Confidential

HYDROLOGICAL / HYDRAULIC STUDY OF NATAL ESTUARIES

DATA REPORT No. 1

MTAMVUNA NS 1

ESTUARINE DYNAMICS (CESD)
NRIO / CSIR
STELLENBOSCH

September 1981

Including the update (1985)

NS 01

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BRIEF NOTES MTAMVUNA NS1

Details of the classification of the lower reaches of the Mtamvuna for 1937, 1943, 1952, 1963, 1966 and 1976 may be seen in Tables NS1/I - VI. Details of river widths and lateral stability are given in Tables NS1/VII and VIII. An abstract of results appears in Table NS1/IX.

The Mtamvuna estuary is geomorphologically stable, with the river flowing through a gorge for half its estuarine length. The lateral stability (average thalweg displacement 18,6 m and coefficient of variation 10,8%), is clearly seen in Figure NS1/1. Only at the mouth is there a distinct lateral shift which is the result of part of the bar being washed away in times of flood. Characteristic sand-spit features may be seen in Figure NS1/4.

Human influence within the estuary is negligible. Riverine vegetation has been preserved (Figure NS1/2) and the suspension bridge, completed in the mid-60's, has had no effect on the estuary, hydrologically. The only settlement is at a caravan site, near the old pont. If this is threatened with flooding when the mouth is closed, the bar at the mouth may be breached artificially.

The only marked change in the period under review, 1937 - 76, is in channel side bar areas (Figure NS1/3). These show an increase, specially between 1937 and 1943. This suggests a change in land-use pattern upstream of the estuary, giving greater silt availability.

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Abbreviations/Symbols used in the Tables

M.A.R.	Mean Annual Run-off
L.B.	Left Bank
R.B.	Right Bank
P	Perimeter
$\bar{x}$	Arithmetic Mean
s	Standard Deviation
V	Coefficient of Variation $\frac{s}{\bar{x}}$
MSL	Mean Sea Level
R	River
d/s	Downstream
———	Maximum Value
....	Minimum Value

TABLE NS1/1

CLASSIFICATION OF THE LOWER REACHES OF NATAL RIVERS

NRIO NS 1

RIVER MTAMVUNA, 100 % ESTUARINE, REACH from 250m d/s rapids to Mouth, 5 km from mouth. REF. DWAFEC _____

AERIAL PHOTO DATE 2-5-37 SCALE 1:10 000 CATCHMENT AREA* 1589 km², M.A.R.* 281 m³x10⁶, No. of DAMS NIL

RIVER VALLEY AND RIVER MOUTH FEATURES

General Description of the Terrain above the Valley

Terrain	Vegetation	Land-Use
mountainous	almost none	none
✓ hilly	✓ grass	✓ scattered cultivation
undulating	✓ sparsely forested (0-25%)	partly cultivated
plains	moderately forested (25-75%)	mainly cultivated
	heavily forested (75-100%)	✓ scattered settlement
	swamp/bog	partly built-up
		urbanised

Valley Sides (Max Well-defined)

Slumping	Vegetation and Land-Use	Left	Right
✓ none	none		
occasional	grass	11	37 %
frequent	trees	89	63 %
	cultivated	NIL	NIL %
	built-up	NIL	NIL %

Comments * Begg

Valley Characteristics

Measurements

valley length _____ m
bottom width(av.) _____ m
valley slope _____ (straight-line)
height at head of reach _____ m to MSL

Terraces

✓ none
indefinite
fragmentary
continuous

Relation of Channel to Valley Bottom (Vertical)

not applicable
not obviously degrading
partly entrenched
✓ entrenched
aggrading

Relation of Channel to Valley Sides or Resistant Terraces (Lateral)

not applicable (no valley or free)
occasionally confined
✓ frequently confined
entrenched

Surface Geology

bedrock
lacustrine deposits
✓ fluvial deposits
aeolian
sand covered _____ % area

Comments _____

River Mouth

Characteristics

open/~~closed~~
natural/~~artificial~~
canalized
✓ sandy
✓ rocks on right bank
rocks on left bank
outer bar
silt plume (fluvial)
✓ suspended sediment (marine)

Measurements

right bank breakwater length _____ m
left bank breakwater length _____ m
rock sill level _____ m to MSL
cliffs on right bank: height _____ m to MSL
cliffs on left bank: height _____ m to MSL
spit/~~bar~~: direction of growth 229 °
length of spit/~~bar~~ 340 m
length stabilized _____ m
width ≈ 120 m

Comments _____

FLOOD PLAIN AND CHANNEL FEATURES

Description of Flood Plain

Presence

✓ none
indefinite
fragmentary
continuous

Extent

✓ none
average width _____ m
maximum width _____ m
aerial length _____ m
area _____ ha

Vegetation

almost none
grass
reed swamp _____
sparsely forested
moderately forested
heavily forested

Forest Type

not known/applicable
✓ riverine:
✓ main channel _____
✓ tributaries
✓ coastal dune/evergreen
mangroves

Land-Use

✓ not cultivated, not built-up ✓
cultivated _____ % area
crop/s _____
partly built-up
mainly built-up

Comments _____

Channel Description

N.B. Estimate of flow stage: ~~LOW~~/NEAR LONG-TERM MEAN/~~HIGH~~

Pattern

straight
✓ sinuous
irregular
regular meanders
irregular meanders
tortuous meanders
bifurcated
lake/s
lagoon

Measurements

thalweg 4960 m
*sinuosity 1,09
*open water area 57 ha
*(whole reach) P=10100 m
lake/lagoon area inundated _____ ha
channel slope _____
channel width x _____ m s = _____ m
river slope _____
river width x 114,3 m s = 53,3 m

Islands/Shoals

none
✓ occasional*
frequent
split
braided

Type of Flow

stagnant/still
✓ uniform water surface
uniform with rapid in reach
irregular
pool & riffle sequence

Bar Type

none
✓ channel side bars
point bars
✓ channel junction bars
mid-channel bars
diamond bars
diagonal bars
sand waves/large dunes

Comments * River bank areas
* near mouth

Obstructions/Constructions

Natural	Degree
✓ none	✓ none
logs	minor
boulders	major
vegetation	

Comments _____

Man-made NONE — Degree of Obstruction/Constriction for Each — Position (from head of reach)

road bridge/s _____
rail bridge/s _____
causeway _____
weir/dam _____
fish traps _____
embankment/s _____
groynes _____
canals _____
drainage furrows _____
others _____

Lateral Channel Activity

Lateral Activity

✓ not detectable
downstream progression
progression & cut-offs
mainly cut-offs
entrenched loop development
irregular lateral activity
avulsion

Nature of Banks

✓ alluvium (silt/sand)
natural levées
rock/boulders
protected/stabilized
cultivation to channel edge

Bank Vegetation

none
weak
✓ good
very strong
left bank 93 %
right bank 68 %

Lateral Stability

✓ stable
slightly unstable
moderately unstable
highly unstable

Comments _____

TABLE NS1/II

CLASSIFICATION OF THE LOWER REACHES OF NATAL RIVERS

NRIO NS 1

RIVER MTAMVUNA, 100 % ESTUARINE, REACH from 250m d/s rapids to Mouth, 5 km from mouth. REF. DWAFEC ____

AERIAL PHOTO DATE DEC '43 SCALE 1:10 000 CATCHMENT AREA* 1589 km², M.A.R.* 281 m³x10⁶, No. of DAMS NIL

RIVER VALLEY AND RIVER MOUTH FEATURES

General Description of the Terrain above the Valley

Terrain	*Vegetation*	*Land-Use*
mountainous	almost none	none
✓ hilly	✓ grass	✓ scattered cultivation
undulating	✓ sparsely forested (0-25%)	partly cultivated
plains	moderately forested (25-75%)	mainly cultivated
	heavily forested (75-100%)	✓ scattered settlement
	swamp/bog	partly built-up
		urbanised

Valley Sides (Well-defined)

Slumping	*Vegetation and Land-Use*	*Left*	*Right*
✓ none	none		
occasional	grass	8	39 %
frequent	trees	92	61 %
	cultivated	NIL	NIL %
	built-up	NIL	NIL %

Comments * Begg

Valley Characteristics

Measurements

valley length ____ m
bottom width(av.) ____ m
valley slope ____ (straight-line)
height at head of reach ____ m to MSL

Terraces

✓ none
indefinite
fragmentary
continuous

Relation of Channel to Valley Bottom (Vertical)

not applicable
not obviously degrading
partly entrenched
✓ entrenched
aggrading

Relation of Channel to Valley Sides or Resistant Terraces (Lateral)

not applicable (no valley or free)
occasionally confined
✓ frequently confined
entrenched

Surface Geology

bedrock
lacustrine deposits
✓ fluvial deposits
aeolian
sand covered ____ % area

Comments ____

River Mouth

Characteristics

open/closed
natural/artificial
canalized
✓ sandy
✓ rocks on right bank
rocks on left bank
outer bar
silt plume (fluvial)
✓ suspended sediment (marine)

Measurements

right bank breakwater length ____ m
left bank breakwater length ____ m
rock sill level ____ m to MSL
cliffs on right bank: height ____ m to MSL
cliffs on left bank: height ____ m to MSL
spit/bar: direction of growth 225 °
length of spit/bar 350 m
length stabilized NIL m
width x̄ 88 m

Comments ____

FLOOD PLAIN AND CHANNEL FEATURES

Description of Flood Plain

Presence

✓ none
indefinite
fragmentary
continuous

Extent

✓ none
average width ____ m
maximum width ____ m
aerial length ____ m
area ____ ha

Vegetation

almost none
grass
✓ reed swamp ____
sparsely forested
moderately forested
heavily forested

Forest Type

not known/applicable
✓ riverine:
✓ main channel ____
✓ tributaries
✓ coastal dune/evergreen
mangroves

Land-Use

✓* not cultivated, not built-up ✓
cultivated ____ % area
crop/s ____
partly built-up
mainly built-up

Comments * narrow strips along R. bank
** River bank areas

Channel Description N.B. Estimate of flow stage: HIGH/NEAR LONG-TERM MEAN/LOW

Pattern

straight
✓ sinuous
irregular
regular meanders
irregular meanders
tortuous meanders
bifurcated
lake/s
lagoon

Measurements

thalweg 4940 m
*sinuosity 1,09
*open water area 51 ha
*(whole reach) P = 10 020 m
lake/lagoon area ____ ha
inundated
channel slope ____
channel width x̄ ____ m s = ____ m
river slope ____
river width x̄ 101,8 m s = 43,7 m

Islands/Shoals

none
✓ occasional ✓
frequent
split
braided

Type of Flow

stagnant/still
✓ uniform water surface
uniform with rapid in reach
irregular
pool & riffle sequence

Bar Type

none
✓ channel side bars
point bars
✓ channel junction bars
mid-channel bars
diamond bars
diagonal bars
sand waves/large dunes

Comments * near mouth

Obstructions/Constructions

Natural	*Degree*	*Man-made* NONE	*Degree of Obstruction/Constriction for Each*	*Position (from head of reach)*
✓ none	✓ none	road bridge/s		
logs	minor	rail bridge/s		
boulders	major	causeway		
vegetation		weir/dam		
		fish traps		
		embankment/s		
		groynes		
		canals		
		drainage furrows		
		others		

Comments ____

Lateral Channel Activity

Lateral Activity

✓ not detectable
downstream progression
progression & cut-offs
mainly cut-offs
entrenched loop development
irregular lateral activity
avulsion

Nature of Banks

✓ alluvium (silt/sand)
natural levées
rock/boulders
protected/stabilized
cultivation to channel edge

Bank Vegetation

none
weak
✓ good
very strong
left bank 95 %
right bank 75 %

Lateral Stability

✓ stable
slightly unstable
moderately unstable
highly unstable

Comments ____

TABLE NS1/III

CLASSIFICATION OF THE LOWER REACHES OF NATAL RIVERS

NRIO NS 1

RIVER MTAMVUNA, 100 % ESTUARINE, REACH from 250m d/s rapids to Mouth, 5 km from mouth. REF. DWAFEC _____

AERIAL PHOTO DATE 16-8-52 SCALE 1:10 000 CATCHMENT AREA 1589 km², M.A.R. 281 $m^3 \times 10^6$, No. of DAMS NIL

RIVER VALLEY AND RIVER MOUTH FEATURES

General Description of the Terrain above the Valley

Terrain	*Vegetation*	*Land-Use*
mountainous	almost none	none
✓ hilly	✓ grass	✓ scattered cultivation
undulating	✓ sparsely forested (0-25%)	partly cultivated
plains	moderately forested (25-75%)	mainly cultivated
	heavily forested (75-100%)	✓ scattered settlement
	swamp/bog	partly built-up
		urbanised

Valley Sides (~~Not~~ Well-defined)

Slumping	*Vegetation and Land-Use*	*Left*	*Right*
✓ none	none		
occasional	grass	6 %	40 %
frequent	trees	93 %	60 %
	cultivated	%	%
	built-up	1 %	NIL %

Comments _____

Valley Characteristics

Measurements

valley length ____ m
bottom width(av.) ____ m
valley slope ____ (straight-line)
height at head of reach ____ m to MSL

Terraces

✓ none
indefinite
fragmentary
continuous

Relation of Channel to Valley Bottom (Vertical)

not applicable
not obviously degrading
partly entrenched
✓ entrenched
aggrading

Relation of Channel to Valley Sides or Resistant Terraces (Lateral)

not applicable (no valley or free)
occasionally confined
✓ frequently confined
entrenched

Surface Geology

bedrock
lacustrine deposits
✓ fluvial deposits
aeolian
sand covered ____ % area

Comments _____

River Mouth

Characteristics

open/~~closed~~
natural/~~artificial~~
canalized
✓ sandy
✓ rocks on right bank
rocks on left bank
outer bar
silt plume (fluvial)
✓ suspended sediment (marine)

Measurements

right bank breakwater length ____ m
left bank breakwater length ____ m
rock sill level ____ m to MSL
cliffs on right bank: height ____ m to MSL
cliffs on left bank: height ____ m to MSL
spit/~~bar~~: direction of growth 225 °
length of spit/~~bar~~ 340 m
length stabilized ____ m
width $\bar{x}$ 121 m

Comments _____

FLOOD PLAIN AND CHANNEL FEATURES

Description of Flood Plain

Presence

✓ none
indefinite
fragmentary
continuous

Extent

✓ none
average width ____ m
maximum width ____ m
aerial length ____ m
area ____ ha

Vegetation

almost none
grass
✓ reed swamp ____
sparsely forested
moderately forested
heavily forested

Forest Type

not known/applicable
✓ riverine:
✓ main channel ____
✓ tributaries
✓ coastal dune/evergreen
mangroves

Land-Use

✓ not cultivated, not built-up**
cultivated ____ % area
crop/s ____
partly built-up
mainly built-up

