

- Implement IVRM principles in catchment to enhance:
 - Growth
 - Development
 - Work creation
 - Information & education programmes
- Determine, optimise & manage physical and biological conditions in the dam to ensure reduction in algae (blue-green), hyacinth and undesired fish biomass

Main objectives

- Physical measures (dam basin)
 - Biomass removal (algae and hyacinths)
 - Litter and debris
- Biological Measures
 - Biomass Establishment (shoreline = riparian & in-stream)
 - Floating Wetlands
 - Food web restructuring (fish harvesting)
- Nutrient load reduction:
 - Sediment management (internal & external)
 - Target PO₄ in catchment
 1. Reduction at source – urine diversion & detergents
 2. Direct re-use of WWTW's effluent
 3. Compliance & enforcement (IWUL)

Job Creation

- 23 permanent Shoreline & floating islands
- 47 permanent Algae, hyacinth & debris removal
- 14 permanent Fish SMME
- 3 permanent Office Management
- Temporary 90 at Roodeplaat dam hyacinth removal 2008/9 plus others on demand
- SMME development in progress:
 - Extend small fisheries teams
 - Shoreline & floating islands: construction & maintenance
 - Vermiculture: composting & waste recycling
 - Aqua culture, recreation guiding & fly fishing
 - Silt removal & management: many opportunities

Foodweb Restructuring – Efficient Nutrient & Energy Flow

- Fish
 - Removal of substantial volumes
 - Decline in carp / catfish
- Zooplankton
 - Increase in species *Daphnia pulex* / *D magna*
- Phytoplankton
 - Microcystis to be replaced as dominant species (Jul – Nov)
 - Creation of positive plant succession (filamentous algae in littoral zone)

Restructuring of the fish population

Non desirable fish species

Common carp

Catfish or barbel

Canary curper

Desirable fish species

Yellow fish

Small barb

Mozambique Tilapia

Desired / undesired fish species

Future target = 350 tons p/a
Equal to R12 million p/a

Harties, metsi a me

Fish health & edibility

Study outcome:
Both macroscopic and histological alterations in selected organs (liver, kidney and gills) confirms that all organ indexes were classified as Class 1 with the exception of the liver for barbel (Class 2)

- **Class 1** (index value <10) Normal tissue structure with slight histological alterations
- **Class 2** (index value 10-25) Normal tissue structure with moderate histological alterations
- **Class 3** (index value 26-35) Pronounced alterations of organ tissue
- **Class 4** (index value >35) Severe alterations of organ tissue

Harties, metsi a me

Biomass Removal

Removal of:

- Algae & hyacinth
- Crocodile River Inlet
- Magalies River Inlet
- Leeuwenspruit Inlet

