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# INTEGRATED POLLUTION CONTROL MANAGEMENT PLANS: A CASE STUDY

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Integrated pollution control management plans involve the development of a plan that reduces existing and controls future pollution in a river or catchment. The plan must be credible, achievable, useable and implementable.

To date a number of studies have looked at the pollution issues along the Kaalspruit, which flows through the northern parts of Kempton Park towards Centurion collecting drainage from the formal and informal areas of Tembisa/Ivory Park and the industrial areas of Clayville.
Of importance was the fact that the KMC did not want yet another general study on the problems being experienced in the Kaalspruit catchment. A study was needed to meet the following objectives while assisting in capacity building within the KMC and relevant municipalities:

- identify pollution source
- using a risk based approach assess actual and potential impacts on water users
- identify remedial measures
- provide preliminary best management cost estimates on controls which would stop or minimise adverse impacts
- involve the input of interested and affected parties
- prioritise the problems with respect to the risk posed and the cost of control
- develop a management plan, which will include capacity and technical considerations and outline the strategy, areas of responsibility and community involvement.

This paper will outline the historical situation and explain the activities carried out and the lessons learned during the development of the plan. The paper will also identify potential problem areas, which will make a development plan unimplementable.

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## INTRODUCTION

The Kaalspruit is a natural watercourse running through Tembisa in the Khayalami Metropolitan Council (KMC) in a northerly direction which joins with the Olifants River before entering Centurion Council Area.

A number of complaints have been received regarding the unacceptable levels of pollution in the spruit and Centurion Lake.

Part 4 of Chapter 3 of the new Water Act (Act 36 of 1998), deals with pollution prevention, and in particular the situation where pollution of a water resource occurs or might occur as a result of activities on land. The person who owns, controls, occupies or uses the land in question is responsible for taking measures to prevent pollution of the watercourse.

It is thus important that the KMC adhere to the water law and develop and implement an integrated pollution control management plan for the Kaalspruit. To assist in this a limited public participation approach was used, which included appropriate stake holders such as the local authorities, industry and the community.

## OBJECTIVES OF THE PAPER

The objectives of the paper are to outline the methodology and results of the study undertaken in the Kaalspruit.

## OBJECTIVES OF STUDY

The KMC undertook an integrated pollution control management plan that has as its objectives the following:

- Determine who, why and what is causing the pollution.
- Develop a management plan to minimise the pollution in the Kaalspruit.

## PROBLEM STATEMENT

Pollution in the Kaalspruit has become a problem with extensive urbanisation, both in terms of formal, informal and industrial townships, increasing the flow in the river. This combined with the catchment activities has lead to a deterioration in water quality in the river.

Uncontrolled runoff is the main carrier of contaminants from point and especially diffuse pollution sources and leads to significant pollution of rivers (Braune and Wood, 1999). Furthermore the increase in runoff peaks experienced with increased urbanisation leads to an increase in overland and channel flow velocities substantially increasing the erosion potential along a natural or man made channel and unsurfaced roads.

Figure 1 shows that the runoff peak flow rate for fully developed informal areas can be about four times higher than that of a virgin (undeveloped) area and about three times higher for a formally developed area. This means contamination from developed areas is carried faster and more easily to the receiving watercourse.

Figure 2 shows typical levels of pollutants originating from a densely populated informal development and a formal development. It is observed that the pollution concentrations of the stormflow are higher than those of dry weather flow. It is furthermore seen that runoff from informal settlements is worse due to wastewater flowing into the river with storm water. This

wastewater can comprise raw sewage, wash water, kitchen wastewater and other domestic wastewater that would normally go the sewage system. This wastewater is commonly referred to as grey water.

