Report No: P WMA
19/G10/00/2413/1

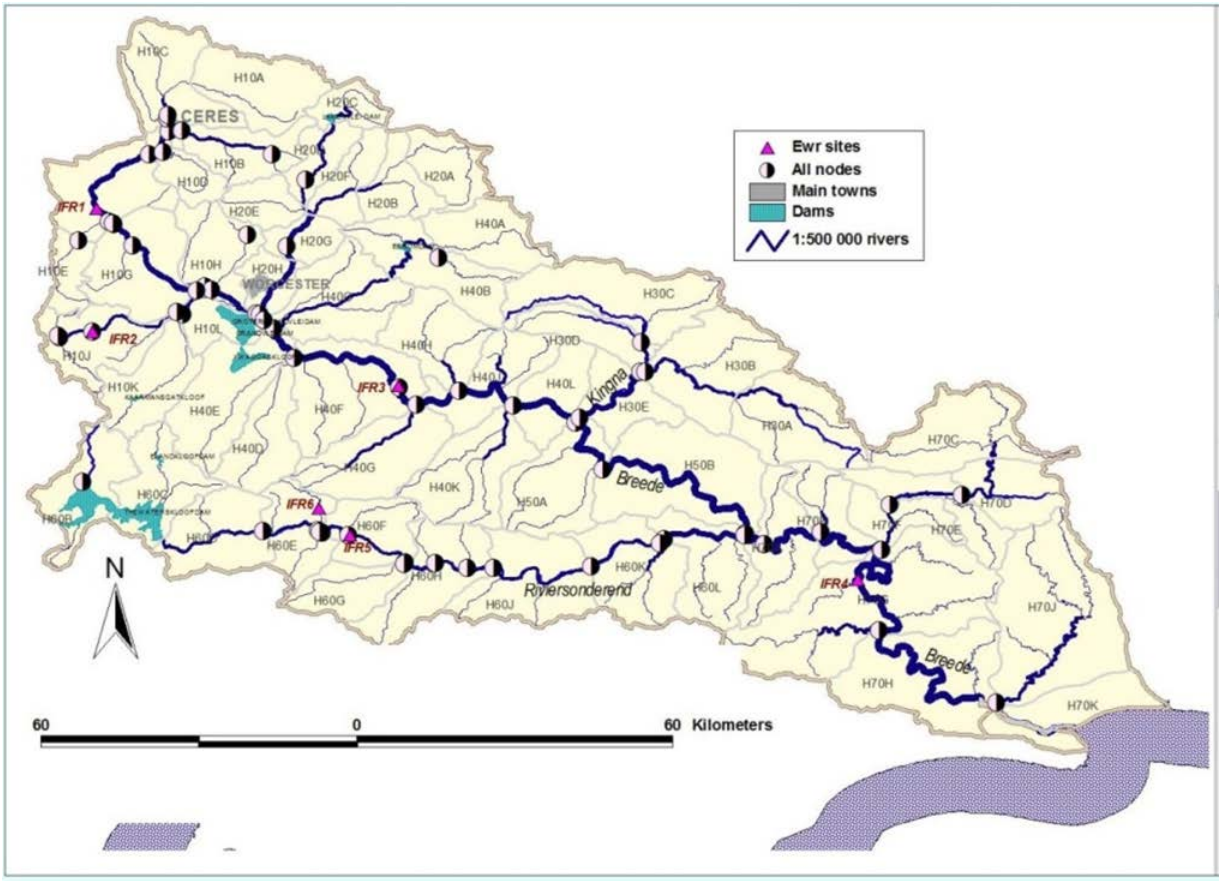
Department of Water Affairs
Directorate: Options Analysis

PRE-FEASIBILITY AND FEASIBILITY STUDIES FOR AUGMENTATION OF THE WESTERN CAPE WATER SUPPLY SYSTEM BY MEANS OF FURTHER SURFACE WATER DEVELOPMENTS

REPORT No.1 – VOLUME 1
Riverine Environmental Water Requirements

APPENDIX No.5

Habitat Integrity – Breede River



June 2012

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1	ECOLOGICAL WATER REQUIREMENT ASSESSMENTS	Vol 1	PWMA19 G10/00/2413/1	**Riverine Environmental Water Requirements**
				Appendix 1: EWR data for the Breede River
				Appendix 2: EWR data for the Palmiet River
				Appendix 3: EWR data for the Berg River
				Appendix 4: Task 3.1: Rapid Reserve assessments (quantity) for the Steenbras, Pombers and Kromme Rivers
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		Vol 3	PWMA19 G10/00/2413/3	**Berg Estuary Environmental Water Requirements**
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2	PRELIMINARY ASSESSMENT OF OPTIONS		PWMA19 G10/00/2413/4	Appendix 1: Scheme Yield Assessments and Diversion Functions
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REPORT No	REPORT TITLE	VOLUME No.	DWA REPORT No.	VOLUME TITLE
3	FEASIBILITY STUDIES	Vol 1	PWMA19 G10/00/2413/5	**Berg River-Voëlvlei Augmentation Scheme**
				Appendix 1: Updating of the Western Cape Water Supply System Analysis for the Berg River-Voëlvlei Augmentation Scheme
				Appendix 2: Configuration, Calibration and Application of the CE-QUAL-W2 model to Voëlvlei Dam for the Berg River-Voëlvlei Augmentation Scheme
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				Appendix 7 - 12: See list under Volume 2 below
		Vol 2	PWMA19 G10/00/2413/6	**Breede-Berg (Michell's Pass) Water Transfer Scheme**
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4	RECORD OF IMPLEMENTATION DECISIONS		PWMA19 G10/00/2413/7	

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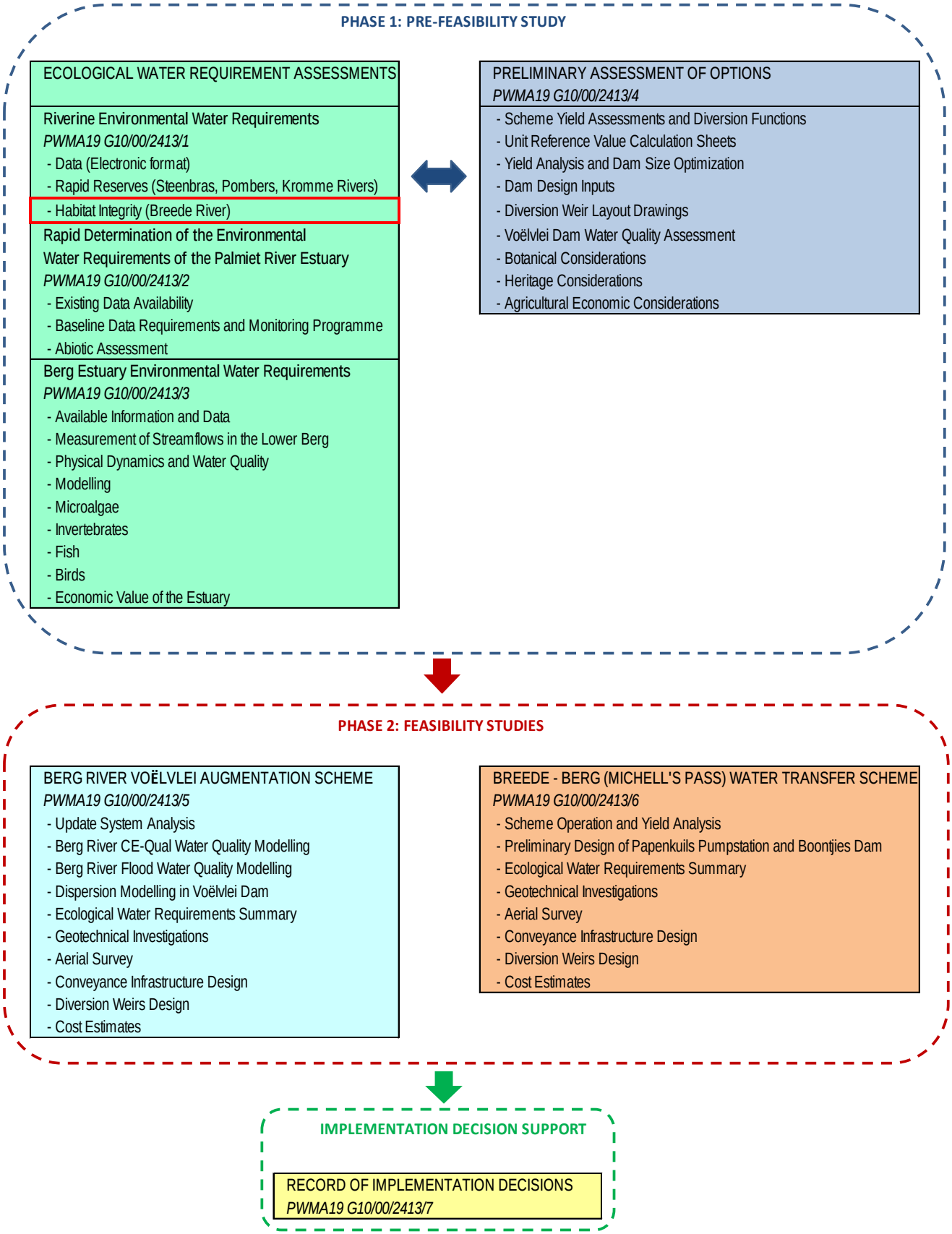

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1 INTRODUCTION

1.1 General background

The Western Cape Water Supply System (WCWSS) serves the City of Cape Town (CCT), other urban users and irrigators. It comprises infrastructure owned and operated by both the CCT and the Department of Water Affairs (DWA).

The Western Cape Reconciliation Strategy Study (DWAF 2007) reviewed the future water requirement scenarios of greater Cape Town and the reconciliation options for meeting these water requirements within a planning horizon to 2030. It identified potential suites of options for meeting future water demand from the WCWSS. It also identified various alternative implementation options, which offered flexibility in planning, such that possible changes in the projected water requirements could be accommodated. One set of implementation options is to further develop the surface water resources of the Berg and Breede Water Management Areas (WMAs).

In July 2008, the then Department of Water Affairs and Forestry (now Department of Water Affairs; DWA) appointed the Western Cape Water Consultants Joint Venture to undertake Pre-feasibility and Feasibility level investigations of the potential development of six surface water options, namely:

- the Michell's Pass Diversion Scheme;
- the First Phase Augmentation of Voëlvlei Dam;
- Further Phases of Voëlvlei Dam Augmentation;
- the Molenaars River Diversion;
- the Upper Wit River River Diversion;
- Further Phases of the Palmiet Transfer Scheme.

This entailed investigations in three major catchments, *viz*. Breede, Palmiet and Berg Catchments.

One aspect of these investigations was the a series of tasks aimed at providing data on the Ecological Water Requirements (EWR) the rivers in these catchments, which would facilitate consideration of the Ecological Reserve (NWA 1998) in the Pre-feasibility and Feasibility assessments of the schemes.

1.2 Purpose of this report

This report (Volume 1, Appendix 4) addresses the Habitat integrity assessments conducted across the Breede River WMA:

Main Report: This report, which covers Tasks 1 and 2 (Table 1.1), and as such is a synthesis of existing EWR data, and the additional data generated in Tasks 3, 4 and 6.
Appendix 1: The rules for establishing WRCS nodes.
Appendix 2: The raw EWR data (only available electronically).
Appendix 3: Task 3: Rapid II Reserve assessments for the Steenbras, Pombers and Krom Rivers.
Appendix 4: Habitat Integrity assessments, Breede River WMA.

Tasks 4, 5 and 6 are addressed in separate reports.

Table 1.1 Reserve-related tasks in the WCWSS

Task No.	Description
1	Generation of catchment-wide Reserve estimates for the Breede and Palmiet Catchments as per the technical requirements of the WRCS.
2	Generation of catchment-wide Reserve estimates for the Berg River Catchments as per the technical requirements of the WRCS.
3	Rapid II Reserve assessments (quantity) for the Steenbras, Pombers and Krom Rivers.
4	Comprehensive Reserve determination for the Berg River Estuary.
5	Resource Economics Assessment of the implications of flow change in the Berg River Estuary.
6	Rapid Reserve determination for the Palmiet River Estuary.
ADD	Ecological condition assessments in the Breede Catchment

1.3 Additional Task: Ecological condition assessments in the Breede Catchment

The Reserves for rivers and estuaries are dependant on the ecological condition of those systems. Since no recent assessments were available for the Breede River and its tributaries, in September 2009 condition assessments were done for 50 sites, represented by nodes (see Volume 1) in the catchment.

The time available to conduct each assessment was limited (half an hour per node), and so it was not possible to apply the comprehensive and current methods for determining PES (Kleynhans *et al*. 2008). Instead, a rapid method of assessing condition, known as a Habitat Integrity (HI) assessment, developed by Kleynhans (1996) was used (see Section 2.1).

The assessment team comprised a riparian vegetation specialist (Karl Reinecke) and macro-invertebrate specialist (Rembu Magoba). In addition, a geomorphologist (Mark Rountree) accompanied the team to 23 of the sites, which covered a range of river types and types of impact. This afforded the assessment team the opportunity of learning the range of factors to consider when scoring geomorphological aspects for the integrated HI assessment, and they then assessed the remaining 28 sites.

1.3.1 ***Previous assessments***

The desktop estimates of RDM for river ecosystems (Kleynhans 2000) were developed to serve the National Water Balance and provide estimates of the water quantity component of the ecological Reserve at the quaternary scale for planning purposes only. The estimates were not intended for use in evaluation. The desktop data generated was preliminary since no field surveys were conducted. The data contained in this appendix thus refines and updates the PES of main stem rivers and tributaries in the Breede WMA.

1.4 Layout of this report

Section 1: This section is a brief introduction to the study in general and the need for condition assessments in the Breede Catchment.
Section 2: A brief description of the Habitat Integrity Status method.
Section 3: Results of the HI assessments for the Breede River and its tributaries.
Section 4: Discussion.

2 METHODS

2.1 Habitat Integrity

Habitat integrity can be defined as a river ecosystem's "ability to support and maintain a balanced, integrated composition of physico-chemical and habitat characteristics, as well as biotic components on temporal and spatial scales that are comparable to the natural characteristics of ecosystems of the region" (Kleynhans 1996).

The HI assessment method is based on the qualitative assessment of a number of pre-weighted criteria that indicate the integrity of the instream and riparian habitats available for use by riverine biota. The assessment is based on the professional judgement and experience of the study team.

The criteria considered indicative of the habitat integrity of the river were selected on the basis that anthropogenic modification of their characteristics could generally be regarded as the primary causes of degradation of the integrity of the river. Certain modifications will have a detrimental impact on the habitat integrity of a river, the extent of that impact being dependent on their severity.

The assessment of the severity of impact of modifications is based on six descriptive categories with ratings ranging from 0 (no impact), 1 to 5 (small impact), 6 to 10 (moderate impact), 11 to 15 (large impact), 16 to 20 (serious impact) and 21 to 25 (critical impact).

The HI Assessment is based on assessment of the impacts on two components of the river, the riparian zone and the instream habitat. Assessments are made separately for both components, but data for the riparian zone are interpreted primarily in terms of the potential impact on the instream component. The relative weightings of criteria are detailed in Table 2.1.

Table 2.1 Criteria and weights used for the assessment of instream and riparian zone habitat integrity (taken from Kleynhans 1996)

Instream criteria	Weight	Riparian zone criteria	Weight
Water abstraction	14	Indigenous vegetation removal	13
Flow modification	13	Exotic vegetation encroachment	12
Bed modification	13	Bank erosion	14
Channel modification	13	Channel modification	12
Water quality	14	Water abstraction	13
Inundation	10	Inundation	11
Exotic macrophytes	9	Flow modification	12
Exotic fauna	8	Water quality	13
Solid waste disposal	6		
TOTAL	100	TOTAL	100

The estimated impact of each criterion is calculated as:

Rating for the criterion /maximum value (25) x weight (percent).

The estimated impacts of all criteria calculated in this way are summed, expressed as a percentage and subtracted from 100 to arrive at a provisional assessment of Intermediate HI for the instream and riparian components, respectively.

The total scores for the instream and riparian zone components are then used to calculate the overall category (Table 2.2).

Table 2.2 Ecological categories and percentage scores relative to natural (Kleynhans 1996)

Category	Description	Score
A	Unmodified, natural	100
B	Largely modified with few modification. A small change in natural habitats and biota may have taken place but the ecosystem functions are largely unchanged.	80-99
C	Moderately modified. A loss and change of natural habitat and biota have occurred but the basic ecosystem functions are still predominantly unchanged.	60-79
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40-59
E	The loss of natural habitat, biota and basic ecosystem functions are extensive.	20-39
F	Modifications have reached critical level and the lotic system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible.	0-19

It was not possible to quantify the impact associated with exotic fauna through the sorts of visual assessments undertaken for this exercise, but various species of exotic fish are known to occur widely through the catchment. To cater for this shortcoming, and to avoid an under assessment of condition, a score of 10/25 was applied to all assessed nodes.

2.2 The use of SASS

A SASS 5 (Dickens and Graham 2002) sample was taken at some sites to assist in scoring the impact of water quality on HI. The estimate of water quality condition was based upon the presence of sensitive or tolerant taxa at each site. Where appropriate, data obtained at sampled sites was extrapolated to other similar river reaches. The assumption was that reaches with similar physical characteristics and disturbances support comparable aquatic macroinvertebrate assemblages.

2.3 Organisation of the data

2.3.1 *Grouping of the nodes*

The WRCS nodes in the Breede Catchment are listed in Table 2.3 (from Volume 1). For the HI assessment, nodes were grouped on the basis of location (Figure 2.1; Table 2.3), and each group discussed separately in Section 3. Some inaccessible or outlier nodes were not assessed.

Table 2.3 WRCS nodes in the Breede Catchment

Node	Comment	River	LON (E)	LAT (S)	Quat	Assessed?	Group
Nvii3	U/s of confluence with Titus, at gauge H1H016	Rooikloof	19.4777	-33.42146	H10B	N	1
Niv3	U/s of confluence with Breede	Titus	19.3236	-33.37987	H10B	Y	1
Nvi4	2 km d/s of confluence with Dwars/ Titus	Breede	19.3022	-33.38129	H10C	Y	1
Niv2	U/s of confluence with Koekedou	Dwars	19.3006	-33.35445	H10C	Y	1
Niv1	U/s of confluence with Dwars	Koekedou	19.2983	-33.35961	H10C	Y	1
Nvi3	U/s of junction of roads R46/ R43	Breede	19.2684	-33.42148	H10D	Y	2
Niv4	U/s of confluence with Breede	Witels	19.2924	-33.41749	H10D	Y	2
Nvi2	At Tweede Tol on Bainskloof Pass (R303)	Wit	19.1479	-33.56785	H10E	Y	2
Nviii1	D/s confluence with Wabooms, nearest quaternary boundary to EWR 1	Breede	19.2073	-33.53985	H10F	Y	2
Niv6	U/s of confluence with Breede	Wabooms	19.2062	-33.53827	H10F	Y	2
Niv5	U/s of confluence with Breede	Wit	19.1994	-33.53577	H10F	Y	2
Niii1	U/s of confluence with Molenaars (Smalblaar)	Breede	19.3491	-33.65363	H10G	N	3
Niv7	U/s of confluence with Slanghoek	Slanghoek	19.2402	-33.57666	H10G	Y	2
Niv8	U/s of confluence with Breede	Bothaspruit/ Witrivier	19.3634	-33.6472	H10H	Y	3
Nv3	U/s of confluence with Hex (at Brandvlei reservoir)	Breede	19.451	-33.69282	H10H	Y	3
Nvii6	At gauging weir H1H020, 7.5 km North of Worcester	Hartbees	19.4359	-33.55895	H10H	N	3
Niv9	U/s of confluence with Breede	Hartbees/ de Wetskloof	19.3747	-33.65185	H10H	Y	3
Niv40	U/s of confluence with Molenaars	Elands	19.1157	-33.73389	H10J	Y	2
Niv41	U/s of confluence with Molenaars	Krom	19.1123	-33.73017	H10J	Y	2
Nvii2	At gauging weir H1H018, EWR 2	Molenaars	19.1709	-33.72392	H10J	Y	2
Niv42	Just South of Rawsonville	Molenaars/ Smalblaar	19.3159	-33.68995	H10J	Y	3
Niv12	Just South of Rawsonville	Holsloot	19.3251	-33.69406	H10K	Y	3
Nii1	D/s of Hex/Breede confluence	Breede	19.4638	-33.70374	H10L/ H10H	N	3
Nvii4	At gauging weir H2H005, 7 km West of Hex River Valley	Sanddrif/ Spek	19.5361	-33.46457	H20D	N	3
Nvii7	At gauging weir H2H006, North of Worcester on N1	Hex	19.5033	-33.57849	H20G	Y	3
Niv10	U/s of confluence with Breede	Hex	19.4565	-33.69419	H20H	Y	3
Niv18	U/s of confluence with Kogmanskloof	Kingna	20.116	-33.79284	H30B	Y	4
Niv20	U/s of confluence with Keisie	Pietersfontein	20.1083	-33.74194	H30C	Y	4
Nvii9	U/s of confluence with Kogmanskloof	Keisie	20.1068	-33.79282	H30D	Y	4
Nii2	At gauging weir H3H011, u/s of confluence with Breede	Kogmanskloof	20.0032	-33.87049	H30E	Y	4
Nvii5	At gauging weir H4H008, 2.3 km North of Worcester	Koo	19.7629	-33.5973	H40B	N	3
Niv11	U/s of confluence with Breede	Nuy	19.4813	-33.71801	H40C	Y	3
Niv13	U/s of confluence with Breede, d/s of Hoeks/Doring (Bobbejaans/Kiesie)	Doring	19.5158	-33.76905	H40D	Y	3
Ni1	U/s of confluence with Poesjenels	Breede	19.7252	-33.84912	H40F	Y	4
Nvii8	At gauging weir H4H017, EWR 3	Breede	19.6947	-33.81871	H40F	Y	4
Niv15	U/s of confluence with Breede	Vink	19.7975	-33.82419	H40H	Y	4
Niv14	U/s of confluence with Breede	Keisers	19.8899	-33.85032	H40K	Y	4

