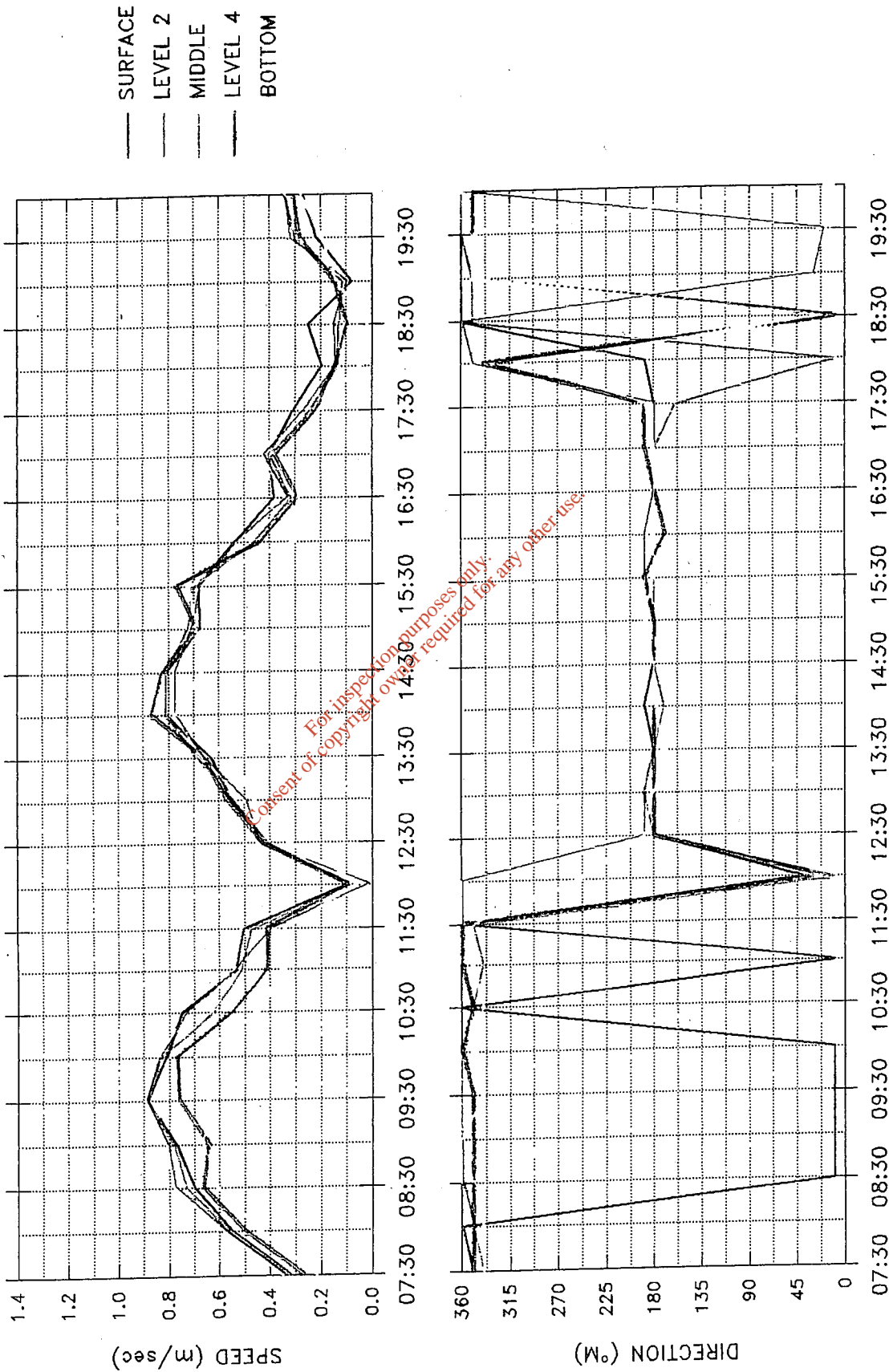


MIDDLETON SEWERAGE SCHEME

CURRENT SPEED AND DIRECTION IN EAST CHANNEL OFF RATHCOURSE.. 25/AUG/'93



NOTE : Fixed station performed by IHD. TIME (hrs BST)

Figure 2.3 Fixed Station Data

MIDLETON SEWERAGE SCHEME OUTFALL STUDY 1993

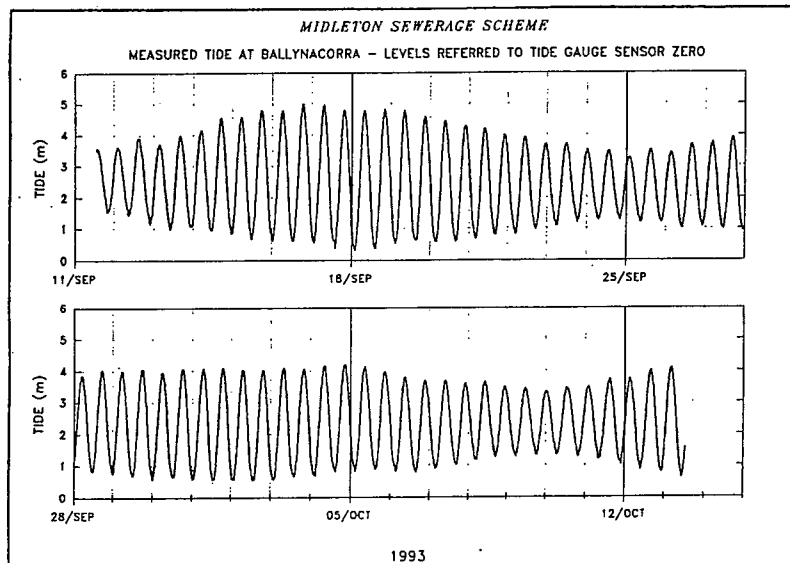
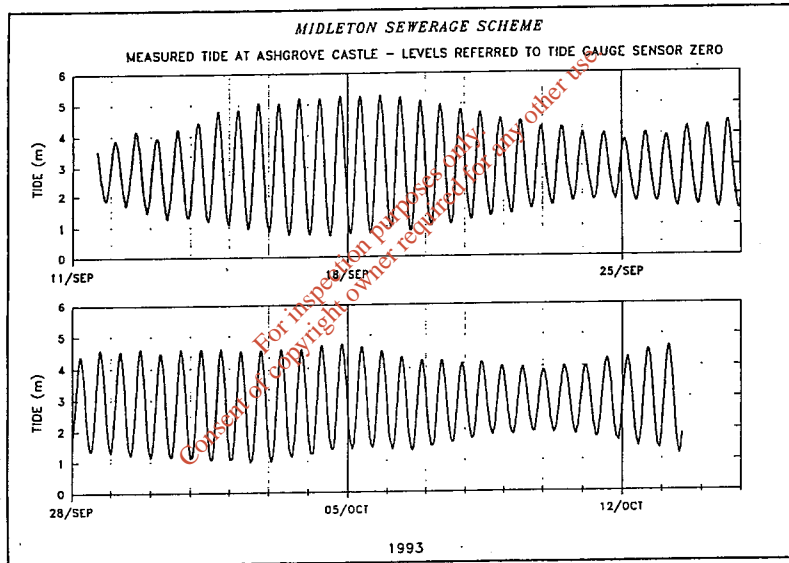
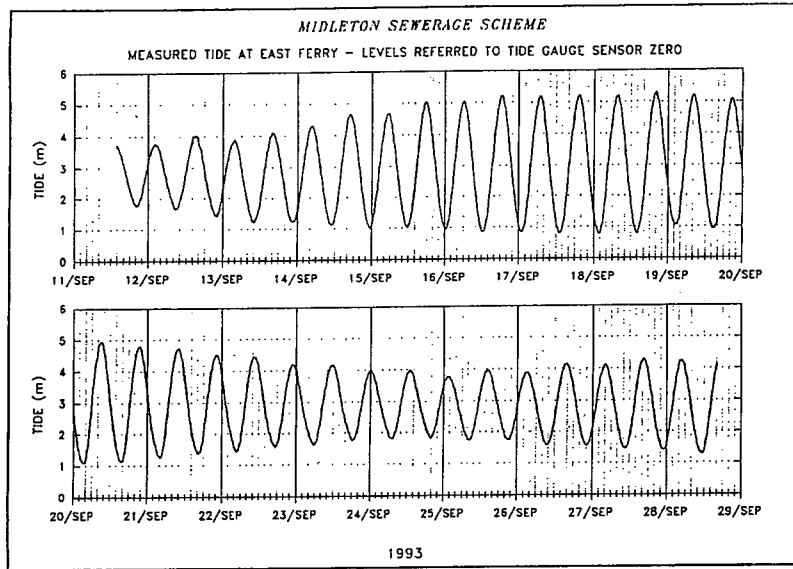


Figure 2.4 Tidal Data

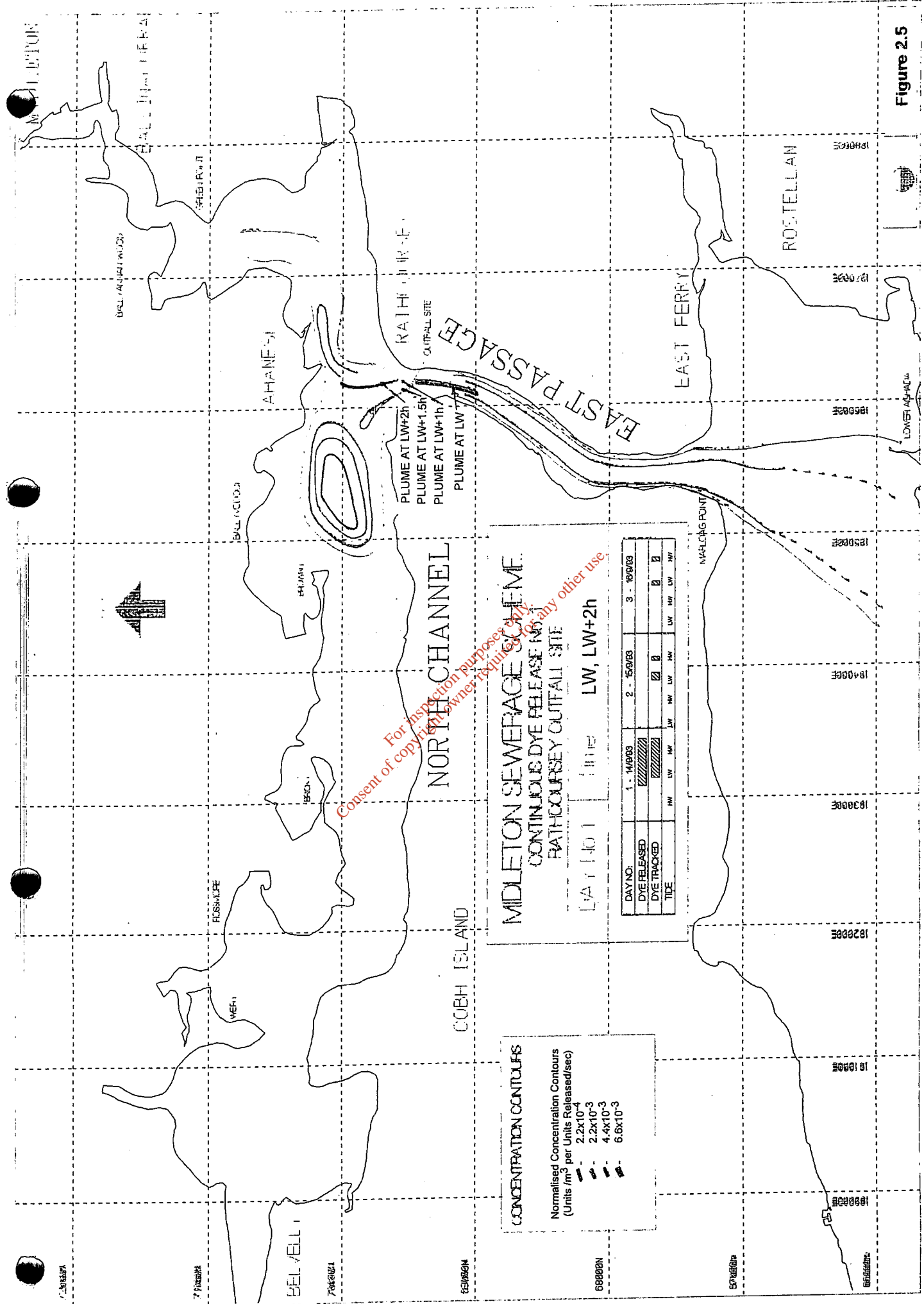


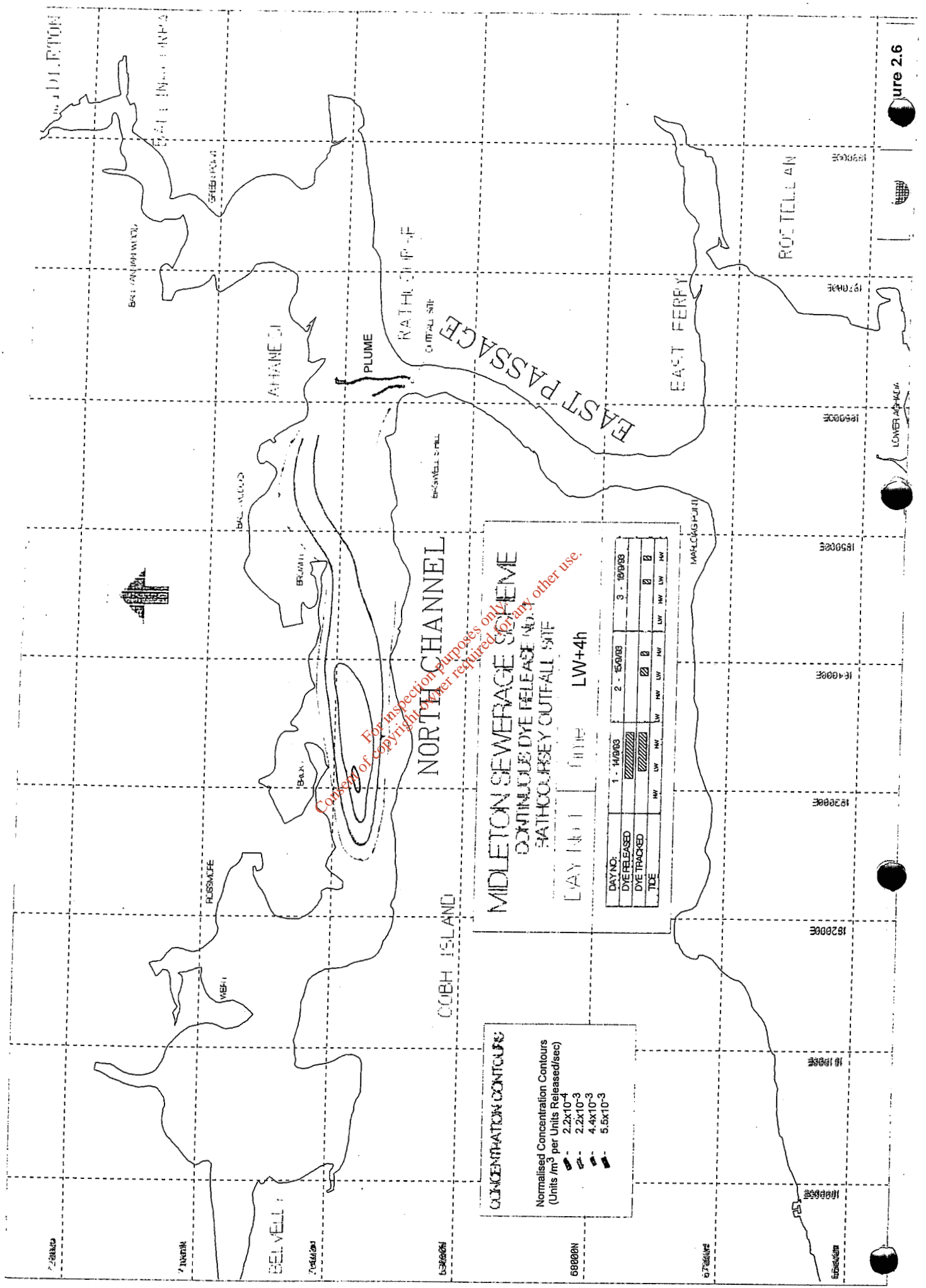
Figure 2.5

MIDLETON SEWERPAGE SCHEME
 CONTINUOUS DYE RELEASE FROM
 RATHCOURSE OUTFALL SITE
 DAY 1101 TIME LW, LW+2h

CONCENTRATION CONTOURS
 Normalised Concentration Contours
 (Units /m³ per Units Released/sec)
 - - - 2.2x10⁻⁴
 - - - 2.2x10⁻³
 - - - 4.4x10⁻³
 - - - 6.6x10⁻³

