

BEST PRACTICE GUIDELINES FOR WATER RESOURCE PROTECTION IN THE SOUTH AFRICAN MINING INDUSTRY



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BPG H4 : WATER TREATMENT



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Pollution Prevention (BPG H1/H2)



Minimisation of Impacts (BPG H1/H2)



Water Reuse or Reclamation (BPG H3)



WATER TREATMENT (BPG H4)



Discharge or Disposal of Waste



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Water treatment improves quality

- & Protect receptor
- & For reuse – at source (mine) or other users
- & For discharge – legal, reserve, users

All phases of mine life-cycle



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Limitations of BPG

- & Overview of options – no detail
- & Not all alternatives considered
- & Improvement of existing technologies
- & Development of new technologies
- & Not comprehensive – specialist input
- & Not internal water treatment



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Objective of BPG

- & Provide sufficient info to assist with decision-making procedure considering all factors that influence selection process
- & Technical methodology to apply to:
 - Identify constituents of concern
 - Identify suitable types of technologies
- & Prepare IWWMP sections



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When to treat water

- & Scope: Water & salt balance (BPG G2)
- & First 3 steps were implemented →
NOT zero discharge
- & Require reduction of pollution load or
minimisation of impacts
- & Experience water quality related problems
– reuse on mine or downstream



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Importance of BPG

& Mines

- Impact on environment
- Motivation for closure etc

& DWAF

- Responsible for water resource protection
- Ensure logical process / methodology followed



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Mine water contamination categories

- & Acidity & low pH
- & Dissolved metals (Fe, Mn, Al etc)
- & Radionuclides (U, Ra etc)
- & Turbidity / suspended solids
- & Salinity (Na, SO₄ etc)
- & Nutrients (ammonia, nitrate etc)
- & Oxygen demand (organics)
- & Aesthetics



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Efficiency of water treatment process

& Chemistry of product water
(reuse, discharge, polishing)

& Sludge / residue nature
(volume, toxicity, disposal)

& Marketable products recovered
(metals, potable water, sell)



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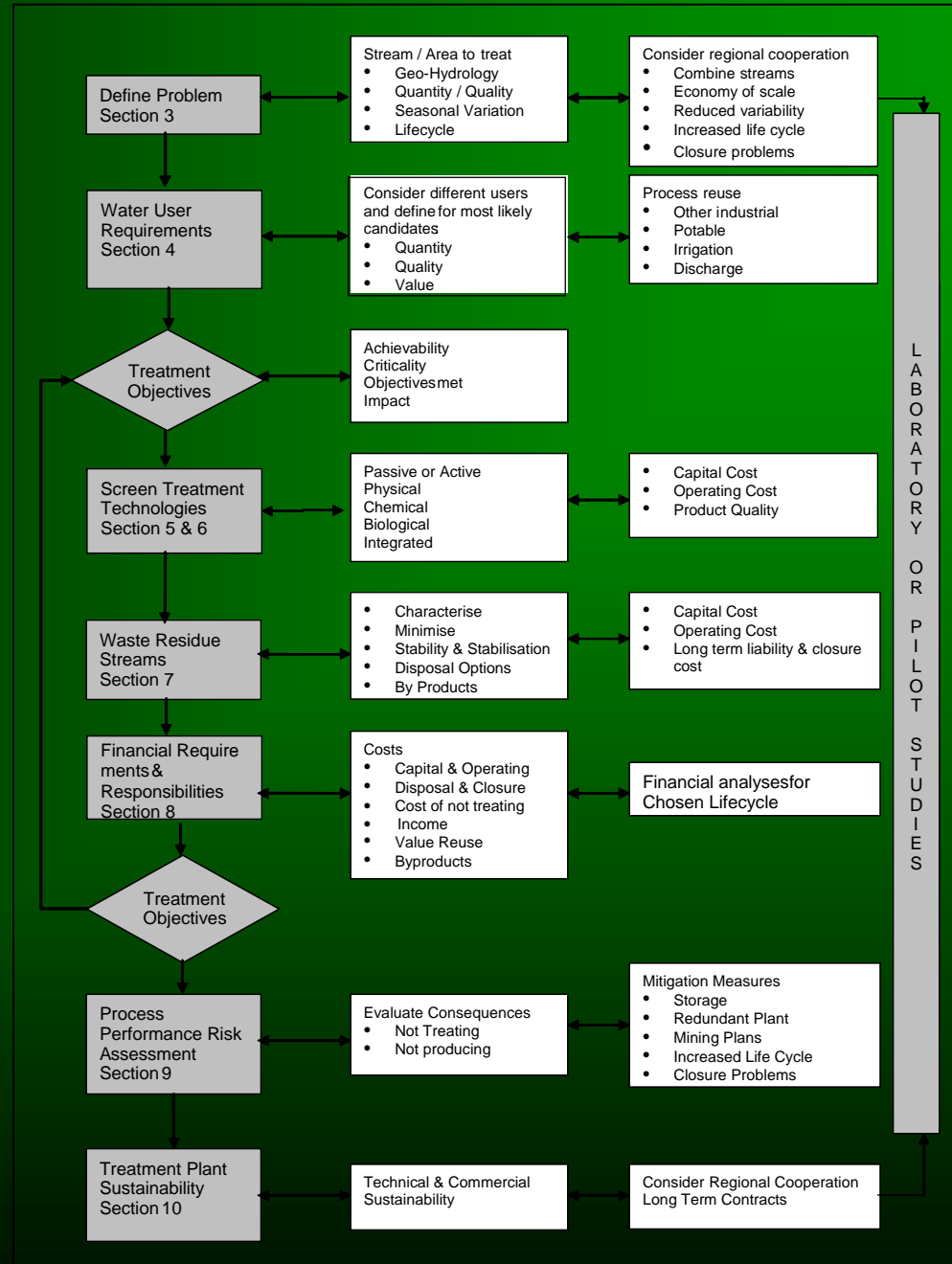
Evaluation & comparison of water treatment options