**Figure 1 - IMPACT OF URBANISATION ON RUNOFF QUANTITY (Braune and Wood, 1999)**

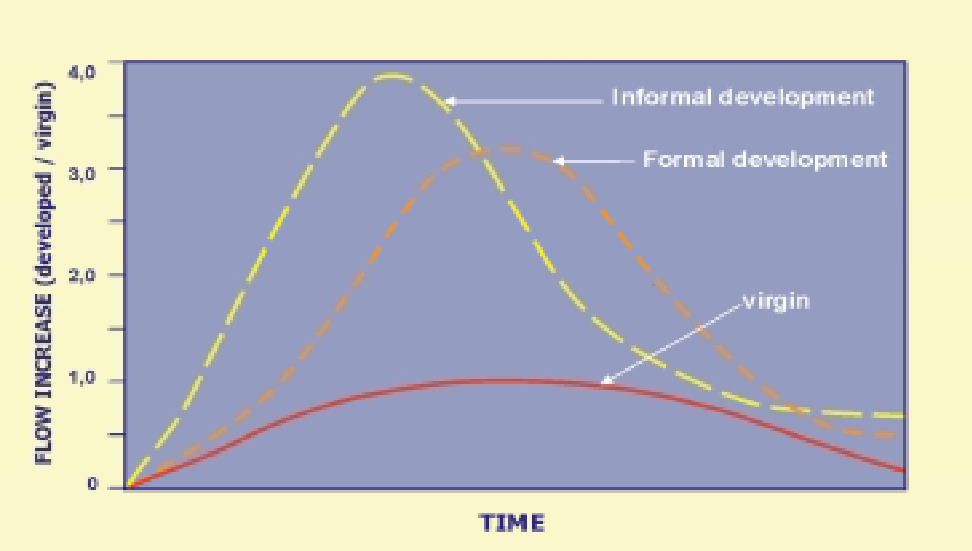
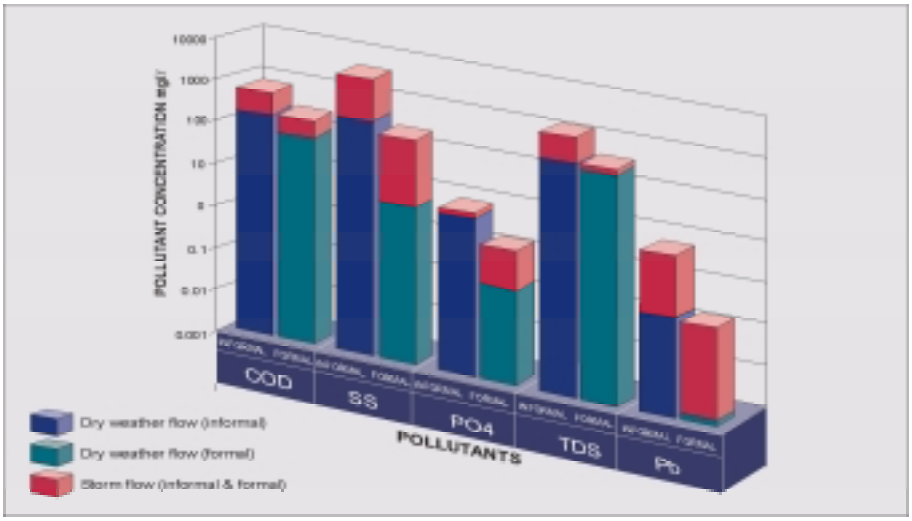



**Figure 2 - IMPACT OF URBANISATION ON RUNOFF QUALITY (Braune and Wood, 1999)**



## METHODOLOGY

The following approach was adopted in the study:

- Review existing pollution related reports and studies, and assess what plans and monitoring exists along the Kaalspruit.
- Identify the sources of pollutants and characterise pollution along the Kaalspruit.
- Identify and prioritise, using a risk based approach, the sources of pollutants Data used included: water use requirements (Department of Water Affairs and Forestry 1996). MLC water quality results; SRK water quality result; and a hydrological and water quality model. This data will be presented in the geographic information system (GIS), which is presently being developed by SRK and KMC. (Note: Water use will be considered to include; domestic, industrial, agricultural, recreational and aquatic ecology).
- Develop a priority based, integrated pollution control management plan for the Kaalspruit, which will outline a strategy to minimise pollution in all source media, as well as identify local authority responsibilities and recommend monitoring requirements.
- Design to a conceptual level, with preliminary costs, controls that could be implemented to minimise pollution within the Kaalspruit catchment.

By adopting the above approach is was ensured that all results and output data conforms to the integrated pollution control plan which has been recommended to the KMC. A participatory approach was adopted so that selected and relevant stakeholders were involved in the development of the plan. Participation was achieved by three holding interactive workshops.

The flow diagram given in Figure 3.1 outlines the process that was followed.

## RESULTS

The main results of the study are outlined below:

### Pollution Problems in Order of Importance

The identification of problems occurred during the site visits and the initial workshops. These areas were then confirmed at the workshops and the severity of the problem was then agreed or adjusted depending on the social perspective.