Comments * narrow strips along R. banks
** River bank areas

Channel Description N.B. Estimate of flow stage: ~~BANK~~/NEAR LONG-TERM MEAN/~~HIGH~~

Pattern

straight
✓ sinuous
irregular
regular meanders
irregular meanders
tortuous meanders
bifurcated
lake/s
lagoon

Measurements

thalweg 4990 m
*sinuosity 1,10
*open water area 49 ha
*(whole reach) P = 10 420 m
lake/lagoon area ____ ha
inundated
channel slope _
channel width $\bar{x}$ ____ m s = ____ m
river slope _
river width $\bar{x}$ 91,2 m s = 44,4 m

~~Islands~~/*Shoals*

none
✓ occasional*
frequent
split
braided

Type of Flow

stagnant/still
✓ uniform water surface
uniform with rapid in reach
irregular
pool & riffle sequence

Bar Type

none
✓ channel side bars
point bars
✓ channel junction bars
mid-channel bars
diamond bars
diagonal bars
sand waves/large dunes

Comments _____
* near mouth

Obstructions/Constructions

Natural _____ *Degree*

✓ none
logs
boulders
vegetation

✓ none
minor
major

Comments _____

Man-made NONE *Degree of Obstruction/Constriction for Each* *Position (from head of reach)*

road bridge/s _____
rail bridge/s _____
causeway _____
weir/dam _____
fish traps _____
embankment/s _____
groynes _____
canals _____
drainage furrows _____
others _____

Lateral Channel Activity

Lateral Activity

✓ not detectable
downstream progression
progression & cut-offs
mainly cut-offs
entrenched loop development
irregular lateral activity
avulsion

Nature of Banks

✓ alluvium (silt/sand)
natural levées
rock/boulders
protected/stabilized
cultivation to channel edge

Bank Vegetation

none
weak
✓ good
very strong
left bank 85 %
right bank 60 %

Lateral Stability

✓ stable
slightly unstable
moderately unstable
highly unstable

Comments _____

TABLE NS1/IV

CLASSIFICATION OF THE LOWER REACHES OF NATAL RIVERS

NRIO NS 1

RIVER MTAMVUNA, 100 % ESTUARINE, REACH from 250m d/s rapids to Mouth, 5 km from mouth. REF. DWAFEC _____

AERIAL PHOTO DATE 5-5-63 SCALE 1:10 000 CATCHMENT AREA* 1589 km², M.A.R.* 281 m³x10⁶, No. of DAMS NIL

RIVER VALLEY AND RIVER MOUTH FEATURES

General Description of the Terrain above the Valley

Terrain	*Vegetation*	*Land-Use*
mountainous	almost none	none
✓ hilly	✓ grass	✓ scattered cultivation
undulating	✓ sparsely forested (0-25%)	partly cultivated
plains	moderately forested (25-75%)	mainly cultivated
	heavily forested (75-100%)	✓ scattered settlement
	swamp/bog	partly built-up
		urbanised

Valley Sides (~~Not~~ Well-defined)

Slumping	*Vegetation and Land-Use*	*Left*	*Right*
✓ none	none		
occasional	grass	6 %	37 %
frequent	trees	93 %	63 %
	cultivated	NIL %	NIL %
	built-up	1 %	NIL %

Comments * Begg

Valley Characteristics

Measurements

valley length _____ m
bottom width(av.) _____ m
valley slope _____ (straight-line)
height at head of reach _____ m to MSL

Terraces

✓ none
indefinite
fragmentary
continuous

Relation of Channel to Valley Bottom (Vertical)

not applicable
not obviously degrading
partly entrenched
✓ entrenched
aggrading

Relation of Channel to Valley Sides or Resistant Terraces (Lateral)

not applicable (no valley or free)
occasionally confined
✓ frequently confined
entrenched

Surface Geology

bedrock
lacustrine deposits
✓ fluvial deposits
aeolian
sand covered _____ % area

Comments _____

River Mouth

Characteristics

open/~~closed~~
natural/~~artificial~~
canalized
✓ sandy
✓ rocks on right bank
rocks on left bank
outer bar
silt plume (fluvial)
✓ suspended sediment (marine)

Measurements

right bank breakwater length _____ m
left bank breakwater length _____ m
rock sill level _____ m to MSL
cliffs on right bank: height _____ m to MSL
cliffs on left bank: height _____ m to MSL
spit/~~bar~~: direction of growth 217 °
length of spit/~~bar~~ 540 m
length stabilized _____ m
width $\bar{x}$ 77 m

Comments _____

FLOOD PLAIN AND CHANNEL FEATURES

Description of Flood Plain

Presence

✓ none
indefinite
fragmentary
continuous

Extent

none
average width _____ m
maximum width _____ m
aerial length _____ m
area _____ ha

Vegetation

almost none
grass
✓* reed swamp _____
sparsely forested
moderately forested
heavily forested

Forest Type

not known/applicable
✓ riverine:
✓ main channel _____
✓ tributaries _____
✓ coastal dune/evergreen
mangroves

Land-Use

✓** not cultivated, not built-up
cultivated _____ % area
crop/s _____
partly built-up
mainly built-up

Comments * narrow strips along R banks
** River bank areas

Channel Description N.B. Estimate of flow stage: ~~BKF~~/NEAR LONG-TERM MEAN/~~HIGH~~

Pattern

straight
✓ sinuous
irregular
regular meanders
irregular meanders
tortuous meanders
bifurcated
lake/s
lagoon

Measurements

thalweg 5110 m
*sinuosity 1,10
*open water area 50 ha
*(whole reach) P = 10420m
lake/lagoon area inundated _____ ha
channel slope _____
channel width $\bar{x}$ _____ m s = _____ m
river slope _____
river width $\bar{x}$ 94,7 m s = 51,0 m

Islands/Shoals

none
✓ occasional*
frequent
split
braided

Type of Flow

stagnant/still
✓ uniform water surface
uniform with rapid in reach
irregular
pool & riffle sequence

Bar Type

none
✓ channel side bars
point bars
✓ channel junction bars
mid-channel bars
diamond bars
diagonal bars
sand waves/large dunes

Comments * near mouth

Obstructions/Constructions

Natural	*Degree*
✓ none	✓ none
logs	minor
boulders	major
vegetation	

Comments _____

Man-made NONE *Degree of Obstruction/Constriction for Each* *Position (from head of reach)*

road bridge/s _____
rail bridge/s _____
causeway _____
weir/dam _____
fish traps _____
embankment/s _____
groynes _____
canals _____
drainage furrows _____
others _____

Lateral Channel Activity

Lateral Activity

✓ not detectable
downstream progression
progression & cut-offs
mainly cut-offs
entrenched loop development
irregular lateral activity
avulsion

Nature of Banks

✓ alluvium (silt/sand)
natural levées
rock/boulders
protected/stabilized
cultivation to channel edge

Bank Vegetation

none
weak
✓ good
very strong
left bank 82 %
right bank 60 %

Lateral Stability

✓ stable
slightly unstable
moderately unstable
highly unstable

Comments _____

TABLE NS1/V

CLASSIFICATION OF THE LOWER REACHES OF NATAL RIVERS

NRIO NS 1

RIVER MTAMVUNA, 100 % ESTUARINE, REACH from 250m d/s rapids to Mouth, 5 km from mouth. REF. DWAFEC _____

AERIAL PHOTO DATE 11-6-66 SCALE 1:10 000 CATCHMENT AREA× 1589 km², M.A.R.× 281 m³x10⁶, No. of DAMS Nil

RIVER VALLEY AND RIVER MOUTH FEATURES

General Description of the Terrain above the Valley

Terrain	*Vegetation*	*Land-Use*
mountainous	almost none	none
✓ hilly	✓ grass	✓ scattered cultivation
undulating	✓ sparsely forested (0-25%)	partly cultivated
plains	moderately forested (25-75%)	mainly cultivated
	heavily forested (75-100%)	✓ scattered settlement
	swamp/bog	partly built-up
		urbanised

Valley Sides (Not Well-defined)

Slumping	*Vegetation and Land-Use*	*Left*	*Right*
✓ none	none		
occasional	grass	6	39 %
frequent	trees	93	61 %
	cultivated	Nil	Nil %
	built-up	1	Nil %

Comments × Begg

Valley Characteristics

Measurements

valley length _____ m
bottom width(av.) _____ m
valley slope _____
(straight-line)
height at head
of reach _____ m to MSL

Terraces

✓ none
indefinite
fragmentary
continuous

Relation of Channel to Valley Bottom (Vertical)

not applicable
not obviously degrading
partly entrenched
✓ entrenched
aggrading

Relation of Channel to Valley Sides or Resistant Terraces (Lateral)

not applicable (no valley or free)
occasionally confined
✓ frequently confined
entrenched

Surface Geology

bedrock
lacustrine deposits
✓ fluvial deposits
aeolian
sand covered _____ % area

Comments _____

River Mouth

Characteristics

open/closed
natural/artificial
canalized
✓ sandy
✓ rocks on right bank
rocks on left bank
outer bar
silt plume (fluvial)
✓ suspended sediment (marine)

Measurements

right bank breakwater length _____ m
left bank breakwater length _____ m
rock sill level _____ m to MSL
cliffs on right bank: height _____ m to MSL
cliffs on left bank: height _____ m to MSL
spit/bar: direction of growth 232 °
length of spit/bar 260 m
length stabilized _____ m
width x̄ 126 m

Comments _____

FLOOD PLAIN AND CHANNEL FEATURES

Description of Flood Plain

Presence

✓ none
indefinite
fragmentary
continuous

Extent

✓ none
average width _____ m
maximum width _____ m
aerial length _____ m
area _____ ha

Vegetation

almost none
grass
✓ reed swamp _____
sparsely forested
moderately forested
heavily forested

Forest Type

not known/applicable
✓ riverine:
✓ main channel _____
✓ tributaries
✓ coastal dune/evergreen
mangroves

Land-Use

not cultivated, not built-up×
cultivated _____ % area
crop/s _____
partly built-up
mainly built-up

Comments × narrow strips along R banks
× River bank areas

Channel Description N.B. Estimate of flow stage: Low/NEAR LONG-TERM MEAN/High

Pattern

straight
✓ sinuous
irregular
regular meanders
irregular meanders
tortuous meanders
bifurcated
lake/s
lagoon

Measurements

thalweg 4910 m
*sinuosity 1,08
*open water area 46 ha
*(whole reach) P= 9980 m
lake/lagoon area _____ ha
inundated
channel slope _____
channel width x̄ _____ m s = _____ m
river slope _____
river width x̄ 89,2 m s = 42,3 m

Islands/Shoals

none
✓ occasional×
frequent
split
braided

Type of Flow

stagnant/still
✓ uniform water surface
uniform with rapid in reach
irregular
pool & riffle sequence

Bar Type

none
✓ channel side bars
point bars
✓ channel junction bars
mid-channel bars
diamond bars
diagonal bars
sand waves/large dunes

Comments _____
× near mouth

Obstructions/Constructions

Natural	*Degree*	*Man-made*	*Degree of Obstruction/Constriction for Each*	*Position (from head of reach)*
✓ none	✓ none	road bridge/s	Suspension Br. R. confined	4,2 km
logs	minor	rail bridge/s		
boulders	major	causeway		
vegetation		weir/dam		
		fish traps		
		embankment/s		
		groynes		
		canals		
		drainage furrows		
		others		

Comments _____

Lateral Channel Activity

Lateral Activity

✓ not detectable
downstream progression
progression & cut-offs
mainly cut-offs
entrenched loop development
irregular lateral activity
avulsion

Nature of Banks

✓ alluvium (silt/sand)
natural levées
rock/boulders
protected/stabilized
cultivation to
channel edge

Bank Vegetation

none
weak
✓ good
very strong
left bank 95 %
right bank 75 %

Lateral Stability

✓ stable
slightly unstable
moderately unstable
highly unstable

Comments _____

TABLE NS1/VI

CLASSIFICATION OF THE LOWER REACHES OF NATAL RIVERS

NRIO NS1

RIVER MTAMVUNA, 100 % ESTUARINE, REACH from 250m d/s rapids to Mouth, 5 km from mouth. REF. DWAFEC _____

AERIAL ~~PHOTO~~ DATE 23-6-76 SCALE 1:10 000 CATCHMENT AREA* 1589 km², M.A.R.* 281 m³x10⁶, No. of DAMS NIL
orthophoto

RIVER VALLEY AND RIVER MOUTH FEATURES

General Description of the Terrain above the Valley

Terrain	*Vegetation*	*Land-Use*
mountainous	almost none	none
✓hilly	✓grass	✓scattered cultivation
undulating	✓sparsely forested (0-25%)	partly cultivated
plains	moderately forested (25-75%)	mainly cultivated
	heavily forested (75-100%)	✓scattered settlement
	swamp/bog	partly built-up
		urbanised

Valley Sides (~~Non~~ Well-defined)

Slumping	*Vegetation and Land-Use*	*Left*	*Right*
✓none	none		
occasional	grass	6 %	39 %
frequent	trees	93 %	61 %
	cultivated	NIL %	NIL %
	built-up	1 %	NIL %

Comments * Begg

Valley Characteristics

Measurements	*Terraces*	*Relation of Channel to Valley Bottom (Vertical)*	*Relation of Channel to Valley Sides or Resistant Terraces (Lateral)*	*Surface Geology*
valley length 4780 m	✓none	not applicable	not applicable (no valley or free)	bedrock
bottom width(av.) 244 m	indefinite	not obviously degrading	occasionally confined	lacustrine deposits
valley slope ≐ 1:1593	fragmentary	partly entrenched	✓frequently confined	✓fluvial deposits
(straight-line)	continuous	✓entrenched	entrenched	aeolian
height at head		aggrading		sand covered ____ % area
of reach ± 3 m to MSL approx.				