- & Applicability – raw water quality (COC)
- & Performance criteria & process principle
- & Process efficiency
- & Plant reliability (achieve objectives)
- & Environmental & social impact (risk)
- & Residues – treatment & disposal
- & Proven technology – examples, success
- & Cost – capital & operating



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Water treatment considerations

1. Areas / streams to be treated
2. Water user requirements
3. Pre-screening: potential technologies
4. Water treatment technology requirements
5. Waste / residue streams
6. Financial requirements & responsibilities
7. Process performance risk assessment
8. Treatment plant sustainability
9. Laboratory and/or pilot studies



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1. Areas / streams to be treated

- & Problem: water available but cannot use
- & Identify (audit, BPG G2)
- & Define: water quality & quantity (variation)
- & Source characterisation (modeling)
- & Data & statistics for 5 years (BPG G3)
- & Conservative assumptions & data
- & Future: mine phases & changes
- & Stakeholder consultation (integrate & save cost)



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2. Water user requirements

& Users:

- Mine & surrounding industry
- Agriculture & domestic
- Aquatic ecosystems & environment

& Experience water quality related problems

& Constituents of concern

& Data record (BPG G3)

& Specify objectives for treated water



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3. Pre-screening



Criteria	Active	Passive
Period / phase	Exploration & operational	Decommissioning, closure & post
Financial	High capital & operational cost	Medium capital & low operation & maintenance cost
Energy	Mechanical or electrical power	Not external (solar power)
Supervision	High degree (continuous control) & on-going maintenance	Minimum maintenance required
Flows	High	Lower (0.1 - 2 MI/day)
Input material	Ongoing - addition of chemicals	Natural and self-sustaining
Constituents	Any pH, metals, IX; EDR & RO, biological SO ₄ reduction, adsorption; electrochemical	Not all (TDS, EC, Na, Cl) pH (ALD) Metals (wetlands) Sulphate (SRU)
Product	Very high quality water with high degree of surety	Water of lower & variable quality



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Processes

pH ADJUSTMENT

Objective:	neutralize acidic mine water
Description:	addition of a base reagent to acidic mine water to neutralise
Example:	addition of lime - $\text{Ca}(\text{OH})_2$
Waste:	sludge (density; stability & volume differ)
Benefits:	metal precipitation
Constraints:	handling of sludge residue
Other:	reagent choice determined by cost



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4. Water treatment technology requirements

- & Feed: flow / volume & quality
- & Ability to deal with variation
- & Design life & period in mine life-cycle
- & Data record (BPG G3)
- & Future predictions (BPG G4)
- & Land requirements – space, topography



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Manage inflow & process



Consistent outflow



No consequence to user



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5. Waste / residue streams

- & Identify (brines / sludges)
- & Characterise (quantity, quality, impact)
- & Phased approach (segregation)
- & Legal implications at feasibility stage
- & Safe management & disposal
- & Risks: pollution, hazardousness
- & Classification



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5. Waste / residue streams

- & Costs: transport & disposal
- & Disposal options: dump, off-site
- & Reduction of quantity: dewater
- & Sludge stabilisation: fixation (solidify)
- & Sludge stability: pH, temperature
- & Product recovery: reduce volume, risk & liability



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6. Financial requirements & responsibilities

& Specific factors to consider

& Cost

- Land & discharge
- Capital, operational & maintenance
- Monitoring & legal
- Waste management

& Cost evaluation

& Resources: funding & management

& Risk & cost benefit assessment



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7. Process performance risk assessment

& Reduced efficiency/performance or failure

& Consequences:

- Infrastructure damage
- Loss of human life
- Compromised product water quality
- Downstream impacts

& Degree & surety of outflow – flexibility

& Management measures to address



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8. Treatment plant sustainability

- & Expected duration of treatment
- & Requirements over mine life-cycle phases
- & Different technologies at different stages
- & Post-closure planning
- & Future prediction (BPG G4)



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9. Laboratory / pilot studies

& Uncertainty

- Product water characteristics
- Waste / residue characteristics
- Technology performance & sensitivity

& Depend on technology – proven or not

& Manner of operation – full-scale

& Generate required info & define response

& Difficulty to predict full-scale (variability)



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Regional treatment plants

- & Number of mines in region
→ central point
- & Economy of scale benefits
- & Mixing various stream – more treatable
- & Benefits – shared funding
- & Pitfalls - legal



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THANK YOU



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