

FIELD GUIDE TO PRESENT ECOLOGICAL STATUS SCORES

WESTERN CAPE RIVERS

BY

**CATE BROWN
JUSTINE EWART-SMITH
RODNEY FEBRUARY**



A Southern Waters Information Report No. 01/01.

March 2001

WATER ABSTRACTION

Brief explanation of the impacts of water abstraction:

1. The three driving variables determining the character of a river are climate, geology and topography. These factors dictate the flow regime, the general geomorphological character of the river, the shape and size of the river channel, the size of the bed particles, and the basic water chemistry and temperature. These in turn determine the fauna and flora that inhabit the river.
2. Abstraction of water alters the flow regime, thereby potentially affecting all aspects of a river.

Without hydrological records it is extremely difficult to deduce a score for water abstraction, thus the scoring system presented here attempts to use various clues from the activities in the catchment or on the river to arrive at a likely abstraction pressure for a given river in the Western Cape.

Scoring system:

The scoring systems, as presented here for water abstraction, works as follows:

1. If hydrological records are available, and thus the % MAR abstracted from the system is known, then use only % MAR abstracted to determine the water abstraction score (see column 1 overleaf).
2. If hydrological records are not available, use columns 2-6 to estimate abstraction pressure.
 - a. If nothing is know about one of the variables listed in columns 2-6, then leave that column out and move to the next one.
 - b. The abstraction score will equal the HIGHEST score obtained using the criteria in columns 2-6. For example, in a catchment with approximately 50% of the catchment area given over to vineyards, approximately 3 pumps in the river per kilometre, and a major dam upstream of the study reach, the abstraction score would be 21.
3. Un-disturbed tributaries can considerably mitigate the impacts of water abstraction. Thus, if the study reach is situated downstream of an undisturbed tributary, then the abstraction score should be mitigated as indicated in the table overleaf. For example, if the study reach in 2b was situated downstream of an undisturbed tributary that supplied 10% of its MAR, the abstraction score would be adjusted by multiplying by 0.75. Thus, the final abstraction score would be 16.

WATER ABSTRACTION

SCALE: Whole catchment (i.e. between tributaries). Abstraction from upstream river and tribs must be considered.

Note: Use landuse maps to infer abstraction levels.

Use 1:50 000 maps to count farm dams. If one of listed criteria is not met, then ranking can't be used.

	% abstracted	Score		Yes/No	Score		Whole upstream system	Score		No. per sq km	Score		No. per km of river	Score		Whole upstream system	Score		Whole upstream system	Score				
Percentage MAR abstracted:	0	0	Stream (both perennial and seasonal) only flows after unusually high rainfall, i.e., no lowflows only floods	NO	0	Major Dams (unmitigated)	NO	0	No. of farm dams	0	0	No. of pumps	0	0	Abstraction weirs (unmitigated)	0	0	% of catchment under forestry, alien veg, vineyards, cashcrops and/or orchards	0	0				
	n/a	1		n/a	1		n/a	1		n/a	1		n/a	1		n/a	1		n/a	1	n/a	1		
	n/a	2		n/a	2		n/a	2		n/a	2		n/a	2		n/a	2		n/a	2	n/a	2	n/a	2
	10	3		n/a	3		n/a	3		n/a	3		n/a	3		n/a	3		n/a	3	n/a	3	n/a	3
	20	4		n/a	4		n/a	4		n/a	4		n/a	4		n/a	4		n/a	4	n/a	4	n/a	4
	30	5		n/a	5		n/a	5		n/a	5		</=0.25	5		</=1	5		n/a	5	n/a	5	10	5
	35	6		n/a	6		n/a	6		n/a	6		n/a	6		n/a	6		n/a	6	n/a	6	n/a	6
	40	7		n/a	7		n/a	7		n/a	7		n/a	7		n/a	7		n/a	7	n/a	7	n/a	7
	45	8		n/a	8		n/a	8		n/a	8		</=1	8		</=1.5	8		1	8	n/a	8	n/a	8
	50	9		n/a	9		n/a	9		n/a	9		n/a	9		n/a	9		n/a	9	n/a	9	n/a	9
	55	10		n/a	10		n/a	10		n/a	10		n/a	10		n/a	10		n/a	10	n/a	10	25	10
	60	11		n/a	11		n/a	11		n/a	11		n/a	11		n/a	11		n/a	11	n/a	11	n/a	11
	65	12		n/a	12		YES	12		YES	12		n/a	12		n/a	12		2	12	n/a	12	n/a	12
	70	13		n/a	13		n/a	13		n/a	13		</=1.5	13		</=2	13		n/a	13	n/a	13	40	13
	75	14		n/a	14		n/a	14		n/a	14		>1.5	14		>2	14		n/a	14	n/a	14	45	14
	n/a	15		n/a	15		n/a	15		n/a	15		n/a	15		n/a	15		n/a	15	n/a	15	50	15
	80	16		n/a	16		n/a	16		n/a	16		n/a	16		n/a	16		n/a	16	n/a	16	n/a	16
	n/a	17		n/a	17		n/a	17		n/a	17		n/a	17		n/a	17		n/a	17	n/a	17	n/a	17
	85	18		n/a	18		n/a	18		n/a	18		</=2	18		</=3	18		n/a	18	n/a	18	60	18
	n/a	19		n/a	19		n/a	19		n/a	19		>2	19		>3	19		n/a	19	n/a	19	n/a	19
	90-94	20		n/a	20		n/a	20		n/a	20		n/a	20		n/a	20		n/a	20	n/a	20	75	20
	n/a	21		n/a	21		n/a	21		n/a	21		</=3	21		</=4	21		n/a	21	n/a	21	n/a	21
	n/a	22		n/a	22		n/a	22		n/a	22		n/a	22		>4	22		n/a	22	n/a	22	n/a	22
	n/a	23		n/a	23		n/a	23		n/a	23		n/a	23		n/a	23		n/a	23	n/a	23	80	23
	n/a	24		n/a	24		n/a	24		n/a	24		n/a	24		n/a	24		n/a	24	n/a	24	n/a	24
>/=95	25	YES	25	YES	25	n/a	25	>3	25	n/a	25	n/a	25	n/a	25	n/a	25							