Removal of

- Algae & hyacinth
- Debris & litter

Harties, metsi a me

Dec/ Jan 2011 Floods >500 tons litter & debris

Harties, metsi a me

Removed biomass is turned into compost

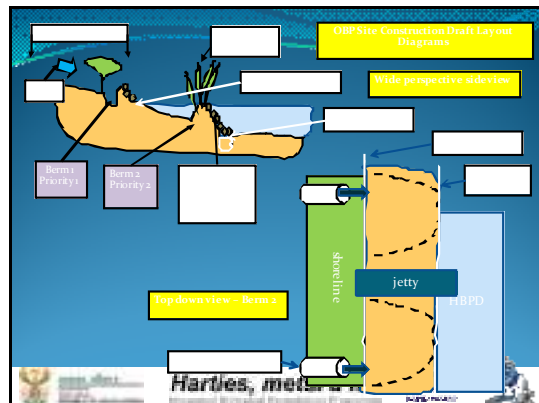
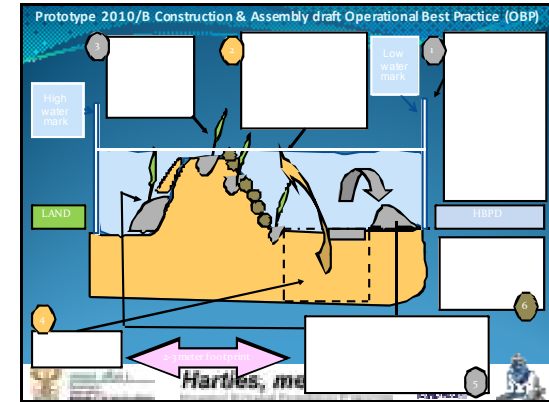
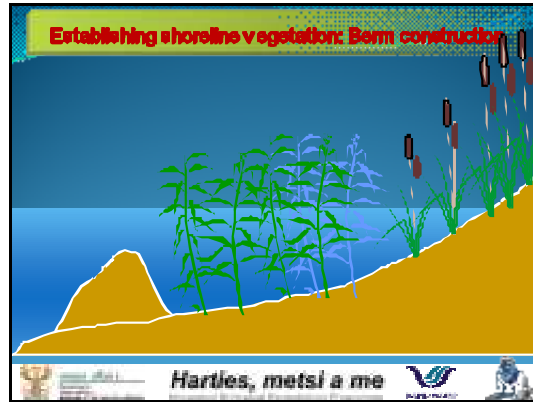
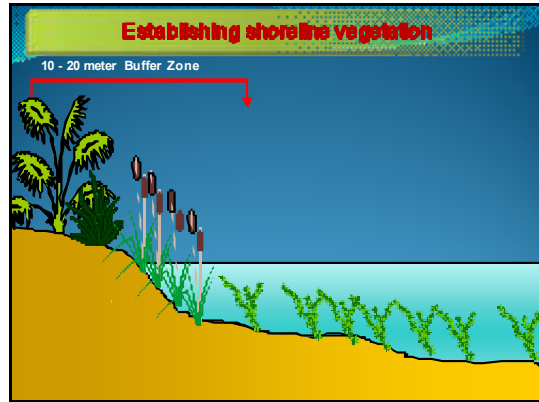
Harties, metsi a me

Biomass & debris removal

Total removal and treatment to date

• Algae	16 000m ³
• Hyacinth	27 000m ³
• Litter & debris	750m ³
• Vermicast	160 tons

Harties, metsi a me





Biomass establishment

Shoreline severely impacted



Need to be replaced with floating wetlands

Harties, metsi a me

Clearwater state – end October 2009



Harties, metsi a me

Foodweb Restructuring

Total removal and treatment to date

- Fish removed
 - Catfish 43.7 tons
 - Carp 34.5 tons
- Biomass established
 - Shoreline 5 200m²
 - Floating wetlands 2 066m²



Harties, metsi a me

Sediment management – project goals

- Reduce Internal Nutrients Load and Nutrients Recycling by the dredging of active sediment layer
- Support of overall efforts to shift Dam trophic level from hyper-eutrophic to meso-eutrophic
- Recover lost settling/retention capacity of inlet section
- Recover a part of exhausted Dam's live storage
- Beneficiate removed sediments (land amendment, composting, mine tailings dams rehabilitation, construction materials and manufacturing)
- Re-Use of separated water
- Create new jobs - Sediments removal, processing and use
- Recover a major part of costs

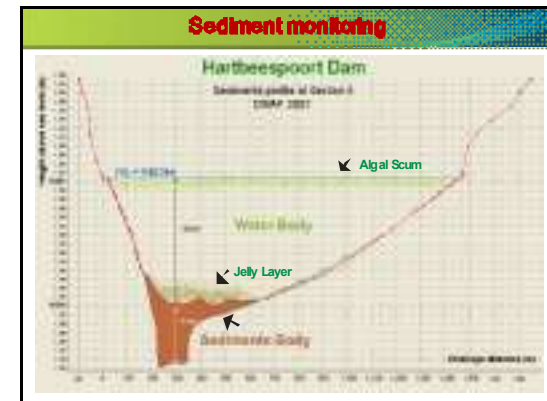
Harties, metsi a me

Sediment management - status

- Sediment characterisation study
- Sediment management plan
- Pilot dredging and excavating
 - Crocodile River mouth (50 tons + 11 500 tons)
 - Jelly layer at dam wall – phase I completed