DAY NO.	1 - 14/03	2 - 15/03	3 - 16/03
DYE RELEASED	///	///	///
DYE TRACKED	///	///	///
TIDE	HW LW HW LW HW LW HW LW HW LW HW LW HW LW HW LW	HW LW HW LW HW LW HW LW HW LW HW LW HW LW HW LW HW LW	HW LW HW LW HW LW HW LW HW LW HW LW HW LW HW LW HW LW HW LW

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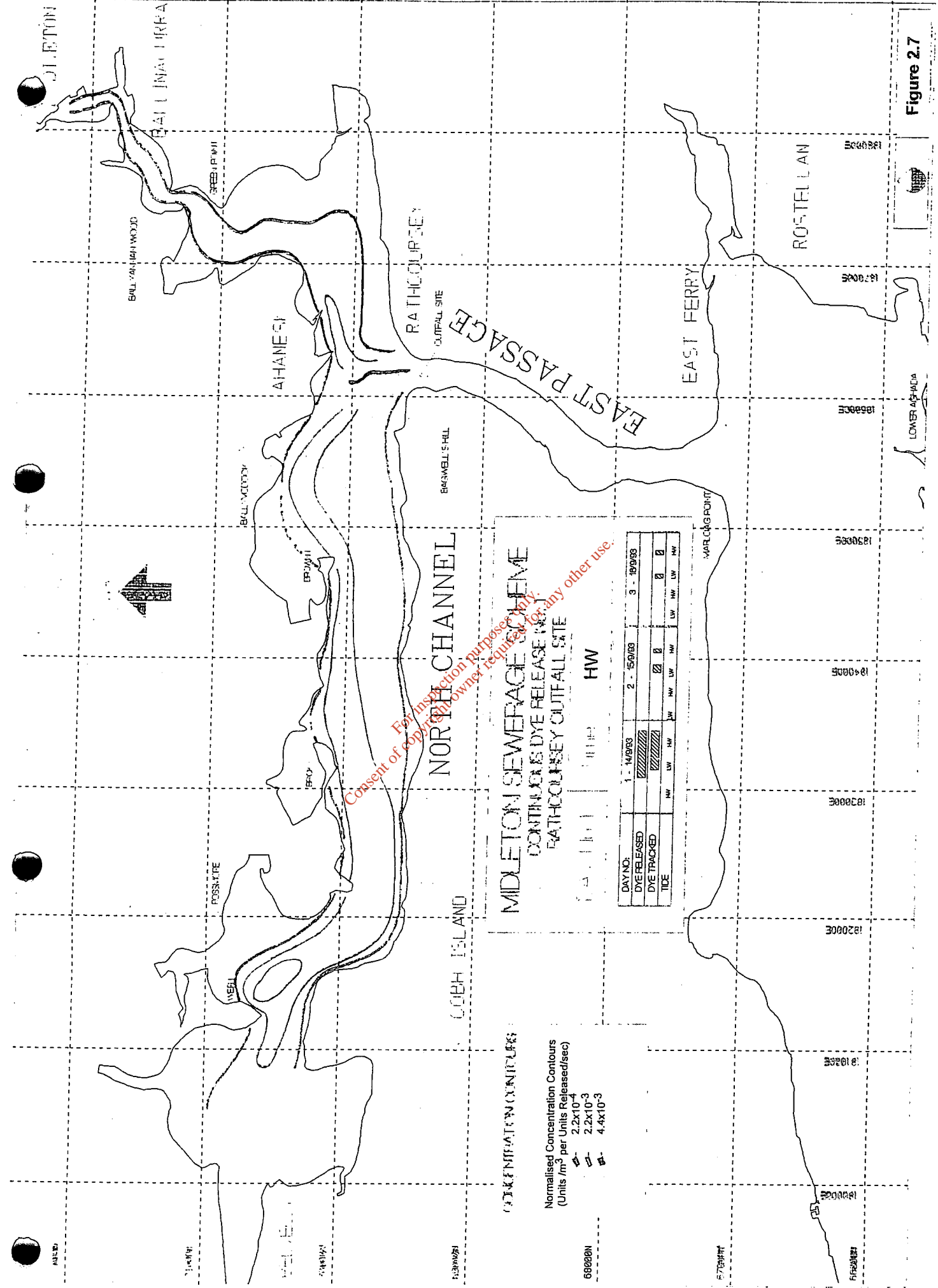
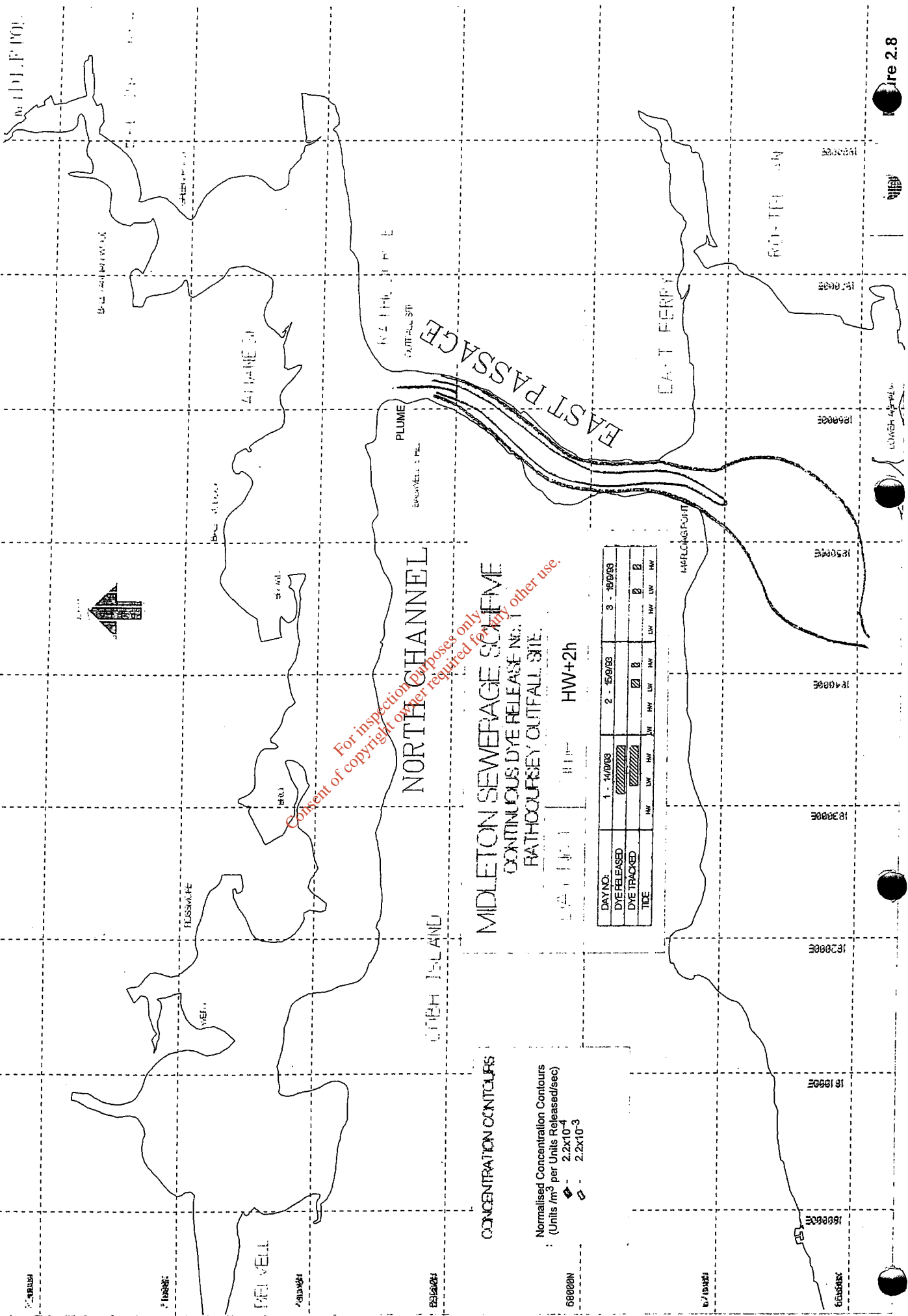


Figure 2.7



MIDDLETON SEWERAGE SCHEME
 CONTINUOUS DYE RELEASE NO. 1
 RATHCOURSEY OUTFALL SITE

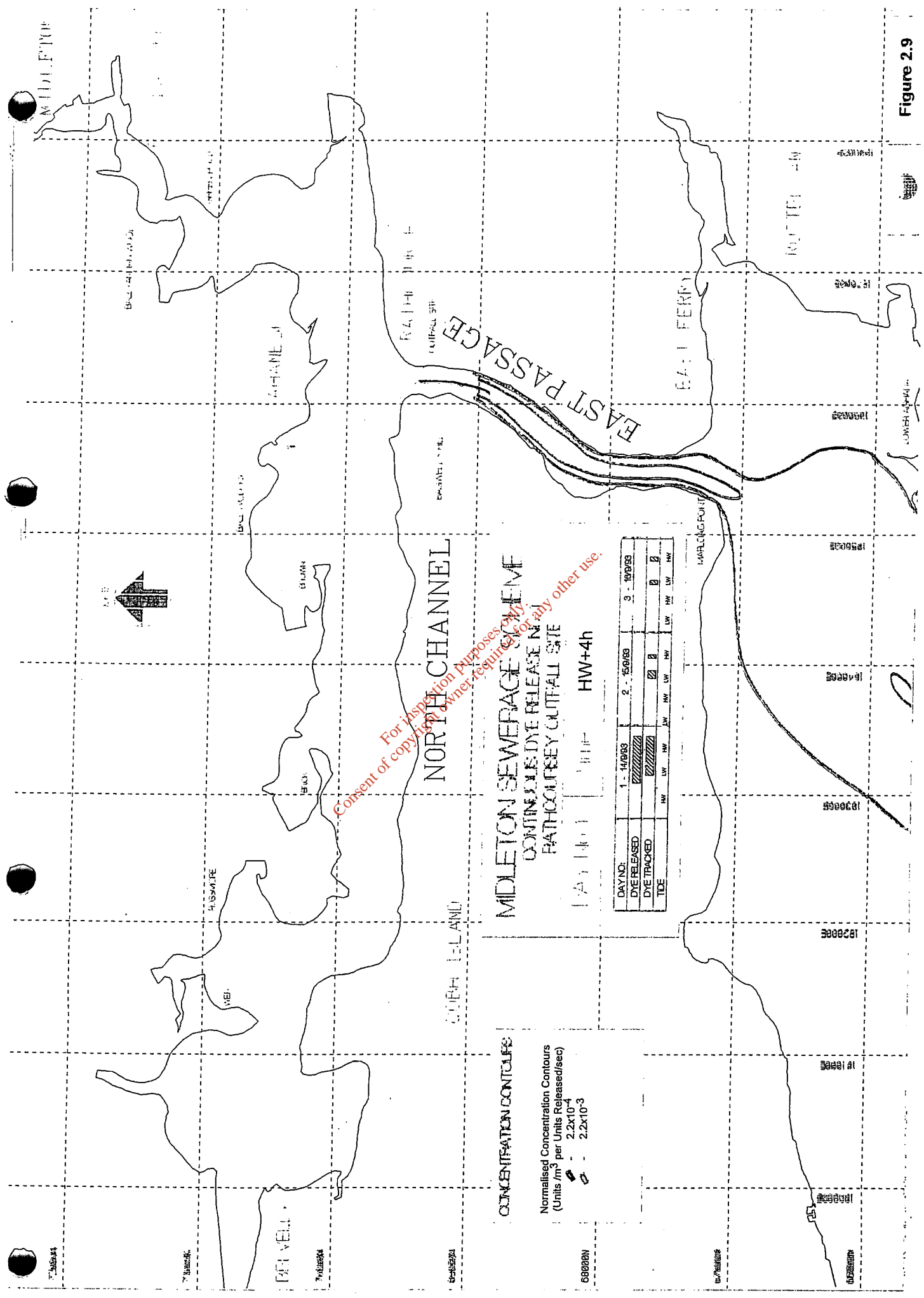
DAY NO.	1 - 14/08	2 - 15/08	3 - 16/08
DYE RELEASED	[Hatched Box]	[Hatched Box]	[Hatched Box]
DYE TRACKED	[Hatched Box]	[Hatched Box]	[Hatched Box]
TIDE	HW LW HW LW HW LW HW LW	HW LW HW LW HW LW HW LW	HW LW HW LW HW LW HW LW

HW+2h

CONCENTRATION CONTOURS

Normalised Concentration Contours
 (Units / m³ per Units Released/sec)
 ○ - 2.2x10⁻⁴
 ● - 2.2x10⁻³

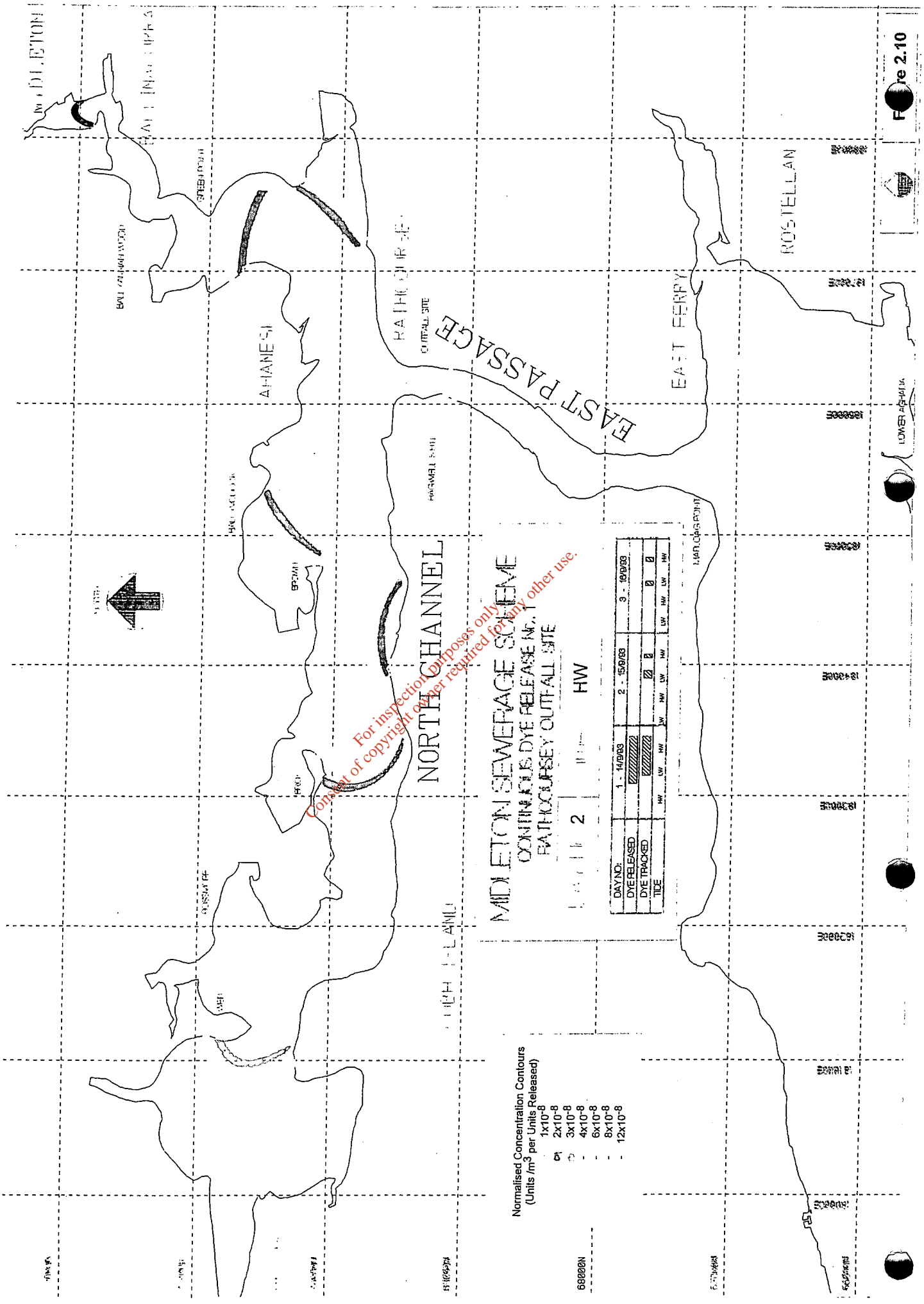
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DAY NO.	1 - 14/09/03	2 - 15/09/03	3 - 16/09/03
DYE RELEASED	██████████	██████████	██████████
DYE TRACKED	██████████	██████████	██████████
TIDE	HW LW HW LW HW LW HW LW	HW LW HW LW HW LW HW LW	HW LW HW LW HW LW HW LW