MITIGATION:

% contribution to flow by undisturbed tributaries	>/= 10%	multiply score by 0.75
	>/= 20%	multiply score by 0.5
	>/=50%	multiply score by 0.25

INUNDATION

Scoring system:

The scoring systems, as presented here for inundation, works as follows:

1. Estimate the percentage of the upstream channel that is inundated by dams, weirs, road crossings, etc., use corresponding score in the table overleaf.
 - a. This can be estimated most effectively using 1:50 000 topographical maps and/or aerial photographs.

EXTENT OF INUNDATION OF THE RIVER CHANNEL

SCALE: Reach level (i.e. between tributaries).

Note: Use 1:50 000 maps to calculate % inundation.

	Percentage inundation	Score
Extent of inundation of the river channel.	0	0
	4	1
	8	2
	12	3
	16	4
	20	5
	24	6
	28	7
	32	8
	36	9
	40	10
	44	11
	48	12
	50%	13
	56	14
	60	15
	64	16
	68	17
	72	18
	76	19
	80	20
	84	21
	88	22
	92	23
	96	24
100%	25	

FLOOD MANIPULATION

Scoring system:

The scoring system for flood manipulation works as follows:

1. The timing, magnitude and frequency of flood are most affected by in-channel large dams in the upstream catchment. Thus, these are the two factors used to estimate a score for manipulation of flood flows.
2. The flood manipulation score will equal the HIGHEST score obtained using the criteria in columns 1-2. For example, a study reach with approximately 1 farm dam per km² in the upstream catchment and a single large dam less than 15 kms upstream of the reach, the flood manipulation score would be 18.
3. Un-disturbed tributaries can considerably mitigate the impacts of upstream dams. Thus, if the study reach is situated downstream of an undisturbed tributary, then the abstraction score should be mitigated as indicated in the table overleaf. For example, if the study reach in 2 was situated downstream of an undisturbed tributary that supplied 20% of its MAR, the abstraction score would be adjusted by multiplying by 0.5. Thus, the final abstraction score would be 9.

FLOOD MANIPULATION

SCALE: Reach level (i.e. between tributaries).

Note: Use 1:50 000 maps to count dams.

	Whole upstream system	Score		No. per sq km	Score
Major Dams (unmitigated)	0	0	No. of farm dams	0	0
	n/a	1		n/a	1
	n/a	2		n/a	2
	n/a	3		n/a	3
	n/a	4		n/a	4
	n/a	5		>/= 1	5
	n/a	6		n/a	6
	n/a	7		n/a	7
	n/a	8		>/= 2	8
	n/a	9		n/a	9
	n/a	10		>/=3	10
	n/a	11		n/a	11
	YES > than 5 kms	12		n/a	12
	n/a	13		n/a	13
	n/a	14		n/a	14
	n/a	15		n/a	15
	n/a	16		n/a	16
	n/a	17		n/a	17
	YES within 5 km of reach	18		n/a	18
	n/a	19		n/a	19
	n/a	20		n/a	20
	n/a	21		n/a	21
	n/a	22		n/a	22
	n/a	23		n/a	23
	n/a	24		n/a	24
n/a	25	n/a	25		