Comments _____

River Mouth

Characteristics	*Measurements*		
open/~~closed~~	right bank breakwater length	____	m
natural/~~artificial~~	left bank breakwater length	____	m
canalized	rock sill level	____	m to MSL
✓sandy	cliffs on right bank: height	____	m to MSL
✓rocks on right bank	cliffs on left bank: height	____	m to MSL
rocks on left bank	spit/~~bar~~: direction of growth	230	°
outer bar	length of spit/~~bar~~	350	m
silt plume (fluvial)	length stabilized	NIL	m
suspended sediment (marine)	width ≈	107	m

Comments _____

FLOOD PLAIN AND CHANNEL FEATURES

Description of Flood Plain

Presence	*Extent*	*Vegetation*	*Forest Type*	*Land-Use*
✓none	✓none	almost none	not known/applicable	✓not cultivated, not built-up ✓
indefinite	average width ____ m	grass	✓riverine:	cultivated ____ % area
fragmentary	maximum width ____ m	✓*reed swamp ____	✓main channel ____	crop/s ____
continuous	aerial length ____ m	sparsely forested	✓tributaries	partly built-up
	area ____ ha	moderately forested	✓coastal dune/evergreen	mainly built-up
		heavily forested	mangroves	

Comments *narrow strips along R. banks
** River bank areas

Channel Description N.B. Estimate of flow stage: ~~BANK~~/NEAR LONG-TERM MEAN/~~HIGH~~

Pattern	*Measurements*			*~~Islands~~/Shoals*	*Type of Flow*	*Bar Type*
straight	thalweg	4960	m	none	stagnant/still	none
✓sinuous	*sinuosity	1,10		✓occasional×	✓uniform water surface	✓channel side bars
irregular	*open water area	49	ha	frequent	uniform with rapid in reach	point bars
regular meanders	*(whole reach) P =	10050	m	split	irregular	✓channel junction bars
irregular meanders	lake/lagoon area inundated	____	ha	braided	pool & riffle sequence	mid-channel bars
tortuous meanders	channel slope	____				diamond bars
bifurcated	channel width x̄	____	m s =	____ m		diagonal bars
lake/s	river slope	____				sand waves/large dunes
lagoon	river width x̄	91,9	m s =	46,6 m		

Comments _____
× near mouth

Obstructions/Constructions

Natural	*Degree*
✓none	✓none
logs	minor
boulders	major
vegetation	

Comments _____

Man-made	*Degree of Obstruction/Constriction for Each*	*Position (from head of reach)*
road bridge/~~s~~	Suspension Br R. confined	4,2 km
rail bridge/s		
causeway		
weir/dam		
fish traps		
embankment/s		
groynes		
canals		
drainage furrows		
others		

Lateral Channel Activity

Lateral Activity	*Nature of Banks*	*Bank Vegetation*	*Lateral Stability*
✓not detectable	✓alluvium (silt/sand)	none	✓stable
downstream progression	natural levées	weak	slightly unstable
progression & cut-offs	rock/boulders	✓good	moderately unstable
mainly cut-offs	protected/stabilized	very strong	highly unstable
entrenched loop development	cultivation to channel edge	left bank 95 %	
irregular lateral activity		right bank 78 %	
avulsion			

Comments _____

TABLE NS1/VII RIVER WIDTHS

MTAMVUNA NS 1

Station	Approx. distance along mid-channel from 250 m d/s rapids	River widths (in metres) Date 2-5-37	Dec.1943	16-8-52	5-5-63	11-6-66	23-6-76	$\bar{x}$	s	V%
	(m)									
1	0	35	35*	35*	35	40*	40	36,7	2,6	7,0
2	310	65	65*	65*	65	67*	67	65,7	1,0	1,6
3	620	40	35	35	35	35*	35	35,8	2,0	5,7
4	930	95	87	65	65	68*	68	74,7	13,0	17,4
5	1 240	114	110	85	72	70*	70	86,8	20,3	23,4
6	1 550	125	78	90	75	75*	69	85,3	20,6	24,2
7	1 860	135	110	100	100	82	82	101,5	19,8	19,5
8	2 170	145	138	125	100	106	100	119,0	19,8	16,7
9	2 490 (d/s pont)	110	105	85	95	95	85	95,8	10,2	10,7
10	2 790	125	119	105	105	108	105	111,2	8,7	7,8
11	3 100	140	105	115	120	115	100	115,8	13,9	12,0
12	3 410	78**	65**	60**	60**	60**	60**	63,8	7,2	11,3
13	3 720	150	148	135	138	130	145	141,0	7,9	5,6
14	4 030 (Suspension bridge)	194	175	185	174	170	160	176,3	11,8	6,7
15	4 340	150	155	165	150	145	168	155,5	9,1	5,9
16	4 650	216	155	75 (55+15+5)	205	140	180	161,8	51,4	31,7
17	≃ 4 960(nr.mouth)	25	45	25	15	15	28	25,5	11,0	43,2
$\bar{x}$		114,3	101,8	91,2	94,7	89,5	91,9	97,2		14,7
s		53,3	43,7	44,4	51,0	42,2	46,6			
V%		46,6	43,0	48,7	53,8	47,2	50,7			

*: estimate (out of photo range) **: estimate (shadow cast by trees on cliffs on L.B.)

TABLE NS1/VIII LATERAL STABILITY

MTAMVUNA NS 1

Station	Approx. distance along mid-channel from 250 m d/s rapids (m)	Distance from maximum observed L.B. position to mid-channel (m)						Max-Min	$\bar{x}$	s	V%
		Date									
		2-5-37	Dec.1943	16-8-52	5-5-63	11-6-66	23-6-76				
1	0	22,5	22,5	22,5	22,5	20,0	20,0	2,5	21,7	1,3	6,0
2	310	32,5	32,5	32,5	32,5	33,5	33,5	1,0	32,8	0,5	1,6
3	620	20,0	17,5	17,5	17,5	17,5	17,5	2,5	17,9	1,0	5,7
4	930	47,5	43,5	32,5	32,5	34,0	34,0	15,0	37,3	6,5	17,4
5	1 240	57,0	60,0	57,5	61,0	65,0	65,0	8,0	60,9	3,5	5,7
6	1 550	62,5	85,0	70,0	87,5	82,5	84,5	25,0	78,7	10,0	12,8
7	1 860	67,5	62,0	55,0	68,0	65,0	70,0	15,0	64,6	5,4	8,4
8	2 170	72,5	74,0	67,0	68,0	63,0	70,0	11,0	69,1	4,0	5,8
9	2 490 (d/s pont)	55,0	57,5	47,5	57,5	47,5	47,5	10,0	52,1	5,1	9,8
10	2 790	62,5	65,0	57,5	58,5	54,0	57,5	11,0	59,2	4,0	6,7
11	3 100	70,0	80,5	67,5	70,0	62,5	62,0	18,5	68,8	6,7	9,8
12	3 410	40,0	37,5	30,0	40,0	30,0	30,0	10,0	34,6	5,1	14,8
13	3 720	75,0	74,0	67,5	69,0	65,0	72,5	10,0	70,5	4,0	5,6
14	4 030 (Suspension bridge)	100,0	92,5	92,5	90,0	90,0	92,0	10,0	92,8	3,7	4,0
15	4 340	90,0	92,5	82,5	75,0	72,5	84,0	20,0	82,8	7,9	9,6
16	4 650	108,0	128,0	122,7	147,5	120,0	135,0	39,5	126,9	13,5	10,7
17	≈ 4 960 (nr.mouth)	105,0	115,0	65,0	95,0	7,5	102,0	107,5	81,6	40,1	49,1
$\bar{x}$		64,0	67,0	58,1	64,2	54,7	63,4	18,6			10,8
s		26,8	30,8	26,9	31,5	28,9	31,3	24,7			10,7
V%		41,8	45,9	46,2	49,1	52,9	49,3	132,8			98,7

Average lateral displacement 1937-76 = 18,6 m Average V 1937-76 = 10,8%

TABLE NS1/IX

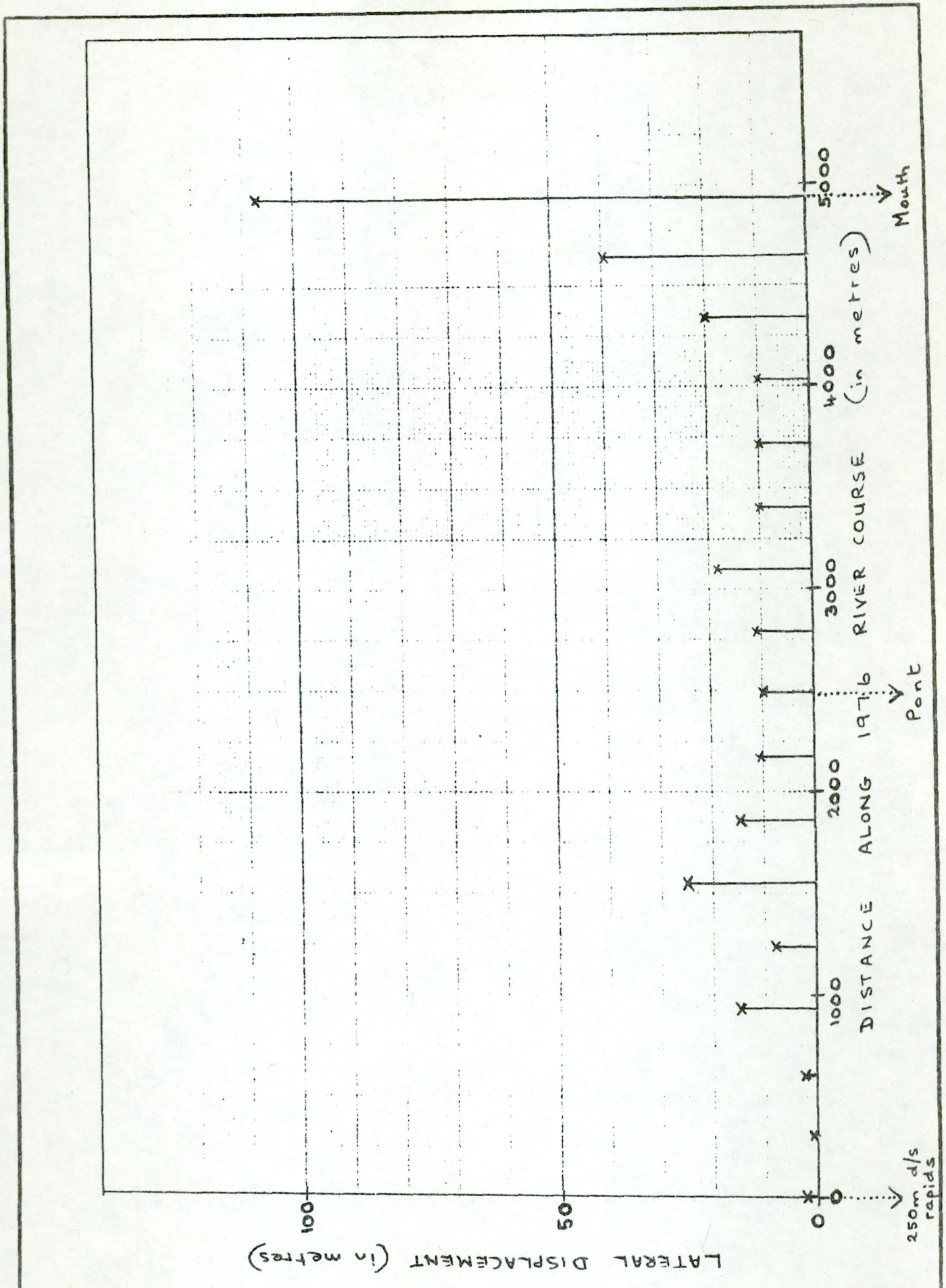
ABSTRACT

MTAMVUNA

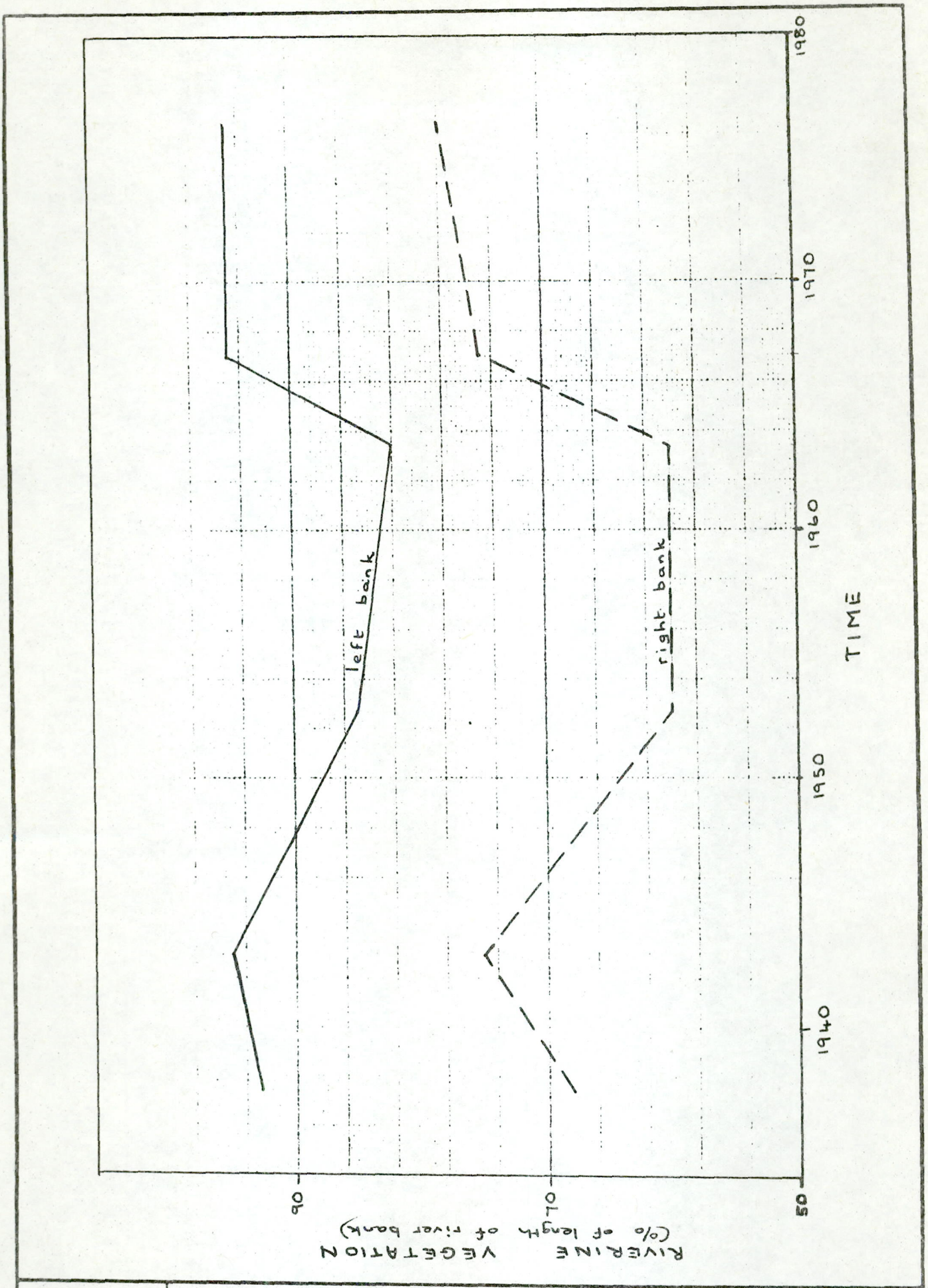
		1937 - 1976
1	Sinuosity	Range 1,08 - 1,10
2	River width	$\bar{x}$ Range 89,5 m - 114,3 m
3	Lateral displacement	$\bar{x}$ = 18,6 m
	Average coefficient of variation	$\frac{s}{\bar{x}}$ = 10,8%
4	Thalweg	Range 4 910 m - 5 110 m
5	Increase in channel side bar area	8,9 ha
6	Riverine vegetation	L.B. Range 82 - 95%
		R.B. Range 60 - 78%
7	Human influence: *within estuarine area*	Nil
	(a) Suspension bridge built in mid-60s: no effect on river course	
	(b) No cultivation	
	(c) No destruction of riverine vegetation	

upstream estuarine area

The increase in channel side bar deposition suggests a change in land-use pattern upstream of the estuary, giving greater silt availability