Node	Comment	River	LON (E)	LAT (S)	Quat	Assessed?	Group
Nvi1	U/s of confluence with Kogmanskloof	Breede	19.9965	-33.87871	H40L	N	4
Niii3	U/s of confluence with Boesmans	Breede	20.0426	-33.95977	H50A	N	4
Ni2	U/s of confluence with Riviersonderend	Breede	20.2866	-34.06867	H50B	N	4
Nvii10	U/s of Theewaterskloof Dam	Du Toits	19.1539	-33.97951	H60B	Y	6
Nv7	2.5 km u/s of confluence with Meul	Riviersonderend	19.4633	-34.06361	H60D	Y	6
Niv28	U/s of confluence with Riviersonderend, d/s of EWR 6 on Baviaans	Baviaans	19.5567	-34.06331	H60E	Y	6
Nv8	South of Genadendal, d/s of R404 bridge	Riviersonderend	19.5639	-34.06627	H60E	Y	6
Niv29	U/s of confluence with Riviersonderend	Sersants	19.5591	-34.06608	H60E	Y	6
Niv30	U/s of confluence with Riviersonderend	Gobos	19.6091	-34.07054	H60F	Y	6
Nv9	At confluence with Kwartel	Riviersonderend	19.7049	-34.11756	H60F	N	6
Niv31	U/s of confluence with Riviersonderend	Kwartel	19.703	-34.12027	H60G	Y	6
Nv10	D/s of confluence with Slang and Lindeshof town	Riviersonderend	19.8562	-34.12656	H60H	Y	6
Niv34	U/s of confluence with Riviersonderend	Slang	19.8113	-34.12776	H60H	Y	6
Niv33	U/s of confluence with Riviersonderend	Soetmelksvlei	19.7563	-34.1185	H60H	Y	6
Nv11	9 km u/s of Stormsvlei, alongside N2	Riviersonderend	20.0232	-34.1247	H60J	Y	6
Niv35	U/s of confluence with Riviersonderend	Kwassadie	20.1414	-34.08539	H60K	Y	6
Nv12	D/s of confluence with Kwassadie	Riviersonderend	20.1474	-34.07773	H60K	N	6
Ni3	U/s of confluence with Breede	Riviersonderend	20.2851	-34.07071	H60L	N	6
Niv24	U/s of confluence with Riviersonderend	Leeu	20.3186	-34.08595	H70A	Y	4
Nv2	U/s of confluence with Buffelsjag	Breede	20.5172	-34.09622	H70B	N	4
Niv24a	U/s of confluence with Riviersonderend	Klip	20.4151	-34.06616	H70B	Y	4
Nv13	At Suurbraak	Buffeljags	20.6567	-34.00276	H70D	N	4
Nv14	U/s of Buffeljags Dam	Buffeljags	20.5726	-34.00277	H70E	Y	4
Niv25	U/s of confluence with Riviersonderend	Buffeljags	20.5188	-34.09603	H70F	N	4
Niii4	D/s of EWR 4, at Napkei confluence	Breede	20.5146	-34.23372	H70G	N	5
Niv26	U/s of confluence with Breede	Slang	20.7149	-34.35731	H70J	N	5

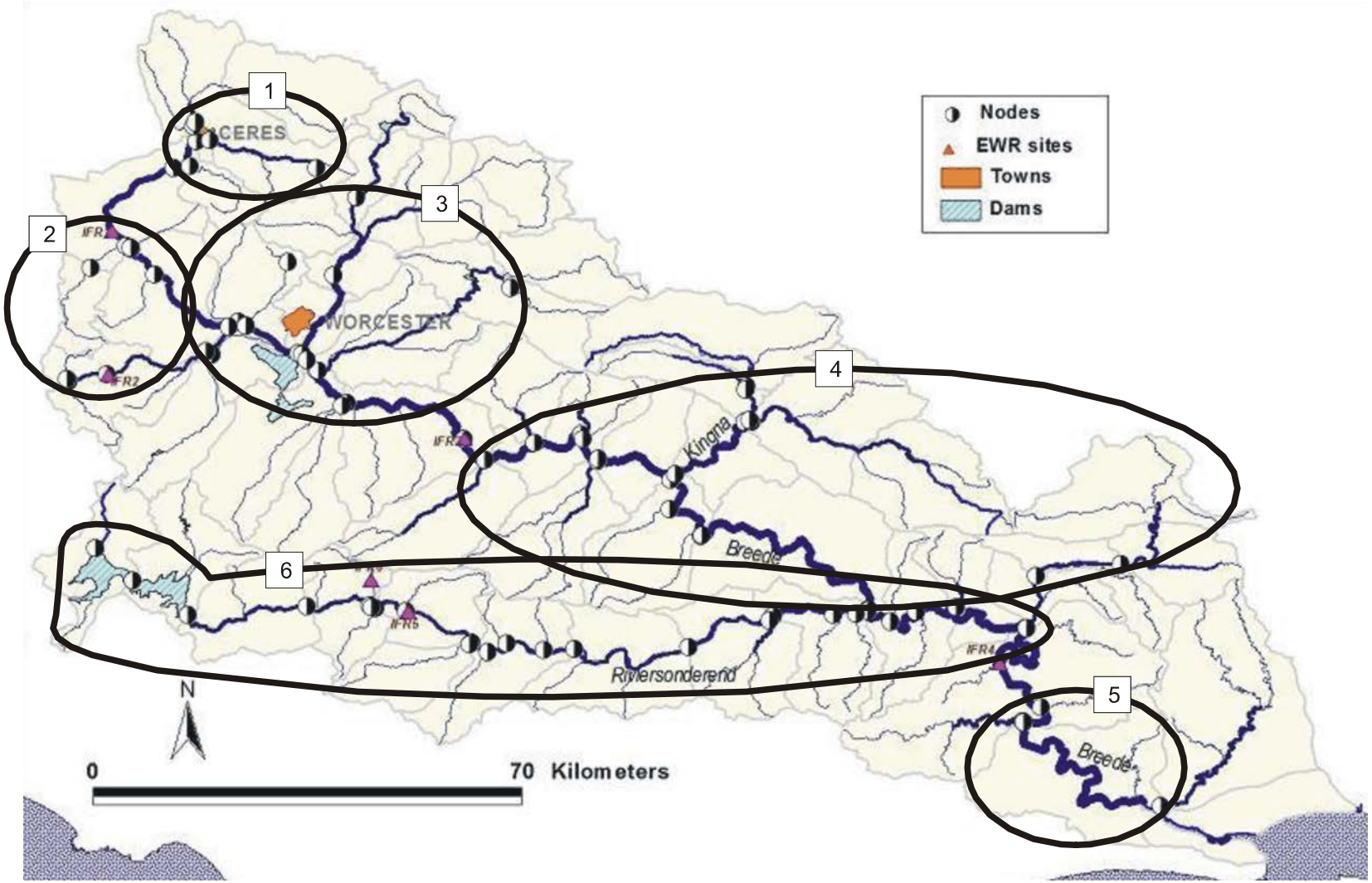

Figure 2.1 Breede River catchment showing the 63 WRCS nodes, grouped into six groups (1-6).

2.3.2 *Riparian vegetation data*

The riparian vegetation at the nodes was classified according to growth form (Table 2.4 and Table 2.5). Exotic species are indicated with an asterisk (*).

Table 2.4 Growth forms assigned to species (after Goldblatt and Manning 2000).

Growth form	Definition
Aquatic	Free floating, not rooted in river substrata.
Forb	A broad leaved herbaceous plant other than graminoids (grasses, sedges and rushes).
Geophyte	A perennial plant that propagates by underground bulbs, tubers or corms.
Graminoid	Includes grasses (Poaceae), sedges (Juncaceae) and rushes (Cyperaceae). **Restios (Restionaceae) were placed in this category for this report due to their similar growth form.**
Shrub	A woody perennial plant with multiple woody stems.
Tree	A tall woody plant with main trunk, branches and a distinct elevated crown.

Table 2.5 Riparian vegetation species commonly occurring in the Breede River valley. Codes represent growth forms: Aq. = aquatic, Fo. = forb, Ge. = geophyte, Gr. = graminoid, Sh. = shrub and Tr. = tree.

Species	Common name	Code	Exotic species	Common name	Code
Pteridium aquilinum	Bracken fern	Aq.	**Azolla filiculoides*	Water fern	Aq.
Aponogeton distachyos	Waterblommetjie	Ge.	**Lantana camara*	Lantana	Sh.
Zantedeschia aethiopica	Arum lily	Ge.	**Rubus fruticosus*	Blackberry	Sh.
Calopsis paniculata		Gr.	**Conyza bonariensis*	Hairy horseweed	Fo.
Juncus acutus		Gr.	**Conyza canadensis*	Horseweed	Fo.
Juncus effusus		Gr.	**Phytolacca americana*	American pokeweed	Fo.
Juncus exsertus	Biesie	Gr.	**Rumex acetosella*	Sheep's sorrel	Fo.
Juncus krausii	Rush	Gr.	**Solanum nigrum*	Black nightshade	Fo.
Juncus lomatophyllus		Gr.	**Arundo donax*	Spanish reed	Gr.
Pennisetum macrourum	Beddinggras	Gr.	**Digitaria debilis*	Finger grass	Gr.
Phragmites australis	Common reed	Gr.	**Paspalum urvillei*	Langbeen paspalum	Gr.
Pycreus polystachyos		Gr.	**Pennisetum clandestinum*	Kikuyu	Gr.
Schoenoplectus scirpoides	Papgras	Gr.	**Ricinus communis*	Castor oil plant	Sh.
Typha capensis	Bullrush	Gr.	**Solanum mauritianum*	Bugweed	Sh.
Cyperus papyrus	Papyrus	Gr.	**Acacia longifolia*	Long-leaved wattle	Tr.
Cyperus textilis	Mat sedge	Gr.	**Acacia mearnsii*	Black wattle	Tr.
Elegia capensis		Gr.	**Acacia melanoxylon*	Blackwood	Tr.
Ehrharta calycina		Gr.	**Eucalyptus camaldulensis*	Red river gum	Tr.
Ehrharta setacea		Gr.	**Paraserianthes lophantha*	Stinkbean	Tr.
Ficinia oligantha		Gr.	**Pittosporum undulatum*	Australian cheesewood	Tr.
Isolepis digitata		Gr.	**Populus X canescens*	Grey poplar	Tr.
Isolepis prolifer		Gr.	**Quercus robur*	English Oak	Tr.
Searsia (Rhus) lancea	Karee	Sh.	**Salix babylonica*	Weeping willow	Tr.
Stoebe plumosa	Slangbos	Sh.	**Schinus molle*	Pepper tree	Tr.
Chrysanthemoides monilifera	Tick berry	Sh.	**Eucalytpus sp.*		Tr.
Diospyros glabra	Bloubessiebos	Sh.			
Erica caffra	Water heath	Sh.			
Freylinia lanceolata	Heuningklokkiesbos	Sh.			
Leonotis leonurus	Wilde dagga	Sh.			
Melianthus major	Giant honey flower	Sh.			
Podylaria calyptrata	Sweet-pea bush	Sh.			
Polygala myrtifolia	September bush	Sh.			
Prionium serratum	Palmiet	Sh.			
Psoralea pinnata	fonteinbos	Sh.			
Searsia (Rhus) angustifolia	Wilgerkorentebos	Sh.			
Carprobrotus edulis	Suurvygie	Sh.			
Cliffortia graminea	Vleirooigras	Sh.			
Acacia karoo	Sweet thorn	Sh.			
Rapanea melanophloeos	Cape beech	Tr.			
Searsia pendulina	White Karee	Tr.			
Salix mucronata	Cape willow	Tr.			
Brabejum stellatifolium	Wild almond	Tr.			
Brachylaena neriifolia	Waterwilels	Tr.			
Halleria lucida	Tree fuschia	Tr.			
Kiggelaria africana	African peach	Tr.			
Maytenus acuminata	Sybas	Tr.			
Metrosideros angustifolia	Cape myrtle	Tr.			
Morella serrata	Waterolier	Tr.			
Podocarpus elongatus	Breeriviergeelhout	Tr.			

3 HABITAT INTEGRITY FOR THE NODES ON THE BREEDE RIVER AND ITS TRIBUTARIES

The results of the HI site assessments for each group are presented below. For each group a map showing the location of the nodes in that group is provided followed by a description of the site at the node. For each site, the general channel characteristics, and the state of the aquatic-macroinvertebrate and riparian-vegetation communities are summarised, and the HI scores provided.

3.1 Group 1

Group 1 nodes are located alongside and upstream of the town of Ceres (Figure 3.1). There were five nodes in Group 1: four tributary nodes and one node on the Breede River.

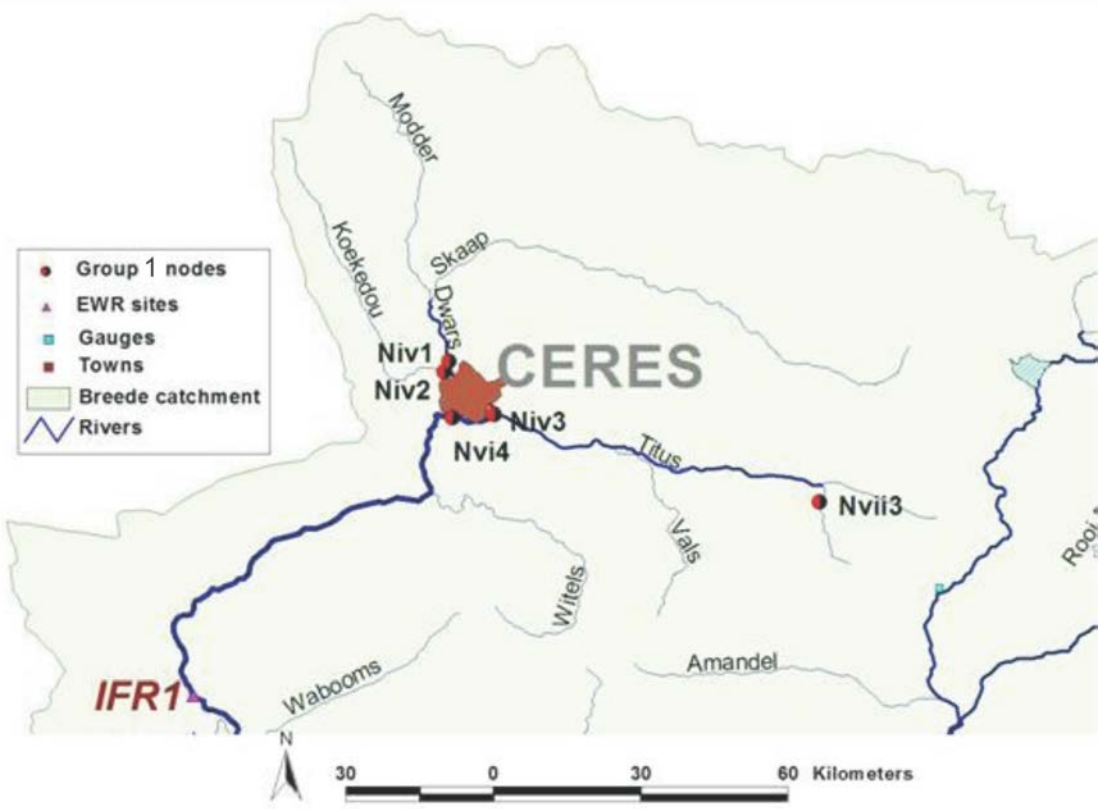

Figure 3.1 Location of the five nodes in Group 1, Breede River catchment

3.1.1 *Niv1: Koekedou River*

A bedrock/boulder bed mountain stream with a limited sand bedload component. Bedrock riffles and rapids with pools dominate the morphology. Palmiet in-channel and *Podocarpus* (yellowwood) along the bank were the common riparian plants (Figure 3.2). This morphology is insensitive to flow modification. The catchment was largely pristine and the geomorphology was estimated in an A or A/B category.

Figure 3.2 Niv1: Koekedou River

There were no obvious signs of disturbance to the riparian vegetation community (Table 3.1).

Table 3.1 Riparian vegetation habitat diversity assessment, Niv1: Koekedou River

Lateral zone	Comment
Wet Bank species: *Prionium serratum*, *Erica caffra*, *Brabejum stellatifolium*, *Metrosideros angustifolia*.	Well-established, good mix of various growth forms, no alien species present. Riparian scrub seedlings and juveniles present, indicating good recruitment by the dominant community members.
Dry Bank species: *Searsia angustifolia*, *Diospyros glabra*, *Calopsis paniculata*.	Well established, good mix of various growth forms, some scattered individuals of alien Blackwood *(*Acacia melanoxylon)*. Riparian scrub seedlings and juveniles present, indicating good recruitment by the dominant community members.

This site presented good quality macroinvertebrate habitat Table 3.2, but presented low macro-invertebrate diversity Table 3.3, possibly due to flow modification as a result of the reservoir upstream.

Table 3.2 Macroinvertebrate habitat diversity assessment, Niv1: Koekedou River

Habitat diversity	General Comments
• Good range of biotopes, with some that are sensitive to flow changes. • Extensive cobble substrata at a depth that allows for the sampling of invertebrates. • Some macrophytes (mostly Palmiet).	Excellent riffles, runs, and pool habitat present optimal conditions; diverse velocity and depth of flow present (i.e. slow, fast, shallow and deep water). Supported low macroinvertebrate diversity with two taxa (Oligoneuridae and Hydropsychidae) that are highly sensitive to flow modification. Comparable to the best habitat conditions for this Ecoregion.

Table 3.3 SASS5 scores, Niv1: Niv1: Koekedou River

SASS5 score	38
No. of taxa	4
Average Score Per Taxon (ASPT)	9.5

Table 3.4 HI scores and category, Niv1: Koekedou River

INSTREAM CRITERIA		RIPARIAN CRITERIA	
water abstraction	20	indigenous vegetation removal	0
flow modification	23	exotic vegetation encroachment	3
bed modification	13	bank erosion	0
channel modification	0	channel modification	0
water quality	5	water abstraction	20
inundation	8	inundation	10
exotic macrophytes	0	flow modification	23
exotic fauna	10	water quality	5
solid waste disposal	0		
TOTAL (%)	61.6	**TOTAL (%)**	70.6
HI Category	C	**HI Category**	C

The overall condition of the site was Category C (Table 3.4).

3.1.2 ***Niv2: Dwars River***

The channel was highly incised as a result of extensive engineering and channelisation along the banks. The reach was a single thread channel with bed and banks composed of fine silts and sands (Figure 3.3), but the reference condition was probably multiple channels across the floodplain with a coarser sediment load. There was also extensive invasion by exotic vegetation (including willows, **Eucalyptus*, black wattle and Spanish reed), which bears testimony to the extent of past disturbance. The geomorphology was estimated to be an E category.

Figure 3.3 Niv2: Dwars River

This site was situated within cultivated orchards and fallow fields and the riparian vegetation was severely disturbed (Table 3.5).

Table 3.5 Riparian vegetation habitat diversity assessment, Niv2: Dwars River

Lateral zone	Comment
Wet Bank species: **Pennisetum clandestinum*.	One or two isolated individual indigenous species. Predominantly exotic species.
Dry Bank species: **Salix babylonica*, **Rubus fruticosus*.	One or two isolated individual indigenous species. Predominantly exotic species.

The poor diversity of habitat available Table 3.6, supported a low diversity of macroinvertebrates Table 3.7.

Table 3.6 Macroinvertebrate habitat diversity assessment, Niv2: Dwars River

Habitat diversity	General Comments
• No cobble substrata at depth suitable for the sampling of invertebrates. • Sparse marginal vegetation dominated by grass. • Majority of river bed consisted of mud covered with algae.	Relatively uniform velocity. Supported relatively lower macroinvertebrate diversity with more taxa that are tolerant to flow modification. The lower ASPT score is an indication of poor river condition. Lower score may be associated with Orchard activities on the left bank.