MITIGATION:

% contribution by undisturbed tributaries	>/= 10%	x score by 0.75
	>/= 20%	x score by 0.5
	>/=50%	x score by 0.25

LOWFLOW MANIPULATION

Scoring system:

Impacts on lowflows are extremely difficult to judge without detailed hydrological information. Thus, the scoring system presented here concentrated on the major impact on lowflows in the Western Cape, *viz.* changing perennial rivers into seasonal rivers. It is, however, acknowledged that there may be other, more subtle, impacts on lowflows that will not be assessed using this scoring system. It is also particular to Western Cape perennial rivers.

The scoring system for flood manipulation works as follows:

1. Determine, through consultation with people familiar with the area (e.g., farmers or local residents), whether or not the river was once perennial and whether or not it now dries up during the summer months.
2. If so, determine the frequency and duration of no-flow periods.
3. Obtain a score for lowflow manipulation by dividing the water abstraction score by the appropriate compounding factor given overleaf.

LOWFLOW MANIPULATION

SCALE: Reach level (i.e. between tributaries).

ABSTRACTION WEIGHTED BY A COMPOUNDING VARIABLE

Propensity to dryout in months where flow would have naturally occurred	
If flow occurs in all months where it naturally occurred.	= abstraction score
Flow stops every year in months where it naturally occurred:	Divide abstraction by 0.5 to a maximum of 25
Flow stops occasionally (less frequently than 3 years) in months where it naturally occurred:	Divide abstraction by 0.75 to a maximum of 25
In perennial systems if flow stops for > 1 month:	Subtract 0.2 from above (before dividing)

BED MODIFICATION

Scoring system (with reference to Rowntree and Wadeson 1999):

The scoring system for bed modification considers a combination of three factors most commonly responsible for bed modification in Western Cape rivers, *viz.* sedimentation as a result of a loss of flushing flows, concrete canalisation and/or bull dozing of the river channel (usually resulting in a uniform trapezoidal channel shape). Once again, there may be other factors that can result in bed modification, but incorporation and assessment of these is at the discretion of the PES assessor.

The scoring system for bed modification works as follows:

1. The bed modification score will equal the HIGHEST score obtained using the criteria in columns 1-3. For example, that has been canalised with concrete will ALWAYS score 25, regardless of whether or not there are silt depositions in the channel.

Embeddedness refers to the condition where spaces between coarser material (cobbles and boulders) are infilled with fine particles (normally sand or silt). Pictures of different levels of embeddedness are a useful reference and are available in Rowntree and Wadeson (1999).

BED MODIFICATION

SCALE: Reach level (i.e., between tributaries).

	Score		Score		% river bed affected in the reach	Score	
	0		NO		0	0	
	n/a				4	1	
	n/a				8	2	
	n/a				12	3	
	n/a				16	4	
	Silt/gravel in interstitial spaces but spaces between particles are largely open.				20	5	
	n/a				24	6	
	n/a				28	7	
	n/a				32	8	
	Silt/gravel in interstitial spaces, and space between the cobble and boulders are in-filled with fine material fine material – sand and silt).				36	9	
Habitat degradation, as a result of sedimentation as a result of bank or catchment erosion and/or reduction in transporting power - not applicable to lower river and/or foothill gravel bed	n/a				40	10	
	n/a				44	11	
	n/a				48	12	
	Silt drapes at channel margins, evidence of deposition in runs and pools. Space between the cobble and boulders are in-filled with fine material fine material		Canalisation		Dredging/bulldozing/road crossings	52	13
	n/a				56	14	
	n/a				60	15	
	n/a				64	16	
	n/a				68	17	
	Large drapes at channel margins, evidence of deposition in runs and pools. Cobble and boulders more than 1/2 covered by fine material – sand and silt.				72	18	
	n/a				76	19	
	n/a				80	20	
	n/a				84	21	
	n/a				88	22	
	n/a				92	23	
	n/a				96	24	
	Cobbles and or boulders completely covered - silt blanket.	25		YES	25	100%	25

CHANNEL MODIFICATION

Scoring system:

The scoring system for channel modification considers the impacts resulting from infilling or channelisation (digging down) on channel shape and structure. It also takes account of the potential impact of bridges or other features that constrict river flow, thereby affecting channel shape and direction. Once again, there may be other factors that can result in channel modification, but these are less frequent than the ones listed above and incorporation and assessment of any additional factors is at the discretion of the PES assessor.