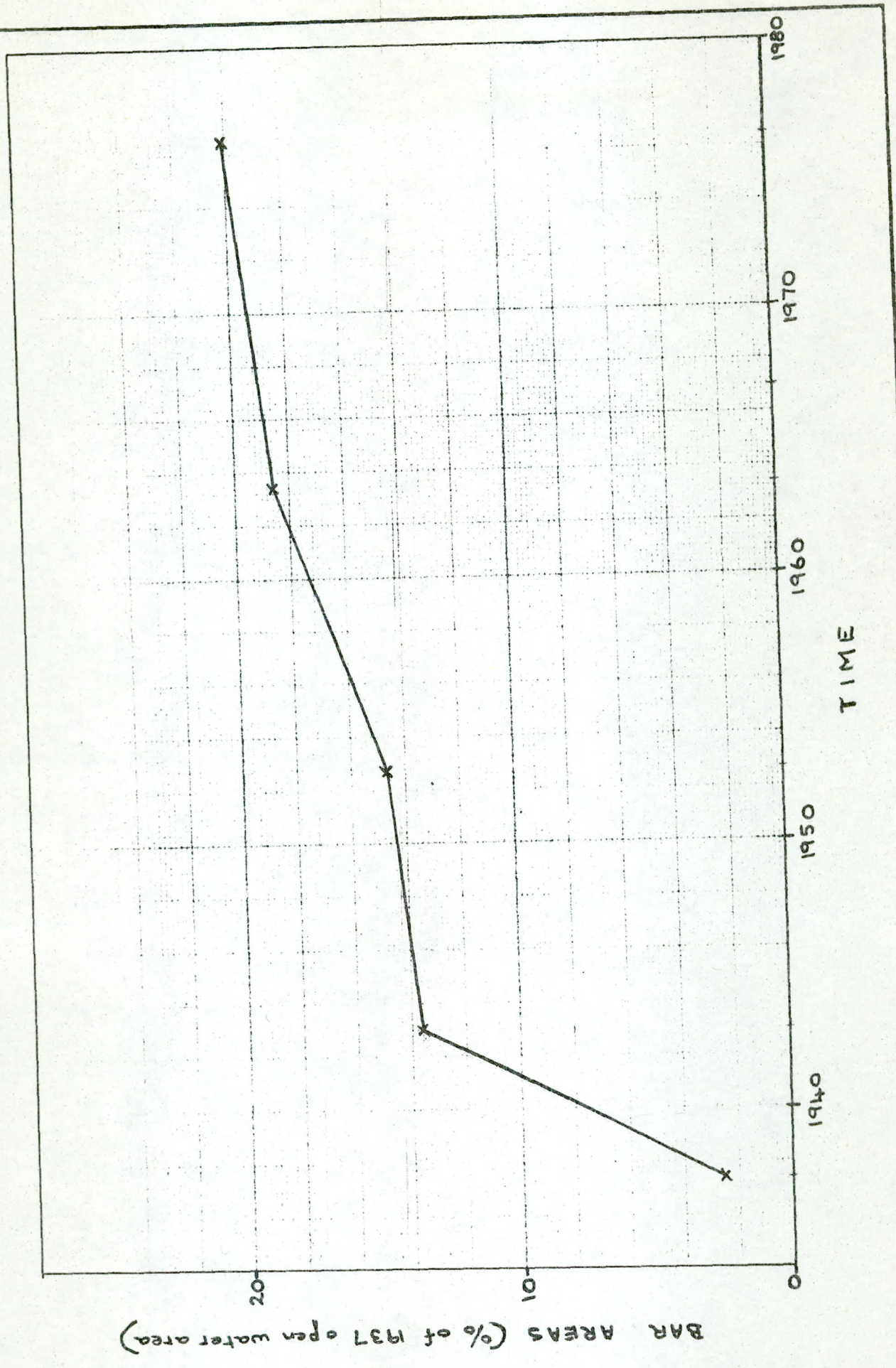


TRACED CHECKED DATE REF	NATAL ESTUARIES: MTAMVUNA THALWEG DISPLACEMENT 1937 - 76	FIGURE NS1/1
NATIONAL RESEARCH INSTITUTE FOR OCEANOLOGY		

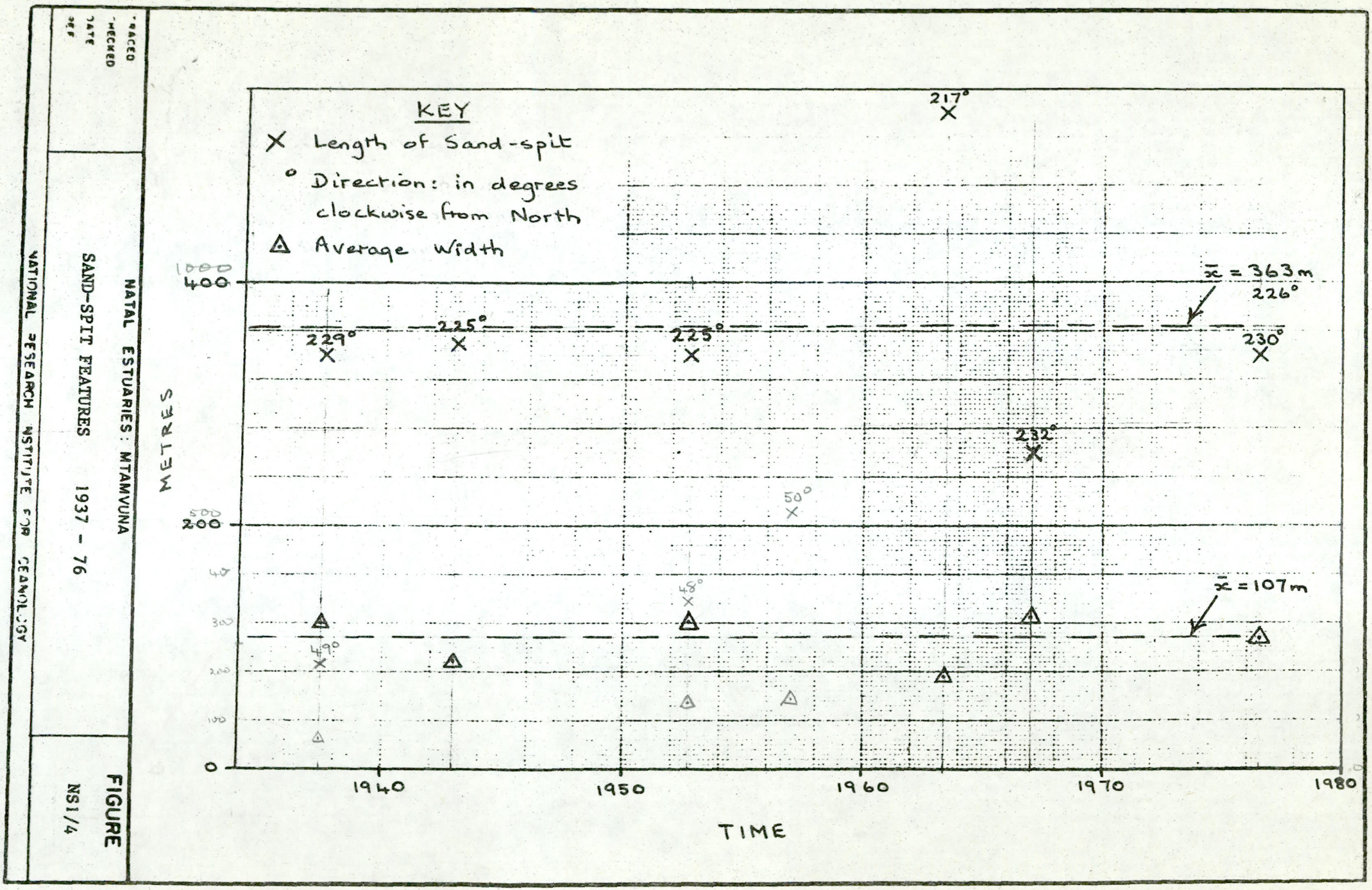


TRACED CHECKED DATE REF	NATAL ESTUARIES: MTAMVUNA RIVERINE VEGETATION 1937 - 76	FIGURE NS1/2

NATIONAL RESEARCH INSTITUTE FOR OCEANOLOGY



TRACED CHECKED DATE REF	NATAL ESTUARIES: MTAMVUNA CHANNEL SIDE BARS 1937 - 76	FIGURE NS1/3
NATIONAL RESEARCH INSTITUTE FOR OCEANOLOGY		



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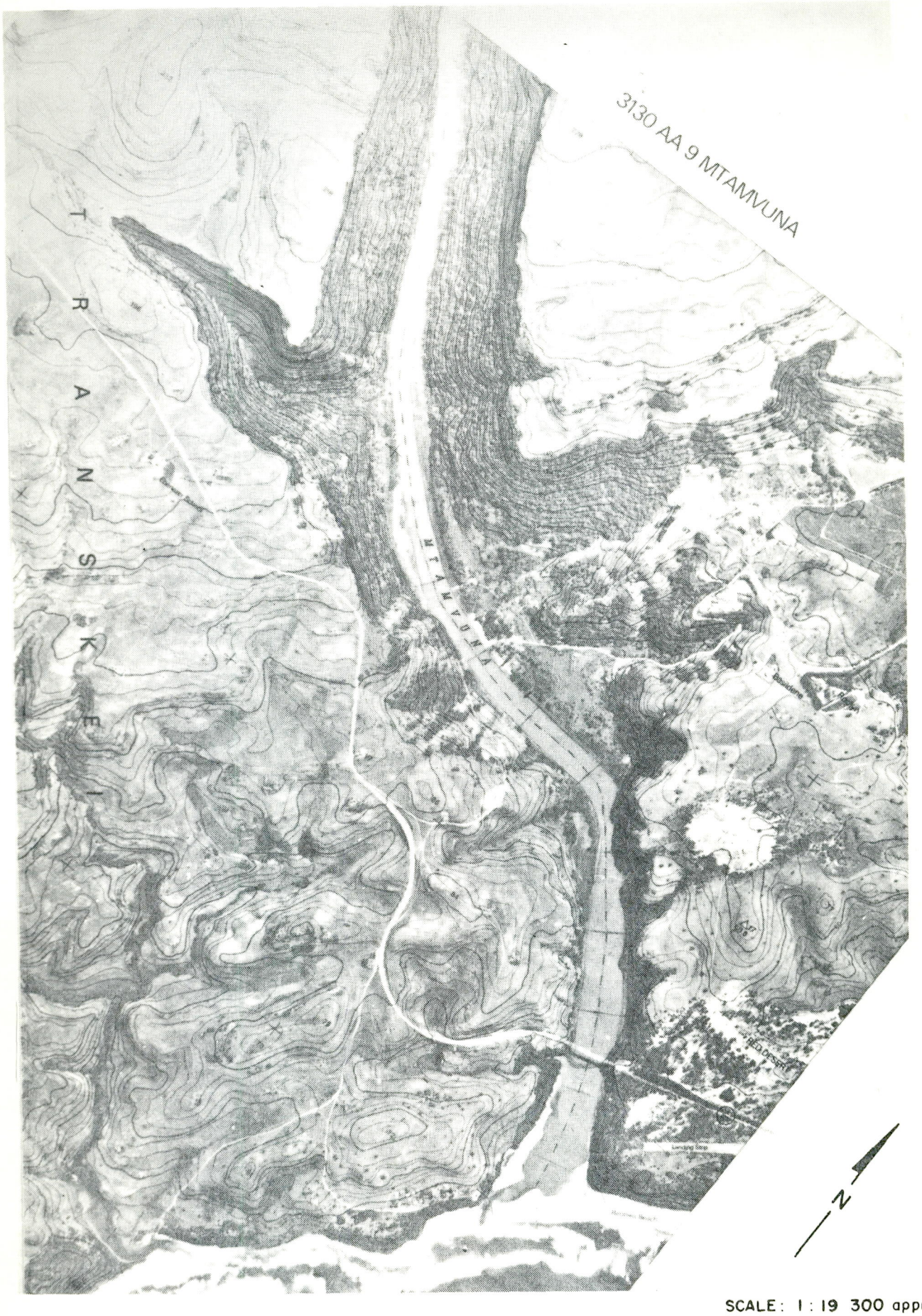
NATAL ESTUARIES: MTAMVUNA

SAND-SPIT FEATURES 1937 - 76

FIGURE NS1/4

TRACED
CHECKED
DATE
REF



SCALE: 1 : 19 300 approx.

TRACED DS CHECKED DATE REF	NATAL ESTUARIES : MTAMVUNA ORTHOPHOTO : 23-6-76	PHOTOGRAPH NSI / 1

NATIONAL RESEARCH INSTITUTE FOR OCEANOLOGY

HYDRO CLASSIFICATION OF THE LOWER REACHES

of the

M T A M V U N A N S 1

(D a t a R e p o r t N o . 1 U p d a t e d)

J.E. PERRY

March 1985

MTAMVUNA NS 1

Additional Note for the Sponsor

The Mtamvuna is the only estuary, sensu stricto, of 5 km length on the Natal South coast.

Main hydro points for its conservation

(i) Can silt supply from u/s be reduced? (78% B.I.)

(ii) Riverine forests on valley sides should be conserved

(iii) Spit at mouth should continue to be allowed to function naturally (no stabilization or artificial breaching).

TABLE NS1/I

RIVER MTAMVUNA NS 1

ABSTRACT

BASIC DATA / CALCULATIONS

Lateral displacement (1937 - 1976)	$\bar{x}$	18,6	m (19,1% $\bar{R}$ width)
Relative lateral stability (1937 - 1976)	$\bar{V}$	10,8	%
Area of catchment		1553	km^2
Area of flood plain		Nil	ha
Area of envelope of mobility		63,0	ha
Simulated M.A.R. (1921 - 1975)	$\bar{x}$	153,65	x 10^6 m^3 Median 135,54
	s	79,77	x 10^6 m^3
	$\bar{V}$	51,92	%

Dates of major floods: Nov. 1936, May 1959, March 1976 + frequent minor flood flows.