Table 3.7 SASS5 scores, Niv2: Dwars River

SASS5 score	11
No. of taxa	4
Average Score Per Taxon (ASPT)	2.8

Table 3.8 HI scores and category, Niv2: Dwars River

INSTREAM CRITERIA		**RIPARIAN CRITERIA**	
water abstraction	18	indigenous vegetation removal	23
flow modification	10	exotic vegetation encroachment	20
bed modification	20	bank erosion	13
channel modification	20	channel modification	20
water quality	13	water abstraction	10
inundation	5	inundation	5
exotic macrophytes	10	flow modification	10
exotic fauna	10	water quality	5
solid waste disposal	5		
TOTAL (%)	47.2	**TOTAL (%)**	47.3
HI Category	D	**HI Category**	D

The overall condition of the site was Category D (Table 3.8)

3.1.3 *Niv3: Titus River*

Niv 3 had a similar landscape setting to Niv 2: Dwars River but was in much better condition (Figure 3.4). The geomorphology was estimated to be in a C/D category. The mixed sand and cobble bed river with braid bars, riffles and runs were less confined than in the Dwars River, and there were some remaining near-natural sections in the reach. Large reedbeds were found along the marginal zone, and in some places the incising active channel had exposed peat deposits. These impacts were however localised and on a relatively small scale and much of the riparian wetland was intact. The odour and presence of algae at the site suggested poor water quality.

Figure 3.4 Niv3: Titus River

The river flowed through cultivated and pastoral fields. The riparian zone consisted largely of graminoids and some scattered woody exotics (Table 3.9).

Table 3.9 Riparian vegetation habitat diversity assessment, Niv3: Titus River

Lateral zone	Comment
Wet Bank species: *Isolepis digitata*, *Isolepis prolifer*, *Juncus lomatophyllus*, *Phragmites australis*.	Indigenous species present but patchily distributed within macro-channel.
Dry Bank species: **Acacia longifolia*, **Acacia mearnsii*, **Populus X canescens*.	Some indigenous shrubs present, but isolated and scattered. Mostly exotic woody trees.

There was a variety of macroinvertebrate habitat present Table 3.10 that supported a moderately diverse assemblage Table 3.10.

Table 3.10 Macroinvertebrate habitat diversity assessment, Niv3: Titus River

Habitat diversity	General Comments
• Variety of aquatic macroinvertebrate biotopes (including stones in and out of current, sand and instream vegetation. • Flow diversity high. • Sparse marginal vegetation dominated by grass and reeds in some places. • Algae attached to cobbles.	Supported moderate macroinvertebrate diversity with more taxa that are tolerant of flow modification.

Table 3.11 SASS5 scores, Niv3: Titus River

SASS5 score	51
No. of taxa	6
Average Score Per Taxon (ASPT)	8.5

Table 3.12 HI scores and category, Niv3: Titus River

INSTREAM CRITERIA		RIPARIAN CRITERIA	
water abstraction	15	indigenous vegetation removal	18
flow modification	15	exotic vegetation encroachment	18
bed modification	13	bank erosion	10
channel modification	13	channel modification	13
water quality	15	water abstraction	10
inundation	3	inundation	3
exotic macrophytes	3	flow modification	10
exotic fauna	10	water quality	3
solid waste disposal	3		
TOTAL (%)	56.7	**TOTAL (%)**	58.5
HI Category	D	**HI Category**	D

The overall condition of the site was Category D (Table 3.12)

3.1.4 ***Nvii3: Rooikloof River***

Not assessed.

3.1.5 ***Nvi4: Breede River, Ceres***

This reach is immediately downstream of the town of Ceres. There was lots of litter and incision of the active channel, but the upper channel banks were intact and floods could have overtopped and inundated the floodplain and upper terraces (Figure 3.5). Within the active channel, the cobbles were embedded and there was a high fines load and extensive algae deposits.

Further downstream the river was in a better condition. The alien trees had been removed, and there was a mobile cobble bed (although fines were still elevated – embeddedness was less marked). The geomorphology was in a C category.

Figure 3.5 Nvi4: Breede River, Ceres

The river flowed through farmland and much of the riparian vegetation had been removed (Table 3.13).

Table 3.13 Riparian vegetation habitat diversity assessment, Nvi4: Breede River, Ceres

Lateral zone	Comment
Wet Bank species: *Pennisetum macrourum*, *Juncus lomatophyllus*.	Dominated by graminoids.
Dry Bank species: **Pennisetum clandestinum*.	Cultivated fields of kikuyu, no indigenous species present.

There was a variety of macroinvertebrate habitat present Table 3.14 and a moderately diverse macroinvertebrate assemblage Table 3.15.

Table 3.14 Macroinvertebrate habitat diversity assessment, Nvi4: Breede River, Ceres

Habitat diversity	General Comments
• Variety of aquatic macroinvertebrate biotopes present including stones in and out of current, sand and instream vegetation. • Flow diversity high. Algae attached to cobbles. • Sparse marginal vegetation dominated by grass and reeds in some places.	Supported moderate macroinvertebrate diversity with more taxa that are tolerant to flow modification. Similar to Titus River (Section 3.1.3).

Table 3.15 SASS5 scores, Nvi4: Breede River, Ceres

SASS5 score	51
No. of taxa	6
Average Score Per Taxon (ASPT)	8.5

Table 3.16 HI scores and category, Nvi4: Breede River, Ceres

INSTREAM CRITERIA		**RIPARIAN CRITERIA**	
water abstraction	13	indigenous vegetation removal	20
flow modification	5	exotic vegetation encroachment	10
bed modification	18	bank erosion	7.5
channel modification	15	channel modification	15
water quality	15	water abstraction	7.5
inundation	0	inundation	2.5
exotic macrophytes	0	flow modification	7.5
exotic fauna	10	water quality	7.5
solid waste disposal	15		
TOTAL (%)	58.3	**TOTAL (%)**	60.9
HI Category	D	**HI Category**	C

The overall condition of the site was Category C (Table 3.16).

3.1.6 *Group1: Comparison with 2000 PES assessment*

These rivers are the headwater of the Breede River surrounding the town of Ceres. In general, the rivers scored better in the 2009 assessments than they did in 2000 (Table 3.17). This could be partly a result of improved management, e.g., of Koekoedou Dam and clearing of alien vegetation, but this would need to be confirmed and could just as likely be a product of the fact that the sites were not visited in the 2000 assessment.

Table 3.17 Comparison of PES (Kleynhans 2000) and HI (2009) for nodes in Group 1

Node	PES (2000)	HI 2009	
		Instream	Riparian
Niv1: Koekedou River	D	C	C
Niv2: Dwars River	D	D	D
Niv3: Titus River	D	D	D
Nvii3: Rooikloof river	D	-	-
Nvi4: Breede River, Ceres	D	D	C

3.2 Group 2

Group 2 nodes are located to the South of Ceres and to the West of Worcester (Figure 3.6). There were 10 nodes in Group 2, seven nodes on tributaries and three nodes on the Breede River.

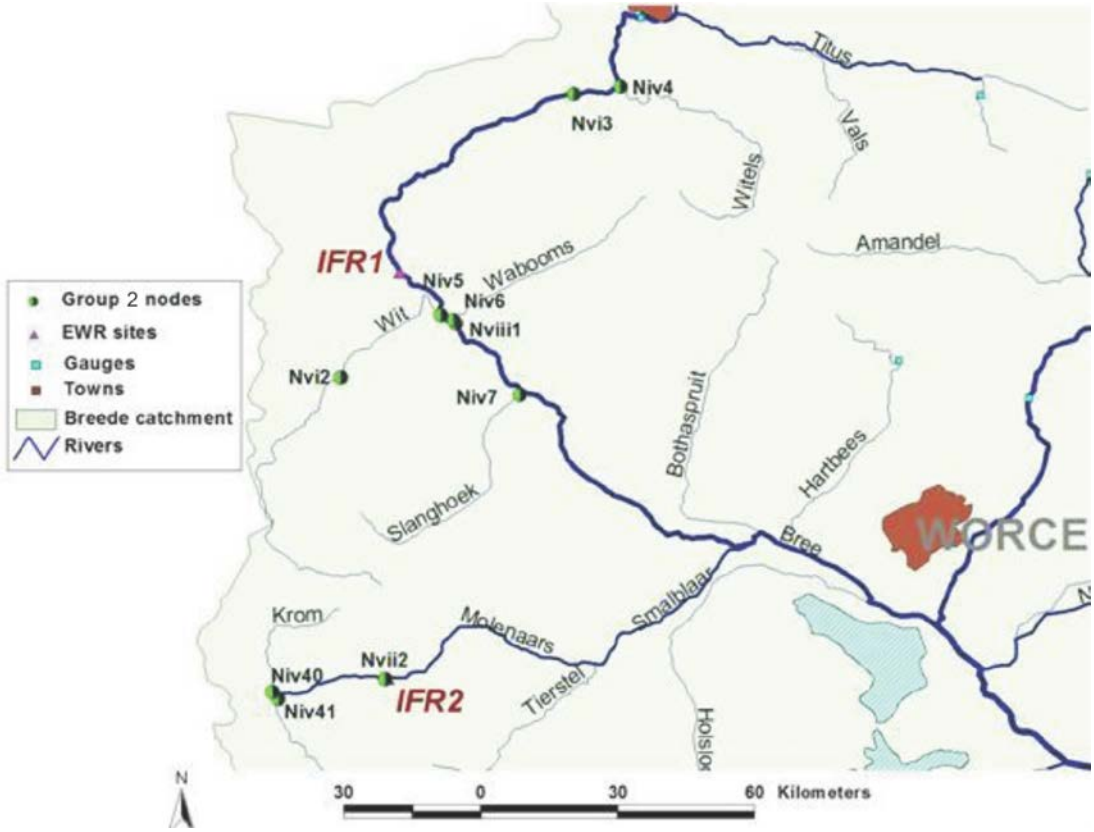

Figure 3.6 Location of the 10 nodes in Group 2, Breede River catchment

3.2.1 *Niv4: Witels River*

The river was undisturbed in this reach (Figure 3.7). The cobbles on the bed had some algae growth on them, but the geomorphology was considered to be in an A/B condition.

Figure 3.7 Niv4: Witels River

The riparian vegetation (Table 3.18) and macroinvertebrate communities (Table 3.19 and Table 3.20) were also fairly natural.

Table 3.18 Riparian vegetation habitat diversity assessment, Niv4: Witels River

Lateral zone	Comment
Wet Bank species: *Prionium serratum*, *Erica caffra*, *Brabejum stellatifolium*, *Metrosideros angustifolia*, *Brachylaena neriifolia*, *Morella serrata*.	Good mix of various growth forms, no alien species present. Riparian scrub seedlings and juveniles present, indicating good recruitment by the dominant community members.
Dry Bank species: *Searsia angustifolia*, *Diospyros glabra*, *Calopsis paniculata*, *Elegia capensis*.	Good mix of various growth forms, some scattered individuals of alien Long-leaved wattle *(Acacia longifolia)*. Riparian scrub seedlings and juveniles present, indicating good recruitment by the dominant community members.

Table 3.19 Macroinvertebrate habitat diversity assessment, Niv4: Witels River

Habitat diversity	General Comments
• Variety of aquatic macroinvertebrate biotopes, e.g., stones in and out of current, sand and instream vegetation. • Flow diversity high. • Sparse marginal vegetation mainly grass and reeds. • Algae attached to cobbles.	Supported moderate diversity with more taxa that are tolerant to flow modification. Similar to Titus River in terms of invertebrate biotope availability (Section 3.1.3).

Table 3.20 SASS5 scores, Niv4: Witels River

SASS5 score	51
No. of taxa	6
Average Score Per Taxon (ASPT)	8.5

Table 3.21 HI scores and category, Niv4: Witels River

INSTREAM CRITERIA		RIPARIAN CRITERIA	
water abstraction	0	indigenous vegetation removal	0
flow modification	0	exotic vegetation encroachment	3
bed modification	0	bank erosion	0
channel modification	0	channel modification	0
water quality	0	water abstraction	0
inundation	0	inundation	0
exotic macrophytes	0	flow modification	0
exotic fauna	10	water quality	0
solid waste disposal	0		
TOTAL (%)	96.8	**TOTAL (%)**	98.8
HI Category	B	**HI Category**	B

The overall condition of the site was Category B (Table 3.21).

3.2.2 *Nvi3: Breede River, Mitchells Pass/R43*

The river flowed naturally alongside a small floodplain. The upper channel banks were intact and floods could have overtopped and inundated the floodplain and upper terraces. There was a mobile cobble bed with some algal growth.

Figure 3.8 Nvi3: Breede River, Mitchells Pass/R43

This reach flowed through fallow fields that had been cleared of **Acacia mearnsii* (Black wattle) recently and now supported well established Riparian Scrub (Table 3.22).

Table 3.22 Riparian vegetation habitat diversity assessment, Nvi3: Breede River, Mitchells Pass/R43

Lateral zone	Comment
Wet Bank species: *Juncus lomatophyllus*, *Calopsis paniculata*, *Brabejum stellatifolium*, *Metrosideros angustifolia*, *Prionium serratum*.	Indigenous species present and well established within the active channel.
Dry Bank species: *Podocarpus elongatus*, *Searsia angustifolia*, *Diospyros glabra*.	Some indigenous shrubs present close to water's edge, but pastoral fields are a mixture of indigenous and exotic graminoids.

There was a variety of macroinvertebrate habitat available (Table 3.23) that supported moderate diversity of aquatic invertebrates (Table 3.24).

Table 3.23 Macroinvertebrate habitat diversity assessment, Nvi3: Breede River, Mitchells Pass/R43

Habitat diversity	General Comments
• Variety of aquatic macroinvertebrate biotopes (including stones in and out of current, sand and instream vegetation. • Flow diversity high. • Marginal vegetation dominated by grass and reeds in some places.	Supported moderate macroinvertebrate diversity with more taxa that are tolerant to flow modification. Comparable to Breede River, Ceres, in terms of invertebrate biotope availability (Section 3.1.5).

Table 3.24 SASS5 scores, Nvi3: Breede River, Mitchells Pass/R43

SASS5 score	51
No. of taxa	6
Average Score Per Taxon (ASPT)	8.5

Table 3.25 HI scores and category, Nvi3: Breede River, Mitchells Pass/R43

INSTREAM CRITERIA		RIPARIAN CRITERIA	
water abstraction	15	indigenous vegetation removal	5
flow modification	8	exotic vegetation encroachment	10
bed modification	10	bank erosion	3
channel modification	5	channel modification	0
water quality	15	water abstraction	5
inundation	0	inundation	0
exotic macrophytes	0	flow modification	10
exotic fauna	10	water quality	3
solid waste disposal	5		
TOTAL (%)	67.1	**TOTAL (%)**	82.5
HI Category	C	**HI Category**	B

The overall condition of the site was Category C (Table 3.25)

3.2.3 ***Nvi2: Witte River***

This node is situated at Tweede Tol on the Witte River. The upper reaches of the Witte River flow through a protected area and are relatively undisturbed (Figure 3.9). Downstream of Tweede Tol, however, conditions in the river drop, mainly as a result of past and present invasion of **Acacia* spp. and are similar to that of Nviii1 (section 3.2.4).

Figure 3.9 Nvi2: Witte River

At the node, the geomorphology was in a B category. The riparian vegetation was also in relatively natural condition (Table 3.26), and the macroinvertebrate habitat was varied (Table 3.27).

Table 3.26 Riparian vegetation habitat diversity assessment, Nvi2: Witte River

Lateral zone	Comment
Wet Bank species: *Prionium serratum*, *Erica caffra*, *Brabejum stellatifolium*, *Metrosideros angustifolia*.	Good mix of various growth forms, no alien species present. Riparian scrub seedlings and juveniles present, indicating good recruitment by the dominant community members.
Dry Bank species: *Searsia angustifolia*, *Diospyros glabra*, *Calopsis paniculata*, *Brachylaena neriifolia*, *Podocarpus elongatus*.	Good mix of various growth forms. Riparian scrub seedlings and juveniles present, indicating good recruitment by the dominant community members.

Table 3.27 Macroinvertebrate habitat diversity assessment, Nvi2: Witte River

Habitat diversity	General Comments
• Variety of aquatic macroinvertebrate biotopes (including stones in and out of current, sand and instream vegetation. • Flow diversity high. • Marginal vegetation dominated by Palmiet.	Supported moderate macroinvertebrate diversity with more taxa that are tolerant to flow modification.

Table 3.28 HI scores and category, Nvi2: Witte River

INSTREAM CRITERIA		RIPARIAN CRITERIA	
water abstraction	0	indigenous vegetation removal	0
flow modification	3	exotic vegetation encroachment	3
bed modification	0	bank erosion	0
channel modification	0	channel modification	0
water quality	5	water abstraction	0
inundation	0	inundation	0
exotic macrophytes	0	flow modification	3
exotic fauna	10	water quality	5
solid waste disposal	0		
TOTAL (%)	92.7	**TOTAL (%)**	95
HI Category	B	**HI Category**	B

The overall condition of the site was Category B (Table 3.28).

3.2.4 *Nviii1: Breede River (IFR1: Witbrug)*

This reach was characterised by a mobile cobble bed with sand. The channel had been infilled and narrowed, and farming occurred over much of the floodplain. Although the reference condition was likely to have been braided, the channel was a single thread, and large *Phragmites* beds that might have been expected had been narrowed due to infilling and bank stabilisation (Figure 3.10). There was some artificial stabilising of the bank using large cobbles and boulders, but despite this, bed sediments were mobile and well sorted.

Figure 3.10 Nviii1: Breede River (IFR1: Witbrug)

There were few indigenous riparian vegetation species present. The wet bank was depauperate and the dry bank was either exotic species or was under cultivation (Table 3.29). The invertebrates were, however, in relatively good condition (Table 3.30)

Table 3.29 Riparian vegetation habitat diversity assessment, Nviii1: Breede River (IFR1: Witbrug)

Lateral zone	Comment
Wet Bank species: *Prionium serratum*.	Species poor, fragmented. No obvious recruitment was taking place.
Dry Bank species: **Acacia mearnsii*, **Eucalyptus camaldulensis*, *Phragmites australis.*	Mostly black wattle (**Acacia mearnsii*) or cultivated fields of various sorts. Isolated indigenous shrubs or stands of common reed (*Phragmites australis).*

Table 3.30 Macroinvertebrate habitat diversity assessment, Nviii1: Breede River (IFR1: Witbrug)

Habitat diversity	General Comments
• A variety of aquatic macroinvertebrate biotopes. • Marginal vegetation dominated by reeds. • Instream vegetation is mostly Palmiet. • Sand-cobble riverbed.	Supported moderate macroinvertebrate diversity with more taxa that are tolerant to flow modification.

Table 3.31 HI scores and category, Nviii1: Breede River (IFR1: Witbrug)

INSTREAM CRITERIA		RIPARIAN CRITERIA	
water abstraction	15	indigenous vegetation removal	20
flow modification	15	exotic vegetation encroachment	15
bed modification	13	bank erosion	5
channel modification	13	channel modification	13
water quality	10	water abstraction	15
inundation	0	inundation	0
exotic macrophytes	0	flow modification	15
exotic fauna	10	water quality	3
solid waste disposal	5		
TOTAL (%)	60.8	**TOTAL (%)**	57.3
HI Category	C	**HI Category**	D

The overall condition of the site was Category D (Table 3.31).

3.2.5 *Niv6: Wabooms River*

The node was situated in a severely degraded reach of the river. The channel had been dredged, channelized, straightened and the narrow banks armoured with cobbles and boulders, and extensive levees were created above this (Figure 3.11). Further downstream the condition was a little better, but there was dense alien invasion along the banks, levees had been constructed and the floodplain had been infilled. The geomorphology was estimated to be in a D/E category.

Figure 3.11 Niv6: Wabooms River

The riparian zone had been cleared for orchards/vineyards that extended to the water's edge. There was also evidence of clearing of exotic species had taken place. The presence of disturbance-triggered annuals and exotic graminoids indicated ongoing disturbance (Table 3.32). The macroinvertebrate community was depauperate (Table 3.33 and Table 3.34).

Table 3.32 Riparian vegetation habitat diversity assessment, Niv6: Wabooms River

Lateral zone	Comment
Wet Bank species: *Pennisetum macrourum*, *Diospyros glabra*, *Brabejum stellatifolium*.	Few scattered and isolated indigenous shrubs or graminoids.
Dry Bank species: *Brabejum stellatifolium*, **Acacia mearnsii*, **Populus X canescens*, **Quercus robur*.	Various woody exotic species present. Was no apparent recruitment of indigenous species taking place.

Table 3.33 Macroinvertebrate habitat diversity assessment, Niv6: Wabooms River

Habitat diversity	General Comments
• Low macroinvertebrate biotope variety. • Extensive cobble substrata at depth that allows for sampling of invertebrates. • Lack of marginal and instream vegetation.	Very poor invertebrate conditions. Supported low macroinvertebrate diversity, especially those taxa that are highly tolerant to flow modification. Highly modified riverbed. Vine stems dumped on the water's edge. The low number of taxa (three) is an indication of impoverished river conditions.