- grey water
- “first flush” runoff
- erosion
- polluted seepage from waste sites
- sewage overflow
- industrial discharge
- agricultural seepage.

The problem prioritisation has been highlighted in Figure 4 where the Kaalspruit and its tributaries are barcoded so that high priority areas can easily be identified. The river has been divided into a number of reaches between noded points. The coded reaches (i.e. 180 - 200), as indicated on the drawing, do not represent cumulative impacts but relate only to the surrounding catchments.

**The Solutions**

Following consultation it was agreed that the strategy should incorporate the following two solution principles:

- convey the polluted water as fast and safe as possible to the river and then treat the water in the river.
- pre-treatment of water before it reaches the river.

To allow implementation of this strategy a number of cost-effective solutions were tailored to the Kaalspruit and are presented schematically in Figures 5, 6, 7 and 8.

In the case of the Kaalspruit remedial measures for each stretch of river indicated on Figure 4 were identified and costed according the agreed priority. This provided the basis for the development of the plan.

The types of remedial measures that were considered to solve each of the identified pollution sources is presented in Table 1.

**TABLE 1: REMEDIAL MEASURES IDENTIFIED FOR THE KAALSPRUIT**

| Pollution type | Identified remedial measures |
|---|---|
| Sewage overflows | • Ongoing maintenance of sewage system and efficient response to sewage blockages<br>• Identify sewage systems which are under capacity and make necessary upgrades |
| Grey water | • Concrete canals to transfer the grey water to the river as quickly as possible<br>• Diversions to leachfields/filters along the routes of the canals<br>• On site filter systems<br>• Additional sewer lines in critical areas, which are directed into the sewer system<br>• Soakaways where the ground conditions allow it |
| Surface water pollution | • Divert the more polluted runoff (first flush) into appropriately sized leachfields and filters thereby allowing the clearer runoff into the spruit<br>• Add screens to the filter systems to capture the solid waste (regular maintenance of the screens will be required, preferably by local contractors) |
| Erosion | • Design and construct weirs (gabions) in the spruit, which will reduce the velocity (speed) of the river and thus reduce erosion of the river banks<br>• Limit or prevent development within the 1:100 year floodline where possible<br>• Construct stormwater concrete canals within the township<br>• Construct retention ponds where possible (schematically presented in Figure 6.3)<br>• Construct/enhance wetlands, which naturally reduce the velocity of the river and capture eroded sediments |
| Industrial discharges | • Review and implement new by-laws (this is currently underway as a separate project)<br>• Once implemented ensure enforcement of the by-laws by adequate policing and prosecution of offenders<br>• Proactive work with local industries to show how pollution prevention and waste minimisation can reduce costs |
| Treated sewage discharges | • Liaison with DWAF and sewage works operator to ensure compliance with licence conditions |
| Polluted seepage | • Ensure all waste dumps are permitted and comply with necessary legislation/guidelines in liaison with DWAF and Provincial Department of Environmental Affairs (Minimum Requirements, DWAF 1998)<br>• Illegal waste sites need to be dealt with as above or removed<br>• Industrial sites should be encouraged to implement adequate drainage facilities |
| Agricultural seepage and runoff | • Ensure landowners keep a green strip along the river to minimise erosion damage<br>• Provide adequate access to livestock so that river banks are not damaged<br>• Keep overgrazing to a minimum |