MEASUREMENTS/CALCULATIONS from PHOTOGRAPHS

Date	2-5-37	Dec.'43	16-8-52	5-5-63	11-6-66	23-6-76
Thalweg (m)	5011	5099	5082	5333	5023	5017
% Thalweg estuarine	100	100	100	100	100	100
Aerial D (m)	4533	4583	4579	4722	4538	4529
Sinuosity	1,11	1,11	1,11	1,13	1,11	1,11
$\bar{x}$ River width (m)	114,3	101,8	91,2	94,7	89,2	91,9
Open water area (ha)	57,5	50,9	48,6	49,7	46,0	49,4
% envelope of mobility	91,3	80,8	77,1	78,9	73,0	78,4
Bar/island area (ha) Fluvial / Marine	1,4	7,4	8,0	10,2	10,3	11,0
River braided % thalweg	NIL	NIL	NIL	NIL	NIL	NIL
% Flood plain cultivated	NIL	NIL	NIL	NIL	NIL	NIL
Left valley side:						
% grass	11	8	6	6	6	6
% trees	89	92	93	93	93	93
% cultivated	NIL	NIL	NIL	NIL	NIL	NIL
% built up	NIL	NIL	1	1	1	1
Right valley side:						
% grass	37	39	40	37	39	39
% trees	63	61	60	63	61	61
% cultivated	NIL	NIL	NIL	NIL	NIL	NIL
% built up	NIL	NIL	NIL	NIL	NIL	NIL
L.B. % vegetated	93	95	85	82	95	95
R.B. % vegetated	68	75	60	60	75	78
Mouth open/closed o/c	0	0	0	0	0	0
Spit/bar:						
Direction (°)	229	225	225	217	232	230
Length (m)	340	350	340	540	260	350
$\bar{x}$ width (m)	120	88	121	77	126	107

HUMAN INFLUENCES

Within the Reach

1. Land-use

   (a) Cultivation: Valley sides — Nil

   Flood plain — Nil

   To channel edge — Nil

   (b) Bridge building and embankments

	Position	Date
Suspension Bridge	4,2 km from Head of Reach	± 1965

   (c) Canals — Nil

   (d) Urbanization/Industry — Nil

2. Breaching of sandbar — Very seldom

3. Others

Upstream of Reach

(a) Dams in the catchment — Date of construction

Nil

(b) Building construction or canalization immediately upstream of reach

Nil

(c) Land-use malpractices/silt supply — Increase in channel side-bar areas (esp. 1937-43) suggests land-use malpractices in the catchment ∴ greater silt availability

STABILITY FOR PERIOD UNDER REVIEW:

Stable (geomorphologically stable)

TABLE NS1/II — CLASSIFICATION OF THE LOWER REACHES OF NATAL RIVERS — NRIO NS 1

RIVER MTAMVUNA, 100 % ESTUARINE, REACH from 250m d/s rapids, 5,0 km from mouth. REF. DEA T 401a

AERIAL PHOTO DATE 2-5-37 SCALE 1:10 000 CATCHMENT AREA 1553 km², M.A.R. 303,78 $m^3 \times 10^6$, No. of DAMS NIL

RIVER VALLEY AND RIVER MOUTH FEATURES

General Description of the Terrain above the Valley

Terrain	*Vegetation*	*Land-Use*
mountainous	almost none	none
✓ hilly	✓ grass	✓ scattered cultivation
undulating	✓ sparsely forested (0-25%)	partly cultivated
plains	moderately forested (25-75%)	mainly cultivated
	heavily forested (75-100%)	✓ scattered settlement
	swamp/bog	partly built-up
		urbanised

Valley Sides (Not Well-defined)

Slumping	*Vegetation and Land-Use*	*Left*	*Right*
✓ none	coastal dune	1 %	1 %
occasional	grass	11 %	37 %
frequent	trees/bush	88 %	62 %
	cultivated	NIL %	NIL %
	built-up	NIL %	NIL %

Comments _____

Valley Characteristics

Measurements

valley length _____ m
bottom width(av.) ____ m
valley slope _____
height at head of reach ____ m to MSL

Terraces

✓ none
indefinite
fragmentary
continuous

Relation of Channel to Valley Bottom (Vertical)

not applicable
not obviously degrading or aggrading
partly entrenched
✓ entrenched
aggrading

Relation of Channel to Valley Sides or Resistant Terraces (Lateral)

not applicable (no valley or free)
occasionally confined
✓ frequently confined
entrenched

Surface Geology

bedrock
lacustrine deposits
✓ fluvial deposits
aeolian
sand covered ____ % area

Comments _____

River Mouth

Characteristics

✓ open/~~closed~~
✓ natural/~~artificial~~
canalized
✓ sandy
✓ rocks on right bank
rocks on left bank
outer bar
✓ silt plume (fluvial)
suspended sediment (marine)

Measurements

right bank breakwater length _____ m
left bank breakwater length _____ m
rock sill level _____ m to MSL
cliffs on right bank: height _____ m to MSL
cliffs on left bank: height _____ m to MSL
spit/~~bar~~: direction of growth 229 °
length of spit/~~bar~~ 340 m
length stabilized NIL m
width 120 m

Comments _____

FLOOD PLAIN AND CHANNEL FEATURES

Description of Flood Plain

Presence

✓ none
indefinite
fragmentary
continuous

Extent

✓ none
average width _____ m
maximum width _____ m
R. aerial length 4533 m
area _____ ha

Vegetation

almost none
grass
✓ reed swamp * _____ % area
sparsely forested
moderately forested
heavily forested

Forest Type

not known/applicable
✓ riverine:
✓ main channel
✓ tributaries
mangroves

Land-Use

✓ not cultivated, not built-up **
cultivated _____ % area
crop/s _____
partly built-up
mainly built-up

Comments * ± 1,4ha
** River bank areas

Channel Description

N.B. Estimate of flow stage: LOW/NEAR LONG-TERM MEAN/HIGH

Pattern

straight
✓ sinuous
irregular
regular meanders
irregular meanders
tortuous meanders
bifurcated
lake/s
lagoon

Measurements

thalweg 5011 m
*sinuosity 1,11
*open water area 57,5 ha
perimeter 10100 m
lake/lagoon area _____ ha
river X-sections available
channel slope _____
channel width $\bar{x}$ _____ m s = _____ m
river slope _____
river width $\bar{x}$ 114,3 m s = 53,3 m

~~Islands~~/Shoals

none
✓ occasional **
frequent
split
braided

Type of Flow

stagnant/still
uniform water surface
uniform with rapid in reach
irregular
pool & riffle sequence
turbid

Bar Type

none
✓ channel side bars
point bars
✓ channel junction bars
mid-channel bars
diamond bars
diagonal bars
sand waves/large dunes

Comments *whole reach
** near mouth

Obstructions/Constructions

Natural _____ *Degree*

✓ none
logs
boulders
vegetation

✓ none
minor
major

Comments _____

Man-made NONE *Degree of Obstruction/Constriction for Each* *Position (from head of reach)*

road bridge/s _____
rail bridge/s _____
causeway _____
weir/dam _____
fish traps _____
embankment/s _____
groynes _____
canals _____
drainage furrows _____
others _____

Lateral Channel Activity

Lateral Activity

✓ not detectable
downstream progression
progression & cut-offs
mainly cut-offs
entrenched loop development
irregular lateral activity
avulsion

Nature of Banks

✓ alluvium (silt/sand)
natural levées
rock/boulders
protected/stabilized
cultivation to channel edge

Bank Vegetation

none
weak
✓ good
very strong
left bank 93 %
right bank 68 %

Lateral Stability

✓ stable
slightly unstable
moderately unstable
unstable
highly unstable

Comments _____

TABLE NS1/III — CLASSIFICATION OF THE LOWER REACHES OF NATAL RIVERS — NRIO NS 1

RIVER MTAMVUNA, 100 % ESTUARINE, REACH from 250m d/s rapids, 5,1 km from mouth. REF. DEA T401a

AERIAL PHOTO DATE Dec. 1943 SCALE 1:10 000 CATCHMENT AREA 1553 km², M.A.R. 303,78 m³x10⁶, No. of DAMS NIL

RIVER VALLEY AND RIVER MOUTH FEATURES

General Description of the Terrain above the Valley

Terrain	Vegetation	Land-Use
mountainous	almost none	none
✓ hilly	✓ grass	✓ scattered cultivation
undulating plains	✓ sparsely forested (0-25%)	partly cultivated
	moderately forested (25-75%)	mainly cultivated
	heavily forested (75-100%)	✓ scattered settlement
	swamp/bog	partly built-up
		urbanised

Valley Sides (Not Well-defined)

Slumping	Vegetation and Land-Use	Left	Right
✓ none	coastal dune	1 %	1 %
occasional	grass	8 %	39 %
frequent	trees/bush	91 %	60 %
	cultivated	NIL %	NIL %
	built-up	NIL %	NIL %

Comments

Valley Characteristics

Measurements

valley length ____ m
bottom width(av.) ____ m
valley slope ____
height at head of reach ____ m to MSL

Terraces

✓ none
indefinite
fragmentary
continuous

Relation of Channel to Valley Bottom (Vertical)

not applicable
not obviously degrading or aggrading
partly entrenched
✓ entrenched
aggrading

Relation of Channel to Valley Sides or Resistant Terraces (Lateral)

not applicable (no valley or free)
occasionally confined
✓ frequently confined
entrenched

Surface Geology

bedrock
lacustrine deposits
✓ fluvial deposits
aeolian
sand covered ____ % area

Comments

River Mouth

Characteristics

✓ open/~~closed~~
✓ natural/~~artificial~~
canalized
✓ sandy
✓ rocks on right bank
rocks on left bank
outer bar
✓ silt plume (fluvial)
suspended sediment (marine)

Measurements

right bank breakwater length ____ m
left bank breakwater length ____ m
rock sill level ____ m to MSL
cliffs on right bank: height ____ m to MSL
cliffs on left bank: height ____ m to MSL
spit/~~bar~~: direction of growth 225 °
length of spit/~~bar~~ 350 m
length stabilized NIL m
width 88 m

Comments

FLOOD PLAIN AND CHANNEL FEATURES

Description of Flood Plain

Presence

✓ none
indefinite
fragmentary
continuous

Extent

✓ none
average width ____ m
maximum width ____ m
aerial length 4583 m
area ____ ha

Vegetation

almost none
grass
✓ reed swamp * ____ % area
sparsely forested
moderately forested
heavily forested

Forest Type

not known/applicable
✓ riverine:
✓ main channel
✓ tributaries
mangroves

Land-Use

✓ not cultivated, not built-up **
cultivated ____ % area
crop/s ____
partly built-up
mainly built-up

Comments * ± 7,4ha
** River bank areas

Channel Description

N.B. Estimate of flow stage: LOW/NEAR LONG-TERM MEAN/HIGH

Pattern

straight
✓ sinuous
irregular
regular meanders
irregular meanders
tortuous meanders
bifurcated
lake/s
lagoon

Measurements

thalweg 5099 m
*sinuosity 1,11
*open water area 50,9 ha
perimeter 10020 m
lake/lagoon area ____ ha
river X-sections available
channel slope ____
channel width $\bar{x}$ ____ m s = ____ m
river slope ____
river width $\bar{x}$ 101,8 m s = 43,7 m

Islands/Shoals

none
✓ occasional **
frequent
split
braided

Type of Flow

stagnant/still
✓ uniform water surface
uniform with rapid in reach
irregular
pool & riffle sequence
turbid

Bar Type

none
✓ channel side bars
point bars
✓ channel junction bars
mid-channel bars
diamond bars
diagonal bars
sand waves/large dunes

Comments * whole reach
** near mouth

Obstructions/Constructions

Natural	Degree	Man-made: NONE	Degree of Obstruction/Constriction for Each	Position (from head of reach)
✓ none	✓ none	road bridge/s		
logs	minor	rail bridge/s		
boulders	major	causeway		
vegetation		weir/dam		
		fish traps		
		embankment/s		
		groynes		
		canals		
		drainage furrows		
		others		

Comments

Lateral Channel Activity

Lateral Activity

✓ not detectable
downstream progression
progression & cut-offs
mainly cut-offs
entrenched loop development
irregular lateral activity
avulsion

Nature of Banks

✓ alluvium (silt/sand)
natural levées
rock/boulders
protected/stabilized
cultivation to channel edge

Bank Vegetation

none
weak
✓ good
very strong
left bank 95 %
right bank 75 %

Lateral Stability

✓ stable
slightly unstable
moderately unstable
unstable
highly unstable

Comments

TABLE NS1/IV — CLASSIFICATION OF THE LOWER REACHES OF NATAL RIVERS — NRIO NS 1

RIVER MTAMVUNA, 100 % ESTUARINE, REACH from 250 m d/s rapids, 5,1 km from mouth. REF. DEA T 401 9

AERIAL PHOTO DATE 16-8-52 SCALE 1:10 000 CATCHMENT AREA 1553 km², M.A.R. 303,78 m³x10⁶, No. of DAMS NIL

RIVER VALLEY AND RIVER MOUTH FEATURES

General Description of the Terrain above the Valley

Terrain	*Vegetation*	*Land-Use*
mountainous	almost none	none
✓ hilly	✓ grass	✓ scattered cultivation
undulating	✓ sparsely forested (0-25%)	partly cultivated
plains	moderately forested (25-75%)	mainly cultivated
	heavily forested (75-100%)	✓ scattered settlement
	swamp/bog	partly built-up
		urbanised

Valley Sides (Not Well-defined)

Slumping	*Vegetation and Land-Use*	*Left*	*Right*
✓ none	coastal dune	1	1 %
occasional	grass	6	40 %
frequent	trees/bush	92	59 %
	cultivated	NIL	NIL %
	built-up	1	NIL %

Comments _____

Valley Characteristics

Measurements: valley length _____ m; bottom width(av.) ____ m; valley slope _____; height at head of reach ____ m to MSL

Terraces: ✓ none; indefinite; fragmentary; continuous

Relation of Channel to Valley Bottom (Vertical): not applicable; not obviously degrading or aggrading; partly entrenched; ✓ entrenched; aggrading

Relation of Channel to Valley Sides or Resistant Terraces (Lateral): not applicable (no valley or free); occasionally confined; ✓ frequently confined; entrenched

Surface Geology: bedrock; lacustrine deposits; ✓ fluvial deposits; aeolian; sand covered ____ % area

Comments _____

River Mouth

Characteristics: ✓ open/~~closed~~; ✓ natural/~~artificial~~; canalized; ✓ sandy; ✓ rocks on right bank; rocks on left bank; outer bar; silt plume (fluvial); ✓ suspended sediment (marine)

Measurements:

right bank breakwater length	_____	m
left bank breakwater length	_____	m
rock sill level	_____	m to MSL
cliffs on right bank: height	_____	m to MSL
cliffs on left bank: height	_____	m to MSL
spit/~~bar~~: direction of growth	225	°
length of spit/~~bar~~	340	m
length stabilized	NIL	m
width	121	m

Comments _____

FLOOD PLAIN AND CHANNEL FEATURES

Description of Flood Plain

Presence: ✓ none; indefinite; fragmentary; continuous

Extent: ✓ none; average width _____ m; maximum width _____ m; aerial length 4579 m; area _____ ha