Table 3.34 SASS5 scores, Niv6: Wabooms River

SASS5 score	17
No. of taxa	3
Average Score Per Taxon (ASPT)	5.7

Table 3.35 HI scores and category, Niv6: Wabooms River

INSTREAM CRITERIA		RIPARIAN CRITERIA	
water abstraction	13	indigenous vegetation removal	23
flow modification	8	exotic vegetation encroachment	15
bed modification	25	bank erosion	13
channel modification	25	channel modification	25
water quality	10	water abstraction	10
inundation	3	inundation	0
exotic macrophytes	0	flow modification	5
exotic fauna	10	water quality	0
solid waste disposal	8		
TOTAL (%)	51.5	**TOTAL (%)**	54.5
HI Category	D	**HI Category**	D

The overall condition of the site was Category D (Table 3.35).

3.2.6 ***Niv5: lower Witte River***

Not assessed, but similar to Nviii1 (section 3.2.4).

3.2.7 ***Niv7: Slanghoek River***

The node is situated in a severely degraded reach of the Slanghoek River (Figure 3.12). The channel was heavily engineered and infilling and levees had all but destroyed the riparian zone. Cobbles and sand dominate the active channel bed, but these were not well sorted, and the excessive fine sediment load had smothered interstitial spaces. The geomorphological condition was estimated to be in an E or E/F category.

Figure 3.12 Niv7: Slanghoek River

There was little riparian vegetation of any sort present on this river, largely due to clearing for agriculture (Table 3.36). There was, however, some marginal vegetation, which supported a fairly diverse macroinvertebrate community (Table 3.37).

Table 3.36 Riparian vegetation habitat diversity assessment, Niv7: Slanghoek River

Lateral zone	Comment
Wet Bank species: *Diospyros glabra*, *Brabejum stellatifolium*, *Phragmites australis*, *Calopsis paniculata*.	Wet bank reduced and narrow as a result of flow reduction due to abstraction of water.
Dry Bank species: *Searsia angustifolia*, **Acacia mearnsii*, **Rubus fruticosus*, **Quercus robur*.	Many disturbance triggered annuals and graminoids, possibly due to continued clearing via bulldozers, tractors of fire. Were well established woody exotic species in some parts.

Despite poor availability of habitat the macroinvertebrate community was in good condition (Table 3.37 and Table 3.38)

Table 3.37 Macroinvertebrate habitat diversity assessment, Niv7: Slanghoek River

Habitat diversity	General Comments
• Low macroinvertebrate biotope variety. • Extensive cobble substrata at depth that allows for sampling of invertebrates. • Lack of marginal and instream vegetation.	SASS5 scores at this site indicate good water conditions. River flows through vineyards.

Table 3.38 SASS5 scores, Niv7: Slanghoek River

SASS5 score	90
No. of taxa	10
Average Score Per Taxon (ASPT)	9

Table 3.39 HI scores and category, Niv7: Slanghoek River

INSTREAM CRITERIA		RIPARIAN CRITERIA	
water abstraction	20	indigenous vegetation removal	23
flow modification	23	exotic vegetation encroachment	15
bed modification	20	bank erosion	15
channel modification	18	channel modification	20
water quality	15	water abstraction	15
inundation	13	inundation	10
exotic macrophytes	0	flow modification	10
exotic fauna	10	water quality	5
solid waste disposal	5		
TOTAL (%)	39.8	**TOTAL (%)**	44.0
HI Category	E	**HI Category**	D

The overall condition of the site was Category D (Table 3.39).

3.2.8 *Niv41: Krom River*

Geomorphic impacts were limited (Figure 3.13). The riparian vegetation was mature and lush (Table 3.40) along the boulder/bedrock reach, and in-channel sediment appeared to be well sorted. There were a few scattered exotic woody trees. The macroinvertebrate communities were also in good condition (Table 3.41 and Table 3.42).

Figure 3.13 Niv41: Krom River

Table 3.40 Riparian vegetation habitat diversity assessment, Niv41: Krom River

Lateral zone	Comment
Wet Bank species: *Brachylaena neriifolia*, *Metrosideros angustifolia*, *Brabejum stellatifolium*, *Calopsis paniculata*, *Juncus lomatophyllus*, *Isolepis prolifer*, *Isolepis digitata*.	A variety of species and growth forms and recruiting juveniles of the dominant community members.
Dry Bank species: *Brabejum stellatifolium*, *Searsia angustifolia*, *Stoebe plumosa*, *Metrosideros angustifolia*.	A variety of species and growth forms and recruiting juveniles of the dominant community members.

Table 3.41 Macroinvertebrate habitat diversity assessment, Niv41: Krom River

Habitat diversity	General Comments
• Variety of aquatic macroinvertebrate biotopes (including stones in and out of current and sand. • Flow diversity high. • Sparse marginal vegetation dominated by grass in some places. • Cobble riverbed with no instream vegetation.	Supported high macroinvertebrate diversity with more taxa that are highly sensitive to river modification. SASS5 scores at this site indicate good water conditions.

Table 3.42 SASS5 scores, Niv41: Krom River

SASS5 score	69
No. of taxa	10
Average Score Per Taxon (ASPT)	6.9

Table 3.43 HI scores and category, Niv41: Krom River

INSTREAM CRITERIA		RIPARIAN CRITERIA	
water abstraction	0	indigenous vegetation removal	0
flow modification	0	exotic vegetation encroachment	5
bed modification	0	bank erosion	0
channel modification	0	channel modification	0
water quality	0	water abstraction	0
inundation	0	inundation	0
exotic macrophytes	0	flow modification	0
exotic fauna	10	water quality	0
solid waste disposal	0		
TOTAL (%)	96.8	**TOTAL (%)**	97.6
HI Category	B	**HI Category**	B

The overall condition of the site was Category B (Table 3.43).

3.2.9 ***Niv40: Elands River***

The node is situated upstream of the Hugenot Tunnel and the confluence with the Smallblaar River (Figure 3.14). This cobble/boulder bed river was estimated to be in an A/B category. The riparian vegetation was in near natural condition (Table 3.44), but the macroinvertebrates showed some sign of water quality impacts (Table 3.45).

Figure 3.14 Niv40: Elands River

Table 3.44 Riparian vegetation habitat diversity assessment, Niv40: Elands River

Lateral zone	Comment
Wet Bank species: *Brachylaena neriifolia*, *Metrosideros angustifolia*, *Brabejum stellatifolium*, *Calopsis paniculata*, *Juncus lomatophyllus*, *Isolepis prolifer*, *Isolepis digitata*.	A variety of species and growth forms and recruiting juveniles of the dominant community members.
Dry Bank species: *Brabejum stellatifolium*, *Searsia angustifolia*, *Stoebe plumosa*, *Metrosideros angustifolia*.	A variety of species and growth forms and recruiting juveniles of the dominant community members.

Table 3.45 Macroinvertebrate habitat diversity assessment, Niv40: Elands River

Habitat diversity	General Comments
• Variety of aquatic macroinvertebrate biotopes (including stones in and out of current and sand. • Flow diversity high. • Marginal vegetation in most parts. • Cobble riverbed with no instream vegetation.	Supported high macroinvertebrate diversity with more taxa that are highly sensitive to river modification. SASS5 scores at this site indicate good water conditions.

Table 3.46 HI scores and category, Niv40: Elands River

INSTREAM CRITERIA		RIPARIAN CRITERIA	
water abstraction	0	indigenous vegetation removal	0
flow modification	0	exotic vegetation encroachment	5
bed modification	0	bank erosion	0
channel modification	0	channel modification	0
water quality	0	water abstraction	0
inundation	0	inundation	0
exotic macrophytes	0	flow modification	0
exotic fauna	10	water quality	0
solid waste disposal	0		
TOTAL (%)	96.8	**TOTAL (%)**	97.6
HI Category	B	**HI Category**	B

The overall condition of the site was Category B (Table 3.46).

3.2.10 *Nvii2: Molenaars River (IFR 2)*

There was some, limited, infilling where the N1 abuts the river. The channel was meandering channel and associated with lateral bars and floodplain pockets. Cobble and boulders dominated the riverbed (Figure 3.15). The geomorphological condition was estimated to be in an A/B category. Indigenous vegetation had not yet fully re-established in the areas that had been cleared of invasive vegetation (This reach was cleared of black wattle (*Acacia mearnsii)* approximately 20 years ago). The riparian scrub community was well established but the slower-growing trees, which were present upstream, were not yet present (Table 3.47). The macroinvertebrate community was in good condition (Table 3.48 and Table 3.49).

Figure 3.15 Nvii2: Molenaars River (IFR2)

Table 3.47 Riparian vegetation habitat diversity assessment, Nvii2: Molenaars River (IFR2)

Lateral zone	Comment
Wet Bank species: *Brachylaena neriifolia*, *Metrosideros angustifolia*, *Brabejum stellatifolium*, *Calopsis paniculata*, *Freylinia lanceolata*, *Juncus lomatophyllus*, *Isolepis prolifer*.	Well established with a range of growth forms and species. There were recruiting juveniles of many community members present.
Dry Bank species: *Brabejum stellatifolium*, *Searsia angustifolia*, *Stoebe plumosa*, *Metrosideros angustifolia*.	Well established with a range of growth forms and species. There were recruiting juveniles of many community members present.

Table 3.48 Macroinvertebrate habitat diversity assessment, Nvii2: Molenaars River (IFR2)

Habitat diversity	General Comments
• Variety of aquatic macroinvertebrate biotopes (including stones in and out of current and sand. • Flow diversity high. • Marginal vegetation in most parts. • Cobble riverbed with little instream vegetation.	Highly natural river conditions.

Table 3.49 SASS5 scores, Nvii2: Molenaars River (IFR2)

SASS5 score	139
No. of taxa	21
Average Score Per Taxon (ASPT)	6.6

Table 3.50 HI scores and category, Nvii2: Molenaars River (IFR2)

INSTREAM CRITERIA		RIPARIAN CRITERIA	
water abstraction	0	indigenous vegetation removal	10
flow modification	0	exotic vegetation encroachment	10
bed modification	0	bank erosion	3
channel modification	0	channel modification	5
water quality	0	water abstraction	10
inundation	0	inundation	3
exotic macrophytes	0	flow modification	3
exotic fauna	10	water quality	5
solid waste disposal	5		
TOTAL (%)	95.6	**TOTAL (%)**	76.0

HI Category	B	**HI Category**	C

The overall condition of the site was Category B (Table 3.50).

3.2.11 *Group 2: comparison with 2000 PES assessment*

Group 2 nodes represent the headwaters of the Breede River. Seven of the ten nodes assessed in Group 2 were in a better condition than reported by Kleynhans (2000) (Table 3.51). There could be various reasons for this, including a mis-allocation of scores in the 2000 desktop study. However, at least some of the improvement appears to be genuine, for instance, there has been extensive clearing of alien vegetation in the Breede (in Mitchell's Pass), Witte and Molenaars Rivers in the past decade, with a concomitant improvement in condition. Of more concern are the rivers that have declined in condition since 2000, in particular the Slanghoek and Wabooms Rivers, which are both aggressively dredged and channelised. The riparian vegetation alongside them has been all but completely destroyed and the impacts of over-abstraction are noticeable to the naked eye.

Table 3.51 Comparison of PES (Kleynhans 2000) and HI (2009) for nodes in Group 2

Node	PES (2000)	HI (2009)	
		Instream	Riparian
Niv4: Witels River	C	B	B
Nvi3: Breede River, Mitchells Pass/R43	C	C	B
Nvi2: Witte River	C	B	B
Nviii1: Breede River (IFR1: Witbrug)	A	C	D
Niv6: Wabooms River	D	D	D
Niv5: Breede River, Slanghoek bridge	D	-	-
Niv7: Slanghoek River	D	E	D
Niv40: Krom River	D	B	B
Niv41: Elands River	C	B	B
Nvii2: Molenaars River (IFR 2)	C	B	C

3.3 Group 3

Group 3 nodes are on the rivers surrounding the town of Worcester (Figure 3.16). There are 14 nodes in Group 3: 11 tributary nodes and three mainstem nodes. Geomorphological assessments were done at six of these as indicated in the text.

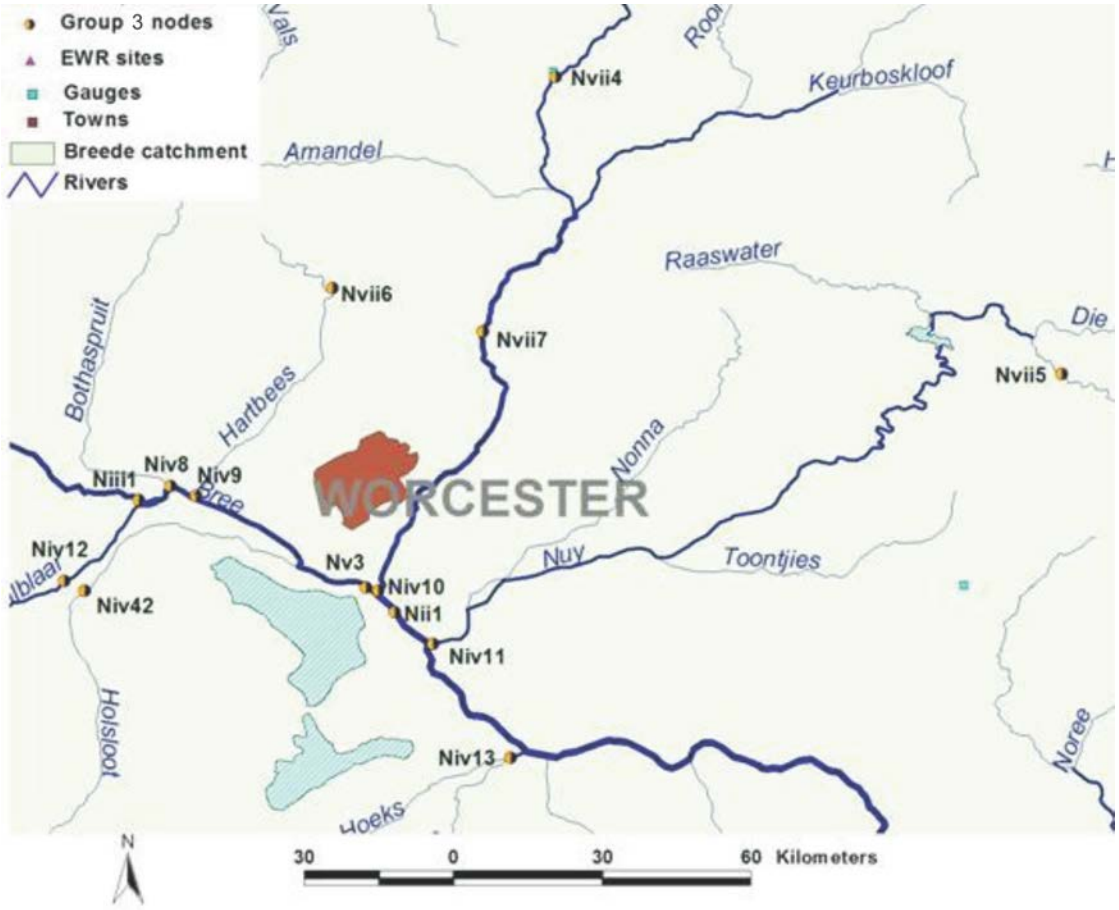

Figure 3.16 Location of the 14 nodes in Group 3, Breede River catchment

3.3.1 *Niv42: Molenaars (Smalblaar) River*

The node is situated at the bridge south-west of Rawsonville. The condition of the Molenaars River dropped suddenly and significantly as it leaves Du Toit's Kloof. In this reach, the bulk of the extensive floodplain was under vineyard cultivation, and the channel had been dredged, mined and channelised, with levees (Figure 3.17). Most of the riparian vegetation had been cleared for farming activities and cultivated fields abutted onto the macro-channel bank edge (Table 3.52). There was considerable disturbance to the inchannel habitats due to sand mining and dredging, the macroinvertebrate community varied (Table 3.53).

Figure 3.17 Niv42: Molenaars (Smalblaar) River

Table 3.52 Riparian vegetation habitat diversity assessment, Niv42: Molenaars (Smalblaar) River

Lateral zone	Comment
Wet Bank species: *Prionium serratum*, *Brabejum stellatifolium*, *Diospyros glabra*, *Freylinia lanceolata*, *Pennisetum macrourum*, *Phragmites australis*, *Calopsis paniculata*.	Wet bank species were relatively well established in the macrochannel.
Dry Bank species: **Acacia mearnsii*, **Pennisetum clandestinum*.	Mainly black wattle (**Acacia mearnsii)* and **Eucalyptus* sp., or under cultivation.

Table 3.53 Macroinvertebrate habitat diversity assessment, Niv42: Molenaars (Smalblaar) River

Habitat diversity	General Comments
• Variety of aquatic macroinvertebrate biotopes (including stones in and out of current and sand. • Flow diversity high. • Sparse marginal vegetation dominated by grass in some places. • Cobble riverbed with no instream vegetation available for macroinvertebrates. • Back waters present with reeds and grasses.	Evidence of sand mining on the riverbed and water abstraction.

Table 3.54 HI scores and category, Niv42: Molenaars (Smalblaar) River

INSTREAM CRITERIA		RIPARIAN CRITERIA	
water abstraction	18	indigenous vegetation removal	20
flow modification	20	exotic vegetation encroachment	20
bed modification	20	bank erosion	8
channel modification	15	channel modification	20
water quality	13	water abstraction	23
inundation	3	inundation	3
exotic macrophytes	0	flow modification	18
exotic fauna	10	water quality	13
solid waste disposal	3		
TOTAL (%)	49.8	**TOTAL (%)**	38.5
HI Category	D	**HI Category**	E

The overall condition of the site was Category D (Table 3.54).

3.3.2 *Niv12: Holsloot River*

The node is located in the lower part of the Holsloot River, where the floodplain has been cultivated and the river channelised (Figure 3.18). The riparian vegetation had been clear felled (Table 3.55). In the upper portions of the river where the valley was narrower, the riparian vegetation was in considerably better condition. There was considerable disturbance to the inchannel habitats due to sand mining and dredging, the macroinvertebrate community varied (Table 3.56).

Figure 3.18 Niv12: Holsloot River

Table 3.55 Riparian vegetation habitat diversity assessment, Niv12: Holsloot River

Lateral zone	Comment
Wet Bank species: *Prionium serratum*, *Brabejum stellatifolium*, *Diospyros glabra*, *Freylinia lanceolata*, *Pennisetum macrourum*, *Phragmites australis*, *Calopsis paniculata*.	Wet bank species were relatively well established in the macrochannel.
Dry Bank species: **Acacia mearnsii*, **Pennisetum clandestinum*.	Mainly black wattle (**Acacia mearnsii)* and **Eucalyptus* sp., or under cultivation.

Table 3.56 Macroinvertebrate habitat diversity assessment, Niv12: Holsloot River

Habitat diversity	General Comments
• Variety of aquatic macroinvertebrate biotopes (including stones in and out of current and sand. • Flow diversity high. • Sparse marginal vegetation dominated by grass in some places. • Cobble riverbed with no instream vegetation available for macroinvertebrates. • Back waters present with reeds and grasses.	Evidence of sand mining on the riverbed and water abstraction.

Table 3.57 HI scores and category, Niv12: Holsloot River

INSTREAM CRITERIA		RIPARIAN CRITERIA	
water abstraction	18	indigenous vegetation removal	20
flow modification	20	exotic vegetation encroachment	20
bed modification	20	bank erosion	8
channel modification	15	channel modification	20
water quality	13	water abstraction	23
inundation	3	inundation	3
exotic macrophytes	0	flow modification	18
exotic fauna	10	water quality	13
solid waste disposal	3		
TOTAL (%)	49.8	**TOTAL (%)**	38.5
HI Category	D	**HI Category**	E

The overall condition of the site was Category D (Table 3.57).

3.3.3 *Nvii4: Sanddrif River*

Not assessed.

3.3.4 *Nvii7: Upper Hex River*

This reach was highly degraded. Levees and drains across the floodplains protected orchards, and in many places infilling had removed the riparian and marginal zones (Figure 3.19). Where fringe vegetation along the channel existed it was heavily invaded by exotic species. The channel had a high fines load due to the eroding banks and infilled material, and the channel was essentially a dredged stormwater conduit. Geomorphology condition was estimated to be an E category.

Figure 3.19 Nvii7: Upper Hex River

There was little indigenous riparian vegetation present. The majority had been cleared for agriculture, and only hardy or pioneer exotic species persisted (Table 3.58).

Table 3.58 Riparian vegetation habitat diversity assessment, Nvii7: Upper Hex River

Lateral zone	Comment
Wet Bank species: *Isolepis prolifer, *Arundo donax, *Solanum nigrum.*	Poorly vegetated wet bank, the channel appeared as if it was dredged regularly, leaving little chance for vegetation to establish.
Dry Bank species:	Was sparse in the cultivated fields of this reach.

Despite poor availability of aquatic habitat the macroinvertebrate community was in a fair condition (Table 3.60 and Table 3.60).

Table 3.59 Macroinvertebrate habitat diversity assessment, Nvii7: Upper Hex River

Habitat diversity	General Comments
• Limited aquatic macroinvertebrate biotopes available. • Flow diversity high. • Little vegetation available for macroinvertebrates. • Cobble riverbed with no instream vegetation.	Modified river bed conditions. Moderate diversity of aquatic macroinvertebrates.