FIGURE 3: CONCEPTUAL METHODOLOGY

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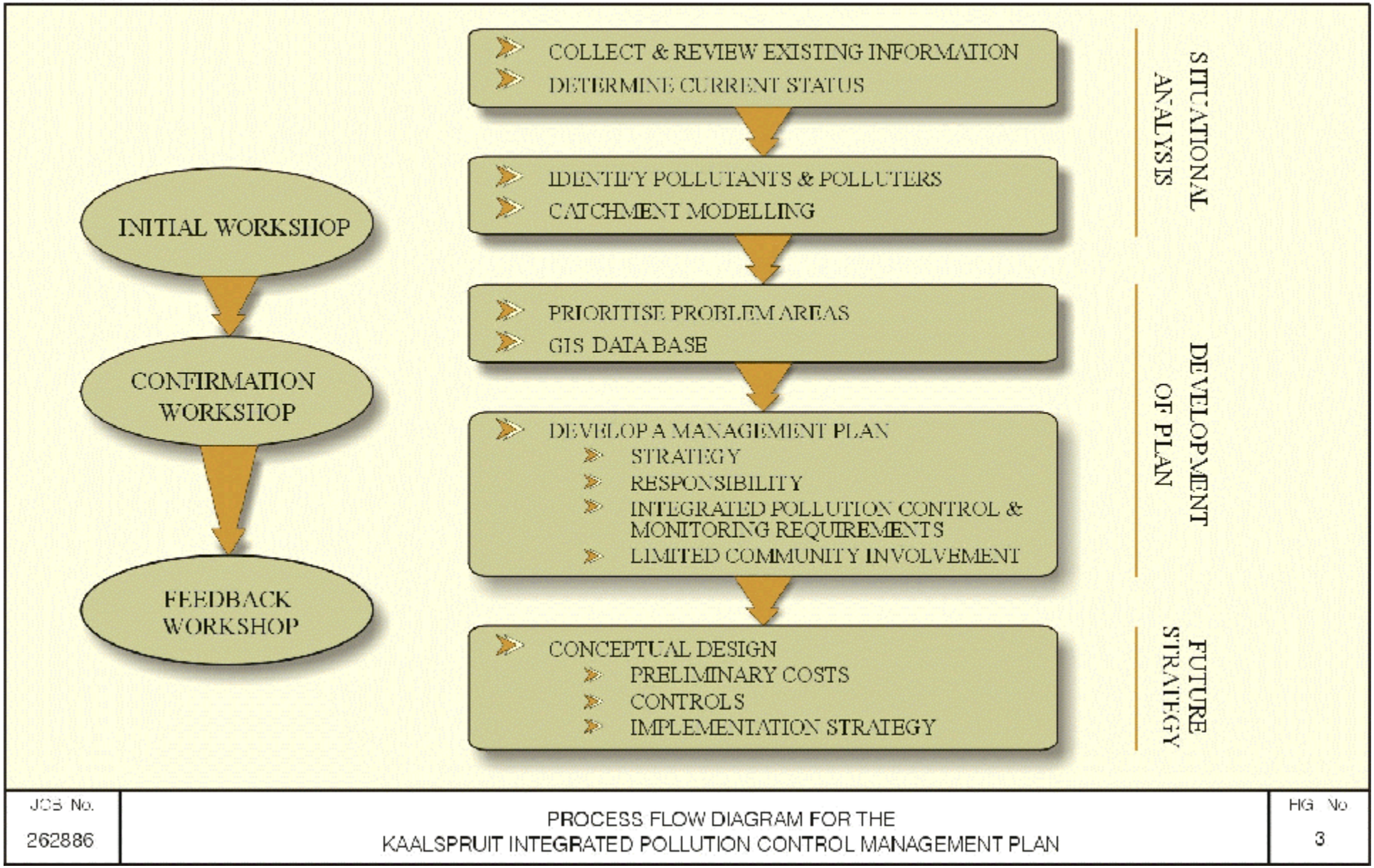



| JOB No. | PROCESS FLOW DIAGRAM FOR THE KAALSPRUIT INTEGRATED POLLUTION CONTROL MANAGEMENT PLAN | HG No |
|---|---|---|
| 262886 | | 3 |