The scoring system for channel modification works as follows:

1. The bed modification score will equal the HIGHEST score obtained using the criteria in columns 1-2.

NOTE: For the CMC study canalised river reaches were automatically assigned a Class 6 rating. The reasons for this were that many of these systems were historically wetland transitional rivers, which meandered through wide riparian wetlands. During the canalisation process both the course and character of these systems were altered completely and irreparably.

CHANNEL MODIFICATION

SCALE: Reach level (i.e. between tributaries).

Note: canalisation would not extend across reaches - i.e., reach defined by canal.

	% in reach	Score		% in reach	Score
Infilling and channelisation	None	0	Bridges	None	0
	n/a	1		n/a	1
	n/a	2		n/a	2
	n/a	3		n/a	3
	n/a	4		n/a	4
	Infilling evident in less than 10% of the reach	5		No lowflow/or arches bridges. < 1 single span bridge per 1 km.	5
	n/a	6		n/a	6
	n/a	7		n/a	7
	n/a	8		n/a	8
	n/a	9		n/a	9
	n/a	10		n/a	10
	n/a	11		n/a	11
	n/a	12		n/a	12
	Infilling evident in less than 50% of the reach (e.g. one bank only or both banks for 25% of reach length)	13		< 0.5 lowflow/or arches bridge and/or < 1 single span bridge per 1 km.	13
	n/a	14		n/a	14
	n/a	15		n/a	15
	Channelisation > 60% of reach, infilling evidence elsewhere	16		n/a	16
	n/a	17		n/a	17
	n/a	18		< 1 lowflow/or arches bridge and/or < 2 single span bridge per 1 km.	18
	n/a	19		n/a	19
	n/a	20		n/a	20
	Channelisation > 75% of reach, infilling evidence elsewhere	21		n/a	21
	n/a	22		n/a	22
	n/a	23		n/a	23
	n/a	24		n/a	24
Canalisation	25		25		

PRESENCE OF EXOTIC MACROPHYTES

Scoring system:

2. The scoring system for exotic macrophytes works as follows:
 - a. Estimate the percentage of the reach that is covered by exotic aquatic macrophytes – regardless of species.

EXOTIC MACROPHYTES

SCALE: Reach level (i.e. between tributaries).

	% cover	Score
Percentage cover in reach - regardless of species	0	0
	4	1
	8	2
	12	3
	16	4
	20	5
	24	6
	28	7
	32	8
	36	9
	40	10
	44	11
	48	12
	52	13
	56	14
	60	15
	64	16
	68	17
	72	18
	76	19
	80	20
	84	21
	88	22
	92	23
	96	24
100	25	

PRESENCE OF EXOTIC FAUNA

Scoring system:

1. The scoring system presented here relates specifically to fish, however, if information is available on other harmful alien species then it should be incorporated at the discretion of the PES assessor.
2. The scoring system for exotic fish is based on the relative impact of different fish species:
3. It is necessary to have some idea of the composition of fish assemblages in a study reach, however, this can often be obtained by some fairly simple observations.

EXOTIC FAUNA

This relates specifically to fish, however if information is available on other harmful alien species then it should be incorporated.

SCALE: Reach level (i.e. between tributaries).

	Percentage	Score
Composition of fish community	None	0
	n/a	1
	n/a	2
	n/a	3
	n/a	4
	Trout present but indigenous fish dominate.	5
	n/a	6
	n/a	7
	Trout dominate but indigenous species present.	8
	n/a	9
	n/a	10
	n/a	11
	n/a	12
	Bass, bluegill and or carp present, but indigenous species dominate.	13
	n/a	14
	n/a	15
	n/a	16
	n/a	17
	n/a	18
	Fish fauna dominated by bass and or carp.	19
	n/a	20
	n/a	21
	n/a	22
	n/a	23
	n/a	24
Only exotics - regardless of species	25	

PRESENCE OF SOLID WASTE

Scoring system:

The scoring system presented here relates specifically to litter and building rubble. The table presented overleaf is self-explanatory.

SOLID WASTE - SPECIFICALLY LITTER, BUILDING RUBBLE AND GARDEN REFUSE

SCALE: Reach level (c. 100m - extrapolated to reach - try other spots checks to groundtruth).