Vegetation: almost none; grass; ✓ reed swamp* _____ % area; sparsely forested; moderately forested; heavily forested

Forest Type: not known/applicable; ✓ riverine: ✓ main channel ✓ tributaries; mangroves

Land-Use: ✓ not cultivated, not built-up**; cultivated _____ % area; crop/s _____; partly built-up; mainly built-up

Comments * ≈ 80 ha

** River bank stage

Channel Description N.B. Estimate of flow stage: LOW/NEAR LONG-TERM MEAN/HIGH

Pattern: straight; ✓ sinuous; irregular; regular meanders; irregular meanders; tortuous meanders; bifurcated; lake/s; lagoon

Measurements:

thalweg	5082	m	
*sinuosity	1,11		
*open water area	48,6	ha	
perimeter	10420	m	
lake/lagoon area	_____	ha	
river X-sections available			
channel slope _	_____		
channel width x	_____	m	s = _____ m
river slope _	_____		
river width x	91,2	m	s = 44,4 m

~~*Islands~~/*Shoals*: none; ✓ occasional**; frequent; split; braided

Type of Flow: stagnant/still; ✓ uniform water surface; uniform with rapid in reach; irregular; pool & riffle sequence; turbid

Bar Type: none; ✓ channel side bars; point bars; ✓ channel junction bars; mid-channel bars; diamond bars; diagonal bars; sand waves/large dunes

Comments *whole reach

** near mouth

Obstructions/Constructions

Natural _____ *Degree*: ✓ none; logs; boulders; vegetation — ✓ none; minor; major

Comments _____

Man-made NONE *Degree of Obstruction/Constriction for Each* — *Position (from head of reach)*

road bridge/s _____
rail bridge/s _____
causeway _____
weir/dam _____
fish traps _____
embankment/s _____
groynes _____
canals _____
drainage furrows _____
others _____

Lateral Channel Activity

Lateral Activity: ✓ not detectable; downstream progression; progression & cut-offs; mainly cut-offs; entrenched loop development; irregular lateral activity; avulsion

Nature of Banks: ✓ alluvium (silt/sand); natural levées; rock/boulders; protected/stabilized; cultivation to channel edge

Bank Vegetation: none; weak; ✓ good; very strong; left bank 85 %; right bank 60 %

Lateral Stability: ✓ stable; slightly unstable; moderately unstable; unstable; highly unstable

Comments _____

TABLE NS1/V — CLASSIFICATION OF THE LOWER REACHES OF NATAL RIVERS — NRIO NS 1

RIVER MTAMVUNA, 100 % ESTUARINE, REACH from 250m d/s rapids, 5,3 km from mouth. REF. DEA T401a

AERIAL PHOTO DATE 5-5-63 SCALE 1:10 000 CATCHMENT AREA 1553 km², M.A.R. 303,78 m³x10⁶, No. of DAMS NIL

RIVER VALLEY AND RIVER MOUTH FEATURES

General Description of the Terrain above the Valley

Terrain
- mountainous
- ✓ hilly
- undulating plains

Vegetation
- almost none
- ✓ grass
- ✓ sparsely forested (0-25%)
- moderately forested (25-75%)
- heavily forested (75-100%)
- swamp/bog

Land-Use
- none
- ✓ scattered cultivation
- partly cultivated
- mainly cultivated
- ✓ scattered settlement
- partly built-up
- urbanised

Valley Sides (Not Well-defined)

Slumping
- ✓ none
- occasional
- frequent

Vegetation and Land-Use

	Left	Right
coastal dune	1	1 %
grass	6	37 %
trees/bush	92	62 %
cultivated	NIL	NIL %
built-up	1	NIL %

Comments _____

Valley Characteristics

Measurements
- valley length ____ m
- bottom width(av.) ____ m
- valley slope ____
- height at head of reach ____ m to MSL

Terraces
- ✓ none
- indefinite
- fragmentary
- continuous

Relation of Channel to Valley Bottom (Vertical)
- not applicable
- not obviously degrading or aggrading
- partly entrenched
- ✓ entrenched
- aggrading

Relation of Channel to Valley Sides or Resistant Terraces (Lateral)
- not applicable (no valley or free)
- occasionally confined
- ✓ frequently confined
- entrenched

Surface Geology
- bedrock
- lacustrine deposits
- ✓ fluvial deposits
- aeolian
- sand covered ____ % area

Comments _____

River Mouth

Characteristics
- ✓ open/~~closed~~
- ✓ natural/~~artificial~~
- canalized
- ✓ sandy
- ✓ rocks on right bank
- rocks on left bank
- outer bar
- ? silt plume (fluvial)
- ✓ suspended sediment (marine)

Measurements
- right bank breakwater length ____ m
- left bank breakwater length ____ m
- rock sill level ____ m to MSL
- cliffs on right bank: height ____ m to MSL
- cliffs on left bank: height ____ m to MSL
- spit/~~bar~~: direction of growth 217 °
  - length of spit/~~bar~~ 540 m
  - length stabilized NIL m
  - width 77 m

Comments _____

FLOOD PLAIN AND CHANNEL FEATURES

Description of Flood Plain

Presence
- ✓ none
- indefinite
- fragmentary
- continuous

Extent
- ✓ none
- average width ____ m
- maximum width ____ m
- aerial length 4722 m
- area ____ ha

Vegetation
- almost none
- grass
- ✓ reed swamp* ____ % area
- sparsely forested
- moderately forested
- heavily forested

Forest Type
- not known/applicable
- ✓ riverine:
- ✓ main channel
- ✓ tributaries
- mangroves

Land-Use
- ✓ not cultivated, not built-up**
- cultivated ____ % area
- crop/s ____
- partly built-up
- mainly built-up

Comments * ≈10,2ha

** River bank areas

Channel Description

N.B. Estimate of flow stage: LOW/NEAR LONG-TERM MEAN/HIGH

Pattern
- straight
- ✓ sinuous
- irregular
- regular meanders
- irregular meanders
- tortuous meanders
- bifurcated
- lake/s
- lagoon

Measurements

thalweg	5333	m
*sinuosity	1,13	
*open water area	49,7	ha
perimeter	10420	m
lake/lagoon area	____	ha
river X-sections available		
channel slope		
channel width $\bar{x}$	____	m s = ____ m
river slope		
river width $\bar{x}$	94,7	m s = 51,0 m

~~Islands~~/Shoals
- none
- ✓ occasional**
- frequent
- split
- braided

Type of Flow
- stagnant/still
- ✓ uniform water surface
- uniform with rapid in reach
- irregular
- pool & riffle sequence
- turbid

Bar Type
- none
- ✓ channel side bars
- point bars
- ✓ channel junction bars
- mid-channel bars
- diamond bars
- diagonal bars
- sand waves/large dunes

Comments *whole reach

** near mouth

Obstructions/Constructions

Natural — *Degree*
- ✓ none — ✓ none
- logs — minor
- boulders — major
- vegetation

Comments _____

Man-made NONE — *Degree of Obstruction/Constriction for Each* — *Position (from head of reach)*
- road bridge/s
- rail bridge/s
- causeway
- weir/dam
- fish traps
- embankment/s
- groynes
- canals
- drainage furrows
- others

Lateral Channel Activity

Lateral Activity
- ✓ not detectable
- downstream progression
- progression & cut-offs
- mainly cut-offs
- entrenched loop development
- irregular lateral activity
- avulsion

Nature of Banks
- ✓ alluvium (silt/sand)
- natural levées
- rock/boulders
- protected/stabilized
- cultivation to channel edge

Bank Vegetation
- none
- weak
- ✓ good
- very strong
- left bank 82 %
- right bank 60 %

Lateral Stability
- ✓ stable
- slightly unstable
- moderately unstable
- unstable
- highly unstable

Comments _____

TABLE NS1/VI — CLASSIFICATION OF THE LOWER REACHES OF NATAL RIVERS — NRIO NS 1

RIVER MTAMVUNA, _____ % ESTUARINE, REACH from 250m d/s rapids, 5,0 km from mouth. REF. DEA T401a

AERIAL PHOTO DATE 11-6-66 SCALE 1:10000 CATCHMENT AREA 1553 km², M.A.R. 303,78 $m^3 \times 10^6$, No. of DAMS NIL

RIVER VALLEY AND RIVER MOUTH FEATURES

General Description of the Terrain above the Valley

Terrain	*Vegetation*	*Land-Use*
mountainous	almost none	none
✓ hilly	✓ grass	✓ scattered cultivation
undulating	✓ sparsely forested (0-25%)	partly cultivated
plains	moderately forested (25-75%)	mainly cultivated
	heavily forested (75-100%)	✓ scattered settlement
	swamp/bog	partly built-up
		urbanised

Valley Sides (Not Well-defined)

Slumping	*Vegetation and Land-Use*	*Left*	*Right*
✓ none	coastal dune	1	1 %
occasional	grass	6	39 %
frequent	trees/bush	92	60 %
	cultivated	NIL	NIL %
	built-up	1	NIL %

Comments _____

Valley Characteristics

Measurements

valley length _____ m
bottom width(av.) ____ m
valley slope _____
height at head of reach ____ m to MSL

Terraces

✓ none
indefinite
fragmentary
continuous

Relation of Channel to Valley Bottom (Vertical)

not applicable
not obviously degrading or aggrading
partly entrenched
✓ entrenched
aggrading

Relation of Channel to Valley Sides or Resistant Terraces (Lateral)

not applicable (no valley or free)
occasionally confined
✓ frequently confined
entrenched

Surface Geology

bedrock
lacustrine deposits
✓ fluvial deposits
aeolian
sand covered ____ % area

Comments _____

River Mouth

Characteristics

✓ open/~~closed~~
✓ natural/~~artificial~~
canalized
✓ sandy
✓ rocks on right bank
rocks on left bank
outer bar
silt plume (fluvial)
✓ suspended sediment (marine)

Measurements

right bank breakwater length _____ m
left bank breakwater length _____ m
rock sill level _____ m to MSL
cliffs on right bank: height _____ m to MSL
cliffs on left bank: height _____ m to MSL
spit/~~bar~~: direction of growth 232 °
length of spit/~~bar~~ 260 m
length stabilized NIL m
width 126 m

Comments _____

FLOOD PLAIN AND CHANNEL FEATURES

Description of Flood Plain

Presence

✓ none
indefinite
fragmentary
continuous

Extent

✓ none
average width _____ m
maximum width _____ m
aerial length 4538 m
area _____ ha

Vegetation

almost none
grass
✓ reed swamp* _____ % area
sparsely forested
moderately forested
heavily forested

Forest Type

not known/applicable
✓ riverine:
✓ main channel
✓ tributaries
mangroves

Land-Use

✓ not cultivated, not built-up**
cultivated _____ % area
crop/s _____
partly built-up
mainly built-up

Comments * = 10,3 ha
** River bank areas

Channel Description

N.B. Estimate of flow stage: LOW/NEAR LONG-TERM MEAN/HIGH

Pattern

straight
✓ sinuous
irregular
regular meanders
irregular meanders
tortuous meanders
bifurcated
lake/s
lagoon

Measurements

thalweg 5023 m
*sinuosity 1,11
*open water area 46,0 ha
perimeter 9980 m
lake/lagoon area _____ ha
river X-sections available
channel slope _____
channel width $\bar{x}$ _____ m s = _____ m
river slope _____
river width $\bar{x}$ 89,2 m s = 42,3 m

~~Islands~~/Shoals

none
✓ occasional**
frequent
split
braided

Type of Flow

stagnant/still
✓ uniform water surface
uniform with rapid in reach
irregular
pool & riffle sequence
turbid

Bar Type

none
✓ channel side bars
point bars
✓ channel junction bars
mid-channel bars
diamond bars
diagonal bars
sand waves/large dunes

Comments *whole reach
** near mouth

Obstructions/Constructions

Natural — *Degree*

✓ none — ✓ none
logs — minor
boulders — major
vegetation

Comments _____

Man-made — *Degree of Obstruction/Constriction for Each* — *Position (from head of reach)*

road bridge/s Suspension Br. R. confined 4,2
rail bridge/s
causeway
weir/dam
fish traps
embankment/s
groynes
canals
drainage furrows
others

Lateral Channel Activity

Lateral Activity

✓ not detectable
downstream progression
progression & cut-offs
mainly cut-offs
entrenched loop development
irregular lateral activity
avulsion

Nature of Banks

✓ alluvium (silt/sand)
natural levées
rock/boulders
protected/stabilized
cultivation to channel edge

Bank Vegetation

none
weak
✓ good
very strong
left bank 95 %
right bank 75 %

Lateral Stability

✓ stable
slightly unstable
moderately unstable
unstable
highly unstable

Comments _____

TABLE NS1/VII — CLASSIFICATION OF THE LOWER REACHES OF NATAL RIVERS — NRIO NS 1

RIVER MTAMVUNA, 100 % ESTUARINE, REACH from 250m d/s rapids, 5,0 km from mouth. REF. DEA T 401a

AERIAL PHOTO DATE 23-6-76 SCALE 1:10 000 CATCHMENT AREA 1553 km², M.A.R. 303,78 m³x10⁶, No. of DAMS NIL (orthophoto)

RIVER VALLEY AND RIVER MOUTH FEATURES

General Description of the Terrain above the Valley

Terrain	*Vegetation*	*Land-Use*
mountainous	almost none	none
✓ hilly	✓ grass	✓ scattered cultivation
undulating	✓ sparsely forested (0-25%)	partly cultivated
plains	moderately forested (25-75%)	mainly cultivated
	heavily forested (75-100%)	✓ scattered settlement
	swamp/bog	partly built-up
		urbanised

Valley Sides (Not Well-defined)

Slumping	*Vegetation and Land-Use*	*Left*	*Right*
✓ none	coastal dune	1 %	1 %
occasional	grass	6 %	39 %
frequent	trees/bush	92 %	60 %
	cultivated	NIL %	NIL %
	built-up	1 %	NIL %

Comments

Valley Characteristics

Measurements

valley length 4780 m
bottom width(av.) 244 m
valley slope ≐1:1593
height at head of reach +3 m to MSL approx.