FIGURE 4: PROBLEM AREAS IN THE KAALSPRUIT

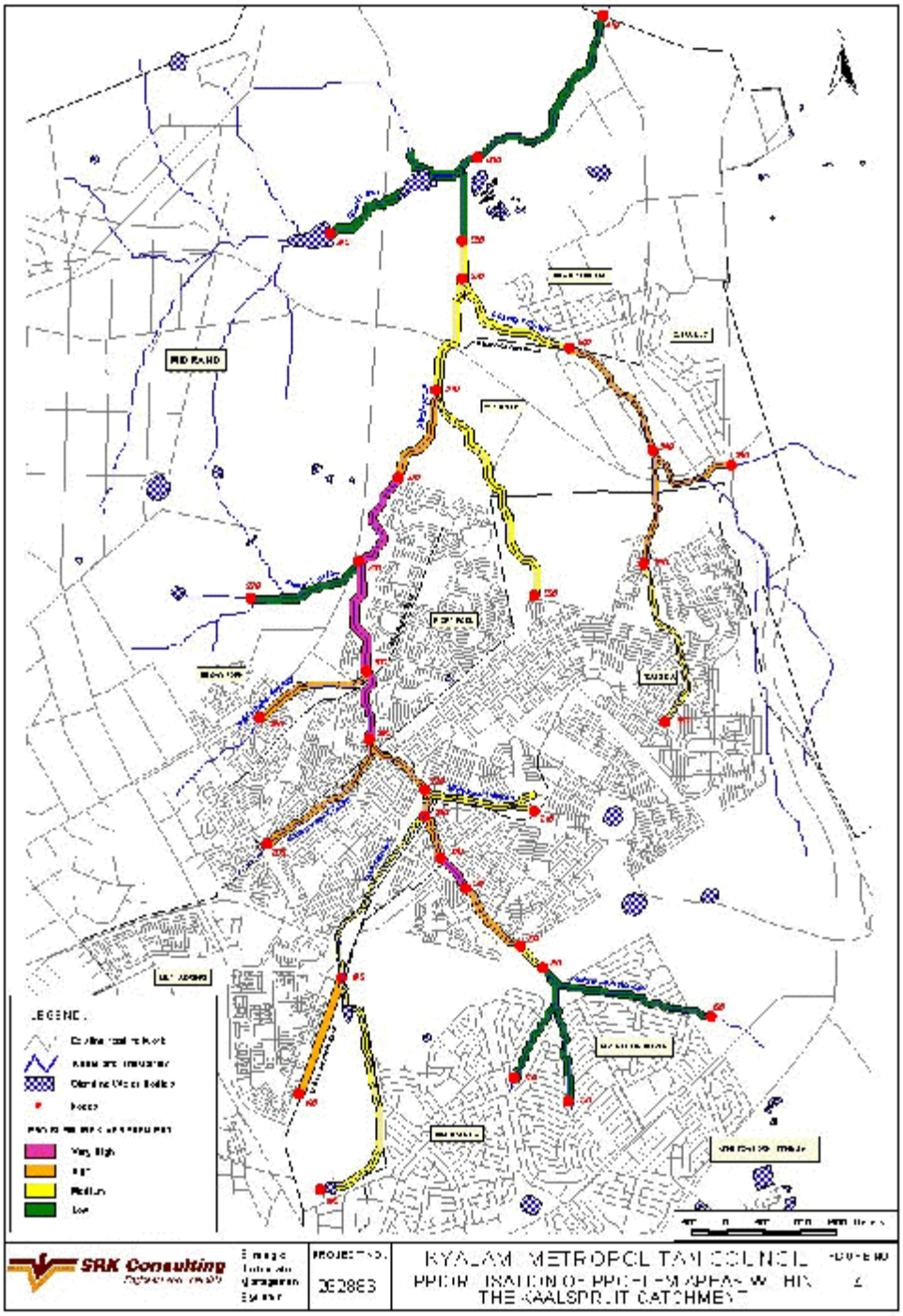


**Figure 5 – SIMPLE FILTER SYSTEM (Sowman and Urquhart, 1998)**

Figure 5 shows a simple filter system which can be used to filter low flow water, similar to a biofilter used in a sewage works.