Figure 2.9



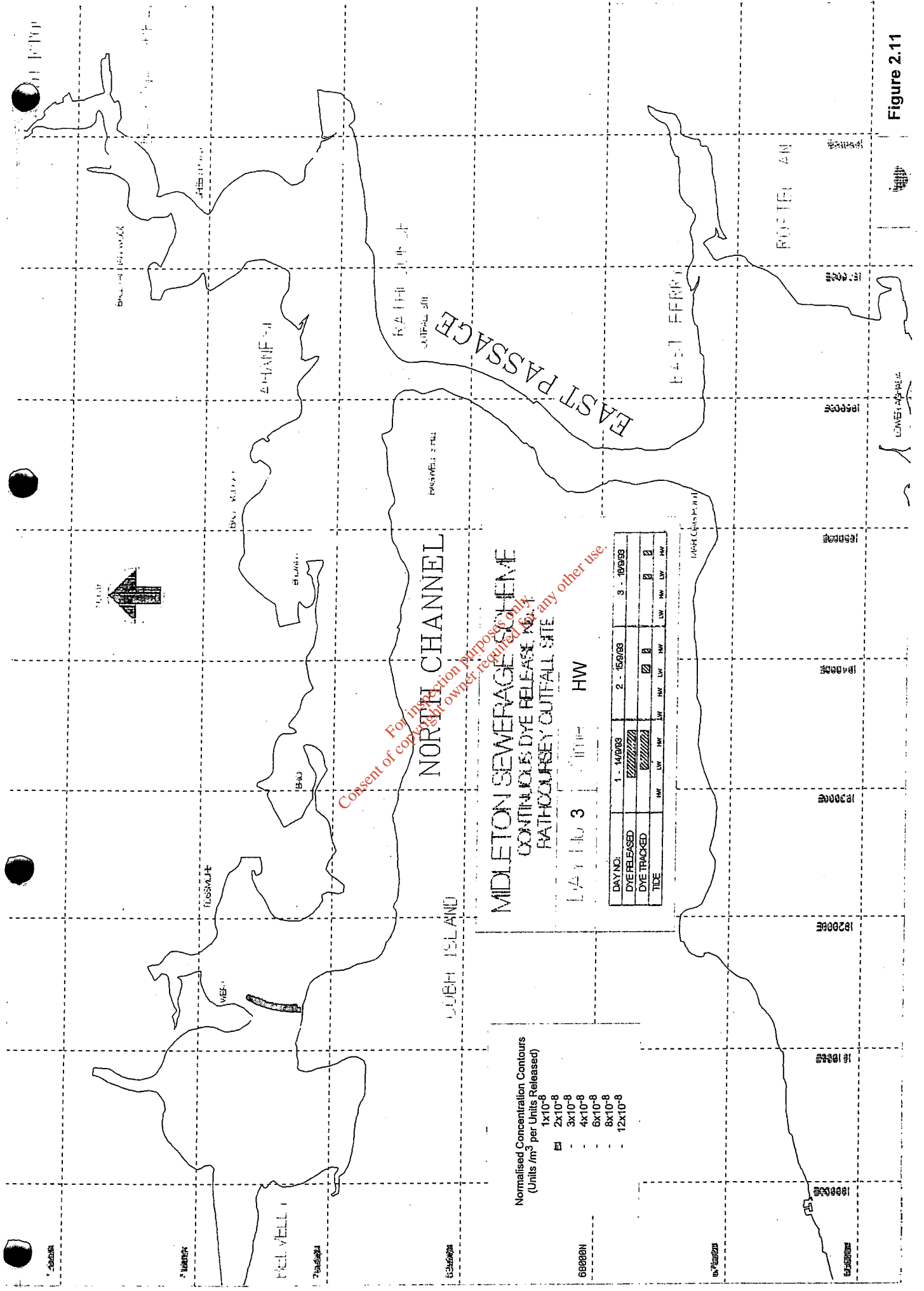
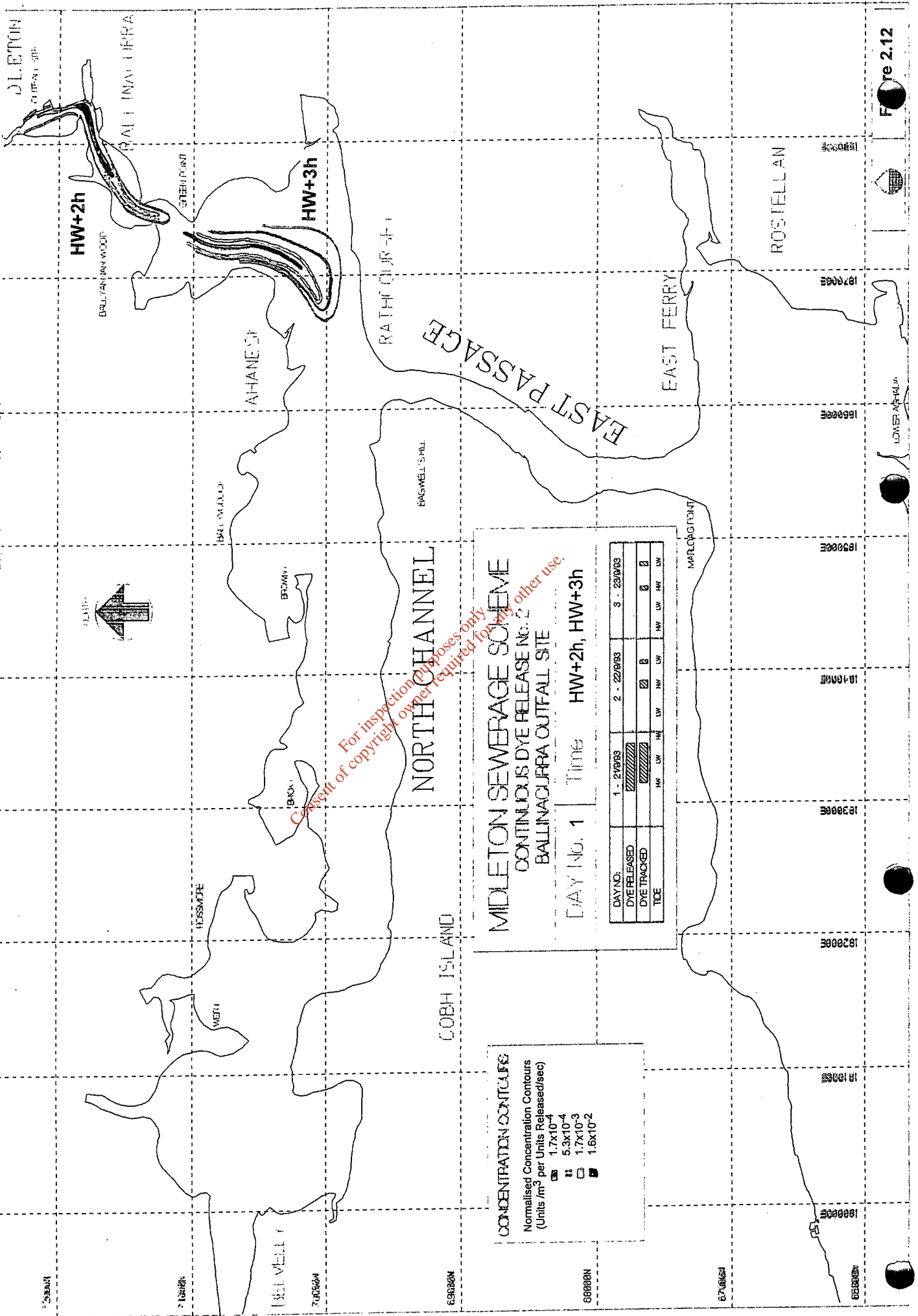


Figure 2.11



MIDLETON SEWERAGE SCHEME
 CONTINUOUS DYE RELEASE No. 2
 BALLINACJORRA OUTFALL SITE

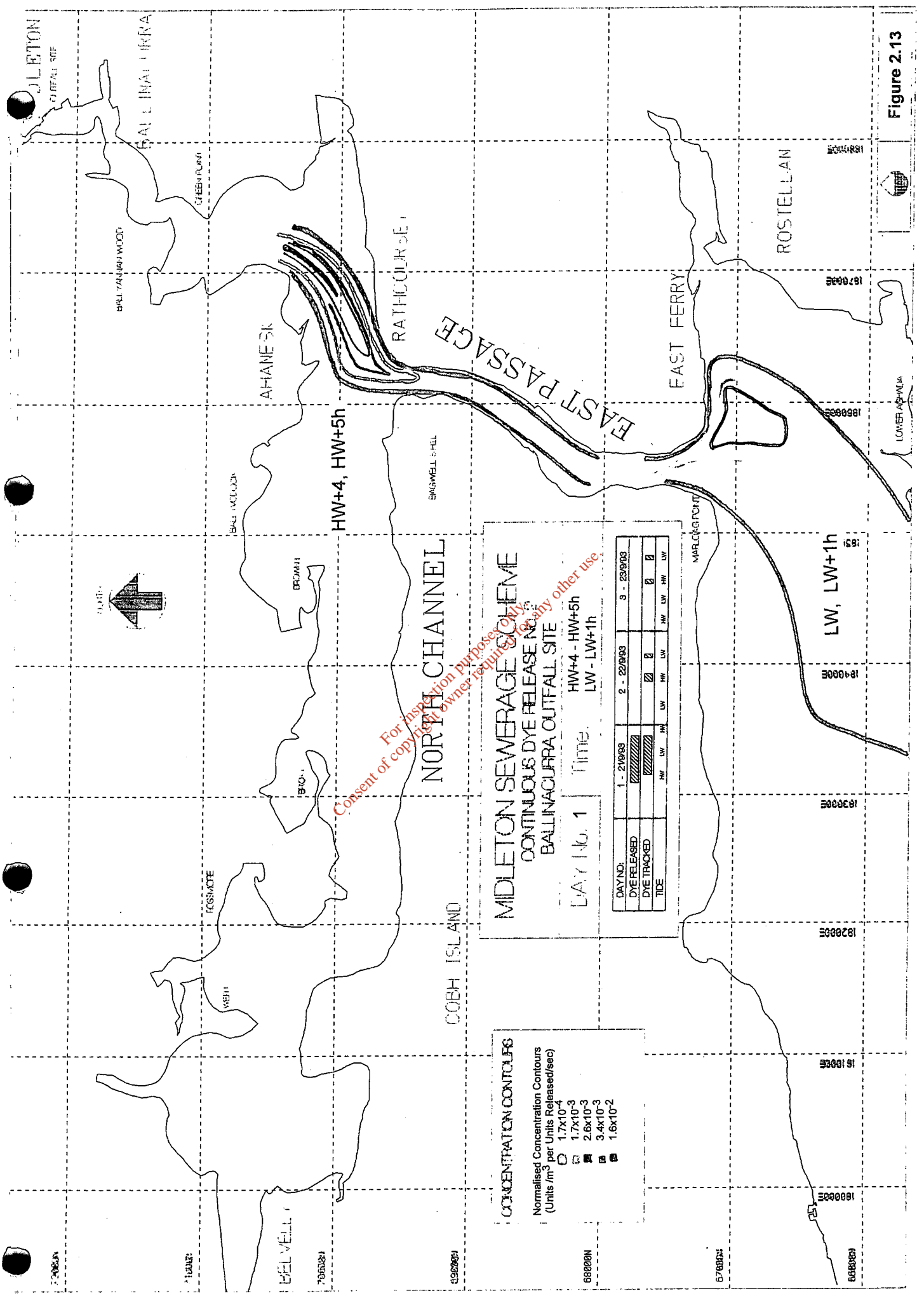
DAY No. 1 | Time | HW+2h, HW+3h

DAY NO.	1 - 21/09/03	2 - 22/09/03	3 - 23/09/03
DYE RELEASED	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
DYE TRACKED	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
TIDE	HW LW HW LW HW LW HW LW HW LW HW LW HW LW HW LW	HW LW HW LW HW LW HW LW HW LW HW LW HW LW HW LW HW LW	HW LW HW LW HW LW HW LW HW LW HW LW HW LW HW LW HW LW HW LW

CONCENTRATION CONTOURS
 Normalised Concentration Contours
 (Units /m³ per Units Released/sec)

- ▬ 1.7x10⁻⁴
- - - 5.3x10⁻⁴
- ⋯ 1.7x10⁻³
- ⋯ 1.6x10⁻²

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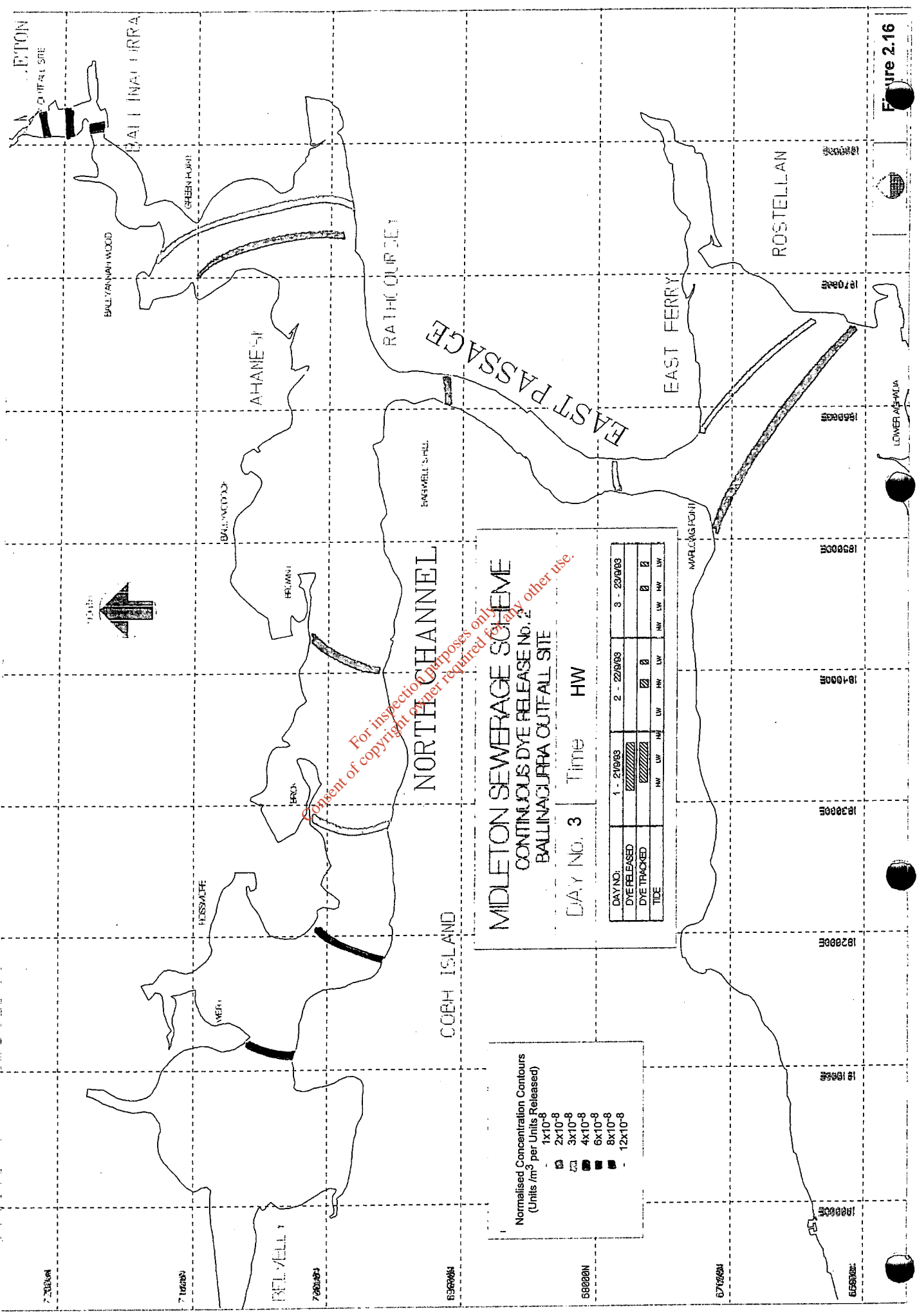
MIDLETON SEWERAGE SCHEME
CONTINUOUS DYE RELEASE NO. 1
BALLINACURRA OUTFALL SITE