Terraces

✓ none
indefinite
fragmentary
continuous

Relation of Channel to Valley Bottom (Vertical)

not applicable
not obviously degrading or aggrading
partly entrenched
✓ entrenched
aggrading

Relation of Channel to Valley Sides or Resistant Terraces (Lateral)

not applicable (no valley or free)
occasionally confined
✓ frequently confined
entrenched

Surface Geology

bedrock
lacustrine deposits
✓ fluvial deposits
aeolian
sand covered ____ % area

Comments

River Mouth

Characteristics

✓ open/~~closed~~
✓ natural/~~artificial~~
canalized
✓ sandy
✓ rocks on right bank
rocks on left bank
outer bar
✓? silt plume (fluvial)
suspended sediment (marine)

Measurements

right bank breakwater length ____ m
left bank breakwater length ____ m
rock sill level ____ m to MSL
cliffs on right bank: height ____ m to MSL
cliffs on left bank: height ____ m to MSL
spit/~~bar~~: direction of growth 230 °
length of spit/~~bar~~ 350 m
length stabilized NIL m
width 107 m

Comments

FLOOD PLAIN AND CHANNEL FEATURES

Description of Flood Plain

Presence

✓ none
indefinite
fragmentary
continuous

Extent

✓ none
average width ____ m
maximum width ____ m
aerial length 4529 m
area ____ ha

Vegetation

almost none
grass
✓ reed swamp * ____ % area
sparsely forested
moderately forested
heavily forested

Forest Type

not known/applicable
✓ riverine:
✓ main channel
✓ tributaries
mangroves

Land-Use

✓ not cultivated, not built-up**
cultivated ____ % area
crop/s ____
partly built-up
mainly built-up

Comments * ≐11,0 ha
**

Channel Description

N.B. Estimate of flow stage: LOW/NEAR LONG-TERM MEAN/HIGH

Pattern

straight
✓ sinuous
irregular
regular meanders
irregular meanders
tortuous meanders
bifurcated
lake/s
lagoon

Measurements

thalweg 5017 m
*sinuosity 1,11
*open water area 49,4 ha
perimeter 10050 m
lake/lagoon area ____ ha
river X-sections available
channel slope ____
channel width $\bar{x}$ ____ m s = ____ m
river slope ____
river width $\bar{x}$ 91,9 m s = 46,6 m

~~*Islands~~/Shoals

none
✓ occasional**
frequent
split
braided

Type of Flow

stagnant/still
✓ uniform water surface
uniform with rapid in reach
irregular
pool & riffle sequence
turbid

Bar Type

none
✓ channel side bars
point bars
✓ channel junction bars
mid-channel bars
diamond bars
diagonal bars
sand waves/large dunes

Comments *whole reach
** near mouth

Obstructions/Constructions

Natural	*Degree*
✓ none	✓ none
logs	minor
boulders	major
vegetation	

Comments

Man-made	*Degree of Obstruction/Constriction for Each*	*Position (from head of reach)*
road bridge/s	Suspension Br. R. confined	4,2 km
rail bridge/s		
causeway		
weir/dam		
fish traps		
embankment/s		
groynes		
canals		
drainage furrows		
others		

Lateral Channel Activity

Lateral Activity

✓ not detectable
downstream progression
progression & cut-offs
mainly cut-offs
entrenched loop development
irregular lateral activity
avulsion

Nature of Banks

✓ alluvium (silt/sand)
natural levées
rock/boulders
protected/stabilized
cultivation to channel edge

Bank Vegetation

none
weak
✓ good
very strong
left bank 95 %
right bank 78 %

Lateral Stability

✓ stable
slightly unstable
moderately unstable
unstable
highly unstable

Comments

TABLE NS1/VIII RIVER WIDTHS

MTAMVUNA NS 1

Station	Approx distance along mid-channel from 250 m d/s rapids	River widths (in metres) Date						$\bar{x}$	s	V%
		2-5-37	Dec.1943	16-8-52	5-5-63	11-6-66	23-6-76			
	(m)									
1	0	35	35*	35*	35	40*	40	36,7	2,6	7,0
2	310	65	65*	65*	65	67*	67	65,7	1,0	1,6
3	620	40	35	35	35	35*	35	35,8	2,0	5,7
4	930	95	87	65	65	68*	68	74,7	13,0	17,4
5	1 240	114	110	85	72	70*	70	86,8	20,3	23,4
6	1 550	125	78	90	75	75*	69	85,3	20,6	24,2
7	1 860	135	110	100	100	82	82	101,5	19,8	19,5
8	2 170	145	138	125	100	106	100	119,0	19,8	16,7
9	2 490 (d/s pont)	110	105	85	95	95	85	95,8	10,2	10,7
10	2 790	125	119	105	105	108	105	111,2	8,7	7,8
11	3 100	140	105	115	120	115	100	115,8	13,9	12,0
12	3 410	78**	65**	60**	60**	60**	60**	63,8	7,2	11,3
13	3 720	150	148	135	138	130	145	141,0	7,9	5,6
14	4 030	194	175	185	174	170	160	176,3	11,8	6,7
15	4 340	150	155	165	150	145	168	155,5	9,1	5,9
16	4 650	216	155	75	205	140	180	161,8	51,4	31,7
17	≃ 4 960(nr.mouth)	25	45	25	15	15	28	25,5	11,0	43,2
$\bar{x}$		114,3	101,8	91,2	94,7	89,5	91,9	97,2		14,7
s		53,3	43,7	44,4	51,0	42,2	46,6			
V%		46,6	43,0	48,7	53,8	47,2	50,7			

*: estimate (out of photo range) **: estimate (shadow cast by trees on cliffs on L.B.)

TABLE NS1/ IX LATERAL STABILITY

MTAMVUNA NS 1

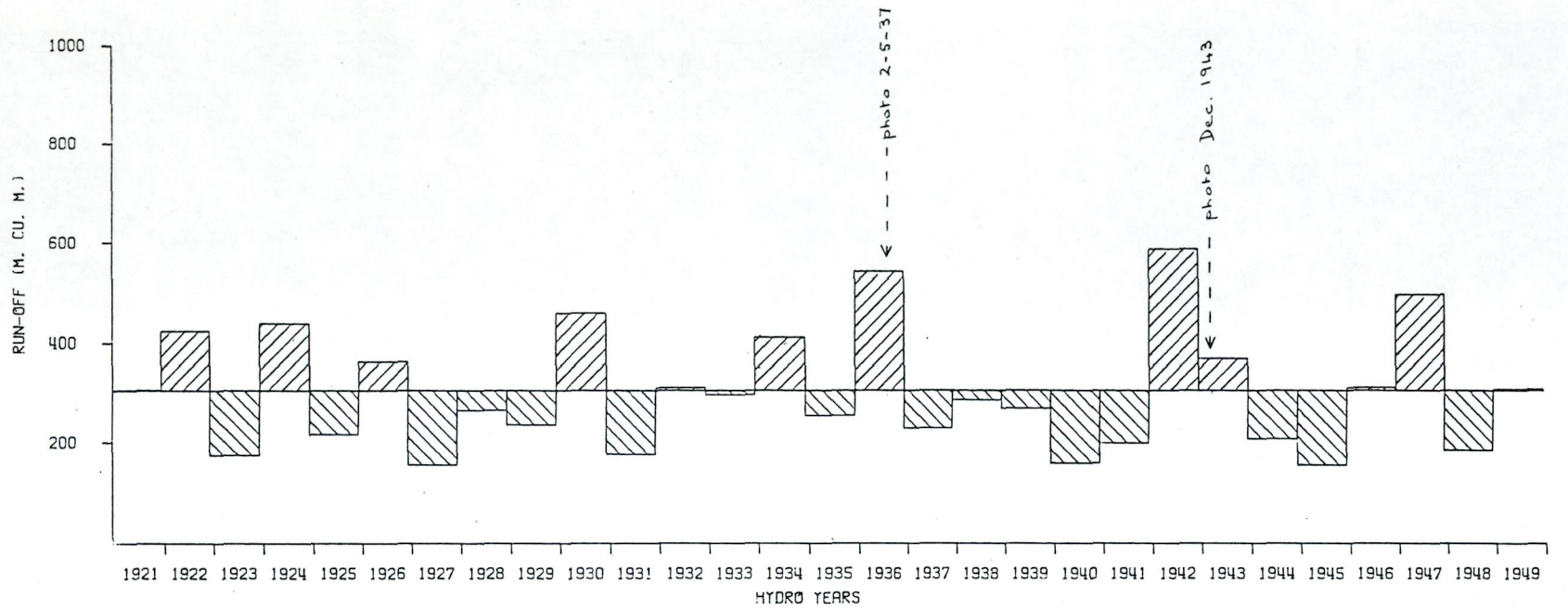
Station	Approx. distance along mid-channel from 250 m d/s rapids	Distance from maximum observed L.B. position to mid-channel						Max-Min	$\bar{x}$	s	V%
		Date									
		2-5-37	Dec.1943	16-8-52	5-5-63	11-6-66	23-6-76				
1	0	22,5	22,5	22,5	22,5	20,0	20,0	2,5	21,7	1,3	6,0
2	310	32,5	32,5	32,5	32,5	33,5	33,5	1,0	32,8	0,5	1,6
3	620	20,0	17,5	17,5	17,5	17,5	17,5	2,5	17,9	1,0	5,7
4	930	47,5	43,5	32,5	32,5	34,0	34,0	15,0	37,3	6,5	17,4
5	1 240	57,0	60,0	57,5	61,0	65,0	65,0	8,0	60,9	3,5	5,7
6	1 550	62,5	85,0	70,0	87,5	82,5	84,5	25,0	78,7	10,0	12,8
7	1 860	67,5	62,0	55,0	68,0	65,0	70,0	15,0	64,6	5,4	8,4
8	2 170	72,5	74,0	67,0	68,0	63,0	70,0	11,0	69,1	4,0	5,8
9	2 490 (d/s pont)	55,0	57,5	47,5	57,5	47,5	47,5	10,0	52,1	5,1	9,8
10	2 790	62,5	65,0	57,5	58,5	54,0	57,5	11,0	59,2	4,0	6,7
11	3 100	70,0	80,5	67,5	70,0	62,5	62,0	18,5	68,8	6,7	9,8
12	3 410	40,0	37,5	30,0	40,0	30,0	30,0	10,0	34,6	5,1	14,8
13	3 720	75,0	74,0	67,5	69,0	65,0	72,5	10,0	70,5	4,0	5,6
14	4 030	100,0	92,5	92,5	90,0	90,0	92,0	10,0	92,8	3,7	4,0
15	4 340	90,0	92,5	82,5	75,0	72,5	84,0	20,0	82,8	7,9	9,6
16	4 650	108,0	128,0	122,7	147,5	120,0	135,0	39,5	126,9	13,5	10,7
17	≃ 4 960 (nr.mouth)	105,0	115,0	65,0	95,0	7,5	102,0	107,5	81,6	40,1	49,1
$\bar{x}$		64,0	67,0	58,1	64,2	54,7	63,4	18,6			10,8
s		26,8	30,8	26,9	31,5	28,9	31,3	24,7			10,7
V%		41,8	45,9	46,2	49,1	52,9	49,3	132,8			98,7

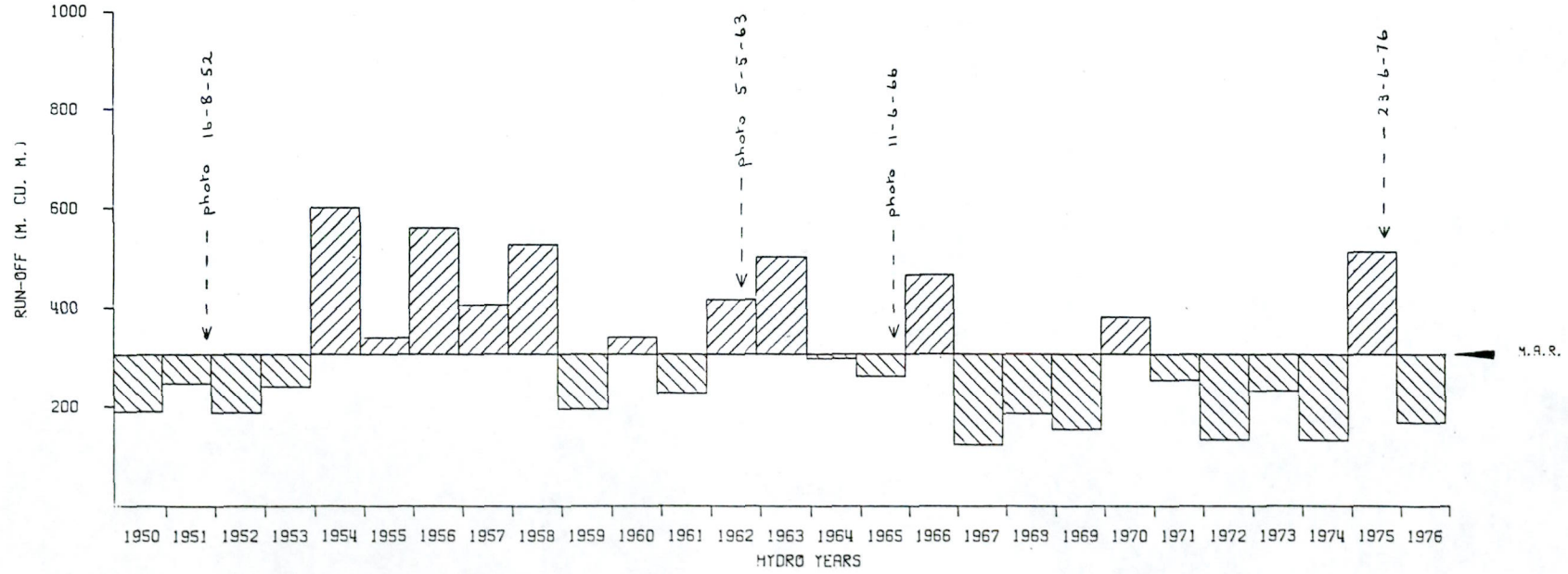
Average lateral displacement 1937-76 = 18,6 m Average V 1937-76 = 10,8%

TABLE NS 1/X SIMULATED RUN-OFF FOR MTAMVUNA NS 1 CATCHMENT AREA= 1553.0SQ.KM.

