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Decision support system for managing stormwater and greywater quality in informal settlements in South Africa

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Table 2-1: Summary of urban water quality management studies undertaken in South Africa

Reference	Study focus	Study location	Type of urban dev/landuse	Socio-economic status			Population density	Biophysical catchment characteristics						Runoff problems		
				Type & density of housing	Level of income	Level of service		Climate	Dominant hydrological process	Relief	Soil/ geology	Area	Other	Main pollutants monitored	Main pollutant sources	Causes of pollution
Simpson (1986)	Urban runoff water quality	Pinetown, KZN	Commercial, light industrial & residential					coastal summer rainfall						SO4, Cl, NOx-N, P, Cd, Cu, Fe, Pb, Zn		
Stephenson & Green (1988)	Urban runoff water quality	Montgomery Park	Residential, few commercial & light industrial	Formal, low-density				inland summer rainfall				1.053 ha		Cl, pH		
		Hillbrow	Residential & commercial	Formal, high-density	Low to high	High (water borne sewerage & stormwater)	12,500 (186 people/ha)		urban runoff	mountainuous	highly impervious	67.2 ha		Ca, Mg, Na, K, Cl, pH, Alk, NO3, NH4, PO4, SO4, EC, TDS, COD, SS, TP, Fe, Pb, Cu, Cr, Turb.	Pollutants buildup, atmospheric fallout, vehicle emissions, roads, pavements, sewer surcharge, spills and illicit discharges, litter, etc	Littering, inappropriate use and abuse of services, overloaded sanitation systems, etc.
Klopers (1989)	Compared stormwater quality in Three Anchor Bay with Mitchell's Plain	Three Anchor Bay	Residential	low density middle class				Coastal winter rainfall region				152 ha		F-Coli, F-Strep, Coliph, Cd, Cu, Fe, Pb, Zn		
		Mitchell's Plain	Residential	medium density working class								1,375 ha		F-Coli, F-Strep, Coliph, Cd, Cu, Fe, Pb, Zn		
Wright (1991)	Urban runoff quality	Atlantis	Industrial town				70,000 people							K, Na, Ca, Mg, NH4-N, SO4, Cl, Alk, Nox-N, P, pH, DO, EC, TDS, Cd, Cu, Fe, Pb, Zn		
Wimberley (1992); Van Veelen & DWAF (1994a, b)	Assessed the effect of urban runoff on water quality of Jukskei river	Alexandra in Gauteng	Residential and commercial	High density, high to low cost formal housing, & low cost informal housing	Low to medium	Low	300,000 (612 p/ha)	Inland summer rainfall	Urban runoff	Between 12.5 to 3.3% slope	Granitic sands	490 ha		F-Coli, E-Coli, EC, pH, TKN, NH4-N, NO3-N, NO2-N, TP, PO4-P, COD, SS, TDS, SO4, Cl, Pb, Fe	greywater, solid waste, sewer/toilet overflows	inadequate service provision, low maintenance levels, illicit discharges and connections, over-crowding, littering, personal hygine etc