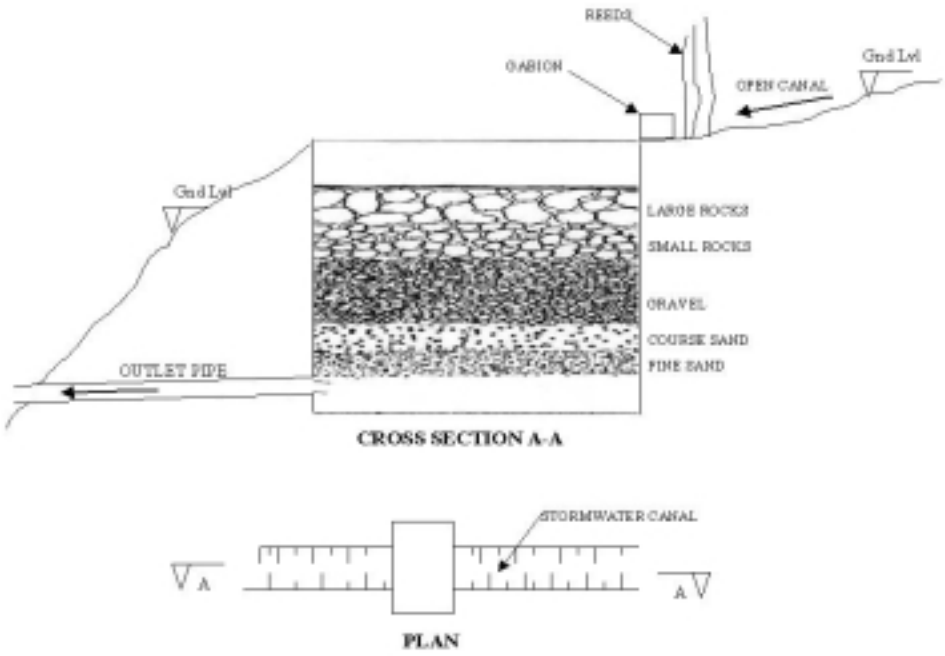



**Figure 6 – EROSION PROTECTION IN A RIVER (Sowman and Urquhart, 1998)**

Figure 6 shows a gabion basket erosion protection structure which is used to reduce velocities and thus erosion in the river.

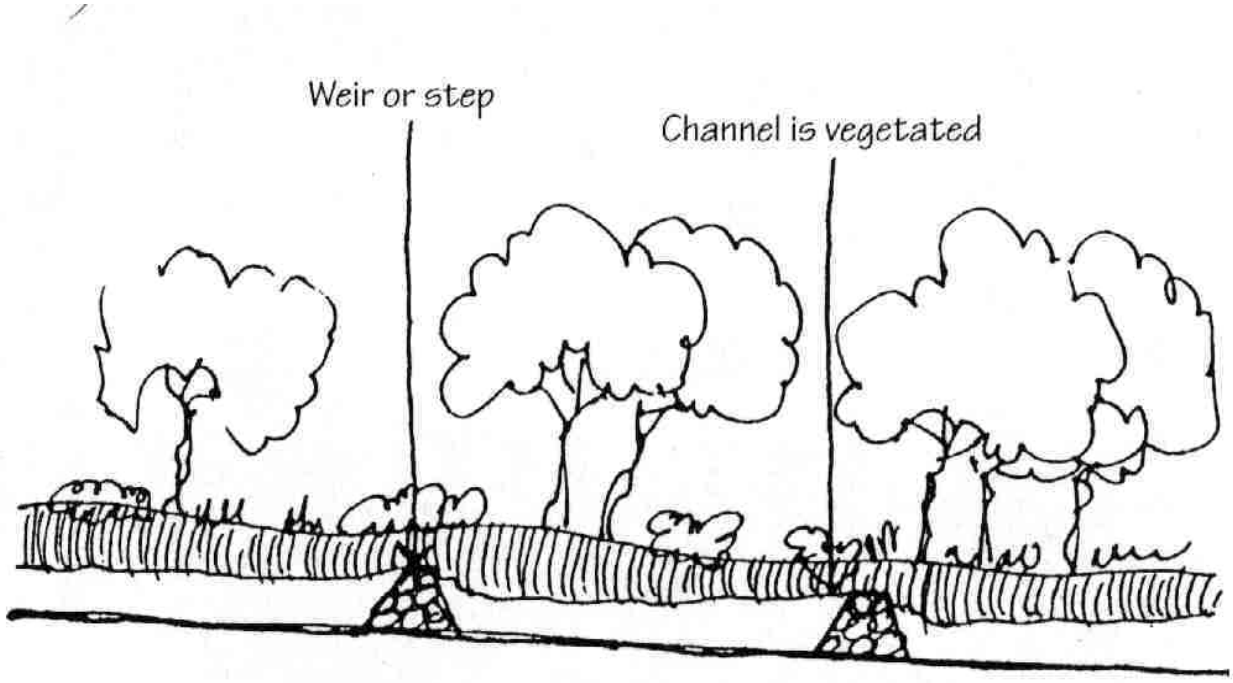


**Figure 7 – APPROPRIATE TREATMENT OF WASTEWATER (From Sowman & Urquart, 1998)**

Figure 7 shows various methods to treat wastewater where no water borne sewage is available. The method selected depends on the soil conditions.