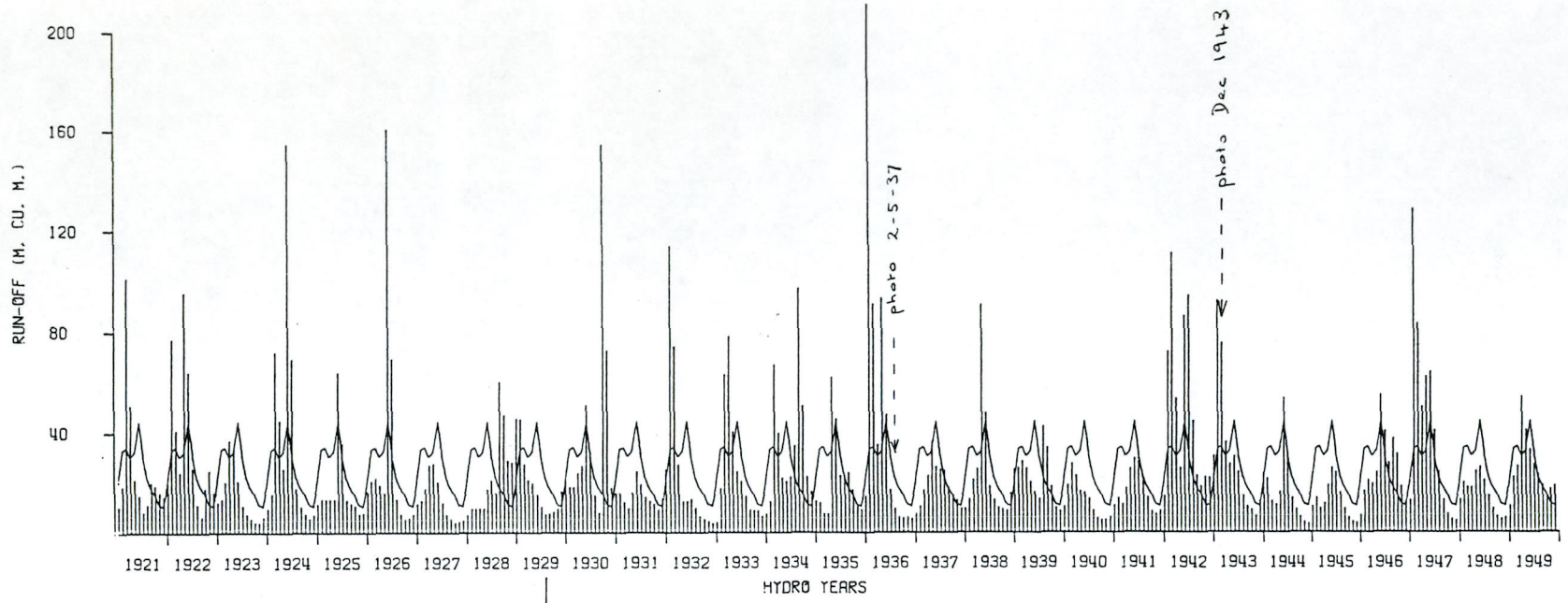
YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL	%M.A.R.
1921	10.58	18.48	101.06	50.27	21.18	14.97	8.30	11.44	20.08	18.80	16.00	14.42	305.60	100.60
1922	19.77	76.80	40.54	24.11	95.37	63.72	25.86	11.29	6.57	17.86	24.78	16.21	422.87	139.20
1923	12.16	13.57	20.35	36.53	33.25	20.55	10.93	7.37	5.63	4.24	4.05	6.27	174.90	57.58
1924	10.06	15.61	71.58	44.46	25.49	154.17	68.86	17.59	10.36	7.44	5.60	7.22	438.44	144.33
1925	11.56	13.70	13.49	13.49	13.48	63.56	35.51	13.24	11.75	11.03	7.60	7.99	216.42	71.24
1926	16.63	20.65	21.84	19.19	16.04	160.20	68.82	13.45	7.45	5.34	5.91	7.31	362.81	119.43
1927	11.60	13.05	17.65	26.96	27.52	20.32	12.00	7.36	5.54	4.21	4.30	4.89	155.39	51.15
1928	7.21	9.89	9.78	10.04	9.85	17.45	20.90	16.13	59.74	46.61	28.70	28.05	264.36	87.02
1929	45.48	45.23	27.34	21.13	19.90	15.31	10.48	7.35	7.81	8.34	9.80	16.66	234.83	77.30
1930	21.01	18.32	18.34	23.72	26.70	50.59	32.41	15.09	7.95	154.03	72.25	17.89	458.30	150.86
1931	16.19	16.19	12.38	9.97	16.23	24.30	19.37	14.35	12.95	11.60	9.23	13.80	176.55	58.12
1932	25.21	113.53	74.02	27.18	12.55	12.99	13.71	10.17	6.87	5.43	4.39	3.80	309.85	102.00
1933	4.17	17.59	62.64	78.01	39.82	24.32	20.44	14.60	9.14	8.99	8.79	6.67	295.18	97.17
1934	7.53	12.54	66.47	39.44	21.85	20.48	22.46	34.50	96.97	50.08	22.34	16.48	411.14	135.34
1935	12.89	11.92	7.80	7.46	61.42	45.02	22.80	22.67	23.88	17.27	10.82	9.24	253.19	83.35
1936	14.66	210.35	90.51	34.82	92.83	46.75	17.21	9.86	6.30	6.03	6.18	5.57	541.09	178.12
1937	7.65	10.78	17.17	23.05	36.34	26.46	25.28	24.64	18.27	15.40	13.16	9.82	228.01	75.06
1938	10.04	13.42	21.08	25.57	90.29	47.42	18.51	13.32	10.25	9.37	8.90	16.05	284.23	93.56
1939	25.24	25.72	28.38	25.62	20.35	16.33	13.76	42.02	33.61	18.40	10.22	8.50	268.15	88.27
1940	10.56	19.18	27.49	22.87	16.87	16.12	13.71	8.87	5.81	5.03	5.26	6.30	158.08	52.04
1941	11.01	13.95	11.55	17.84	25.48	29.47	28.03	21.80	14.17	8.46	7.46	8.84	198.06	65.20
1942	14.61	71.74	110.79	52.94	25.82	86.00	94.06	44.12	22.91	18.63	22.39	21.80	585.81	192.84
1943	30.47	91.98	75.01	35.87	27.31	30.22	24.17	14.76	10.53	9.20	6.98	12.72	369.21	121.54
1944	23.60	21.45	12.58	11.31	16.57	53.23	31.56	13.86	9.21	6.20	4.21	3.38	207.14	68.19
1945	10.57	13.83	9.68	11.65	19.02	25.78	23.90	16.20	9.62	6.15	4.26	4.11	154.77	50.95
1946	7.28	16.95	21.01	19.73	23.90	54.56	40.02	27.51	37.04	31.05	18.44	12.09	309.59	101.91
1947	13.12	128.32	83.09	49.62	61.70	63.53	40.36	24.29	13.28	7.54	5.45	4.78	495.07	162.97
1948	13.19	20.11	18.03	18.02	24.42	26.19	20.85	14.80	9.63	6.70	5.39	6.00	183.32	60.34
1949	10.82	22.04	26.47	53.62	40.56	32.91	27.16	23.37	18.89	14.58	17.43	18.56	306.41	100.87
1950	16.50	15.22	34.34	31.87	23.59	19.80	14.47	9.19	6.45	4.74	5.02	7.53	188.72	62.12
1951	19.34	22.32	22.85	46.72	38.83	25.45	18.69	16.46	12.35	8.85	6.46	6.71	245.03	80.66
1952	8.01	11.14	15.91	22.61	46.29	31.02	17.43	11.38	6.85	4.44	4.39	6.97	186.44	61.37
1953	15.18	26.34	31.95	29.91	28.19	27.30	20.25	16.72	15.35	11.23	7.54	8.36	238.33	78.46
1954	132.82	65.89	22.70	106.69	132.85	56.85	25.70	18.10	13.58	10.14	6.66	8.64	600.64	197.72
1955	14.53	23.48	25.18	14.59	16.71	96.94	68.21	31.21	17.97	11.73	8.56	8.95	338.05	111.28
1956	16.58	84.66	148.99	63.77	27.11	60.03	65.41	34.66	17.50	11.65	9.25	19.94	559.53	184.19
1957	67.58	61.82	32.13	38.81	71.22	40.59	31.05	25.11	13.74	8.74	6.83	6.21	403.83	132.93
1958	7.94	19.59	30.84	27.54	22.01	19.19	17.29	236.16	98.08	19.13	14.72	13.00	525.50	172.98
1959	14.38	18.59	19.77	18.32	17.36	18.94	21.98	21.72	15.94	10.25	7.77	8.89	193.91	63.83
1960	12.41	18.59	27.46	36.66	27.64	26.11	96.85	48.41	15.77	11.71	9.54	8.07	339.24	111.67
1961	8.54	14.53	20.12	20.48	23.82	58.52	34.34	15.98	10.42	6.70	5.97	6.17	225.60	74.26
1962	11.49	19.73	21.48	40.15	30.09	151.78	67.47	16.63	10.06	15.30	18.03	12.37	414.57	136.47
1963	18.06	50.53	66.31	108.91	50.60	24.67	23.46	17.72	68.58	42.45	17.93	11.92	501.14	164.97
1964	71.94	41.15	17.08	16.58	17.65	12.68	7.98	7.35	18.99	29.41	28.79	24.80	294.39	96.91
1965	38.56	57.72	32.76	23.47	21.11	11.93	6.40	13.50	19.09	14.25	9.81	10.41	259.02	85.27
1966	11.92	14.04	15.87	20.89	32.64	139.01	129.15	47.17	17.95	15.74	12.99	8.09	465.47	153.22
1967	7.92	13.77	14.94	11.97	10.52	12.15	13.69	10.85	6.68	4.49	5.73	10.15	122.88	40.45
1968	14.37	15.95	14.37	9.84	12.30	23.55	24.63	22.48	18.39	12.14	8.71	8.33	185.06	60.92
1969	13.15	21.13	23.39	18.29	13.69	9.10	5.28	5.63	8.42	8.44	10.57	16.07	153.15	50.41
1970	81.32	49.98	42.03	33.99	26.98	22.31	19.13	21.20	18.63	16.56	23.28	24.01	379.41	124.90
1971	52.45	37.33	23.98	20.24	36.84	28.84	16.01	9.67	7.68	7.01	6.06	5.27	251.38	82.75
1972	5.94	15.20	21.30	16.90	15.11	15.34	12.56	8.24	4.95	3.64	4.25	8.59	132.03	43.46
1973	12.42	14.54	12.07	12.78	20.60	32.46	28.83	29.13	28.50	19.94	11.38	6.55	229.18	75.44
1974	5.85	10.89	16.37	18.32	19.51	17.84	13.19	8.55	5.65	4.19	3.53	7.89	131.76	43.37
1975	12.34	12.43	16.57	32.36	56.73	221.29	91.27	25.50	18.06	11.12	7.11	7.35	512.11	168.58
1976	20.84	26.21	22.21	20.29	17.64	14.66	11.07	8.15	6.70	5.59	5.15	8.12	166.64	54.86
MEAN	20.49	33.57	34.13	30.31	32.50	44.31	30.59	22.37	18.12	15.42	11.36	10.62	303.78	
S	22.19	36.01	29.17	20.86	24.19	43.55	25.90	30.87	19.40	21.34	10.51	5.64	131.95	
V%	108.31	107.29	85.47	68.83	74.43	98.28	84.65	137.96	107.11	138.38	92.51	53.06	43.44	
MEDIAN	13.12	18.59	22.21	23.47	24.42	26.19	21.98	15.98	12.35	10.14	7.77	8.50	264.36	

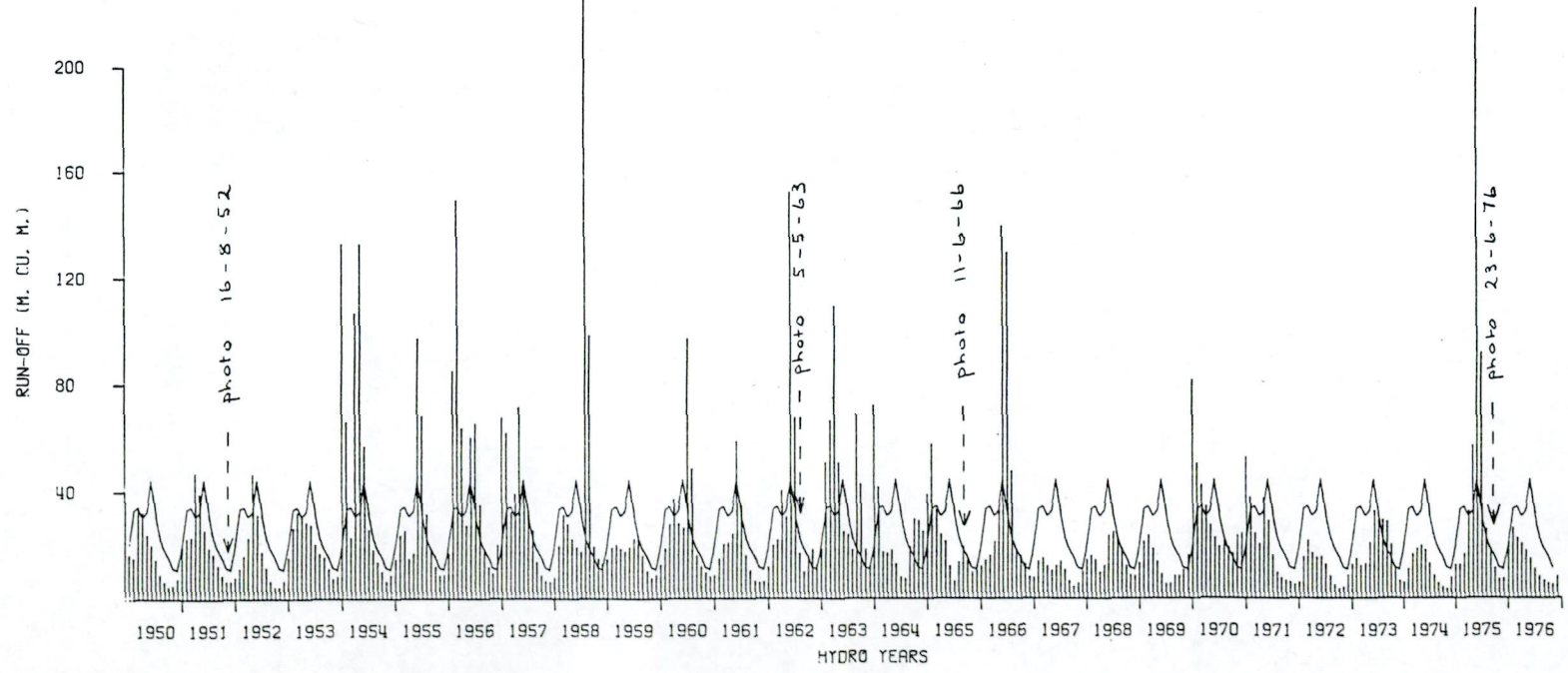
MEAN ANNUAL RUN-OFF= 303.78 MILLION CUBIC METRES. COMPILED FROM HRU REPORT NO.12/81 DATA





TRACED : COMPLOT CHECKED: DATE : REF. :	NATAL ESTUARIES : MTAMVUNA SIMULATED ANNUAL RUN-OFF 1921-1976	FIGURE NS1/1





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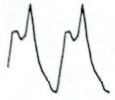
NATAL ESTUARIES : MTAMVUNA

SIMULATED MONTHLY RUN-OFF
1921-1976

FIGURE
NS1/2



MONTHLY MEANS

TRACED : COMPLOT
CHECKED:
DATE :
REF. :

NATAL ESTUARIES: MTAMVUNA

CUMULATIVE ANNUAL RUN-OFF

FIGURE
NS 1/3

Envelope of Mobility & Lines of Measurement
(superimposed on 23-6-76 orthophoto

Photograph
NS1/1

Scale 1:20200 approx