Harties, metsi a me





Pilot dredging campaigns (Dry dredged materials)



Harties, metsi a me

Pilot dredging campaigns (Flood zone dredging)



Harties, metsi a me

Dredged Sediments Beneficiation
Compost production



Gardening: Vegetables production

Harties, metsi a me

Crocodile River (flood zone at Roos se Oord) sediments



Harties, metsi a me

Pilot excavation (Flood zone at Roos se Oord)



Harties, metsi a me

Material excavated from Crocodile River flood zone



Material excavated from crocodile river flood zone at Roos se Oord (left) - as shown / right - after 3 months
Top Soil Dredging, Beneficiation and Reclamation, Tsalengwa Water Rehabilitation

Harties, metsi a me

Dredged Sediments Beneficiation Compost production



Gardening; Vegetables production

Harties, metsi a me

Construction materials manufacturing



The first building block (Strength 30N) produced from dredged material
Also like: floor tiles, paving blocks, etc.

Housing

Harties, metsi a me

"Jelly" Layer pilot dredging



Harties, metsi a me

Eland Platinum mine Pilot pad site



Harties, metsi a me

Dredged materials processing

Temporary Storage

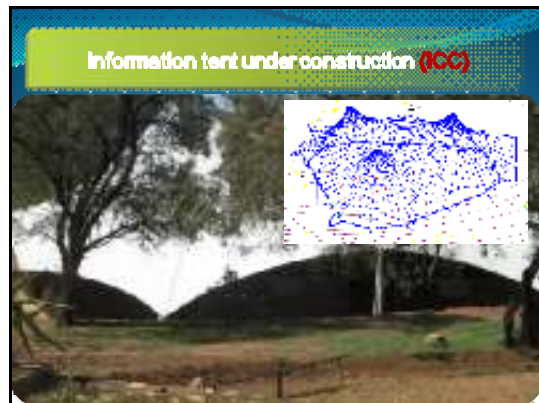
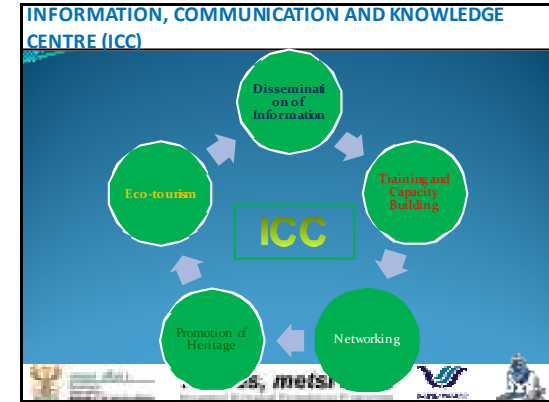
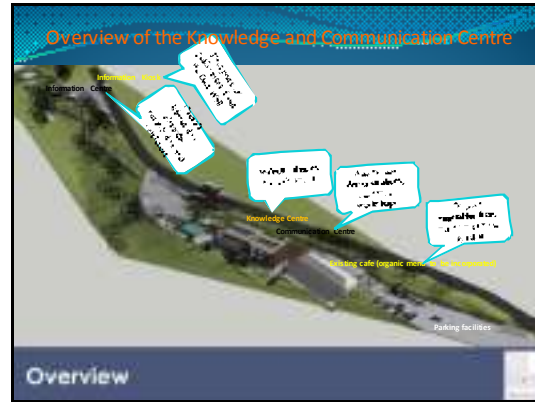
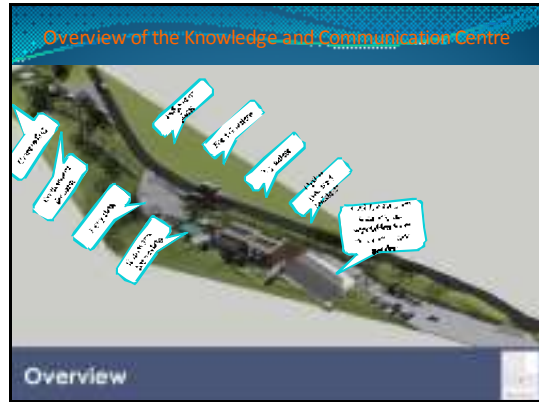
- Dewatering
 - Land Irrigation / Aquifers recharge / Water re-use
 - Slime ponds – solids / liquid separation
 - Drying beds
- Separated Water treatment/make up
- Solids processing for marketable products
 - Time frame 7 years
 - Job creation 250 - 300 for 7 years
 - Potential income R125-150 million