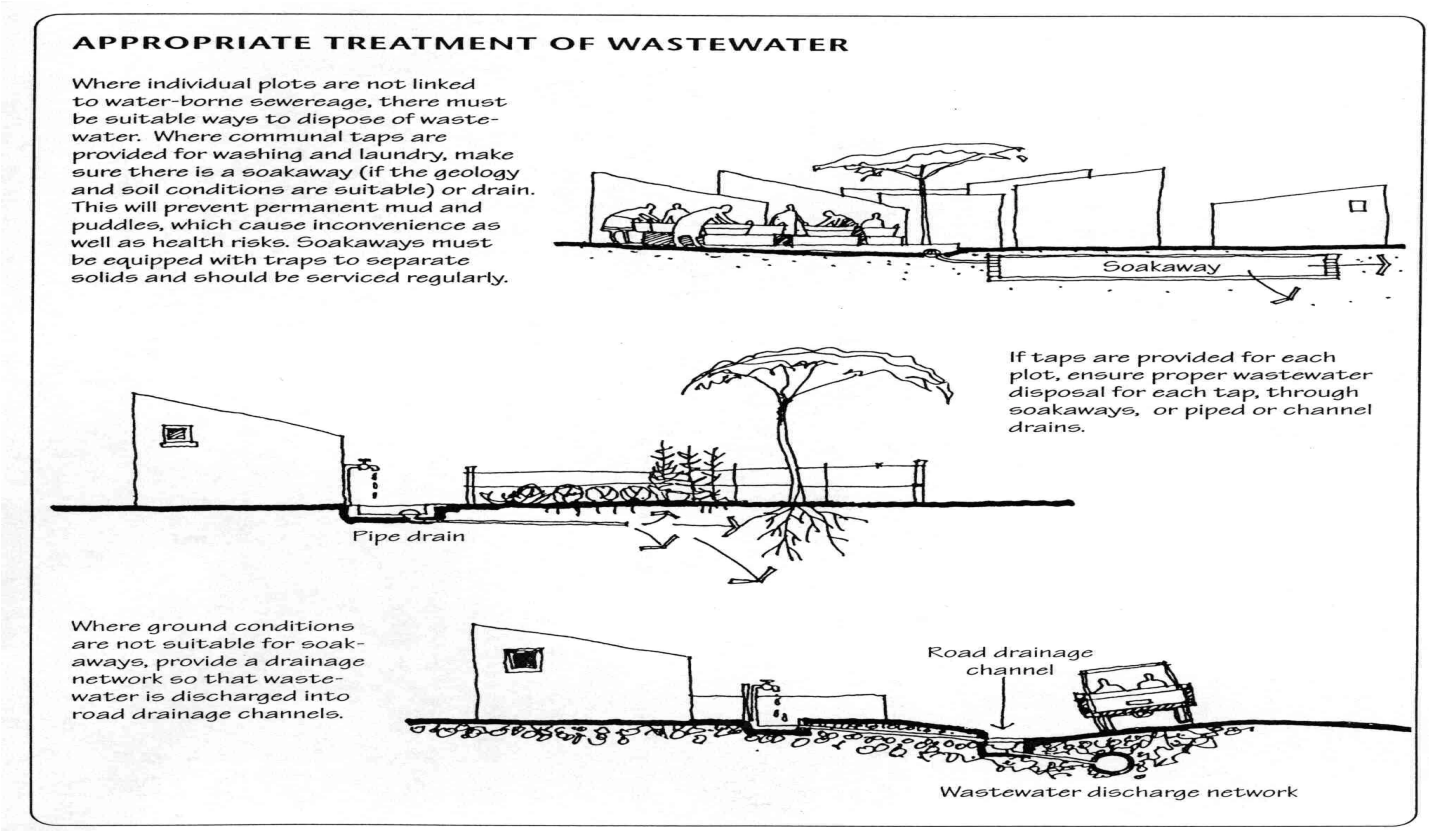
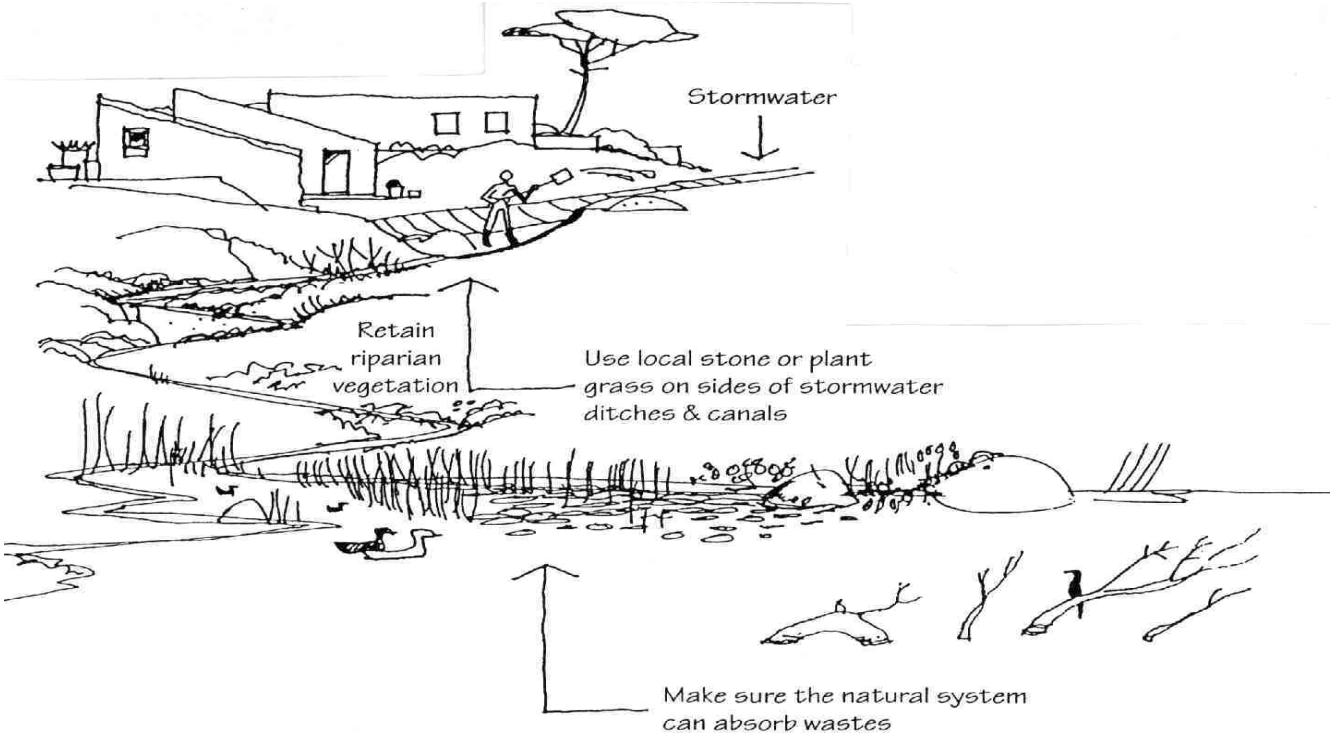