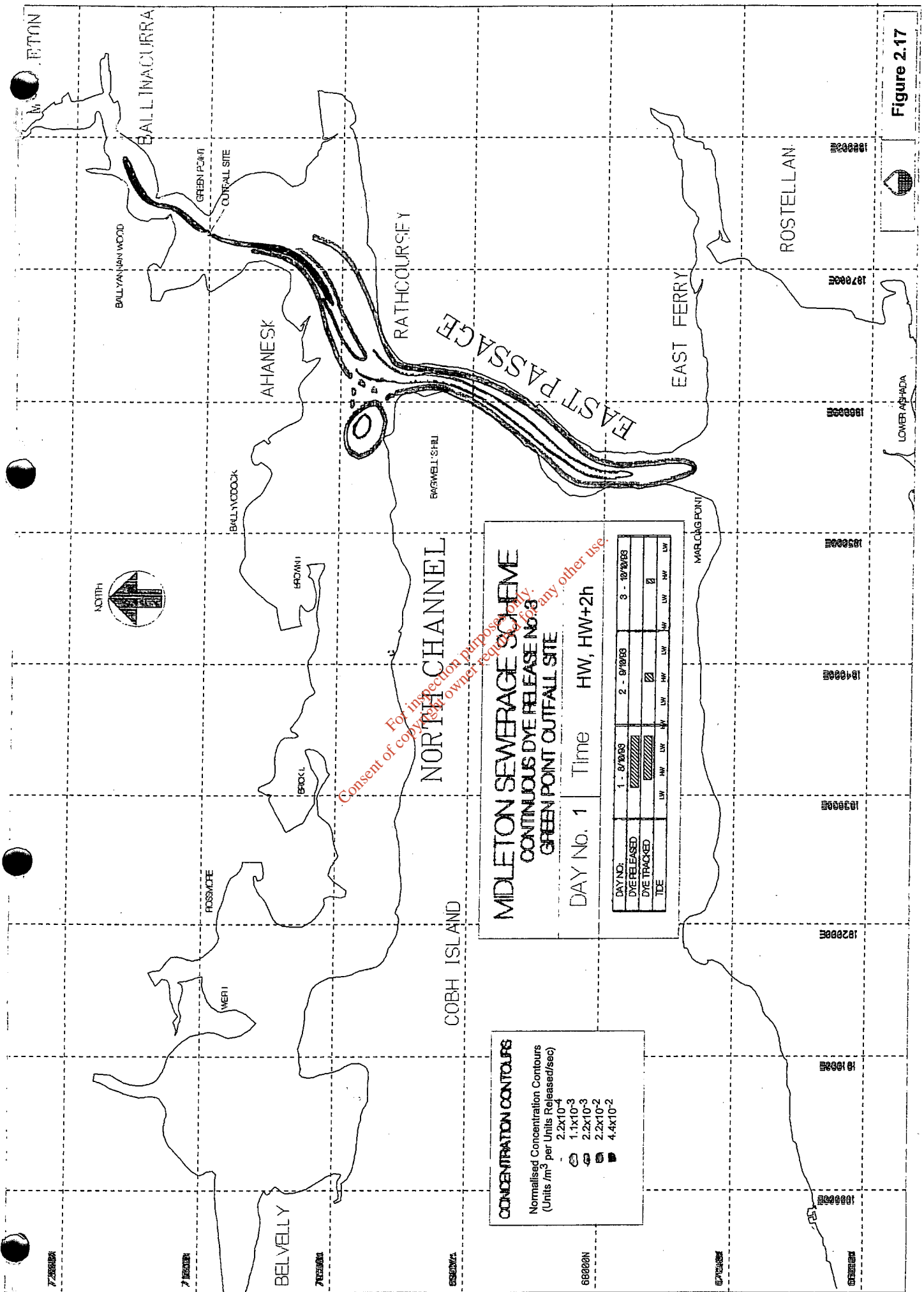
LAY No. 1 Time: HW+4 - HW+5h
 LW - LW+1h

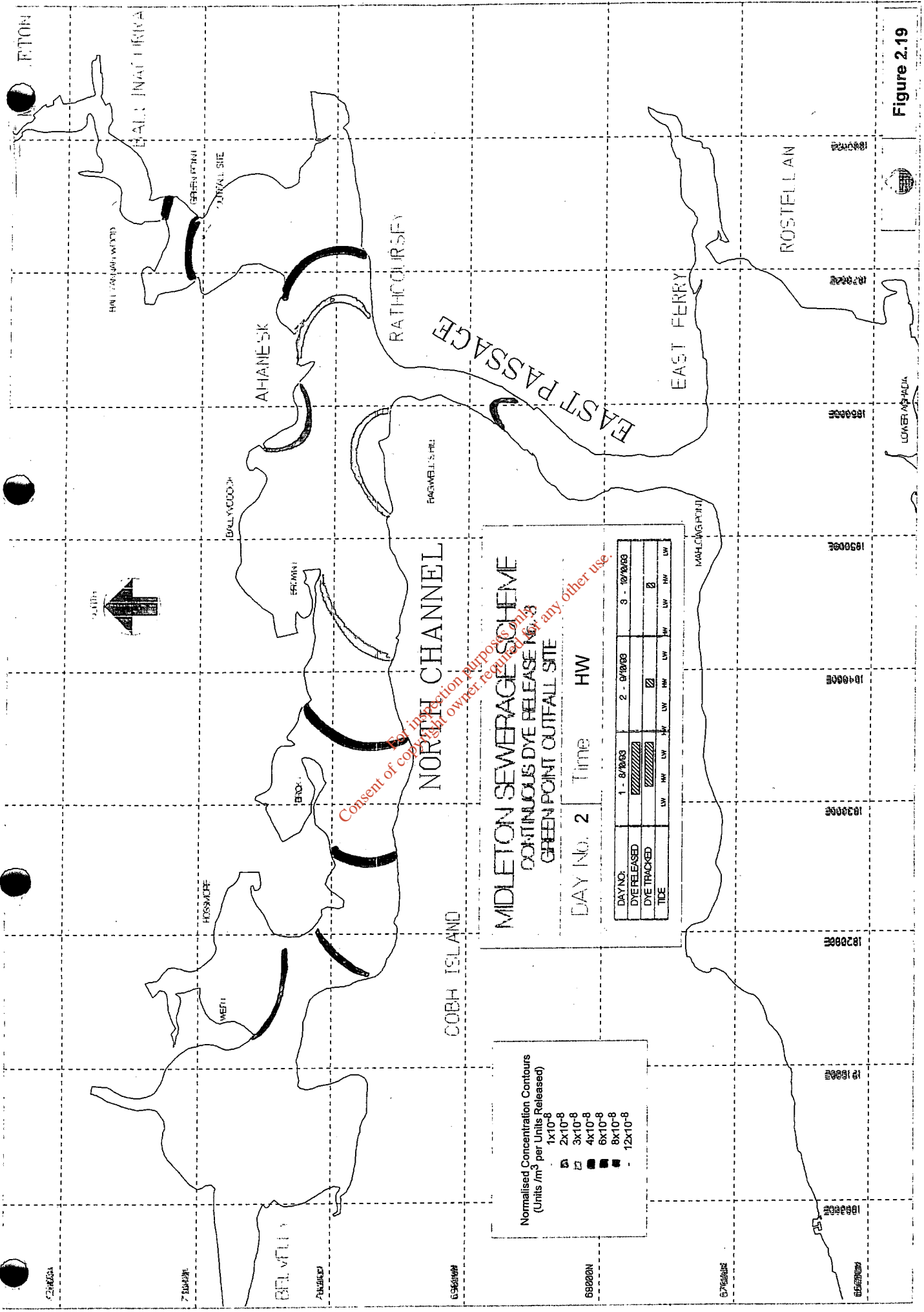
DAY NO.	1 - 21/03/03	2 - 22/03/03	3 - 23/03/03
DYE RELEASED	██████████	██████████	██████████
DYE TRACKED	██████████	██████████	██████████
TIDE	HW LW HW LW HW LW HW LW HW LW HW LW	HW LW HW LW HW LW HW LW HW LW HW LW HW LW	HW LW HW LW HW LW HW LW HW LW HW LW HW LW

CONCENTRATION CONTOURS
 Normalised Concentration Contours
 (Units /m³ per Units Released/sec)

- 1.7x10⁻⁴
- 2.6x10⁻³
- 3.4x10⁻³
- 1.6x10⁻²







MIDLETON SEWERAGE SCHEME
CONTINUOUS DYE RELEASE POINTS
GREEN POINT OUTFALL SITE

DAY No. 2 Time HW

DAY NO.	1 - 6/10/03		2 - 9/10/03		3 - 10/10/03	
	HW	LW	HW	LW	HW	LW
DYE RELEASED						
DYE TRACKED						
TIDE						

Normalised Concentration Contours
 (Units μm^3 per Units Released)

- 1x10⁻⁸ [Symbol]
- 2x10⁻⁸ [Symbol]
- 3x10⁻⁸ [Symbol]
- 4x10⁻⁸ [Symbol]
- 6x10⁻⁸ [Symbol]
- 8x10⁻⁸ [Symbol]
- 12x10⁻⁸ [Symbol]