Table 3.60 SASS5 scores, Nvii7: Upper Hex River

SASS5 score	63
No. of taxa	10
Average Score Per Taxon (ASPT)	6.3

Table 3.61 HI scores and category, Nvii7: Upper Hex River

INSTREAM CRITERIA		RIPARIAN CRITERIA	
water abstraction	18	indigenous vegetation removal	25
flow modification	15	exotic vegetation encroachment	23
bed modification	20	bank erosion	15
channel modification	25	channel modification	25
water quality	15	water abstraction	15
Inundation	3	inundation	3
exotic macrophytes	8	flow modification	3
exotic fauna	10	water quality	8
solid waste disposal	5		
TOTAL (%)	42.5	**TOTAL (%)**	41.8
HI Category	D	**HI Category**	D

The overall condition of the site was Category D (Table 3.61).

3.3.5 ***Niv10: Lower Hex River***

The lower reaches of the Hex River were in better condition than the upper reaches. A wide, braided, unconfined channel existed in many places, with multiple channels allowing for good sediment sorting and high instream habitat diversity, including backwaters (Figure 3.20).

Figure 3.20 Niv10: Lower Hex River

The banks had been cleared and were devoid of indigenous riparian scrub (Table 3.62).

Table 3.62 Riparian vegetation habitat diversity assessment, Niv10: Lower Hex River

Lateral zone	Comment
Wet Bank species:	Are few, if any, indigenous riparian scrub species present, none were seen in the reach assessed.
Dry Bank species:	Are few, if any, indigenous riparian scrub species present, none were seen in the reach assessed.

Despite poor availability of aquatic habitat the macroinvertebrate community was in a fair condition (Table 3.63).

Table 3.63 Macroinvertebrate habitat diversity assessment, Niv10: Lower Hex River

Habitat diversity	General Comments
• Limited aquatic macroinvertebrate biotopes available. • Flow diversity high. • Little vegetation available for macroinvertebrates • Cobble riverbed with no instream vegetation.	Modified river bed and bank conditions. Moderate diversity of aquatic macroinvertebrates.

Table 3.64 HI scores and category, Niv10: Lower Hex River

INSTREAM CRITERIA		RIPARIAN CRITERIA	
water abstraction	20	indigenous vegetation removal	20
flow modification	15	exotic vegetation encroachment	10
bed modification	5	bank erosion	5
channel modification	20	channel modification	20
water quality	10	water abstraction	20
inundation	0	inundation	0
exotic macrophytes	0	flow modification	3
exotic fauna	10	water quality	8
solid waste disposal	3		
TOTAL (%)	58.6	**TOTAL (%)**	56.9
HI Category	D	**HI Category**	D

The overall condition of the site was Category D (Table 3.64).

3.3.6 ***Niii1: Breede River, u/s of Papenkuils***

Not assessed.

3.3.7 ***Niv8: Bothaspruit***

The channel had been bulldozed. The instream habitat was uniform and unnatural - the expected sequence of pools and riffles and the marginal vegetation zone were not present (Figure 3.21).

The banks were either cultivated, with orchards or vineyards, or heavily invaded with woody exotics. There was some indigenous vegetation on the channel fringe in parts but the wet bank was not present (Table 3.65). The macroinvertebrates were poor (Table 3.66).

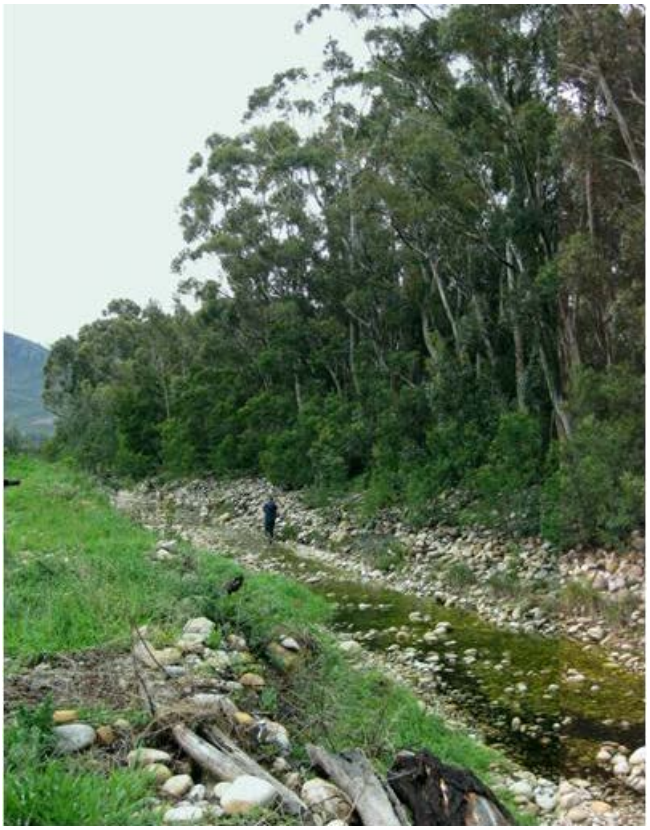

Figure 3.21 Niv8: Bothaspruit

Table 3.65 Riparian vegetation habitat diversity assessment, Niv8: Bothaspruit

Lateral zone	Comment
Wet Bank species:	Few, if any, wet bank species present.
Dry Bank species: *Diospyros glabra, Metrosideros angustifolia, Searsia angustifolia, *Pinus* sp., *Acacia mearnsii, *Eucalyptus* sp.*	Few scattered small individuals. Woody exotics dominated the dry bank.

Table 3.66 Macroinvertebrate habitat diversity assessment, Niv8: Bothaspruit

Habitat diversity	General Comments
• Extensive boulder/cobble substrata at depth sufficient for macroinvertebrate habitation. • Lack of marginal vegetation for aquatic macroinvertebrates. • Dominated by one habitat type (usually runs).	Poor range of macroinvertebrate biotopes, with some lacking e.g. Instream vegetation, sand and mud biotopes). Supported relatively lower macroinvertebrate diversity with more taxa that are tolerant to flow modification. Highly modified (bulldozed) river bed and river margins. Severe loss of habitat and development of algae.

Table 3.67 HI scores and category, Niv8: Bothaspruit

INSTREAM CRITERIA		RIPARIAN CRITERIA	
water abstraction	15	indigenous vegetation removal	20
flow modification	18	exotic vegetation encroachment	20
bed modification	15	bank erosion	15
channel modification	18	channel modification	18
water quality	20	water abstraction	10
inundation	10	inundation	0
exotic macrophytes	0	flow modification	15
exotic fauna	10	water quality	5
solid waste disposal	10		
TOTAL (%)	44.8	**TOTAL (%)**	48.2
HI Category	D	**HI Category**	D

The overall condition of the site was Category D (Table 3.67).

3.3.8 *Nvii6: Upper Hartbees River*

Not assessed.

3.3.9 *Niv9: Lower Hartbees River*

The bed and banks were graded (Figure 3.22). The bed was highly mobile, but there were no pools or sorted material in the channel due to landscaping/bulldozing activities. Geomorphological condition was estimated to be in an E/F category in the upper reaches where these activities were most pronounced. Further downstream in this reach the impacts were less severe and this was estimated to be in a D category. Throughout there was a high fines load resulting from erosion of the banks. Ongoing sand mining operations had armoured the flood terraces through deposition of the cobbles. There was little indigenous riparian vegetation present. The majority had been cleared for agriculture. The banks were completely clear of vegetation (Table 3.68). The macroinvertebrates were poor (Table 3.70 and Table 3.71).

Figure 3.22 Niv9: Lower Hartbees River

Table 3.68 Riparian vegetation habitat diversity assessment, Niv9: Lower Hartbees River

Lateral zone	Comment
Wet Bank species: **Acacia saligna, *Avena* sp., **Solanum nigrum, Isolepis prolifer.*	Few, if any, wet bank species present. Woody exotics were dominant.
Dry Bank species: **Acacia mearnsii, *Eucalyptus sp.*	Few scattered small individuals. Woody exotics dominated.

Table 3.69 Macroinvertebrate habitat diversity assessment, Niv9: Lower Hartbees River

Habitat diversity	General Comments
• Extensive boulder/cobble substrata at depth that allow for invertebrates habitation. • Lack of marginal vegetation for aquatic macroinvertebrates. • Supported relatively lower macroinvertebrate diversity with more that are tolerant to flow modification.	Poor range of macroinvertebrate biotopes, (i.e. Instream vegetation, sand and mud biotopes). Dominated by one habitat type (usually runs). Highly modified (bulldozed) river bed and river margins resulted in severe loss of macroinvertebrate habitats.

Table 3.70 SASS5 scores, Niv9: Lower Hartbees River

SASS5 score	33
No. of taxa	4
Average Score Per Taxon (ASPT)	8.3

Table 3.71 HI scores and category, Niv9: Lower Hartbees River

INSTREAM CRITERIA		RIPARIAN CRITERIA	
water abstraction	20	indigenous vegetation removal	25
flow modification	20	exotic vegetation encroachment	18
bed modification	25	bank erosion	15
channel modification	25	channel modification	25
water quality	15	water abstraction	15
inundation	10	inundation	8
exotic macrophytes	0	flow modification	10
exotic fauna	10	water quality	3
solid waste disposal	10		
TOTAL (%)	34.4	**TOTAL (%)**	41
HI Category	E	**HI Category**	D

The overall condition of the site was Category E (Table 3.71).

3.3.10***Nvii5: Koo River***

Not assessed.

3.3.11***Nv3: Breede River, Papenkuils***

This is a wetland site. The main channel of the Breede River flows to the north of the Papenkuils Wetland, which is a large riparian floodplain (Figure 3.23). The channel is somewhat incised, and there are levees in place that prevent flooding into Papenkuils.

Figure 3.23 Nv3: Breede River (6)

The vegetation on the floodplain is invaded by woody exotic species. Along the margins of the river there was a range of indigenous riparian scrub species (Table 3.72). The macroinvertebrate communities were fair (Table 3.73).

Table 3.72 Riparian vegetation habitat diversity assessment, Nv3: Breede River, Papenkuils

Lateral zone	Comment
Wet Bank species: *Salix mucronata, Prionium serratum.*	Were few, if any, wet bank species present. Woody exotics were dominant.
Dry Bank species: **Acacia mearnsii, *Acacia saligna, *Eucalyptus* sp*., Searsia angustifolia.*	Were few scattered small individuals. Woody exotics dominated the dry bank.

Table 3.73 Macroinvertebrate habitat diversity assessment, Nv3: Breede River, Papenkuils

Habitat diversity	General Comments
• Extensive marginal and instream vegetation. • Mud riverbed. • Lack of riffles present, pools are dominant. • Limited gravel, sand and aquatic biotopes.	Poor range of biotopes, with some lacking e.g. stones out of current. High turbidity, possibly due to the presence of the reservoir. Nutrient rich water, possibly due to agricultural activities and the presence of the reservoir. Silt deposition present at the site with lots autochthonous matter. Pool taxa expected to dominate, however, the presence of reservoir may be a limiting factor for some macroinvertebrates.

Table 3.74 HI scores and category, Nv3: Breede River, Papenkuils

INSTREAM CRITERIA		RIPARIAN CRITERIA	
water abstraction	10	indigenous vegetation removal	13
flow modification	10	exotic vegetation encroachment	23
bed modification	0	bank erosion	5
channel modification	3	channel modification	3
water quality	20	water abstraction	8
inundation	0	inundation	0
exotic macrophytes	5	flow modification	10
exotic fauna	10	water quality	10
solid waste disposal	3		
TOTAL (%)	71.1	**TOTAL (%)**	64.8
HI Category	C	**HI Category**	C

The overall condition of the site was Category C (Table 3.74).

3.3.12 *Nii1: Breede River, d/s of Papenkuils*

The width of the floodplain is less downstream of Papenkuils and the main channel was lined with woody exotics (Figure 3.24), and the floodplain was cleared for agriculture (Table 3.75). The macroinvertebrate communities were fair (Table 3.76).

Figure 3.24 Nii1: Breede River, d/s of Papenkuils

Table 3.75 Riparian vegetation habitat diversity assessment, Nii1: Breede River, d/s of Papenkuils

Lateral zone	Comment
Wet Bank species: **Acacia saligna, Salix mucronata, Phragmites australis.*	Consisted mainly of woody exotic species with some scattered patches of riparian scrub species.
Dry Bank species: **Acacia saligna, *Acacia mearnsii, *Eucalyptus sp.*	Consisted mainly of woody exotic species with some scattered patches of riparian scrub species.

Table 3.76 Macroinvertebrate habitat diversity assessment, Nii1: Breede River. d/s of Papenkuils

Habitat diversity	General Comments
• Extensive marginal and instream vegetation. • Mud riverbed. • Riffle and pool habitats present. • Extensive cobbles on the riverbed.	Poor range of biotopes, with some being lacking e.g. stones out of current. Low turbidity. Silt deposited at the site with autochthonous matter present.

Table 3.77 HI scores and category, Breede River, d/s of Papenkuils

INSTREAM CRITERIA		RIPARIAN CRITERIA	
water abstraction	8	indigenous vegetation removal	18
flow modification	10	exotic vegetation encroachment	23
bed modification	8	bank erosion	5
channel modification	0	channel modification	3
water quality	15	water abstraction	8
inundation	3	inundation	0
exotic macrophytes	8	flow modification	10
exotic fauna	10	water quality	10
solid waste disposal	3		
TOTAL (%)	70.8	**TOTAL (%)**	62.2
HI Category	C	**HI Category**	C

The overall condition of the site was Category C (Table 3.77).

3.3.13 *Niv11: Nuy River*

This river had been dredged and straightened in places, and a centre line had been dug in others (naturally this section would probably have been an unchannelled wetland), but there were no levees and the river was still connected to its floodplain (Figure 3.25). There was a high suspended/fine sediment load, the source of which was not known, but could have indicated an incising/eroding section of wetland upstream.

Figure 3.25 Niv11: Nuy River

The vegetation was mostly reeds; in line with the suggestion that this was once an unchannelled wetland (Table 3.78). There were various sorts of cultivation extending to the channel in places.

Table 3.78 Riparian vegetation habitat diversity assessment, Niv11: Nuy River

Lateral zone	Comment
Wet Bank species: *Phragmites australis, Pycreus polystachyos, Typha capensis.*	Mostly reed dominated wetland.
Dry Bank species: **Eucalyptus sp.*	Consisted mainly of woody exotic species and grazed pastureland.

The macroinvertebrate communities were poor (Table 3.79 and Table 3.80).

Table 3.79 Macroinvertebrate habitat diversity assessment, Niv11: Nuy River

Habitat diversity	General Comments
• Extensive sand substrata at depth for sampling of macroinvertebrates. Extensive marginal vegetation, mostly, grass and reeds. Limited cobbles instream.	Poor in macroinvertebrate diversity. High sediment load in the stream. Supported lower macroinvertebrate diversity with more taxa present that were tolerant of high sediment loads and algal blooms.

Table 3.80 SASS5 scores, Niv11: Nuy River

SASS5 score	48
No. of taxa	9
Average Score Per Taxon (ASPT)	5.3

Table 3.81 HI scores and category, Niv11: Nuy River

INSTREAM CRITERIA		RIPARIAN CRITERIA	
water abstraction	20	indigenous vegetation removal	8
flow modification	13	exotic vegetation encroachment	10
bed modification	20	bank erosion	3
channel modification	8	channel modification	5
water quality	13	water abstraction	5
inundation	0	inundation	8
exotic macrophytes	10	flow modification	10
exotic fauna	0	water quality	15
solid waste disposal	3		
TOTAL (%)	57.2	**TOTAL (%)**	69
HI Category	D	**HI Category**	C

The overall condition of the site was Category C (Table 3.81).

3.3.14***Niv13: Doring River***

This reach was highly disturbed. The floodplain had been infilled; the river dredged; the riparian zones infilled and/or burnt; large levees constructed along the active channel and all connection with the floodplain had been severed (Figure 3.26). The river channel had been reduced by more than 50% in width, with further reductions still being engineered at the time of the site visit. As a result, riparian vegetation was virtually non-existent (Table 3.82). The macroinvertebrate communities were poor (Table 3.83).

Figure 3.26 Niv13: Doring River

Table 3.82 Riparian vegetation habitat diversity assessment, Niv13: Doring River

Lateral zone	Comment
Wet Bank species: *Pycreus polystachyos, Isolepis prolifer, Juncus lomatophyllus, Phragmites australis..*	Were remnants of wet bank species scattered in the channel.
Dry Bank species:	Consisted mainly of woody exotic species,

**Acacia mearnsii, *A. saligna, *A. longifolia, Stoebe plumosa.*	grazed pastureland and cultivated fields.

Table 3.83 Macroinvertebrate habitat diversity assessment, Niv13: Doring River

Habitat diversity	General Comments
• Extensive boulder and cobble substrata at sufficient depth for macroinvertebrates. • Lack of marginal vegetation for aquatic macroinvertebrates.	Poor range of macroinvertebrate biotopes with some lacking e.g. instream vegetation, sand and mud biotopes. Dominated by one habitat type: runs. Highly modified (bulldozed) river bed and banks. Low macroinvertebrate diversity with more taxa that are tolerant to flow modification.

Table 3.84 HI scores and category, Niv13: Doring River

INSTREAM CRITERIA		RIPARIAN CRITERIA	
water abstraction	20	indigenous vegetation removal	25
flow modification	25	exotic vegetation encroachment	23
bed modification	25	bank erosion	13
channel modification	25	channel modification	25
water quality	15	water abstraction	15
inundation	3	inundation	5
exotic macrophytes	0	flow modification	15
exotic fauna	10	water quality	3
solid waste disposal	3		
TOTAL (%)	36.6	**TOTAL (%)**	38.7
HI Category	E	**HI Category**	E

The overall condition of the site was Category E (Table 3.84).

3.3.15 ***Group 3: comparison with 2000 PES assessment***

Nine of the fourteen nodes in this group were assessed (Table 3.85). Of these, none was in a better condition than in 2000, and most scored considerably worse in 2009 than in 2000. In general, the condition of these rivers was poorer that that of Group 1 or 2. For the most part, the tributaries of the Breede River in this area have been extensively 'engineered', with a consequent loss of ecological function and value. Indeed, much of the protection from poor quality runoff from their catchments that would have been afforded these rivers by their riparian vegetation has been destroyed. It is likely that this will have affected not only river condition, but also the reliability of supply for those who depend on these rivers for drinking water.

Table 3.85 Comparison of PES (Kleynhans 2000) and HI (2009) for nodes in Group 3

Node	PES (2000)	HI (PES) 2009	
		Instream	Riparian
Niv42: Molenaars (Smalblaar) River	C	D	E
Niv12: Holsloot River	C	D	E
Nvii4: Sanddrif River	D	-	-
Nvii7: upper Hex River	D	D	D
Niv10: lower Hex River	D	D	D
Niii1: Breede River, u/s of Papenkuils	D	-	-
Niv8: Bothaspruit River	C	D	D
Nvii6: Hartbees River	C	-	-
Niv9: Hartbees River	C	E	D
Nvii5: Koo River	C	-	-
Nv3: Breede River, Papenkuils	C	C	C
Nii1: Breede River, d/s of Papenkuils	C	-	-
Niv11: Nuy River	C	D	C
Niv13: Doring River	C	E	E

3.4 Group 4

Group 4 nodes (Figure 3.27) are located on the rivers between Robertson and Swellendam along the R62. There are 17 nodes in Group 4: 11 tributary nodes and six on the mainstem. Geomorphological assessments were not done for these nodes.