**Figure 8 – APPROPRIATE RIVER MANAGEMENT (from Sowman & Urquhard, 1998)**

Figure 8 schematically presents the ability to maximise the cleaning capacity of a river.



From the workshops it was agreed that leaving the "Kaalspruit as is" is not an option and that the management plan would need to include remedial measures from the two options of:

- conveying the polluted water as fast and safe as possible to the river and then treat the water in the river
- pre-treatment of water before it reaches the river.

The costing of the remedial measures is based on 1999 prices and are given for operational ongoing costs (Opex) and once off capital costs (Capex). The type of remedial measures allocated to each area was based on the node points and an estimate of the length of canal, number of leachfields, number of erosion weirs at other remedial measures. The cost was based on visual requirements and would need to be confirmed at final design stage.

The remedial measures for each reach, as indicated on Figure 4, is presented in Table 2 below.

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**Future Planning Strategy**
The implementation of the plan involves carrying out remediation of the high problem areas in the first years and then the lower priority areas in the latter years. This will enable the 80-20 rule to operate (i.e. if one can spend 20% of the allocated money upfront 80% of the problem may be solved).

To see if the system works a comprehensive and effective monitoring programme needs to be undertaken to measure the effects of implementation of the plan. This would involve establishing a co-ordinated monitoring programme across the whole catchment, not on a local authority basis as is currently in place.

## RECOMMENDATIONS

To ensure the successful implementation the following points need to be considered.

- These short term remedial measures need to be backed up with proper township development and management including maintenance of the installed remedial measures.
- All stakeholders who are affected (local people and relevant authorities) need to be consulted at both final design and implementation stage.
- Budgeting constraints must be recognised as pollution has a low priority at local government level when compared to housing, education and health.

## REFERENCES

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