Figure 2.19

MIDLETON SEWERAGE SCHEME OUTFALL STUDY 1993

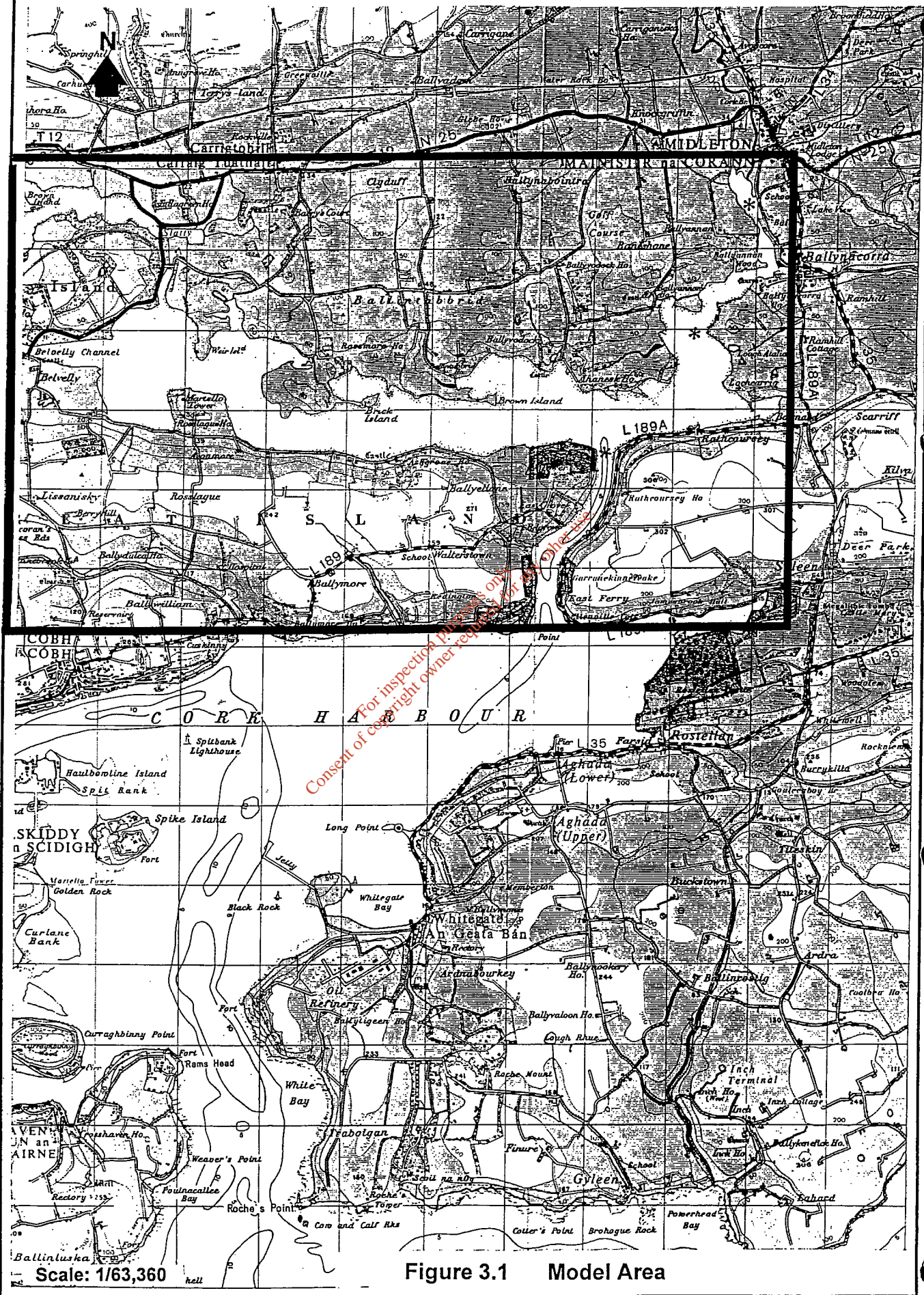


Figure 3.1 Model Area

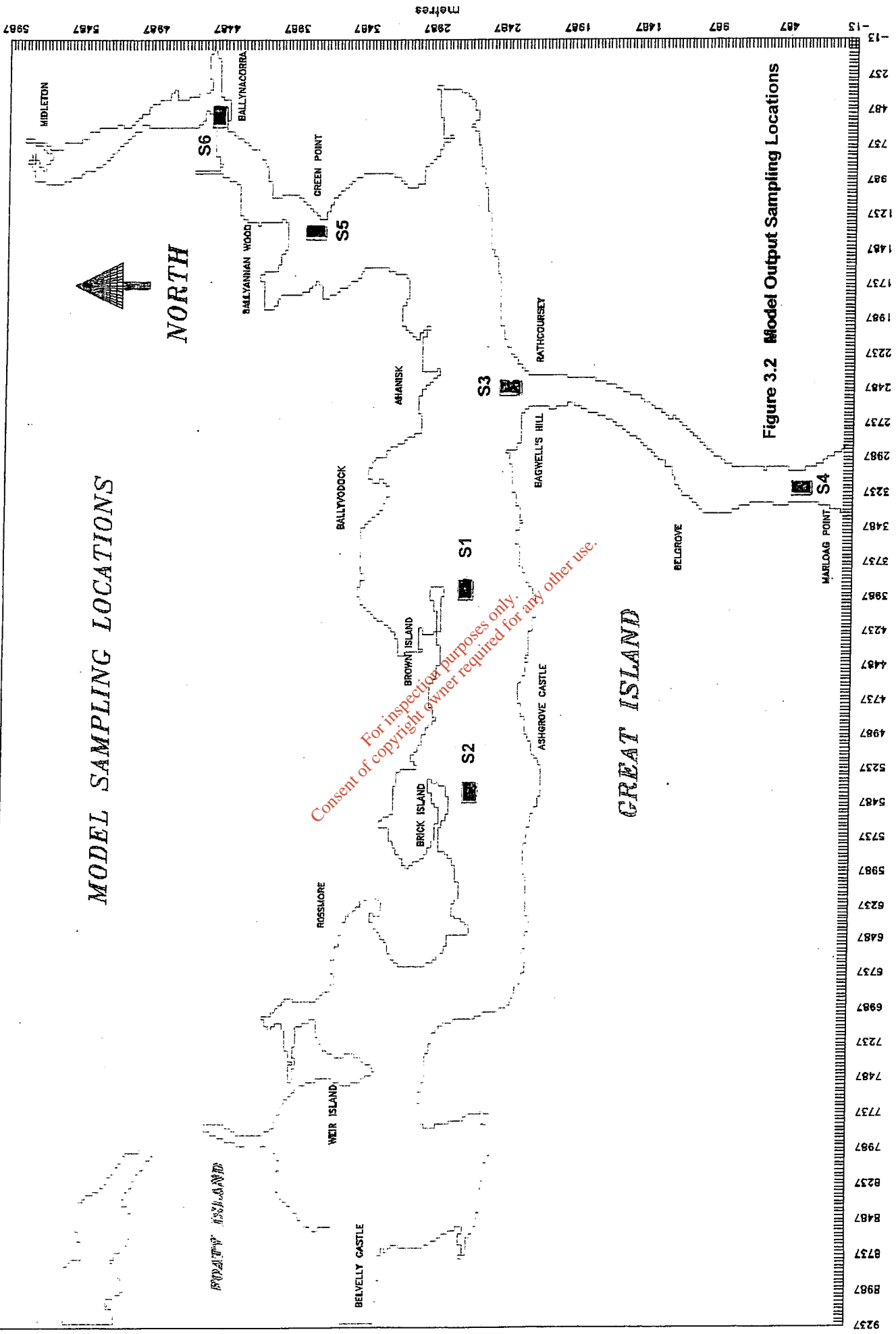
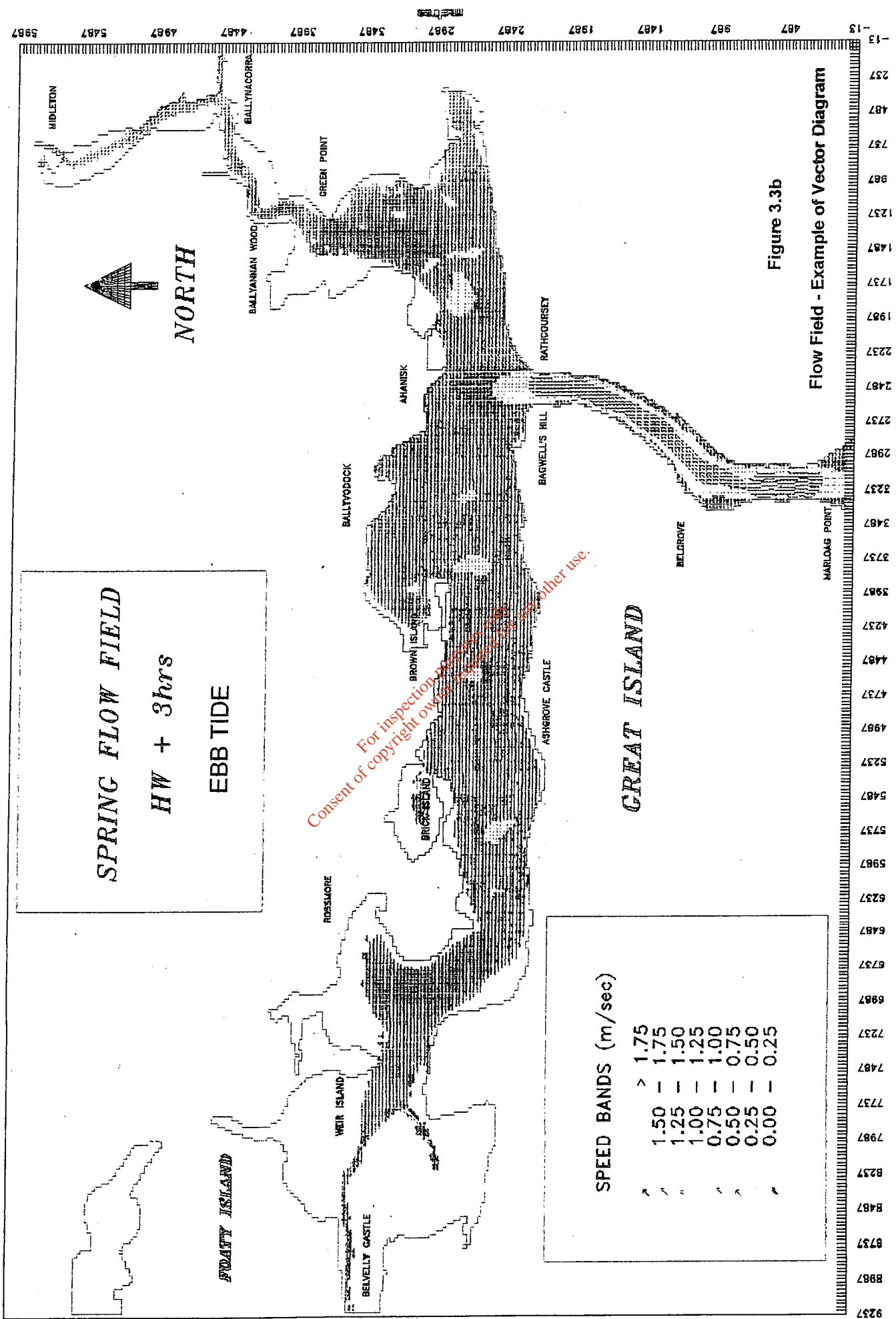


Figure 3.2 Model Output Sampling Locations

MIDDLETON SEWERAGE SCHEME - OUTFALL STUDY



SPRING FLOW FIELD
 HW + 3hrs
 EBB TIDE

SPEED BANDS (m/sec)

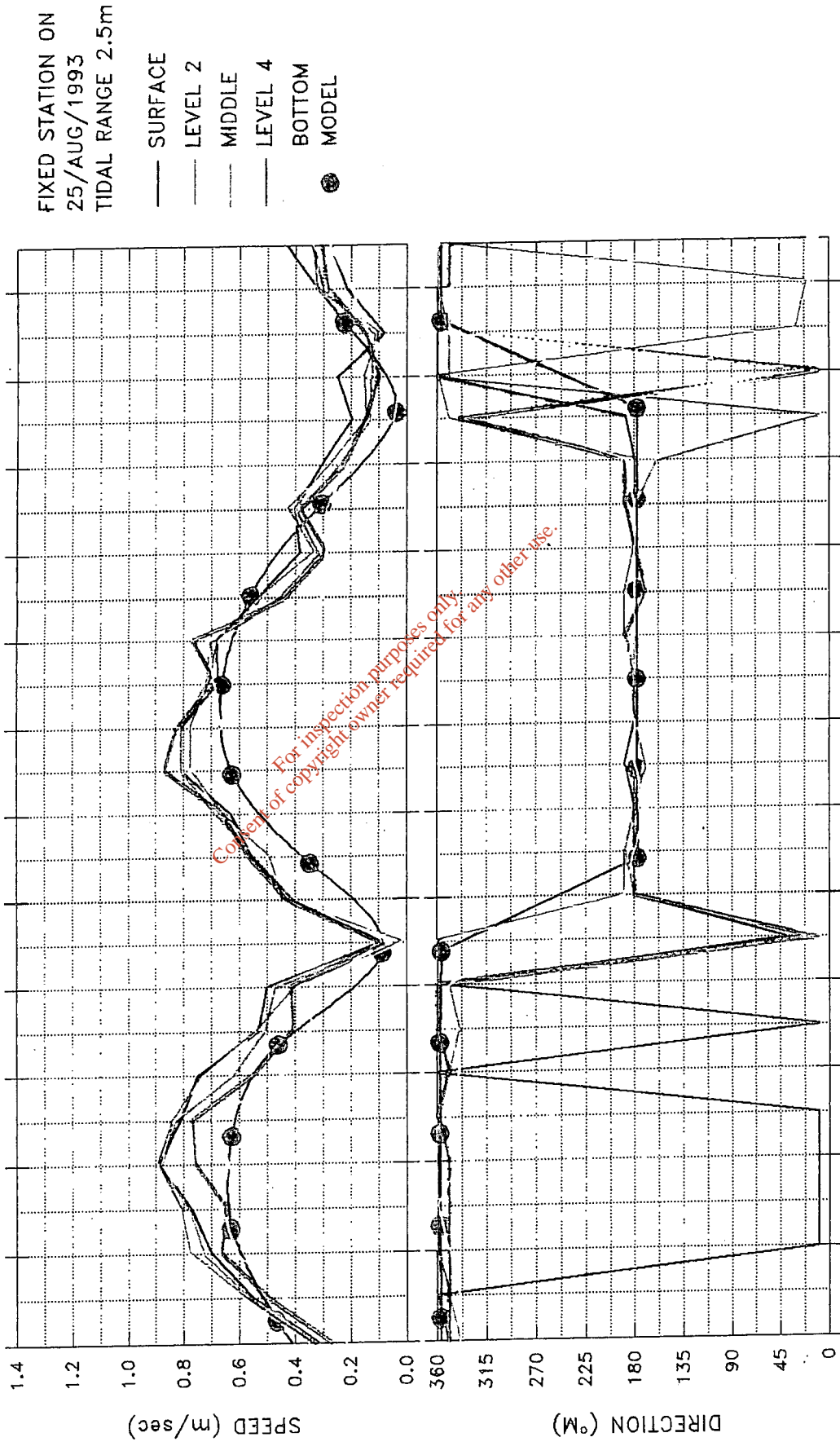
>	1.75
1.50 -	1.75
1.25 -	1.50
1.00 -	1.25
0.75 -	1.00
0.50 -	0.75
0.25 -	0.50
0.00 -	0.25

Figure 3.3b
 Flow Field - Example of Vector Diagram

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MIDDLETON SEWERAGE SCHEME

MEASURED AND MODELLED CURRENT SPEED AND DIRECTION AT MID-CHANNEL OFF RATHCOURSEY POINT



TIME (1-hourly increments)

NOTE : Fixed station performed by IHD.
Model data scaled up from neaps flow field.