	No. in 100m stretch	Score
Litter and rubble in the macro-channel	None	0
	n/a	1
	n/a	2
	n/a	3
	n/a	4
	10 pieces of litter and or buiding rubble (e.g. bricks, gutter) within a c. 100m stretch of river.	5
	n/a	6
	n/a	7
	n/a	8
	10-50 pieces but no evidence of dumping	9
	n/a	10
	n/a	11
	n/a	12
	n/a	13
	Evidence of once-off dumping in ≥ 1 place in the reach. >50 pieces but no evidence of dumping	14
	n/a	15
	n/a	16
	Evidence of once-off dumping in ≥ 2 places in the reach.	17
	n/a	18
	n/a	19
	n/a	20
	Evidence of ongoing dumping into the river channel in ≥ 1 place in the reach.	21
	n/a	22
	n/a	23
	n/a	24
Evidence of ongoing dumping into the river channel in ≥ 2 places in the reach.	25	

REMOVAL OF INDIGENOUS VEGETATION

Scoring system:

The scoring system for removal of indigenous vegetation works as follows:

1. Estimate the percentage of the reach that is devoid of natural riparian vegetation – regardless of species.
2. This includes riparian vegetation that has been out competed by alien trees.
3. As a standard rule use 30 m from the top of bank to define the riparian zone.

REMOVAL OF INDIGENOUS VEGETATION

SCALE: Reach level (i.e. between tributaries).

	% cover	Score
Percentage cover in reach	0	0
	4	1
	8	2
	12	3
	16	4
	20	5
	24	6
	28	7
	32	8
	36	9
	40	10
	44	11
	48	12
	52	13
	56	14
	60	15
	64	16
	68	17
	72	18
	76	19
	80	20
	84	21
	88	22
	92	23
	96	24
100	25	

ENCROACHMENT INTO THE RIPARIAN ZONE BY EXOTIC VEGETATION

Scoring system:

The scoring system for encroachment by exotic vegetation works as follows:

1. Estimate the percentage of the riparian zone of the reach that is invaded by exotic species. As a standard rule, use 30 m from the top of bank to define the riparian zone.
2. Estimate the density of the cover in the invaded areas, *viz.* light or dense. As a general rule, invasion should be considered light/medium if there are indigenous plants clearly visible among the alien plants, and heavy if there are few if any indigenous plants growing between the alien plants.

ENCROACHMENT OF EXOTIC VEGETATION

SCALE: Reach level (i.e. between tributaries).

	% cover	Score
	0	0
	n/a	1
	n/a	2
	10- light	3
	n/a	4
	n/a	5
	10 - dense	6
	n/a	7
	n/a	8
	30 - light	9
	n/a	10
	n/a	11
Percentage cover in reach	30 - dense	12
	n/a	13
	n/a	14
	50 - light	15
	n/a	16
	50 - dense	17
	n/a	18
	60-70	19
	n/a	20
	100 - light	21
	n/a	22
	n/a	23
	n/a	24
	100 - dense	25

EVIDENCE OF BANK EROSION

Scoring system (modified from Rowntree and Wadeson 1999):

Erosion is assessed according to two sets of criteria:

- Evidence of erosion caused by river flow;
- Evidence of erosion caused by other means such as cattle or stormwater runoff.

The scoring system for erosion uses bank slumping, undercutting or scouring as an indication of the seriousness of erosion caused by river flows. Erosion by other means is evident from rilling (small gulleys formed as a result of erosion) or livestock trampling. The degree of erosion is assessed according to the percentage of the bank length affected in a representative 100 m reach of river.

If banks are stabilised by vegetation, and no bank erosion is evident then erosion score = 0 even if there is some bed erosion.

Pictures of different levels types of erosion are given in Rowntree and Wadeson (1999).

EVIDENCE OF BANK EROSION

SCALE: Reach level (c. 100m - extrapolated to reach - try other spots checks to groundtruth).

	No. in 100m stretch	Score
Presence of erosion.	None	0
	n/a	1
	n/a	2
	n/a	3
	n/a	4
	Evidence of $\geq 10\%$	5
	n/a	6
	n/a	7
	n/a	8
	Evidence of $\geq 20\%$	9
	n/a	10
	n/a	11
	n/a	12
	n/a	13
	Evidence of $\geq 40\%$	14
	n/a	15
	n/a	16
	n/a	17
	Evidence of $\geq 50\%$	18
	n/a	19
	n/a	20
	n/a	21
	n/a	22
	n/a	23
	n/a	24
Evidence of $\geq 75\%$	25	

Dear Reader

This document is intended as a rough guide to assist with assessment of the scores required in a Habitat Integrity Assessment (Kleynhans, N. 1999. A Procedure for the Determination of the Ecological Reserve for the Purposes of the National Water Balance Model for South African Rivers). It is in DRAFT form and any comment is welcome. Please email Admin@southernwaters.co.za with any comments you have.

Southern Waters
June 2002.