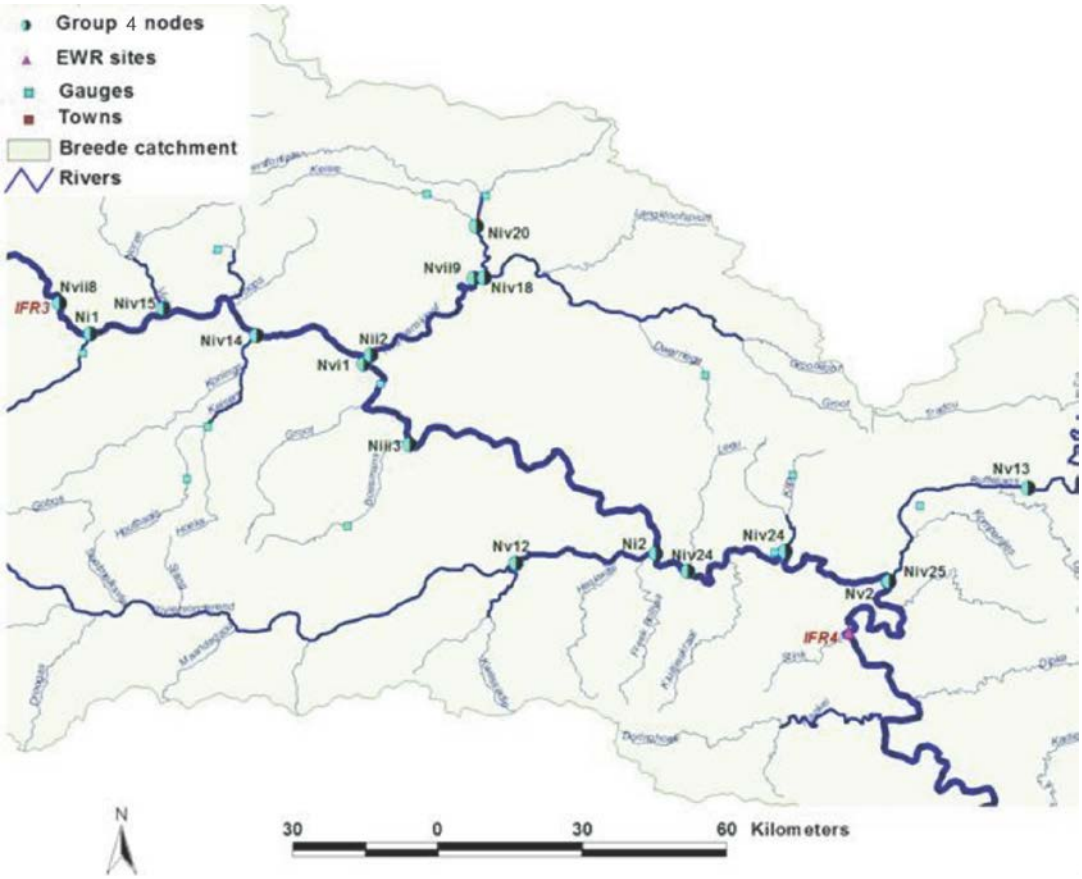

Figure 3.27 Location of the 17 nodes in Group 4, Breede River catchment

3.4.1 *Nvii8: Breede River, Le Chasseur (IFR3)*

The river flowed through a wide, well-vegetated floodplain (Figure 3.28). There were mid-channel bars and the riparian vegetation was intact on both banks. Though the river flows through farmland, cultivation of the floodplain was not intensive (Table 3.86). The macroinvertebrates were in good condition (Table 3.87).

Figure 3.28 Nvii8: Breede River, Le Chasseur (IFR3)

Table 3.86 Riparian vegetation habitat diversity assessment, Nvii8: Breede River, Le Chasseur (IFR3)

Lateral zone	Comment
Wet Bank species: *Salix mucronata, Morella serrata, Polygala virgata.*	Densely vegetated, well established.
Dry Bank species: *Searsia angustifolia, Acacia karoo, Searsia lancea, *Tamarix usenoides, Cliffortia strobilifera.*	Densely vegetated, well established.

Table 3.87 Macroinvertebrate habitat diversity assessment, Nvii8: Breede River, Le Chasseur (IFR3)

Habitat diversity	General Comments
• Extensive marginal and instream vegetation. • Mud riverbed. • Riffle and pool habitats. • Extensive cobbles on the riverbed.	Range of aquatic macroinvertebrate biotopes. Turbidity was high.

Table 3.88 HI scores and category, Nvii8: Breede River, Le Chasseur (IFR3)

INSTREAM CRITERIA		RIPARIAN CRITERIA	
water abstraction	8	indigenous vegetation removal	18
flow modification	10	exotic vegetation encroachment	23
bed modification	8	bank erosion	5
channel modification	0	channel modification	3
water quality	15	water abstraction	8
inundation	3	inundation	0
exotic macrophytes	8	flow modification	10
exotic fauna	10	water quality	10
solid waste disposal	3		
TOTAL (%)	70.8	**TOTAL (%)**	62.2
HI Category	C	**HI Category**	C

The overall condition of the site was Category C (Table 3.88).

3.4.2 *Ni1: Breede River, Poesjenels*

Not assessed, use Nvii8 (Section 3.4.1).

3.4.3 *Niv14: Keisers River*

The river channel was heavily modified, cleared of vegetation and dredged. There was little indigenous vegetation present and the floodplain was cultivated on both banks (Figure 3.29; Table 3.89). The macroinvertebrates were poor (Table 3.90).

Figure 3.29 Niv14: Keisers River

Table 3.89 Riparian vegetation habitat diversity assessment, Niv14: Keisers River

Lateral zone	Comment
Wet Bank species: *Typha capensis, Juncus effusus, *Acacia saligna, Phragmites australis.*	A few indigenous species scattered along the wet bank. Mostly devoid of vegetation due to dredging.
Dry Bank species: **Acacia saligna, Searsia pendulina, *Eucalytpus* sp., *Phragmites australis.*	Mostly woody exotic species present.

Table 3.90 Macroinvertebrate habitat diversity assessment, Niv14: Keisers River

Habitat diversity	General Comments
• Extensive boulder and cobble substrata at depth suitable for habitation of macroinvertebrates. • Limited marginal vegetation for aquatic macroinvertebrates. • Algal blooms present.	Highly modified river bed and banks. Dominated by one habitat type: runs. Severely reduced presence of macroinvertebrate taxa at this site. No aquatic macroinvertebrates present, only tadpoles were present. This is an indication of critically impaired water conditions.

Table 3.91 HI scores and category, Niv14: Keisers River

INSTREAM CRITERIA		RIPARIAN CRITERIA	
water abstraction	23	indigenous vegetation removal	20
flow modification	20	exotic vegetation encroachment	23
bed modification	20	bank erosion	18
channel modification	15	channel modification	18
water quality	23	water abstraction	20
inundation	3	inundation	3
exotic macrophytes	0	flow modification	20
exotic fauna	10	water quality	15
solid waste disposal	10		
TOTAL (%)	39.6	**TOTAL (%)**	31.7
HI Category	E	**HI Category**	E

The overall condition of the site was Category E (Table 3.91).

3.4.4 *Niv15: Vink River*

The river was heavily dredged and the riparian vegetation had been removed (Figure 3.30; Table 3.92). There was an excessive sediment load, the source of which was not clear. The presence of algal blooms indicated elevated nutrient levels. The macroinvertebrates were depauperate (Table 3.93 and Table 3.94).

Figure 3.30 Niv15: Vink River

Table 3.92 Riparian vegetation habitat diversity assessment, Niv15: Vink River

Lateral zone	Comment
Wet Bank species: *Phragmites australis, *Arundo donax, *Solanum mauritianum, Typha capensis, Juncus effusus, Isolepis prolifer.*	The presence of both exotic and indigenous vegetation occurred sporadically in clumps along the river margin.
Dry Bank species: **Acacia saligna, *Arundo donax, Searsia pendulina.*	The presence of both exotic and indigenous vegetation occurred sporadically in clumps along the river margin.

Table 3.93 Macroinvertebrate habitat diversity assessment, Niv15: Vink River

Habitat diversity	General Comments
• Extensive sand substrata at depth suitable for sampling of macroinvertebrates. • Extensive instream vegetation were present (mostly sedges and grass). • Limited cobbles instream.	Reduced macroinvertebrate diversity, especially those taxa that are sensitive to flow modification, sediment load and algal blooms. Dragonflies are possibly benefiting from the recovery of instream vegetation.

Table 3.94 SASS5 scores, Niv15: Vink River

SASS5 score	44
No. of taxa	9
Average Score Per Taxon (ASPT)	4.9

Table 3.95 HI scores and category, Niv15: Vink River

INSTREAM CRITERIA		RIPARIAN CRITERIA	
water abstraction	20	indigenous vegetation removal	15
Flow modification	20	exotic vegetation encroachment	18
Bed modification	20	bank erosion	0
channel modification	25	channel modification	25
water quality	15	water abstraction	15
inundation	3	Inundation	0
exotic macrophytes	13	flow modification	15
exotic fauna	10	water quality	10
solid waste disposal	13		
TOTAL (%)	34.9	**TOTAL (%)**	51.6
PES class	E	**PES class**	D

The overall condition of the site was Category E (Table 3.95).

3.4.5 *Niv20: Pietersfontein River*

The river was dredging and the riparian area had been cleared (Figure 3.31). There was an excessive load of sediment in the channel, the source of which was unknown. There was sparse vegetation present (Table 3.96) and the macroinvertebrates were depauperate (Table 3.97).

Figure 3.31 Niv20: Pietersfontein River

Table 3.96 Riparian vegetation habitat diversity assessment, Niv20: Pietersfontein River

Lateral zone	Comment
Wet Bank species: *Phragmites australis.*	There was generally little vegetation on the wet bank.
Dry Bank species: *Phragmites australis.*	There was generally little vegetation on the dry bank.

Table 3.97 Macroinvertebrate habitat diversity assessment, Niv20: Pietersfontein River

Habitat diversity	General Comments
• Extensive sand and gravel substrata at depth suitable for sampling of macroinvertebrates. • No instream and marginal vegetation present. Limited cobbles instream.	Poor in macroinvertebrate habitat diversity. High sediment load in the stream. Expected to support low macroinvertebrate diversity with more taxa being present that are tolerant to high riverbed modification.

Table 3.98 HI scores and category, Niv20: Pietersfontein River

INSTREAM CRITERIA		RIPARIAN CRITERIA	
water abstraction	18	indigenous vegetation removal	13
flow modification	20	exotic vegetation encroachment	20
bed modification	23	bank erosion	3
channel modification	10	channel modification	18
water quality	25	water abstraction	15
inundation	8	inundation	5
exotic macrophytes	18	flow modification	23
exotic fauna	10	water quality	18
solid waste disposal	18		
TOTAL (%)	32.2	**TOTAL (%)**	44
HI Category	E	**HI Category**	D

The overall condition of the site was Category E (Table 3.98).

3.4.6 ***Niv18: Kingna River***

The river was heavily modified due by dredging and clearing of the riparian area (Figure 3.32). The banks were steep and eroding in places. There were algal blooms indicating an excess of nutrients. Stock access paths were present. The exotic floating water fern, *Azolla filliculoides,* was found in the aquatic zone (Table 3.99). The macroinvertebrates were poor (Table 3.100).

Figure 3.32 Niv18: Kingna River

Table 3.99 Riparian vegetation habitat diversity assessment, Niv18: Kingna River

Lateral zone	Comment
Wet Bank species: *Phragmites australis, *Arundo donax, *Solanum mauritianum, *Pennisetum clandestinum.*	Portions of the wet bank were cultivated; others were heavily grazed.
Dry Bank species: *Phragmites australis.*	The dry bank had been cleared and there was hardly any riparian vegetation.

Table 3.100 Macroinvertebrate habitat diversity assessment, Niv18: Kingna River

Habitat diversity	General Comments
• Extensive algal mat on water surface. • Instream and marginal vegetation were present. • Limited cobbles instream. Lack of flow diversity, dominated by pools.	Poor availability of macroinvertebrate habitat diversity. River bank water's edge modified. High sediment load in the river. High nutrient accumulation in the water. Expected to support low levels of macroinvertebrate diversity with more taxa that are suited to wetland conditions.

Table 3.101 HI scores and category, Niv18: Kingna River

INSTREAM CRITERIA		RIPARIAN CRITERIA	
water abstraction	18	indigenous vegetation removal	13
flow modification	20	exotic vegetation encroachment	20
bed modification	23	bank erosion	3
channel modification	10	channel modification	18
water quality	25	water abstraction	15
inundation	8	Inundation	5
exotic macrophytes	18	flow modification	23
exotic fauna	10	water quality	18
solid waste disposal	18		
TOTAL (%)	32.2	**TOTAL (%)**	44
HI Category	E	**HI Category**	D

The overall condition of the site was Category E (Table 3.101).

3.4.7 *Nvii9: Keisie River*

The river was channelized through the town of Montagu (Figure 3.33). The channel was dredged and the riparian vegetation had been cleared (Table 3.102). There was an excessive load of sediment in the channel, the source of which was not clear. The exotic aquatic water fern, *Azolla filliculoides,* was present in the aquatic zone. The macroinvertebrates were depauperate (Table 3.103 and Table 3.104).

Figure 3.33 Nvii9: Keisie River

Table 3.102 Riparian vegetation habitat diversity assessment, Nvii9: Keisie River

Lateral zone	Comment
Wet Bank species: *Isolepis prolifer, *Pennisetum clandestinum.*	There were graminoids in patches on the channel edge.
Dry Bank species: *Searsia lancea, Stoebe plumosa, Acacia karoo,*	There was generally little vegetation present on the dry bank.

Table 3.103 Macroinvertebrate habitat diversity assessment, Nvii9: Keisie River

Habitat diversity	General Comments
• No instream vegetation, with limited marginal vegetation. • Extensive cobbles instream. Poor flow diversity: mainly runs.	Low macroinvertebrate habitat diversity. Water's edge modified in some parts. Taxa present were tolerant to channel modification and water quality impoverishment. Foul smelling water, possibly Montagu Town sewage effluents.

Table 3.104 SASS5 scores, Nvii9: Keisie River

SASS5 score	26
No. of taxa	5
Average Score Per Taxon (ASPT)	5.2

Table 3.105 HI scores and category, Nvii9: Keisie River

INSTREAM CRITERIA		RIPARIAN CRITERIA	
water abstraction	15	indigenous vegetation removal	23
flow modification	20	exotic vegetation encroachment	8
bed modification	23	bank erosion	18
channel modification	20	channel modification	20
water quality	18	water abstraction	15
inundation	5	inundation	5
exotic macrophytes	10	flow modification	13
exotic fauna	10	water quality	18
solid waste disposal	18		
TOTAL (%)	36.3	**TOTAL (%)**	40.2
HI Category	E	**HI Category**	D

The overall condition of the site was Category E (Table 3.105).

3.4.8 *Nii2: Kogmanskloof River*

The river was heavily modified from dredging and clearing of the riparian vegetation (Figure 3.34; Table 3.106). There was an excessive load of sediment in the channel, the source of which is not clear. The aquatic water fern, *Azolla filliculoides,* was found in patches at the channel edge. The macroinvertebrates were poor (Table 3.107, Table 3.108).

Figure 3.34 Nii2: Kogmanskloof River

Table 3.106 Riparian vegetation habitat diversity assessment, Nii2: Kogmanskloof River

Lateral zone	Comment
Wet Bank species: *Phragmites australis, *Arundo donax, *Pennisetum clandestinum, Cyperus textilis, Digitaria debilis, Pycreus polystachyos.*	The wet bank was well vegetated with large reeds sedges.
*Phragmites australis, *Arundo donax, Acacia karoo, *Solanum mauritianum, *Acacia saligna, *A. mearnsii.*	The dry bank was well vegetated with a mixture of exotic and indigenous species.

Table 3.107 Macroinvertebrate habitat diversity assessment, Nii2: Kogmanskloof River

Habitat diversity	General Comments
• No instream vegetation, with limited marginal vegetation (reeds and sedges). Lack of flow diversity: runs.	Lower levels of modification and invasive alien trees. Reduced macroinvertebrate diversity with more taxa that are tolerant of poor water quality. Foul smelling water, possibly from Montagu Town sewage effluents.

Table 3.108 SASS5 scores, Nii2: Kogmanskloof River

SASS5 score	25
No. of taxa	5
Average Score Per Taxon (ASPT)	5

Table 3.109 HI scores and category, Nii2: Kogmanskloof River

INSTREAM CRITERIA		RIPARIAN CRITERIA	
water abstraction	18	indigenous vegetation removal	13
flow modification	20	exotic vegetation encroachment	13
bed modification	20	bank erosion	3
channel modification	13	channel modification	3
water quality	18	water abstraction	15
inundation	5	inundation	5
exotic macrophytes	10	flow modification	13
exotic fauna	10	water quality	18
solid waste disposal	3		
TOTAL (%)	43.7	**TOTAL (%)**	59.8
HI Category	D	**HI Category**	D

The overall condition of the site was Category D (Table 3.109).

3.4.9 ***Nvi1: Breede River, Ashton***

Not assessed.

3.4.10***Niii3: Breede River, Bonnievale***

Not assessed.

3.4.11***Ni2: Breede River, confluence Riviersonderend***

Not assessed.

3.4.12***Niv24: Klip River***

The river was heavily modified by dredging and clearing of the riparian zone and over-abstraction (Figure 3.35; Table 3.110). There was no flow at the time of the site assessment and it was not possible to sample macroinvertebrates (Table 3.111).

Figure 3.35 Niv24: Klip River

Table 3.110 Riparian vegetation habitat diversity assessment, Niv24: Klip River

Lateral zone	Comment
Wet Bank species: *Pycreus polystachyos, *Rubus fruticosus, Juncus lomatophyllus, J. effusus, Isolepis prolifer.*	There was a thin band of wet bank species.
Dry Bank species: **Acacia mearnsii, *Pinus* sp., **Rubus fruticosus.*	The dry bank had been cleared or was invaded with woody exotics.

Table 3.111 Macroinvertebrate habitat diversity assessment, Niv24: Klip River

Habitat diversity	General Comments
No flow at the site but some standing water.	Highly modified channel and riverbed. No macroinvertebrates sampled. Evidence of sand mining.

Table 3.112 HI scores and category, Niv24: Klip River

INSTREAM CRITERIA		RIPARIAN CRITERIA	
water abstraction	25	indigenous vegetation removal	20
flow modification	25	exotic vegetation encroachment	23
bed modification	20	bank erosion	15
channel modification	8	channel modification	10
water quality	25	water abstraction	20
inundation	13	inundation	5
exotic macrophytes	0	flow modification	20
exotic fauna	10	water quality	15
solid waste disposal	10		
TOTAL (%)	34.1	**TOTAL (%)**	35.6
HI Category	E	**HI Category**	E

The overall condition of the site was Category E (Table 3.112).

3.4.13***Niv24: Leeu River***

The river was heavily modified by dredging, clearing of the riparian zone and over-abstraction (Figure 3.36; Table 3.113). There was little flow at the time of the site assessment. The macroinvertebrates were poor (Table 3.114 and Table 3.115).

Figure 3.36 Niv24: Leeu River

Table 3.113 Riparian vegetation habitat diversity assessment, Niv24: Leeu River

Lateral zone	Comment
Wet Bank species: *Juncus lomatophyllus, J, capensis, Isolepis prolifer, Isolepis digitata, *Phytolacca americana.*	Patches of wet bank species scattered along the channel margin.
Dry Bank species: *Cliffortia graminea, *Acacia saligna, *A, mearnsii, *Rubus fruticosus, *Conyza bonariensis.*	The dry bank was heavily invaded by exotic woody species.

Table 3.114 Macroinvertebrate habitat diversity assessment, Niv24: Leeu River

Habitat diversity	General Comments
• No instream vegetation, and limited marginal vegetation. • Extensive cobbles instream. • Lack of flow diversity, mainly slow flow.	Poor in macroinvertebrate habitat diversity. Highly eroded river banks. Low macroinvertebrate diversity, dominated by tolerant species

Table 3.115 SASS5 scores, Niv24: Leeu River

SASS5 score	20
No. of taxa	5
Average Score Per Taxon (ASPT)	5

Table 3.116 HI scores and category, Niv24: Leeu River

INSTREAM CRITERIA		RIPARIAN CRITERIA	
water abstraction	23	indigenous vegetation removal	23
flow modification	23	exotic vegetation encroachment	20
bed modification	20	bank erosion	18
channel modification	20	channel modification	18
water quality	25	water abstraction	15
inundation	15	inundation	5
exotic macrophytes	0	flow modification	18
exotic fauna	10	water quality	25
solid waste disposal	25		
TOTAL (%)	25.7	**TOTAL (%)**	29.1
HI Category	E	**HI Category**	E

The overall condition of the site was Category E (Table 3.116).

3.4.14 *Nv13: Upper Buffeljags/ Tradouw River*

Not assessed.

3.4.15 *Nv14: Middle Buffeljags River*

The river was heavily modified by dredging and clearing of the riparian zone and over-abstraction (Figure 3.37; Table 3.117). There was little flow at the time of the site assessment (Table 3.118). The macroinvertebrates were poor (Table 3.119).

Figure 3.37 Nv14: Middle Buffeljags River

Table 3.117 Riparian vegetation habitat diversity assessment, Nv14: Middle Buffeljags River

Lateral zone	Comment
Wet Bank species: *Juncus lomatophyllus, Ficinia brevifolia, Cyperus textilis, Cyperus papyrus, Isolepis prolifer, Prionium serratum, *Acacia mearnsii.*	There was generally little vegetation on the wet bank.
Dry Bank species: *Acacia mearnsii, *Paraserianthes lophantha, Digitaria debilis, *Pennisetum clandestinum.*	The dry bank was either cleared or was heavily invaded by woody exotics.

Table 3.118 Macroinvertebrate habitat diversity assessment, Nv14: Middle Buffeljags River

Habitat diversity	General Comments
• Limited instream and marginal vegetation available for a macroinvertebrates. • Extensive cobbles instream. • Lack of flow diversity, dominated by slow flow/ pools. • Lack of riffles.	Highly eroded river banks. Supported low macroinvertebrate diversity, dominated by those that are tolerant of channel modification and poor water quality.