Figure 3.4a

MIDDLETON SEWERAGE SCHEME

MEASURED AND MODELLED CURRENT SPEED AND DIRECTION AT WEST SIDE OF CHANNEL OFF RATHCOURSEY POINT

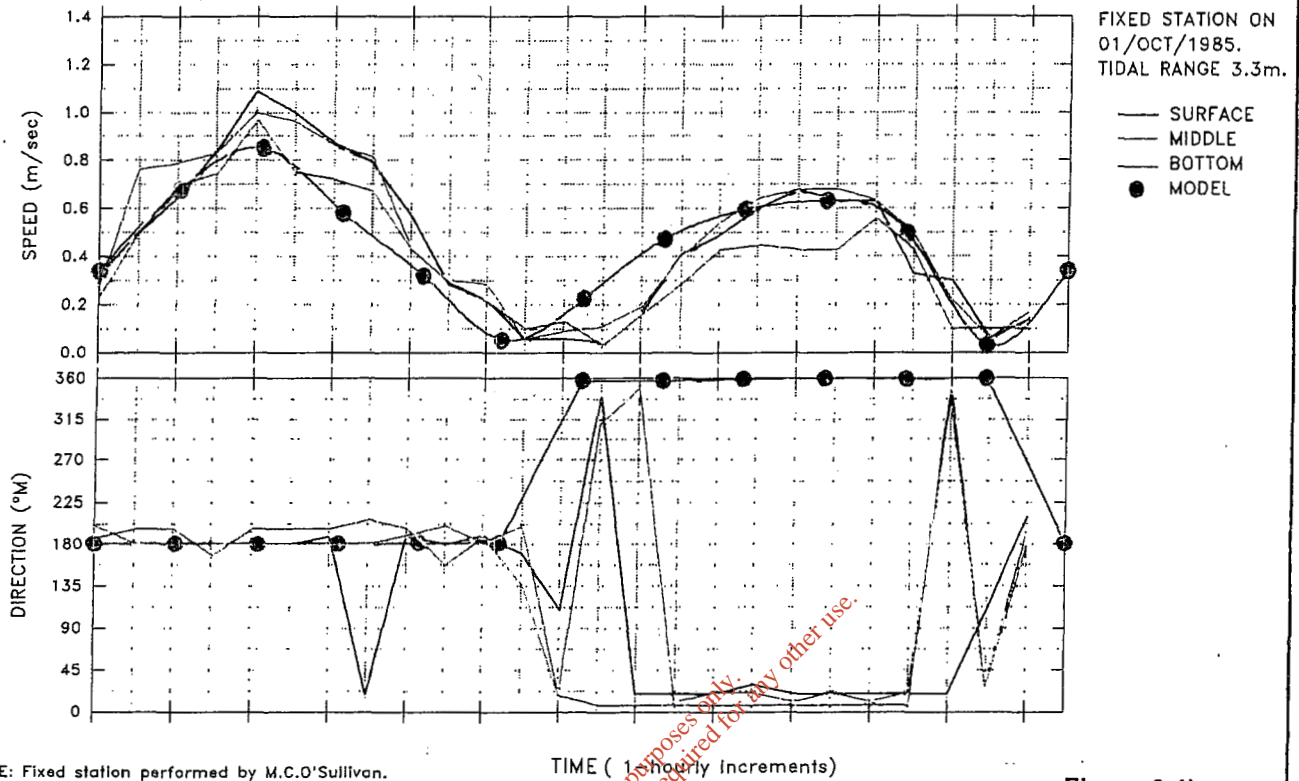


Figure 3.4b

MEASURED AND MODELLED CURRENT SPEED AND DIRECTION AT EAST SIDE OF CHANNEL OFF RATHCOURSEY POINT

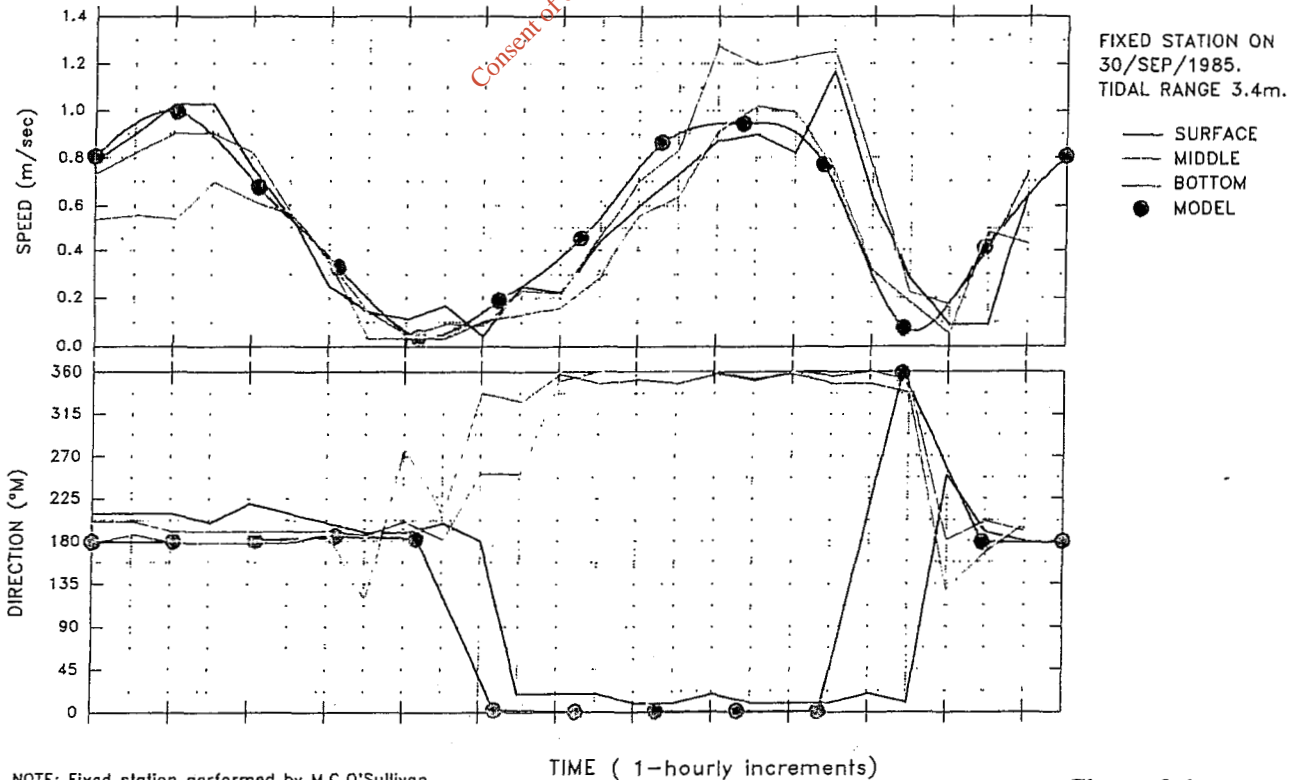
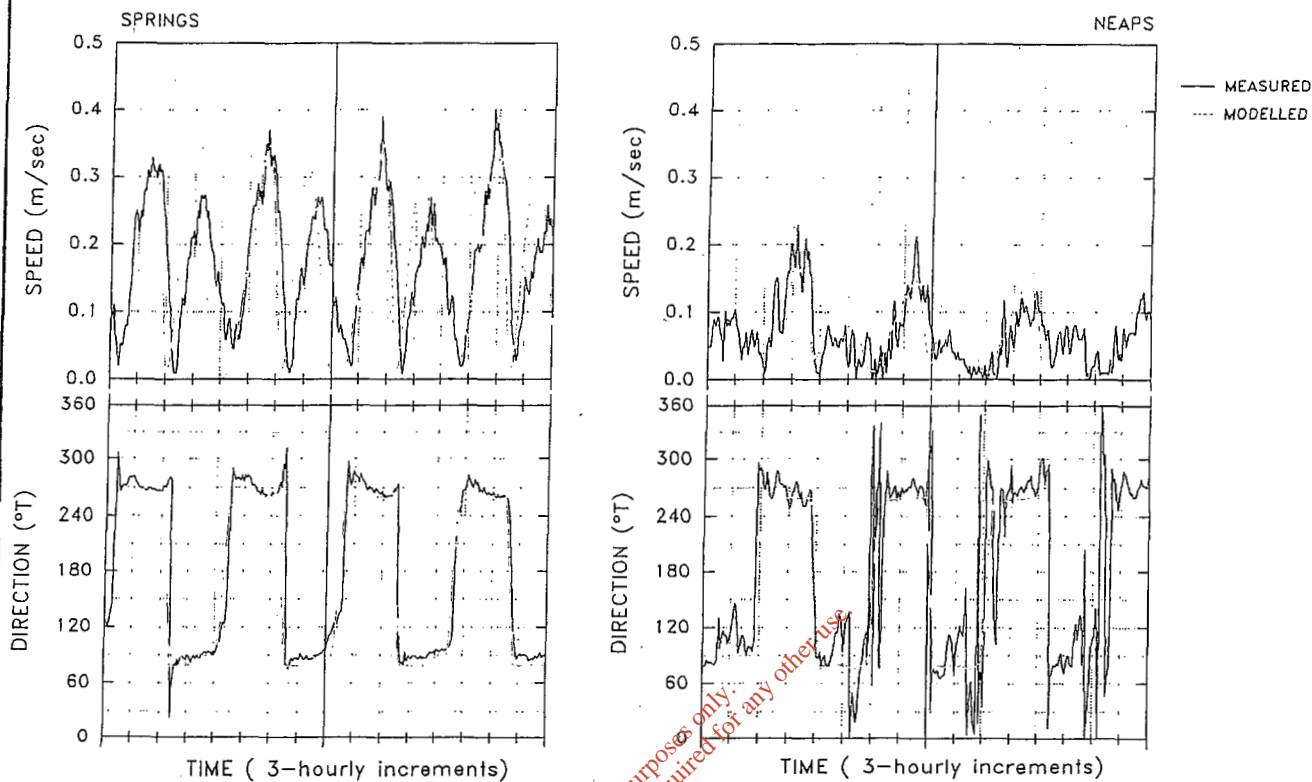


Figure 3.4c

MIDDLETON SEWERAGE SCHEME

MEASURED AND MODELLED CURRENT SPEED AND DIRECTION OFF BROWN ISLAND

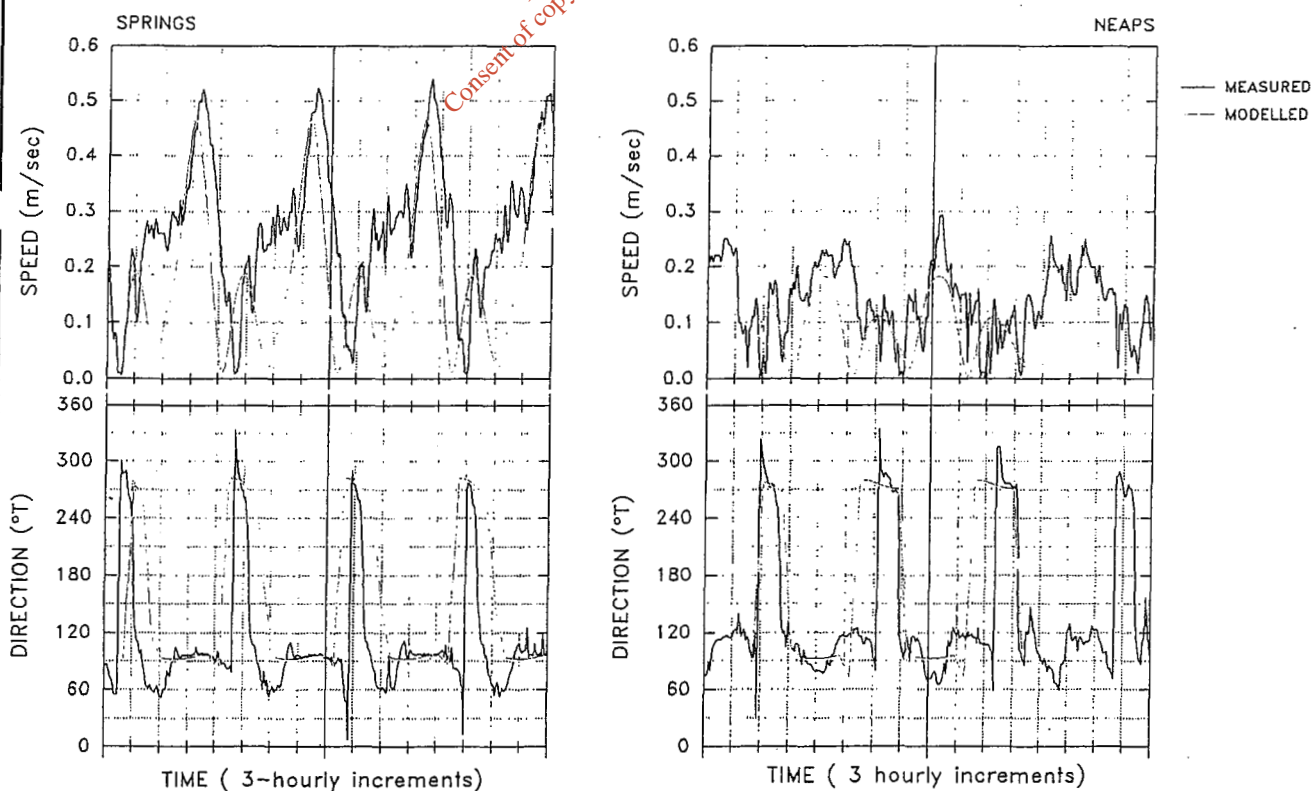


NOTE : Measured data obtained with S4 recording current meter

Figure 3.5a

MIDDLETON SEWERAGE SCHEME

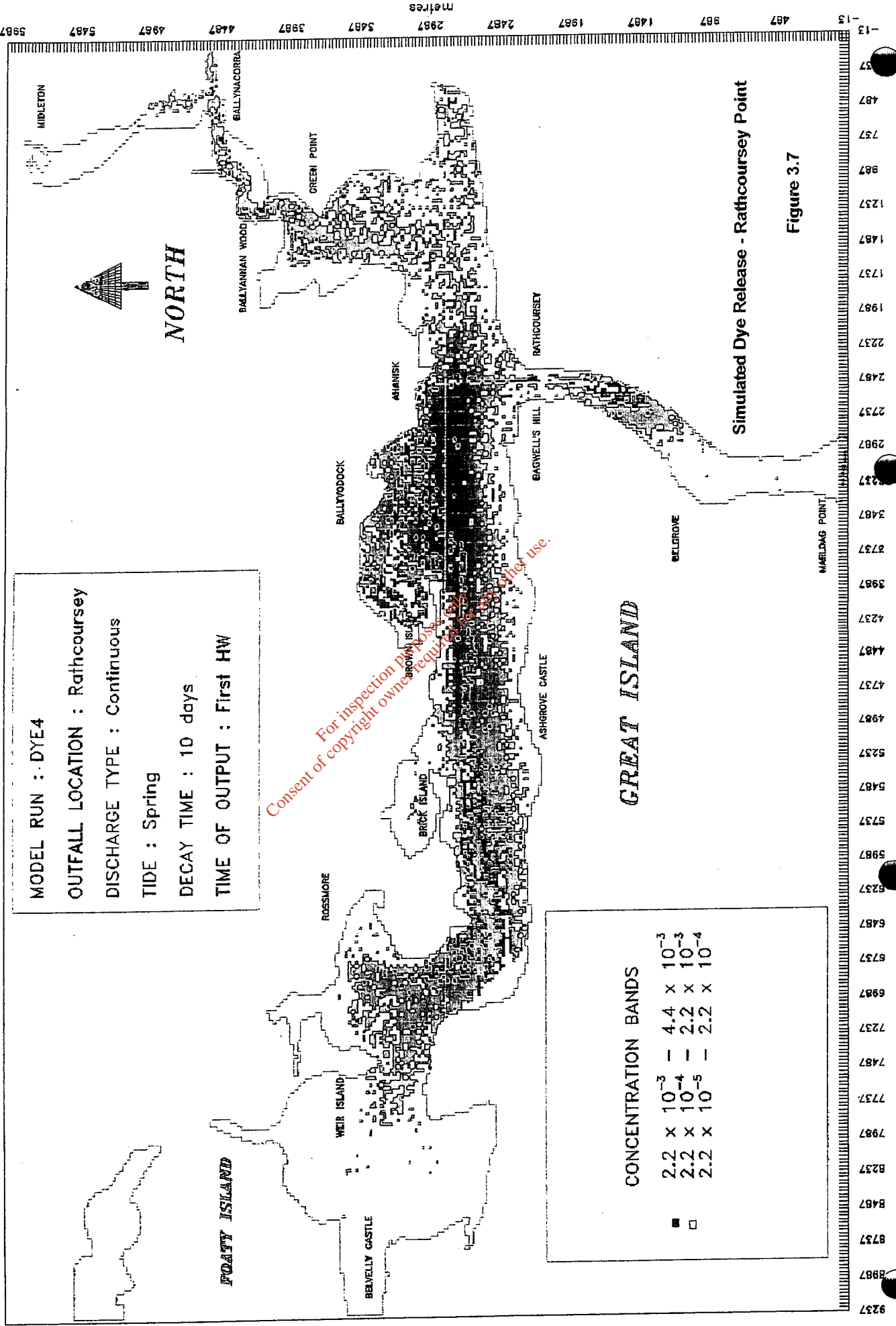
MEASURED AND MODELLED CURRENT SPEED AND DIRECTION IN GYRE OFF NW CORNER OF EAST PASSAGE



NOTE : Measured data obtained with Aanderaa RCM4 recording current meter

Figure 3.5b

MIDDLETON EWERAGE SCHEME - OUTFALL S JDY



MODEL RUN : DYE4

OUTFALL LOCATION : Rathcoursey

DISCHARGE TYPE : Continuous

TIDE : Spring

DECAY TIME : 10 days

TIME OF OUTPUT : First HW

CONCENTRATION BANDS

- 2.2×10^{-3} - 4.4×10^{-3}
- 2.2×10^{-4} - 2.2×10^{-3}
- 2.2×10^{-5} - 2.2×10^{-4}

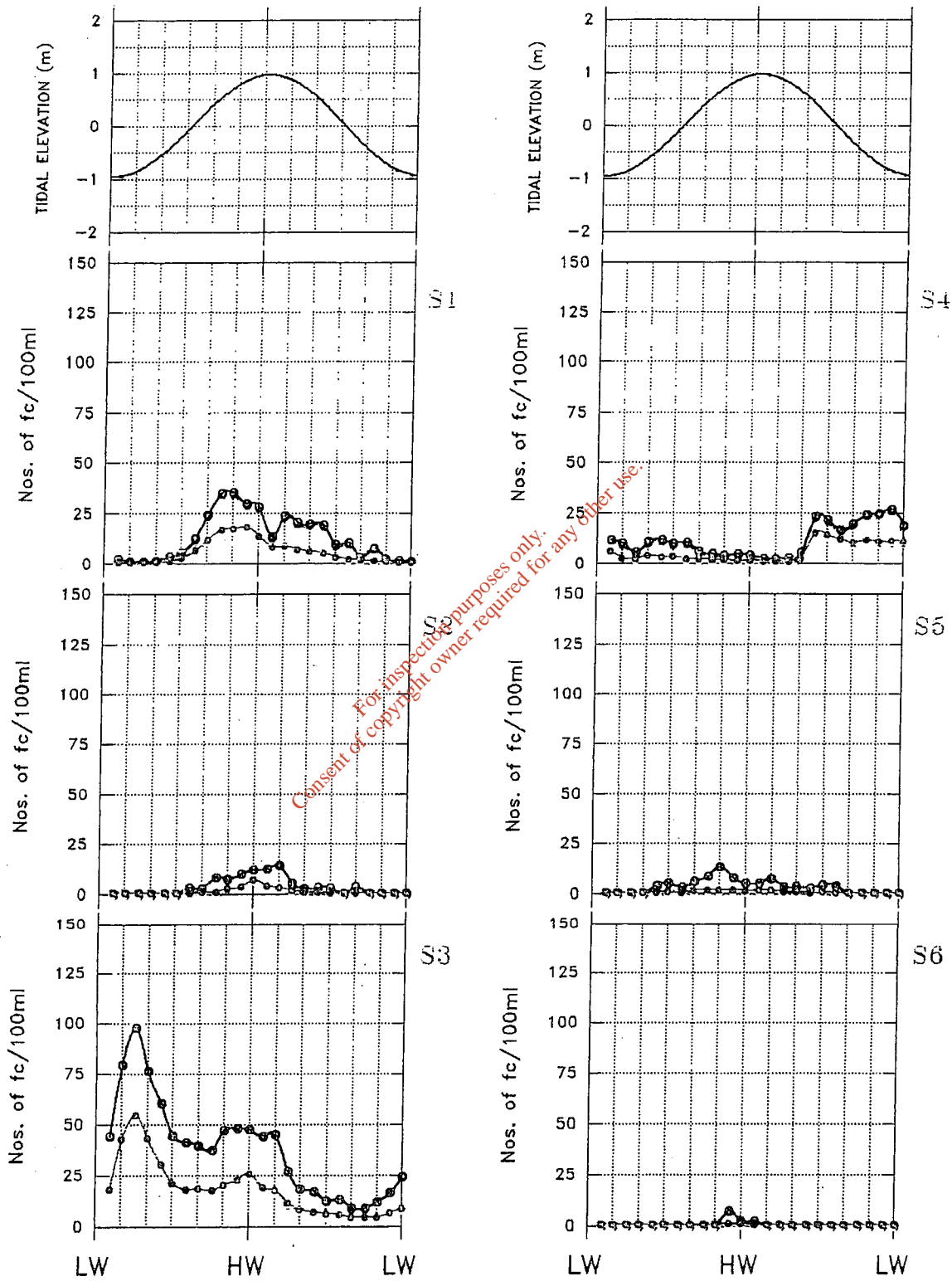
Simulated Dye Release - Rathcoursey Point

Figure 3.7

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MIDDLETON SEWERAGE SCHEME - OUTFALL STUDY

fc/100ml AT FIXED SAMPLING LOCATIONS



● PEAK ○ AVERAGE

Figure 3.8

MODEL RUN : NA01..Continuous discharge at Rathcoursey on a Neap tide, T_{90} 12 hrs.