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Silberbauer & Moolman (1991)	urbanisation & urban runoff water quality deterioration	Rietspruit in Gauteng														
Simpson & Coleman (1992)	Assess applicability of WITSKM TO Shembe catchment	Shembe near Durban	Residential & few commercial	High density, low cost informal housing								560 ha				
Mackey (1993, 1994a, b)	Impact of runoff from townships on lower Swartkops river	Swartkops, near Port Elizabeth	Residential, agricultural and industrial	Formal and informal. Low to high cost and density housing	Mixed						Soils are predominantly lithosols	1370 km2		F Coliform, E-Coli, EC, pH, NH4-N, NO3-N, PO4-P, COD, TSS, TDS		
Van Ginkel et al., (1993)	Impact of runoff from townships on Buffalo river	Eastern Cape coast (Buffalo river catchment)	Irrigation (8.5 km2); Urban-all types (9%); forestry & agriculture (75%)	All types	All levels	All levels	311,000 people (Average population density = 400/km2)	Year-round rainfall region (summer rainfall being double that for winter)		Mountain zone, foothills zones and coastal areas	sandy loam derived from Beaufort sediments and clays from dolerite outcrops	1276 km2		B, Ca, Cl, COD, DOC, EC, F, K, KN, Mg, Na, NH4, NO3+NO2, O2, pH, PO4, Sl, SO4, SS, T-Alk, TDS, Temp, TP, Turb.	Urban runoffs, especially rural villages	Livestocks, inadequate sanitation and solid waste disposal facilities
Wright et al., (1992)	Impact of runoff from townships on receiving river	Khayelitsha	Residential	All types of urbanization. High density housing	Low income (under R4,000/ person/ annum)	Variable (nill in the shack areas and high in the formal areas)	320,000 (1990 census)	Low-intensity winter rainfall	Interflow and groundwater flow		Sand with high infiltration rate. Saturated sand thickness of 20 - 25 m.			F-Coli, F-Strep, Coliph, K, Na, Ca, Mg, NH4-N, SO4, Cl, Alk, Nox-N, P, pH, DO, EC, TDS, Cd, Cu, Fe, Pb, Zn	sewage overflow (serviced sites)	Litter, faecal, high pop density, poor living conditions, lack of envtal awareness, political unrest
Kelbe et al., (1992)	Hydrological response to urbanization	Ntuze catchment, KZN	Rural settlemnts, forest, plantation, subsistence, sugar cane, **mostly grass land**, rocks	Informal housing. Low density	Low	None/low	low	High summer and low winter rainfall	-	10 - 20%	Glenrosa form (Robmore series)			pH, EC, turbidity, SS, PO4 NO3, NH4, DOC, COD, Cl		
Coleman (1992)	Hillbrow quality monitoring, and review of quality models	Hilbrow	Residential & commercial	Formal, high-density	Low to high	High (water borne sewerage & stormwater)	High	inland summer rainfall				67.2 ha				

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Campbell (2001)	Processes pollutants in urban runoff undergo during natural assimilation in rivers	Alexandra	Residential & few commercial	High density, high to low cost formal housing, & low cost informal housing	Low to medium	Low	300,000 (612 p/ha)	Summer rainfall	Urban runoff	Between 12.5 to 3.3% slope	Granitic sands	490 ha		F-Coli, E-Coli, EC, pH, TKN, NH4-N, NO3-N, NO2-N, TP, PO4-P, COD, SS, TDS, SO4, Cl, Pb, Fe	greywater, solid waste, sewer/toilet overflows	inadequate service provision, low maintenance levels, illicit discharges and connections, over-crowding, littering, personal hygineetc
Armitage et. al., (1998)	Removal urban litter from stormwater drains	Springs	Commercial/industrial (85%) and residential (15%)					Summer rainfall (MAP = 750mm)				299 ha		Litter		
		Johannesberg (Robinson canal)	Highly developed. Mix of residential, commercial, idustrial and informal tradinf areas	Formal housing				Inland summer rainfall				800 ha		Litter		
		Cape Town (Capel Sloot culverts)	Undeveloped (60.4%), residential (18.3%), park land (8%) industrial (4.2%) commercial (7.1%) railway land (2%)	Formal housing				Coastal winter rainfall region				1092 ha		Litter		
Grobicki (2001)	Integrated urban catchment management - Lotus rivers	Cape Town	Residential, agricultural (cultivated & uncultivated)	From informal to Formal. Density of informal = 286-13 dwelling units/ha	Low income in the informal settlements. Low to medium income in the formal settlements	Low	380,000 people	Coastal winter rainfall region	Interflow and groundwater flow	Flat	Sand with high infiltration rate.	4816 ha	Acute ecological stress, highly polluted water bodies & significant loss of biodiversity	TN, TP, COD, TSS, EC, pH, Faecal coliform	Sewer overflows, informal setlements, Horticultural areas	Sewer blockages, inadequate/non-existent sanitation in informal setlements, fertilizer use
Pegram et. al., 1998	Policy considerations for non-point source management in S/Africa	South Africa	General	General	General	General	General	General	General	General	General	General	General	General	General	General