Table 3.119 SASS5 scores, NV14: middle Buffeljags River

SASS5 score	20
No. of taxa	5
Average Score Per Taxon (ASPT)	5

Table 3.120 HI scores and category, Nv14: Middle Buffeljags River

INSTREAM CRITERIA		RIPARIAN CRITERIA	
water abstraction	23	indigenous vegetation removal	23
flow modification	20	exotic vegetation encroachment	23
bed modification	20	bank erosion	20
channel modification	20	channel modification	20
water quality	20	water abstraction	20
inundation	10	inundation	10
exotic macrophytes	15	flow modification	20
exotic fauna	10	water quality	13
solid waste disposal	5		
TOTAL (%)	31.3	**TOTAL (%)**	25.8
HI Category	E	**HI Category**	E

The overall condition of the site was Category E (Table 3.120).

3.4.16***Niv25: Lower Buffeljags River***

The river was heavily modified by dredging and clearing of the riparian zone and over-abstraction (Figure 3.38; Table 3.121). There was little flow at the time of the site assessment. The macroinvertebrates were poor (Table 3.122 and Table 3.123).

Figure 3.38 Niv25, lower Buffeljags River

Table 3.121 Riparian vegetation habitat diversity assessment, Niv25: lower Buffeljags River

Lateral zone	Comment
Wet Bank species: *Cyperus textilis, Isolepis prolifer, *Solanum nigrum, Prionium serratum.*	Patches of wet bank species occurred at the channel margin.
Dry Bank species: **Acacia mearnsii, *Arundo donax, *Solanum mauritianum.*	The dry bank was either cultivated field or grazing pasture land, or was heavily invaded by woody exotics.

Table 3.122 Macroinvertebrate habitat diversity assessment, Niv 25: lower Buffeljags River

Habitat diversity	General Comments
• Limited instream and marginal vegetation available for macroinvertebrates. • Extensive cobbles instream. • Lack of flow diversity, dominated by slow flow/ pools. Lack of riffles.	Highly eroded river banks.

Table 3.123 SASS5 scores, Niv 25: lower Buffeljags River

SASS5 score	48
No. of taxa	9
Average Score Per Taxon (ASPT)	5.3

Table 3.124 HI scores and category, Niv 25: lower Buffeljags River

INSTREAM CRITERIA		RIPARIAN CRITERIA	
water abstraction	23	indigenous vegetation removal	23
flow modification	23	exotic vegetation encroachment	23
bed modification	13	bank erosion	13
channel modification	10	channel modification	13
water quality	10	water abstraction	20
Inundation	10	inundation	10
exotic macrophytes	8	flow modification	20
exotic fauna	10	water quality	10
solid waste disposal	5		
TOTAL (%)	47.3	**TOTAL (%)**	34.9
HI Category	D	**HI Category**	E

The overall condition of the site was Category D (Table 3.124).

3.4.17 ***Nv2: Breede River, Swellendam***

Not assessed.

3.4.18 ***Group 4: comparison with 2000 PES assessment***

Apart from two nodes on the Breede mainstem, the condition of all of the others was lower than that in the 2000 assessment (Table 3.125). As was the case for the other groups, part of the reason for this could be an under assessment in the desktop exercise in 2000. Whatever the reason, the current condition of these systems is cause for serious concern. Almost without exception, these tributaries have been dredged, bulldozed, channelized and in some instances levees have been constructed alongside them to prevent overbank flooding. In most cases only hardy and pioneering annuals or exotic species remained in the riparian areas, and there was little or no variety of instream habitat. Some, for example, the Vink, the Kingna and the Kogmanskloof had excessive algal growth and/or exotic instream vegegtation, an indication of a nutrient surplus and a breakdown in the self cleansing functions of the ecosystem. The Leeu, the Klip and the middle Buffeljags Rivers were in the worst poorest condition as the impacts listed above were exacerbated by a complete cessation of flows in September, when the other rivers – themselves subjected to high levels of abstraction – were flowing.

Table 3.125 Comparison of PES (Kleynhans 2000) and HI (2010) for nodes in Group 4

Node	PES (2000)	HI (2010)	
		Instream	Riparian
Nvii8: Breede River, Le Chasseur (IFR3)	D	C	C
Ni1: Breede River, Poesjenels	D	C	C
Niv14: Keisers River	D	E	E
Niv15: Vink River	D	E	D
Niv20: Pietersfontein River	C	E	D
Niv18: Kingna River	C	E	D
Nvii9: Kiesie River	C	E	D
Nii2: Kogmanskloof River	C	D	D
Nvi1: Breede River, Ashton	D	-	-
Niii3: Breede River, Bonnievale	C	-	-
Ni2: Breede River, confluence with Riviersonderend River	C	-	-
Niv24: Klip River	C	E	E
Niv24: Leeu River	C	E	E
Nv13: upper Buffeljags/ Tradouw River	C		
Nv14 middle Buffeljags River	D	E	E
Niv25, lower Buffeljags River	C	D	E
Nv2: Breede River, Swellendam	C	-	-

3.5 Group 5

The two nodes Group 5 are located in the lower most parts of the catchment, on the Agulhas Plain. These nodes were not assessed.

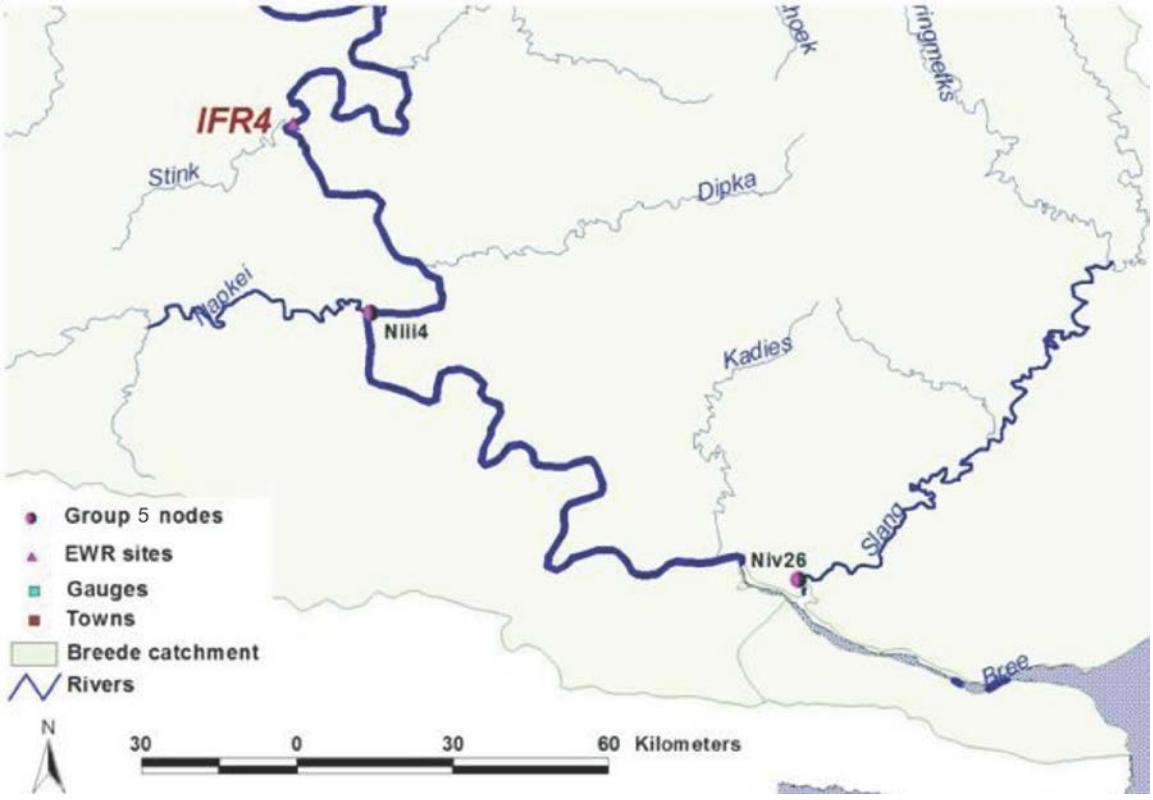

Figure 3.39 Location of the 2 nodes in Group 5, Breede River catchment

3.5.1 *Niii4: Breede River (IFR4)*

Not assessed.

3.5.2 *Niv26: Slang River*

Not assessed.

3.6 Group 6

Group 6 nodes are located on the Riviersonderend River and its tributaries alongside the N2. There are 15 nodes in Group 6: eight on tributaries of the Riviersonderend and seven on the Riviersonderend River. No geomorphological assessments were made for these nodes.

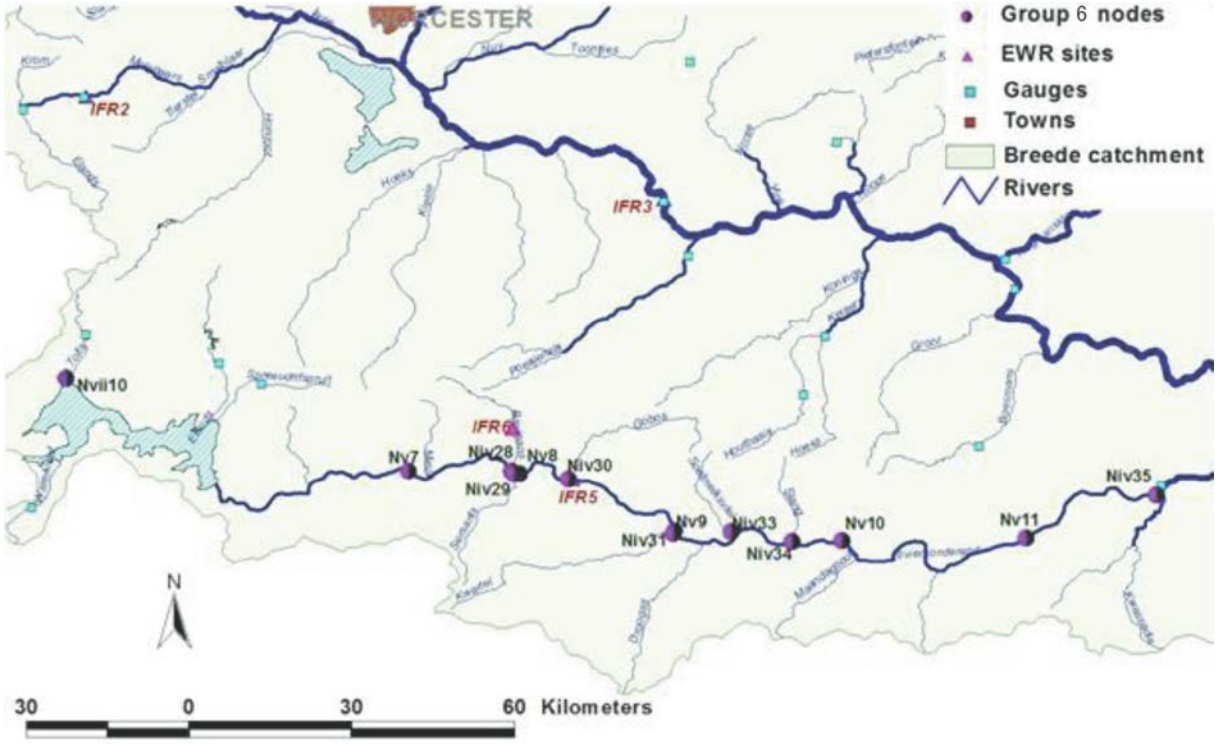

Figure 3.40 Location of 13 of the 15 nodes in Group 6, Breede River catchment

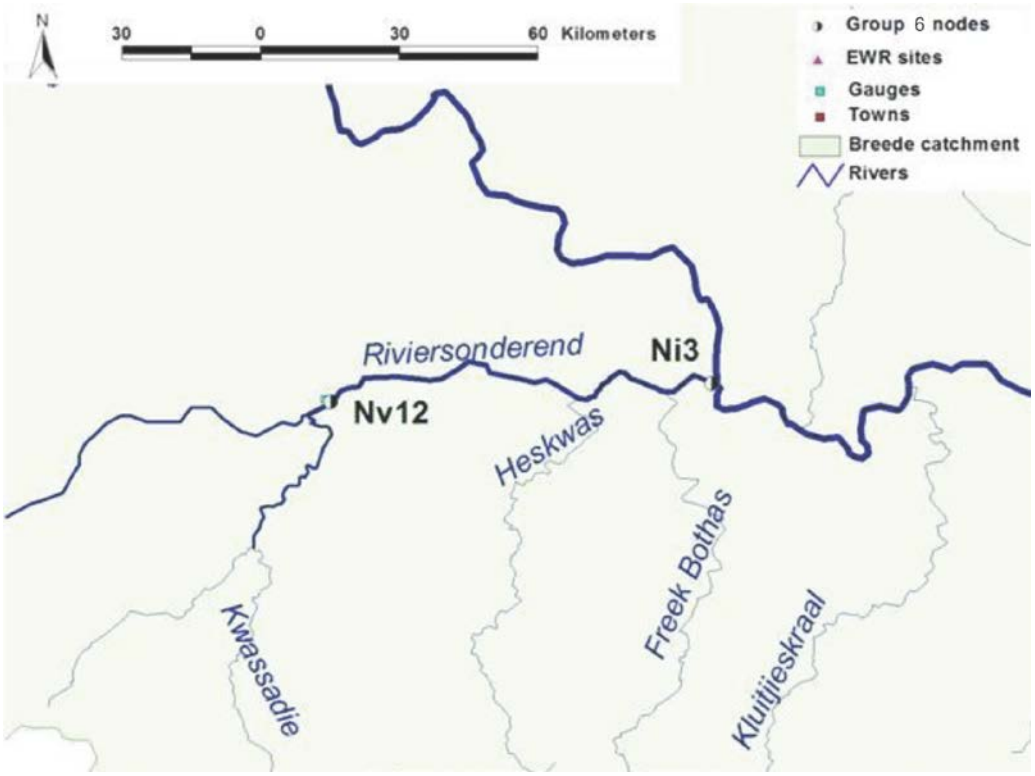

Figure 3.41 Location of the remaining 2 (of 15) nodes in Group 6, Breede River catchment

3.6.1 *Nvii10: Du Toits River*

There were few impacts on the river upstream of Theewaterskloof Reservoir, although some water is abstracted for Franschhoek. The river was in good ecological condition (Figure 3.42; Table 3.126 to Table 3.128).

Figure 3.42 Nvii10: Du Toits River

Table 3.126 Riparian vegetation habitat diversity assessment, Nvii10: Du Toits River

Lateral zone	Comment
Wet Bank species: *Juncus lomatophyllus, J, effusus, Isolepis prolifer, Brachylaena neriifolia, Freylinia lanceolata, Metrosideros angustifolia, Pennisetum macrourum, Erica caffra.*	The wet bank was well vegetated and intact. There were no alien species present.
Dry Bank species: *Brabejum stellatifolium, Metrosideros angustifolia, Morella serrata, Searsia angustifolia.*	The dry bank was well vegetated and intact. There were no alien species present.

Table 3.127 Macroinvertebrate habitat diversity assessment, Nvii10: Du Toits River

Habitat diversity	General Comments
• Good range of biotopes, with some that are sensitive to flow changes. • Extensive cobble substrata interspersed with gravel and sand at depths suitable for macroinvertebrates.	Highly natural macroinvertebrate habitat conditions with good mix between riffles, runs, and pools, and a diverse range of velocity and depth of flow conditions. Extensive marginal vegetation.

Table 3.128 SASS5 scores, Nvii10: Du Toits River

SASS5 score	112
No. of taxa	14
Average Score Per Taxon (ASPT)	8

Table 3.129 HI scores and category, Nvii10: Du Toits River

INSTREAM CRITERIA		RIPARIAN CRITERIA	
water abstraction	0	indigenous vegetation removal	0
flow modification	3	exotic vegetation encroachment	5
bed modification	0	bank erosion	0
channel modification	0	channel modification	0
water quality	0	water abstraction	0
inundation	0	inundation	0
exotic macrophytes	0	flow modification	3
exotic fauna	10	water quality	0
solid waste disposal	0		
TOTAL (%)	95.5	**TOTAL (%)**	96.4
HI Category	B	**HI Category**	B

The overall condition of the site was Category B (Table 3.129).

3.6.2 *Nv7: Riviersonderend River, Helderstroom*

Agriculture had encroached on the floodplain wetland and associated riparian vegetation but a fair amount remained that was in good condition (Figure 3.43; Table 3.130 to Table 3.132).

Figure 3.43 Nv7: Riviersonderend River, Helderstroom

Table 3.130 Riparian vegetation habitat diversity assessment, Nv7: Riviersonderend River, Helderstroom

Lateral zone	Comment
Wet Bank species: *Prionium serratum.*	Palmiet dominated the wet bank.
Dry Bank species: *Melianthus major, *Acacia longifolia, *A. mearnsii, *Eucalyptus* sp.	There were few indigenous shrubs and trees. Some woody exotics persisted in patches.

Table 3.131 Macroinvertebrate habitat diversity assessment, Nv7: Riviersonderend River, Helderstroom

Habitat diversity	General Comments
• Good range of biotopes, some with some that are susceptible to flow changes. • A mix of fines (sand and silt) interspersed with gravel at depths suitable for macroinvertebrates. • Lack of flow diversity. • Extensive marginal and instream vegetation.	A good mix of riffles, runs and pools. Taxa suited to pools are expected to dominate.

Table 3.132 HI scores and category, Nv7: Riviersonderend River, Helderstroom

INSTREAM CRITERIA		RIPARIAN CRITERIA	
water abstraction	10	indigenous vegetation removal	3
flow modification	10	exotic vegetation encroachment	10
bed modification	5	bank erosion	5
channel modification	3	channel modification	0
water quality	13	water abstraction	10
inundation	0	inundation	0
exotic macrophytes	0	flow modification	10
exotic fauna	10	water quality	3
solid waste disposal	3		
TOTAL (%)	74.5	**TOTAL (%)**	79.8
HI Category	C	**HI Category**	C

The overall condition of the site was Category C (Table 3.132).

3.6.3 ***Niv28: Baviaans River***

This is the closest node to IFR Site 6, but is located downstream of the town of Genendendal at the confluence with the Riviersonderend River, whereas IFR Site 6 is upstream of the town and the DWA gauging weir, and is in much better condition. There is a dam, which supplies water to Genadenal situated upstream of IFR Site 6.

Figure 3.44 Niv28: Baviaans River

There was mature riparian vegetation on the river banks despite evidence of dredging and bulldozing in the channel, and the presence of woody exotics. The wet bank was less well vegetated. The macroinvertebrates were poor (Table 3.134 and Table 3.135)

Table 3.133 Riparian vegetation habitat diversity assessment, Baviaans River

Lateral zone	Comment
Wet Bank species: *Prionium serratum, Juncus lomatophyllus, J, effusus, Isolepis prolifer, Zantedeschia aethiopica, Halleria lucida, *Acacia longifolia.*	The wet bank was speciose despite dredging of the active channel and the presence of exotic species.
Dry Bank species: **Eucalyptus* sp., **Lantana camara, *Quercus robur, *Acacia longifolia, Kiggelaria africana, Virgilia oroboides, Metrosideros angustifolia, Brachylaena neriifolia, Erica caffra, *Rubus fruticosus.*	The dry bank though sparsely vegetated was speciose, despite the presence of many mature woody exotic species.

Table 3.134 Macroinvertebrate habitat diversity assessment, Baviaans River

Habitat diversity	General Comments
• No instream vegetation, with limited marginal vegetation. • Extensive cobbles instream. Lack of flow diversity: dominated by slow flow.	Low macroinvertebrate habitat diversity. Highly modified riverbed and channel. Supported macroinvertebrates adapted to pool conditions.

Table 3.135 SASS5 scores, Baviaans River

SASS5 score	34
No. of taxa	5
Average Score Per Taxon (ASPT)	6.8

Table 3.136 HI scores and category, Baviaans River

INSTREAM CRITERIA		**RIPARIAN CRITERIA**	
water abstraction	15	indigenous vegetation removal	20
flow modification	18	exotic vegetation encroachment	20
bed modification	20	bank erosion	13
channel modification	15	channel modification	15
water quality	10	water abstraction	13
inundation	5	inundation	0
exotic macrophytes	0	flow modification	15
exotic fauna	10	water quality	8
solid waste disposal	10		
TOTAL (%)	51.1	**TOTAL (%)**	48.2
HI Category	D	**HI Category**	D

The overall condition of the site was Category D (Table 3.136).

3.6.4 ***Niv29: Sersants River***

The river channel did not appear to have been dredged, but the much of the riparian vegetation had been removed. There were, however, pockets of indigenous and exotic vegetation clustered along the river channel bank (Figure 3.45; Table 3.137). The water had high sediment and suspended algal loads, and macroinvertebrates were poor (Table 3.138).

Figure 3.45 Niv29: Sersants River

Table 3.137 Riparian vegetation habitat diversity assessment, Niv29: Sersants River

Lateral zone	Comment
Wet Bank species: *Juncus lomatophyllus, J, effusus, Isolepis prolifer, Aponogeton distachyos. *Acacia mearnsii, *Eucalytpus* sp., *Cyperus textilis, Juncus acutus, *Pennisetum clandestinum.*	There was generally little vegetation present on the wet bank.
Dry Bank species: **Eucalyptus* sp., *Melianthus major, *Solanum mauritianum, *Quercus robur, Pennisetum macrourum, *Acacia longifolia.*	There was generally little vegetation present on the dry bank, though pockets of alternating woody exotics interspersed with non-woody indigenous species persist.