MIDDLETON SEWERAGE SCHEME - OUTFALL STUDY

fc/100ml AT FIXED SAMPLING LOCATIONS

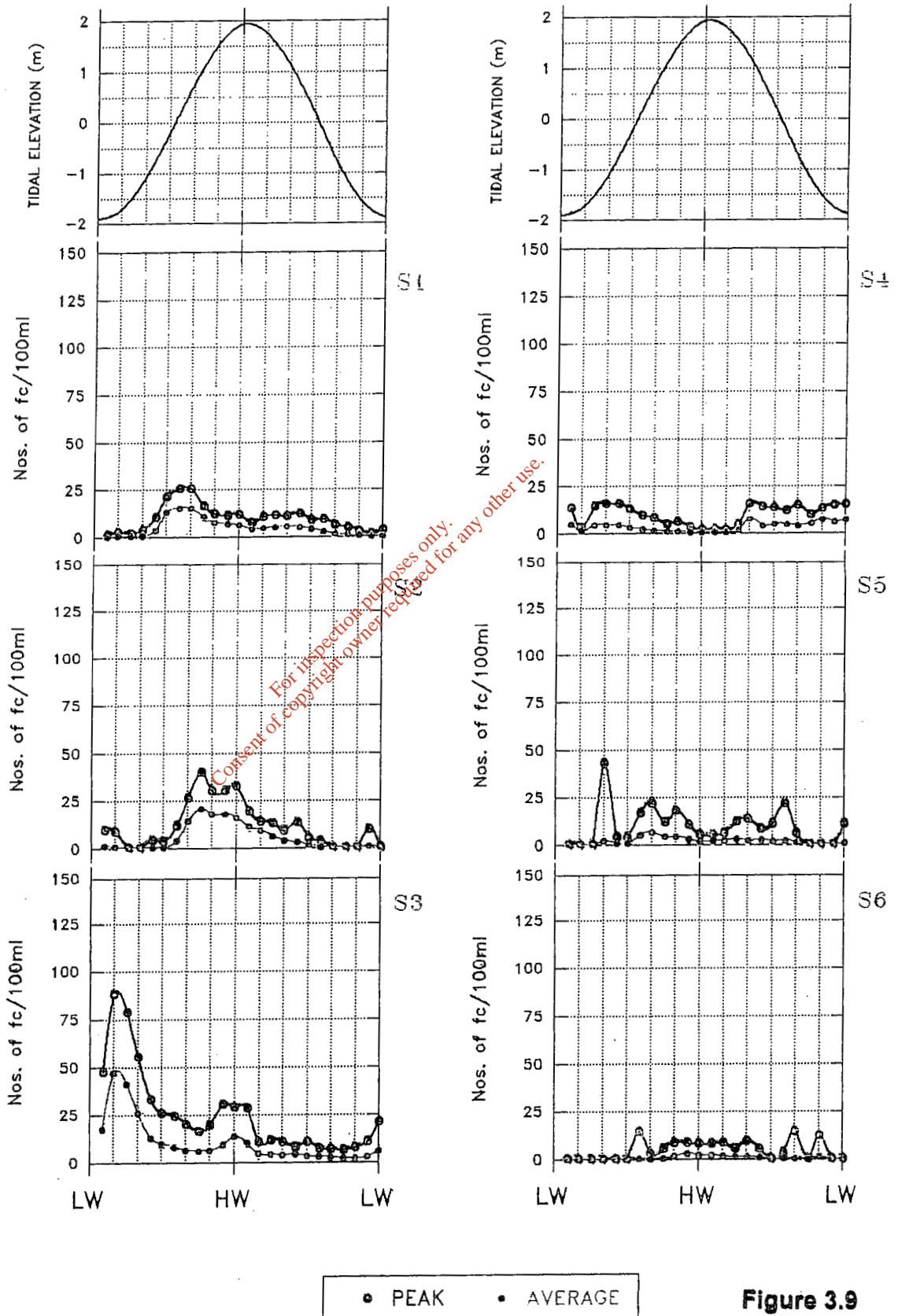
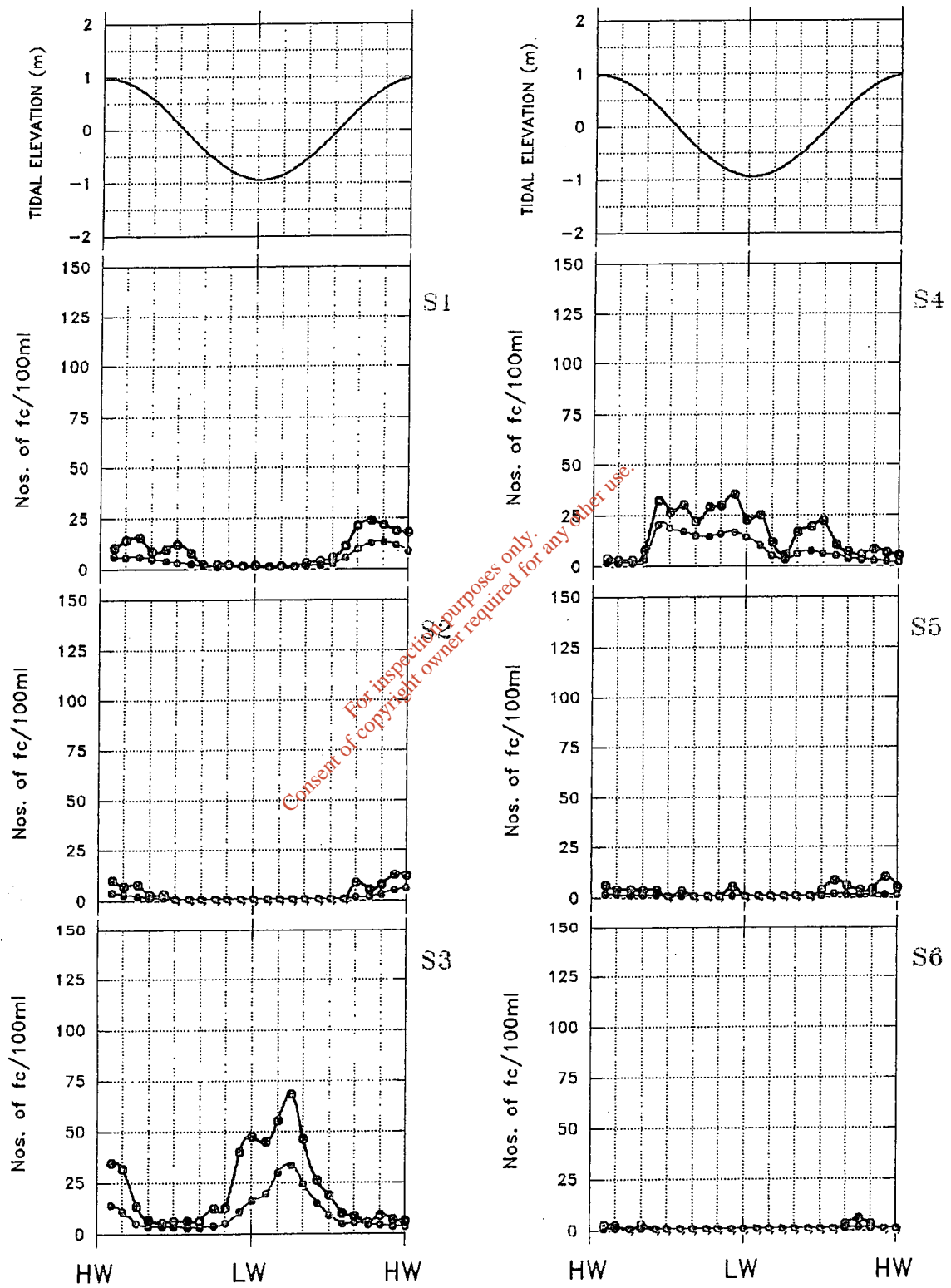


Figure 3.9

MODEL RUN : SA01..Continuous discharge at Rathcoursey on a Spring tide, T_{90} 12 hrs.

MIDDLETON SEWERAGE SCHEME - OUTFALL STUDY

fc/100ml AT FIXED SAMPLING LOCATIONS



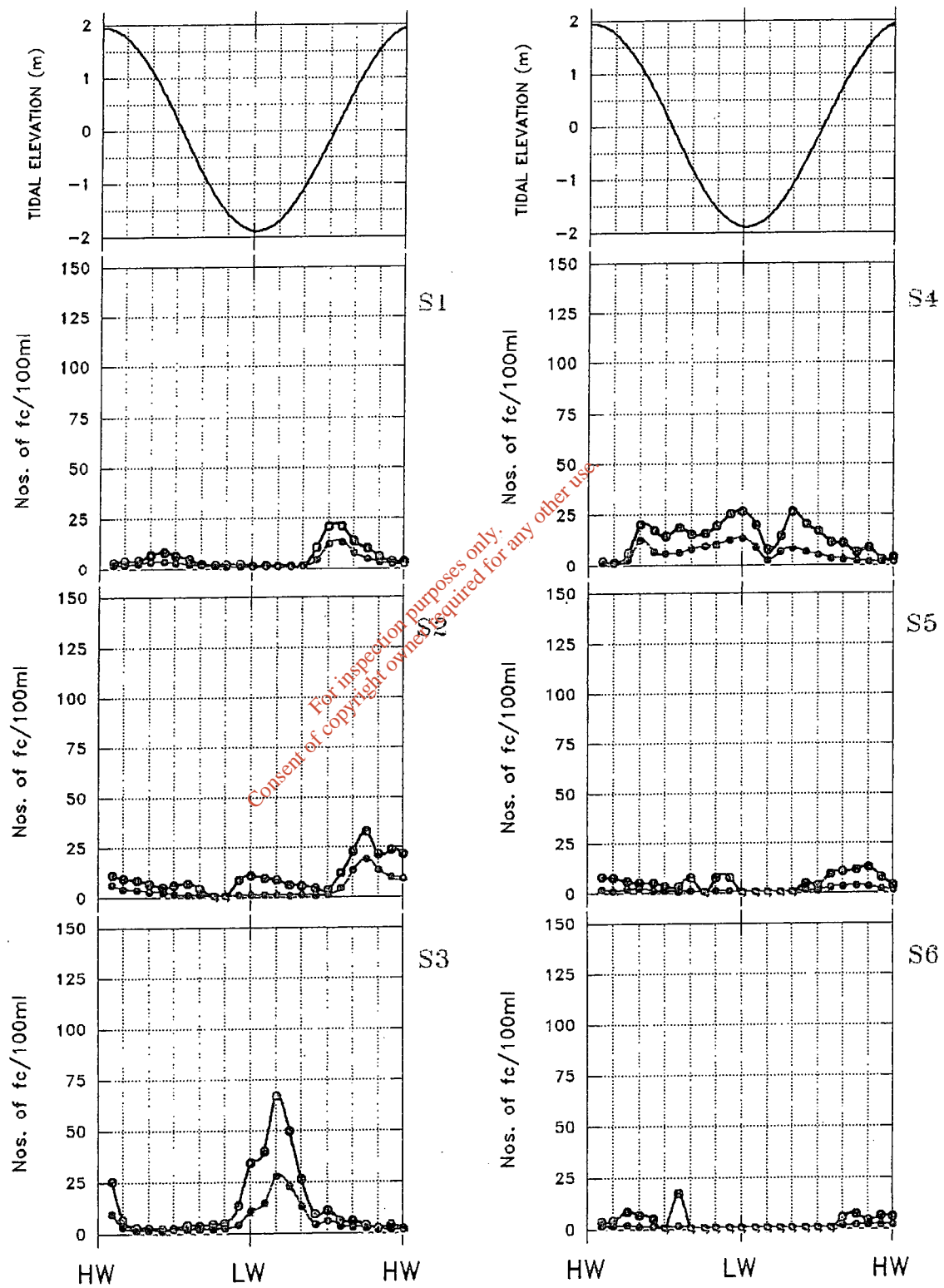
• PEAK ◦ AVERAGE

Figure 3.10

MODEL RUN : NA02..Tidal discharge at Rathcoursey on a Neap tide, T_{90} 12 hrs.

MIDDLETON SEWERAGE SCHEME - OUTFALL STUDY

fc/100ml AT FIXED SAMPLING LOCATIONS



○ PEAK ○ AVERAGE

Figure 3.11

MODEL RUN : SA02..Tidal discharge at Rathcoursey on a Spring tide, T_{90} 12 hrs.

MIDDLETON SEWERAGE SCHEME - OUTFALL STUDY

fc/100ml AT FIXED SAMPLING LOCATIONS

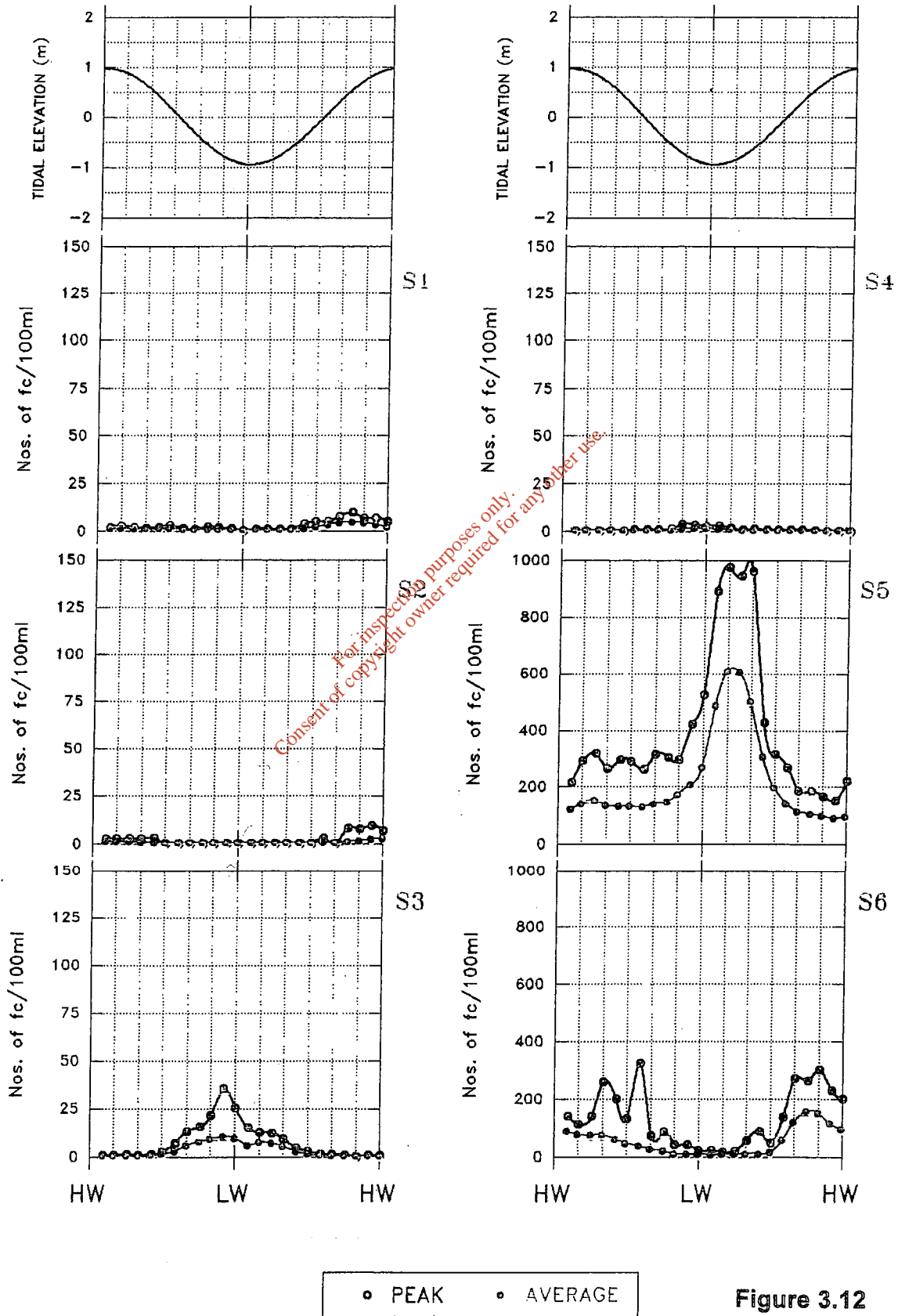


Figure 3.12

MODEL RUN : NB01..Continuous discharge at Green Point on a Neap tide, T_{90} 12 hrs.