Harties, metsi a me

Operational Products and Cost Recovery

• Fish (carp & barbel)	R8 – R10 per kg
• Topsoil	R600 per ton
• Vermicompost	R50 per 15 kg
• Floating wetlands	R3 500 per 6m ²
• Access control register	R50 per book

Harties, metsi a me



- Purpose of the ICC
- ❖ To provide information about the activities relating to Harties Metsi a Me Programme
 - ❖ To organise guided tours for schools, groups and general public
 - ❖ To provide venues for relevant workshops and training
 - ❖ To educate on sustainable development concepts



ICC Operations

ICC (Information & Communication Centre)

Open to the public

Mon - Sat:
9am - 3pm

From 4 Dec

Visit the Information Tent to view:

- Algae & Hyacinth Harvesting
- Litter & Debris removal
- Vermiculture knowledge hub
- Indigenous vegetation

Guided tours:
11am and 1pm

Information Communication Knowledge Centre (ICC)

Operational Programme

Group bookings

Science experiments & environmental awareness

Shoreline vegetation & Ifafi wetlands hub

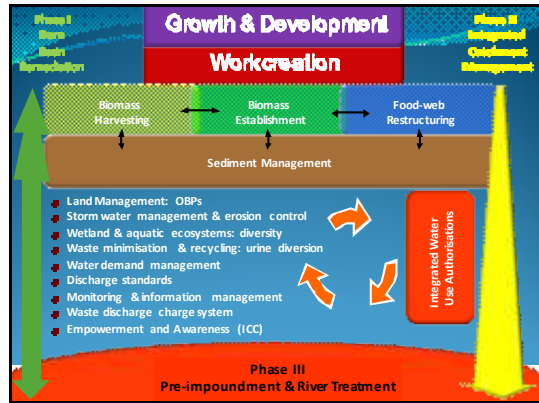
Floating wetlands & aquaculture hub

Stormwater & sediment knowledge hub

Hiking trails (upcoming)

Magalies conservation area, river

Online @ www.dwa.gov.za/hartley/ or
Tel: 012 207 9911/2



Progress & ongoing activities

- Continuation of programme implementation
- Resource Management Plan developed & being implemented
- Information Communication & Knowledge Centre established and operational
- HBP Dam Intergovernmental Steering Committee established and continual functioning essential, transform to Intergovernmental Forum
- Funding secured – Finland, UNESCO, Rand Water contribution, Estates, mining companies
- DWA future funding proposal to be approved

The way forward – Programme Management

- Programme Review
 - Technical
 - Financial
 - Governance
- Extend internal programme management office
- Implement Integrated Catchment Management to better address upstream impacts
- Improve regulation and enforcement (Integrated Authorisations)
- Duplicate & extend to other dams and Catchments

Integrated Monitoring

Objective:

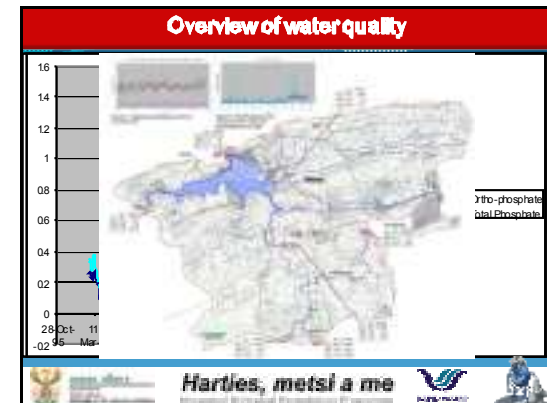
- Develop an integrated monitoring system to improve information on dynamics between sediments, incoming & internal load
- Quantify physical and biological upstream impacts
- Align monitoring programmes to give effect to optimisation of monitoring costs
- Evaluate effects of actions with respect to the implementation of remediation initiatives

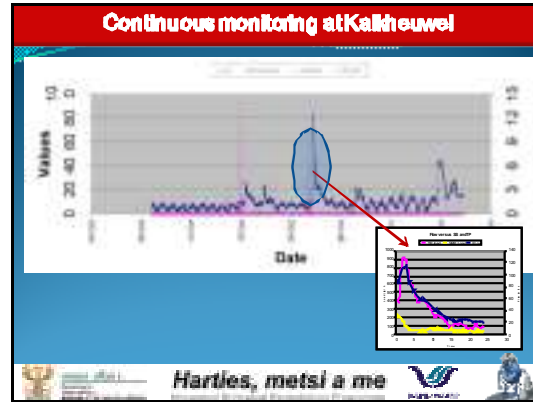
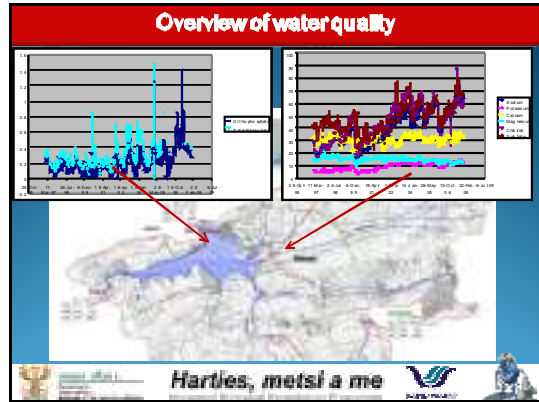
Deliverables & Achievements:

- Development of monitoring framework (1st and 2nd order) and implementation of Integrated Monitoring Strategy
- Integrated monitoring plan for implementation
- 2 weather stations in construction (3rd by Weather Bureau)
- Clean up of WMS data for Hartbeespoort catchment
- Implement 1 continuous storm water monitoring at Crocodile inlet and 1 at dam wall

Challenges of Integrated Monitoring

- Ongoing quantification of total algal mass
- Quantifying physical conditions:
 - Weather, temperature, wind, etc.
 - Stratification of the dam
- Storm water profiling and nutrient load updating
- Allocation of loading (Waste Discharge Charge System)
- Coordination and alignment of several monitoring programmes





Hartbeespoort dam monitoring

- Dam surface temperatures higher in 2010 than in 2009
 - Even though solar radiation on dam was higher in 2008/2009 (Nov, Dec, Jan, Feb, Mar, Apr) than the corresponding time in 2009/2010
- Monitoring done the past two years indicated that incoming temperatures are significantly colder than the dam temperature at all depths
 - As the colder water is more dense, it travels along the bottom, and could potentially disturb sediments
 - Seasonal - especially autumn and early winter

Harties, metsi a me

Hartbeespoort dam monitoring

- Incoming water at lower temperature than benthic water
 - Impact that high energy cold storm floods may have on sediments should be investigated
- Continuous monitoring at dam wall also indicates a number of smaller "turn-overs" where surface temperatures approach deeper temperatures
- Updated water balance more accurate phosphate loading

Harties, metsi a me