Table 3.138 Macroinvertebrate habitat diversity assessment, Niv29: Sersants River

Habitat diversity	General Comments
• Instream and marginal vegetation was present. • Limited cobbles instream. • Flow diversity, dominated by run and pools.	Excessive nutrient accumulation in the water column. High sediment load. Low macroinvertebrate diversity expected, dominated by tolerant taxa.

Table 3.139 HI scores and category, Niv29: Sersants River

INSTREAM CRITERIA		**RIPARIAN CRITERIA**	
water abstraction	18	indigenous vegetation removal	15
flow modification	10	exotic vegetation encroachment	15
bed modification	20	bank erosion	10
channel modification	10	channel modification	5
water quality	20	water abstraction	10
inundation	13	inundation	5
exotic macrophytes	0	flow modification	13
exotic fauna	10	water quality	10
solid waste disposal	13		
TOTAL (%)	44.2	**TOTAL (%)**	59.8
HI Category	D	**HI Category**	D

The overall condition of the site was Category D (Table 3.139).

3.6.5 *Niv30: Gobos River*

The river was heavily modified by dredging and clearing of the riparian zone and over-abstraction (Figure 3.46; Table 3.140). There was no flow at the time of the site assessment and macroinvertebrates were depauperate (Table 3.141).

Figure 3.46 Niv30: Gobos River

Table 3.140 Riparian vegetation habitat diversity assessment, Niv 30: Gobos River

Lateral zone	Comment
Wet Bank species: *Pycreus polystachyos, Juncus lomatophyllus, Isolepis prolifer.*	Limited wet bank vegetation.
Dry Bank species: *Ehrharta calycina, *Acacia mearnsii, *Eucalyptus* sp., **A. longifolia, *Pinus* sp.	There was generally little vegetation on the dry bank.

Table 3.141 Macroinvertebrate habitat diversity assessment, Niv30: Gobos River

Habitat diversity	General Comments
• Extensive cobble substrata at depth that allow for invertebrates sampling. • Limited marginal and instream vegetation were present. Lack of flow diversity.	Highly modified channel and riverbed (bulldozed) with a little instream habitat; similar to Soetmelksvlei River (Section 3.6.9).

Table 3.142 HI scores and category, Niv 30: Gobos River

INSTREAM CRITERIA		RIPARIAN CRITERIA	
water abstraction	23	indigenous vegetation removal	25
flow modification	23	exotic vegetation encroachment	20
bed modification	25	bank erosion	13
channel modification	25	channel modification	25
water quality	8	water abstraction	20
inundation	5	inundation	5
exotic macrophytes	10	flow modification	20
exotic fauna	0	water quality	8
solid waste disposal	3		
TOTAL (%)	39.7	**TOTAL (%)**	32.3
HI Category	E	**HI Category**	E

The overall condition of the site was Category E (Table 3.142).

3.6.6 *Nv8: Riviersonderend River, Genadendal*

The width of the macrochannel was reduced relative to natural, and many of the meanders had been cut off, but the structure of the main channel was intact (Figure 3.47). The river carried a high fine sediment load, of unknown origin. The riparian zone comprised a mixture of disturbance-triggered annuals, fynbos, scrub and woody/non-woody exotic species (Table 3.143). Macroinvertebrates were in a fair condition (Table 3.144).

Figure 3.47 Nv8: Riviersonderend River, Genadendal

Table 3.143 Riparian vegetation habitat diversity assessment, Nv8: Riviersonderend River, Genadendal

Lateral zone	Comment
Wet Bank species: *Prionium serratum.*	Palmiet lined the channel but grazing pastures were found up to the active channel bank.
Dry Bank species: *Cliffortia graminea, *Acacia mearnsii, *Pennisetum clandestinum.*	The floodplain and macrochannel had been turned into pastures. There were few indigenous woody species.

Table 3.144 Macroinvertebrate habitat diversity assessment, Nv8: Riviersonderend River, Genadendal

Habitat diversity	General Comments
• Good range of biotopes, with some that are susceptible to flow changes. • Extensive cobble substrata interspersed with gravel and sand at suitable depths for macroinvertebrates. • Flow diversity high. • Limited marginal and instream vegetation (mostly Palmiet).	Low levels of riverbank and channel modification with good range of riffles, runs and pools.

Table 3.145 HI scores and category, Nv8: Riviersonderend River, Genadendal

INSTREAM CRITERIA		RIPARIAN CRITERIA	
water abstraction	15	indigenous vegetation removal	15
flow modification	15	exotic vegetation encroachment	15
bed modification	13	bank erosion	10
channel modification	10	channel modification	8
water quality	15	water abstraction	10
inundation	10	inundation	8
exotic macrophytes	0	flow modification	13
exotic fauna	10	water quality	18
solid waste disposal	10		
TOTAL (%)	54.1	**TOTAL (%)**	52.2
HI Category	D	**HI Category**	D

The overall condition of the site was Category D (Table 3.145).

3.6.7 *Niv31: Kwartel River*

The river had been heavily impacted and modified by agricultural activities, including abstraction, bulldozing, infilling and grazing. There was a high fines sediment load and the riparian zone was dominated by exotic woody species (Figure 3.48; Table 3.146). There was little flow at the time of the assessment and macroinvertebrates were poor (Table 3.147).

Figure 3.48 Niv31: Kwartel River

Table 3.146 Riparian vegetation habitat diversity assessment, Niv31: Kwartel River

Lateral zone	Comment
Wet Bank species: *Phragmites australis, Isolepis prolifer, *Phytolacca americana, Pennisetum macrourum, Juncus capensis, *Acacia saligna.*	There was a mixture of grazed and non-grazed wet bank sections both with a mixture of exotic and indigenous herbaceous species.
Dry Bank species: **Acacia mearnsii, *Eucalyptus* sp., *Phragmites australis, *Acacia longifolia, Zantedeschia aethiopica, Psoralea pinnata.*	There was a mixture of grazed and non-grazed dry bank sections both with a mixture of exotic and indigenous herbaceous species.

Table 3.147 Macroinvertebrate habitat diversity assessment, Niv31: Kwartel River

Habitat diversity	General Comments
• No instream vegetation, with limited marginal vegetation. • Extensive cobbles instream. Lack of flow diversity, dominated by runs.	Highly canalized river. Expected low macroinvertebrate diversity dominated by tolerant taxa.

Table 3.148 HI scores and category, Kwartel River

INSTREAM CRITERIA		**RIPARIAN CRITERIA**	
water abstraction	18	indigenous vegetation removal	20
flow modification	18	exotic vegetation encroachment	23
bed modification	20	bank erosion	13
channel modification	13	channel modification	15
water quality	15	water abstraction	13
inundation	5	inundation	3
exotic macrophytes	0	flow modification	10
exotic fauna	10	water quality	10
solid waste disposal	8		
TOTAL (%)	48.8	**TOTAL (%)**	47
HI Category	D	**HI Category**	D

The overall condition of the site was Category D (Table 3.148).

3.6.8 *Nv9: Riviersonderend River, Greyton*

This is the closest node to IFR5, but was not assessed. Similar to Nv8 (Section 3.6.6).

3.6.9 *Niv33: Soetmelksvlei River*

The river was heavily impacted by dredging of the channel and clearing of the riparian area. This was probably an unchannelised wetland under natural conditions (hence the name Soetmelksvlei). There was hardly any flow at the time of the site (Figure 3.49; Table 3.149) and macroinvertebrates were (Table 3.150 and Table 3.151).

Figure 3.49 Niv33: Soetmelksvlei River

Table 3.149 Riparian vegetation habitat diversity assessment, Niv33: Soetmelksvlei River

Lateral zone	Comment
Wet Bank species: *Typha capensis, Zantedeschia aethiopica, Juncus effusus, Ficinia brevifolia, *Paspalum urvillei.*	The channel was heavily disturbed and little vegetation remained. The wet bank species present were those able to re-vegetate rapidly.
Dry Bank species: **Rubus fruticosus, Pennisetum macrourum, Cliffortia graminea, *Acacia mearnsii, *Pittosporum undulatum, *Solanum mauritianum.*	The dry bank was cultivated, grazed or invaded by woody exotics. There were a few indigenous species present but these were isolated.

Table 3.150 Macroinvertebrate habitat diversity assessment, Niv33: Soetmelksvlei River

Habitat diversity	General Comments
• Extensive cobble substrata at depths suitable for macroinvertebrates. • Limited instream vegetation were present (mostly sedges and grass). Limited sand and gravel instream.	Highly modified channel and riverbed (bulldozed) with little instream vegetation. Poor macroinvertebrate diversity, especially lacking in those sensitive to flow modification. The absence of dragonflies indicates a lack of instream vegetation.

Table 3.151 SASS5 scores, Niv33: Soetmelksvlei River

SASS5 score	44
No. of taxa	6
Average Score Per Taxon (ASPT)	7.3

Table 3.152 HI scores and category, Niv33: Soetmelksvlei River

INSTREAM CRITERIA		RIPARIAN CRITERIA	
water abstraction	20	indigenous vegetation removal	23
flow modification	23	exotic vegetation encroachment	20
bed modification	20	bank erosion	10
channel modification	20	channel modification	18
water quality	15	water abstraction	13
inundation	5	inundation	5
exotic macrophytes	0	flow modification	13
exotic fauna	0	water quality	10
solid waste disposal	8		

TOTAL (%)	40.9	**TOTAL (%)**	44.8
HI Category	D	**HI Category**	D

The overall condition of the site was Category D (Table 3.152).

3.6.10 *Niv34: Slang River*

The river flowed through cultivated fields but had a relatively intact riparian zone (Figure 3.50; Table 3.153) and although there were a few exotic species they were not dominant. The water was of good quality and macroinvertebrates were in good condition (Table 3.154 and Table 3.155).

Figure 3.50 Niv34: Slang River

Table 3.153 Riparian vegetation habitat diversity assessment, Niv34: Slang River

Lateral zone	Comment
Wet Bank species: *Pycreus polystachyos, Juncus lomatophyllus, J, effusus, Isolepis prolifer, Freylinia lanceolata, Podylaria calyptrata, Aristea major.*	The wet bank was well vegetated with a variety of indigenous species.
Dry Bank species: *Kiggelaria africana, Chrysanthemoides monolifera, *Populus X canescens, Cliffortia graminea, Brabejum stellatifolium, *Pinus* sp.	There dry bank was narrow due to clearing for agriculture but contained a good variety of indigenous species. Woody exotics also occurred here.

Table 3.154 Macroinvertebrate habitat diversity assessment, Niv34: Slang River

Habitat diversity	General Comments
• Good range of biotopes, with some that are sensitive to flow changes. • Extensive cobble substrata interspersed with gravel and sand at depth suitable for macroinvertebrates. • Flow diversity high. • Limited marginal and instream vegetation.	Highly natural macroinvertebrate habitat conditions with good mix between riffles, runs, and pools.

Table 3.155 SASS5 scores, Niv34: Slang River

SASS5 score	90
No. of taxa	10
Average Score Per Taxon (ASPT)	9

Table 3.156 PES scores and category, Niv34: Slang River

INSTREAM CRITERIA		RIPARIAN CRITERIA	
water abstraction	15	indigenous vegetation removal	18
flow modification	10	exotic vegetation encroachment	18
bed modification	15	bank erosion	5
channel modification	13	channel modification	5
water quality	5	water abstraction	10
inundation	3	inundation	5
exotic macrophytes	0	flow modification	10
exotic fauna	10	water quality	3
solid waste disposal	3		
TOTAL (%)	64.5	**TOTAL (%)**	63.8
HI Category	C	**HI Category**	C

The overall condition of the site was Category C (Table 3.156).

3.6.11 *Nv10: Riviersonderend River, u/s Riviersonderend*

The river flowed within naturally shaped banks (Figure 3.51). There were many woody exotic species in the riparian zone but the channel fringe was well vegetated with indigenous species (Table 3.157). Macroinvertebrates were impoverished (Table 3.158 and Table 3.159).

Figure 3.51 Nv10: Riviersonderend River, u/s Riviersonderend

Table 3.157 Riparian vegetation habitat diversity assessment, Nv10: Riviersonderend River, u/s Riviersonderend

Lateral zone	Comment
Wet Bank species: *Prionium serratum, Erharhta calycina, Zantedeschia aethiopica, Aristea major, *Acacia mearnsii, Polygala myrtifolia.*	The wet bank was well vegetated, but restricted by *Acacia mearnsii* on the dry banjk
Dry Bank species: *Diospyros glabra, Brabejum stellatifolium, Rapanea melanophloeos, Kiggelaria africana, Searsia angustifolia, Pteridium aquilinum,*	The dry bank consisted mainly of woody exotics but there were some indigenous trees.

**Rubus fruticosus.*	

Table 3.158 Macroinvertebrate habitat diversity assessment, Nv10: Riviersonderend River, u/s Riviersonderend

Habitat diversity	General Comments
• Extensive mud substrata interspersed with gravel and sand at depth suitable for macroinvertebrates. • Lack of flow diversity. • Extensive marginal vegetation (mostly Palmiet). • Benthic algae on the riverbed.	Low levels of riverbank and channel modification. Very high water turbidity associated with high nutrient content. Very low macroinvertebrate diversity (only two taxa present) dominated by tolerant taxa.

Table 3.159 SASS5 scores, Nv10: Riviersonderend River, u/s Riviersonderend

SASS5 score	11
No. of taxa	2
Average Score Per Taxon (ASPT)	5.5

Table 3.160 HI scores and category, Nv10: Riviersonderend River, u/s Riviersonderend

INSTREAM CRITERIA		**RIPARIAN CRITERIA**	
water abstraction	15	indigenous vegetation removal	20
flow modification	20	exotic vegetation encroachment	23
bed modification	18	bank erosion	13
channel modification	10	channel modification	8
water quality	23	water abstraction	10
inundation	10	inundation	8
exotic macrophytes	0	flow modification	13
exotic fauna	10	water quality	18
solid waste disposal	10		
TOTAL (%)	44.7	**TOTAL (%)**	44.6
HI Category	D	**HI Category**	D

The overall condition of the site was Category D (Table 3.160).

3.6.12 *Nv11: Riviersonderend River, d/s Riviersonderend*

The riparian zone was heavily infested with exotic woody species, and there were few indigenous woody species present (Figure 3.52 and Table 3.161). There was a high fines sediment load. Macroinvertebrates were poor (Table 3.162 and Table 3.163).

Figure 3.52 Nv11: Riviersonderend River, d/s Riviersonderend

Table 3.161 Riparian vegetation habitat diversity assessment, Nv11: Riviersonderend River, d/s Riviersonderend

Lateral zone	Comment
Wet Bank species: *Prionium serratum, Ficinia brevifolia,*	There was generally little vegetation present on the wet bank: indigenous species were patchily distributed.
Dry Bank species: **Acacia mearnsii.*	There were few, if any, dry bank indigenous scrub species.

Table 3.162 Macroinvertebrate habitat diversity assessment, Nv11: Riviersonderend River, d/s Riviersonderend

Habitat diversity	General Comments
• Extensive mud substrata interspersed with gravel and sand at depth suitable for macroinvertebrates. • Lack of flow diversity. • Extensive marginal vegetation (mostly Palmiet). • Benthic algae present on the riverbed.	Low levels of riverbank and channel modification. Very high water turbidity associated with high nutrient content. Only two macroinvertebrate taxa recorded both of which are tolerant to poor habitat and water quality.

Table 3.163 SASS5 scores, Nv11: Riviersonderend River, d/s Riviersonderend

SASS5 score	11
No. of taxa	2
Average Score Per Taxon (ASPT)	5.5

Table 3.164 HI scores and category, Nv11: Riviersonderend River, d/s Riviersonderend

INSTREAM CRITERIA		**RIPARIAN CRITERIA**	
water abstraction	15	indigenous vegetation removal	20
flow modification	20	exotic vegetation encroachment	23
bed modification	18	bank erosion	13
channel modification	15	channel modification	10
water quality	23	water abstraction	10
inundation	10	inundation	8
exotic macrophytes	3	flow modification	13
exotic fauna	10	water quality	18
solid waste disposal	8		
TOTAL (%)	41.8	**TOTAL (%)**	43.4
HI Category	D	**HI Category**	E

The overall condition of the site was Category D (Table 3.164).

3.6.13***Niv35: Kwassadie River***

The river had been dredged and the riparian vegetation cleared (Figure 3.53; Table 3.165). There was no little flow at the time of the site assessment and the river carried a high fines sediment load and excessive algal growth suggested elevated nutrient concentrations. Macroinvertebrates were depauperate (Table 3.166).

Figure 3.53 Niv35: Kwassadie River

Table 3.165 Riparian vegetation habitat diversity assessment, Niv35: Kwassadie River

Lateral zone	Comment
Wet Bank species: *Pycreus polystachyos, Juncus acutus, Phragmites australis.*	There was hardly any vegetation on the wet bank.
Dry Bank species: *Acacia karoo, *A. mearnsii, *A. saligna.*	There was generally little indigenous vegetation present on the dry bank.

Table 3.166 Macroinvertebrate habitat diversity assessment, Niv35: Kwassadie River

Habitat diversity	General Comments
• Extensive algal mat on water surface. • Limited instream and marginal vegetation were present. • Extensive cobbles instream. • Lack of flow diversity: dominated by standing water.	Little flow, low levels of bank erosion. High nutrient accumulation in the water. Expected to support low levels of macroinvertebrate diversity with more that are tolerant of standing water conditions.

Table 3.167 HI scores and category, Niv35: Kwassadie River

INSTREAM CRITERIA		**RIPARIAN CRITERIA**	
water abstraction	23	indigenous vegetation removal	15
flow modification	23	exotic vegetation encroachment	15
bed modification	20	bank erosion	15
channel modification	20	channel modification	10
water quality	25	water abstraction	20
inundation	15	inundation	10
exotic macrophytes	0	flow modification	20
exotic fauna	10	water quality	25
solid waste disposal	20		
TOTAL (%)	26.9	**TOTAL (%)**	34.4
HI Category	E	**HI Category**	E

The overall condition of the site was Category E (Table 3.167).

3.6.14***Nv12: Riviersonderend River, d/s Stormsvlei***

Not assessed.

3.6.15***Ni3: Riviersonderend, confluence with Breede River***

Not assessed.

3.6.16***Group 6: comparison with 2000 PES assessment***

Thirteen of the 15 nodes in this group were assessed. Of these only the Du Toits River was in a higher category than that reported by Kleynhans (2000) (Table 3.168). Eight of the rivers were in poorer condition in 2009 than in 2000. The sorts of impacts recorded were similar to those for Group 3 and 4, although alien infestation was higher in Groups 6 than in Group 3 and 4.

Table 3.168 Comparison of PES (Kleynhans 2000) and HI (2010) for nodes in Group 6

Node	PES (2000)	HI (PES) 2010	
		Instream	Riparian
Nvii10: Du Toits River	C	B	B
Nv7: Riviersonderend, Helderstroom	C	C	C
Niv28: Baviaans River	C	D	D
Niv29: Sersants River	C	D	D
Niv30: Gobos River	C	D	E
Nv8: Riviersonderend, Genadendal	C	D	D
Niv31: Kwartel River	C	D	D
Nv9: Riviersonderend, Greyton	C	-	-
Niv33: Soetmelksvlei River	C	D	D
Niv34: Slang River	C	C	C
Nv10: Riviersonderend, u/s of Riviersonderend	C	D	D
Nv11: Riviersonderend, d/s of Riviersonderend	D	D	D
Niv35: Kwassadie River	D	E	E
Nv12: Riviersonderend, d/s Stormsvlei	D	-	-
Ni3: Riviersonderend, confluence with Breede River	D	-	-

4 OVERALL SUMMARY

The six groups of nodes are shown in Figure 2.1. In general, the condition of the rivers declined from the upper reaches of the Breede eastwards to the estuary. The sites assessed in Groups 1 and 2, near Ceres and in the Du Toitskloof Mountains were in a better condition than those of the other groups. Seventy-five percent of reaches in Group 1 and 80% of those in Group 2 were in a C category or higher. Group 3 nodes near Worcester were generally in a C or D category. Group 4, from Robertson to Swellendam, were in the worst condition with 83% in a D or an E category. Half of the Group 6 nodes were in a D category, the remainder in a B, C or E.

Table 4.1 Proportion of HI Categories for all nodes in the six groups. Data are percentages. The proportion change is a comparison against the PES assessment of Kleynhans (2000) and denotes an improvement or decline in category. Ins. = Instream, Rip. = Riparian.

Group	Category				
	A	B	C	D	E
	Ins.-Rip.	Ins.-Rip.	Ins.-Rip.	Ins.-Rip.	Ins.-Rip.
1	0 - 0	25 - 25	50 - 50	25 - 25	0 - 0
2	20 - 0	40 - 50	20 - 30	10 - 20	10 - 0
3	0 - 0	0 - 0	55 - 45	45 - 55	0 - 0
4	0 - 0	0 - 0	17 - 17	42 - 42	41 - 41
5					
6	0 - 0	8 - 8	17 - 25	67 - 50	8 - 17

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