MIDDLETON SEWERAGE SCHEME - OUTFALL STUDY

fc/100ml AT FIXED SAMPLING LOCATIONS

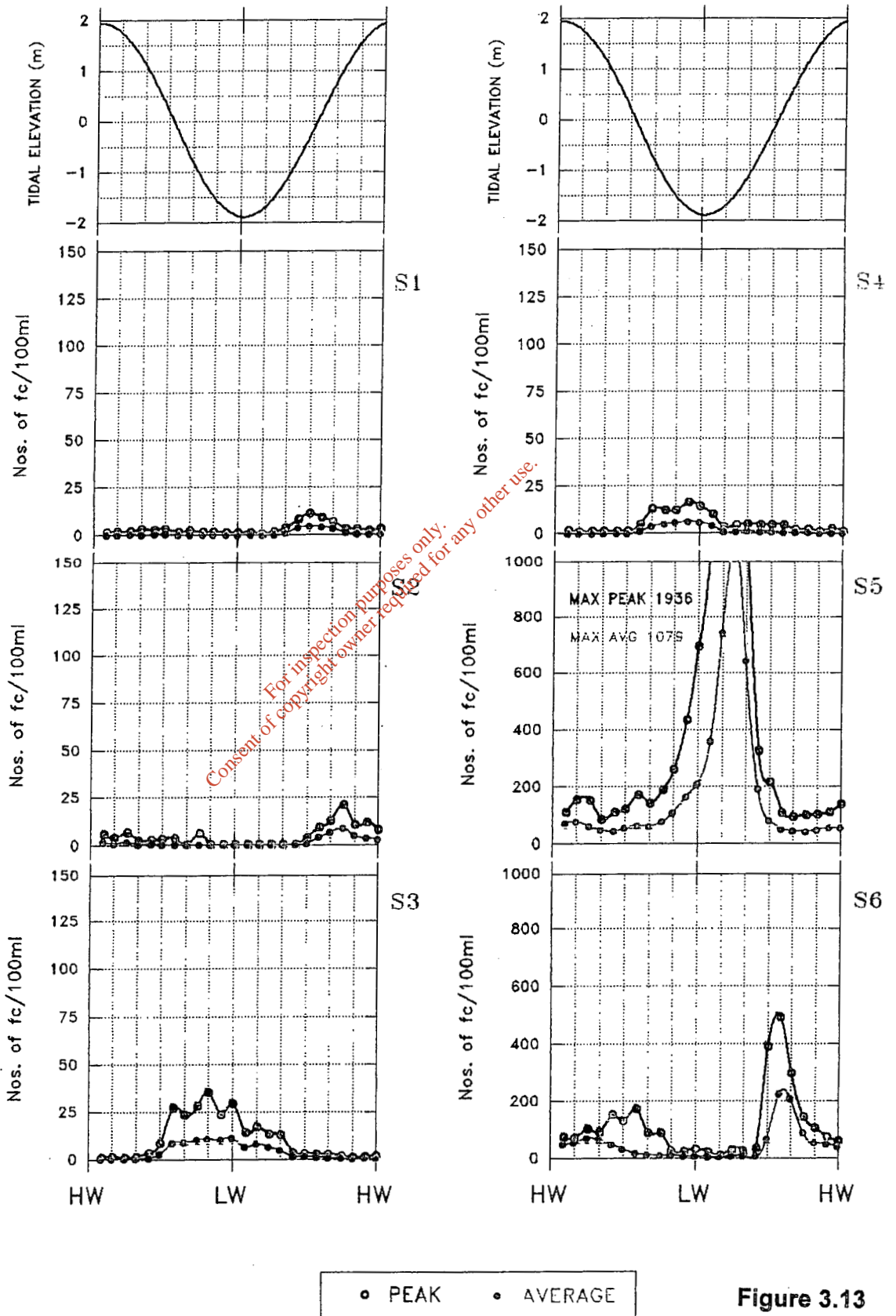
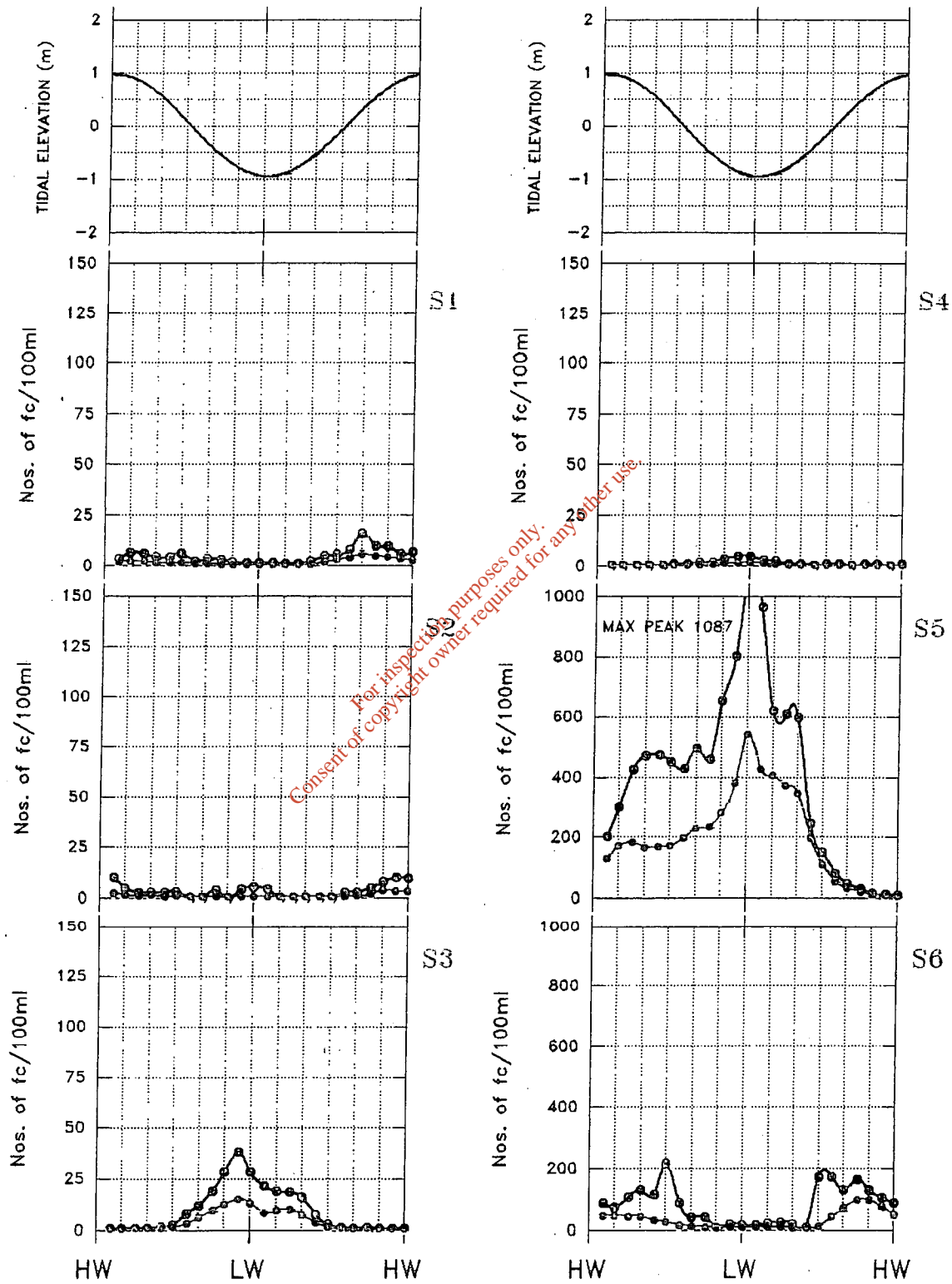


Figure 3.13

MODEL RUN : SB01..Continuous discharge at Green Point on a Spring tide, T_{90} 12 hrs.

MIDDLETON SEWERAGE SCHEME - OUTFALL STUDY

fc/100ml AT FIXED SAMPLING LOCATIONS



• PEAK • AVERAGE

Figure 3.14

MODEL RUN : NB02..Tidal discharge at Green Point on a Neap tide, T_{90} 12 hrs.

MIDDLETON SEWERAGE SCHEME - OUTFALL STUDY

fc/100ml AT FIXED SAMPLING LOCATIONS

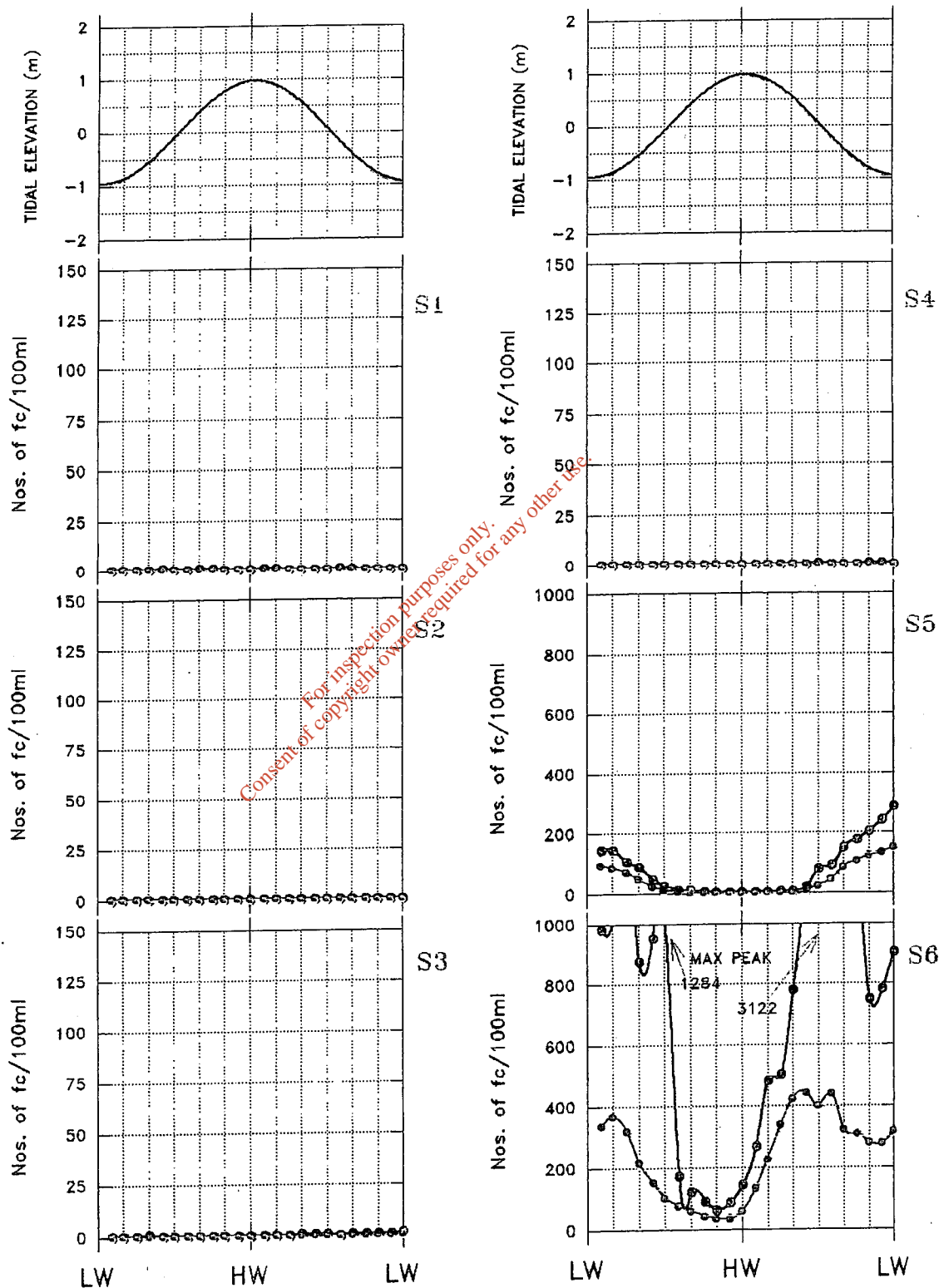
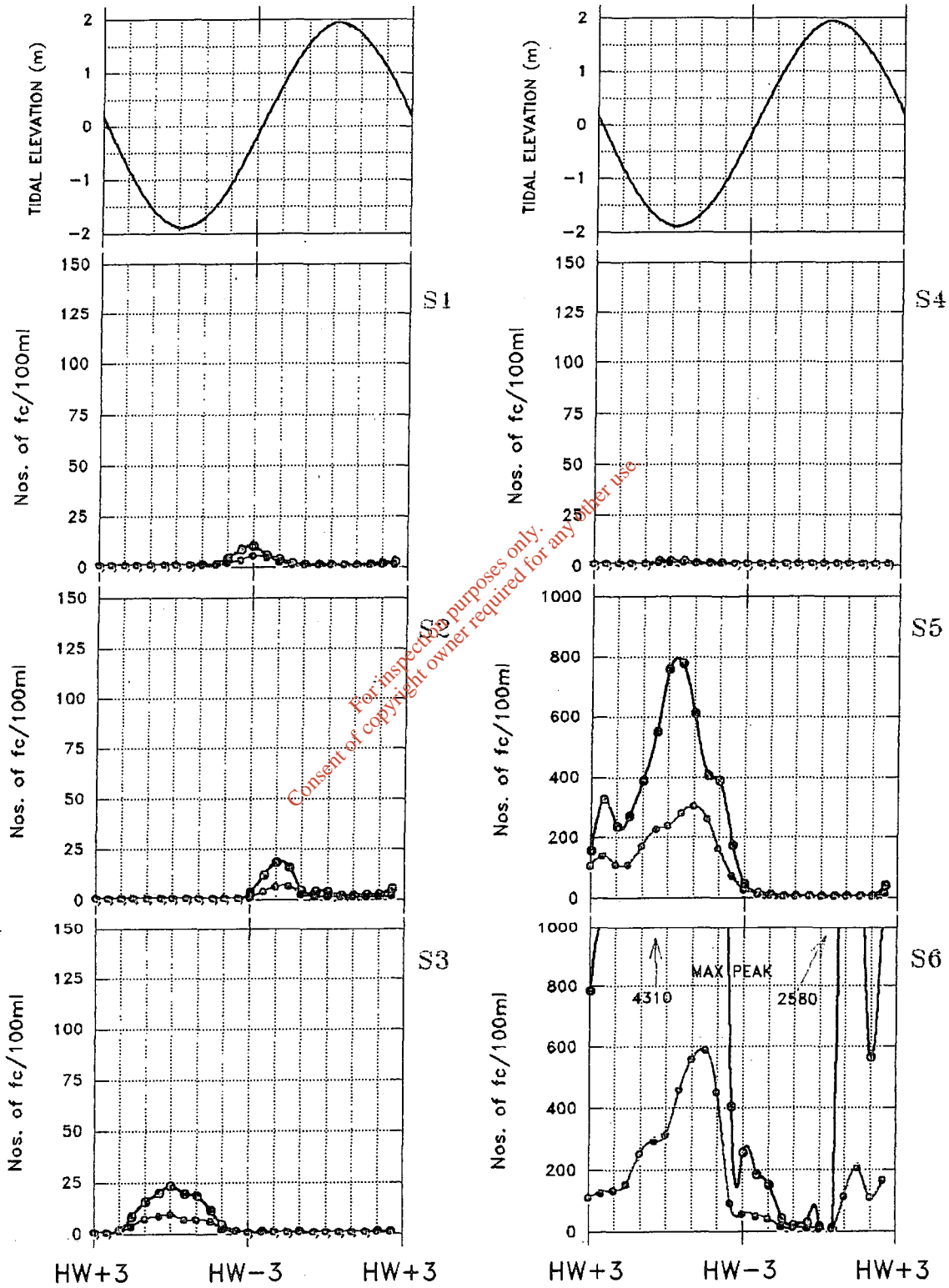


Figure 3.15

MODEL RUN : NC01..Continuous discharge at Middleton on a Neap tide, T_{90} 12 hrs.

MIDDLETON SEWERAGE SCHEME - OUTFALL STUDY

fc/100ml AT FIXED SAMPLING LOCATIONS



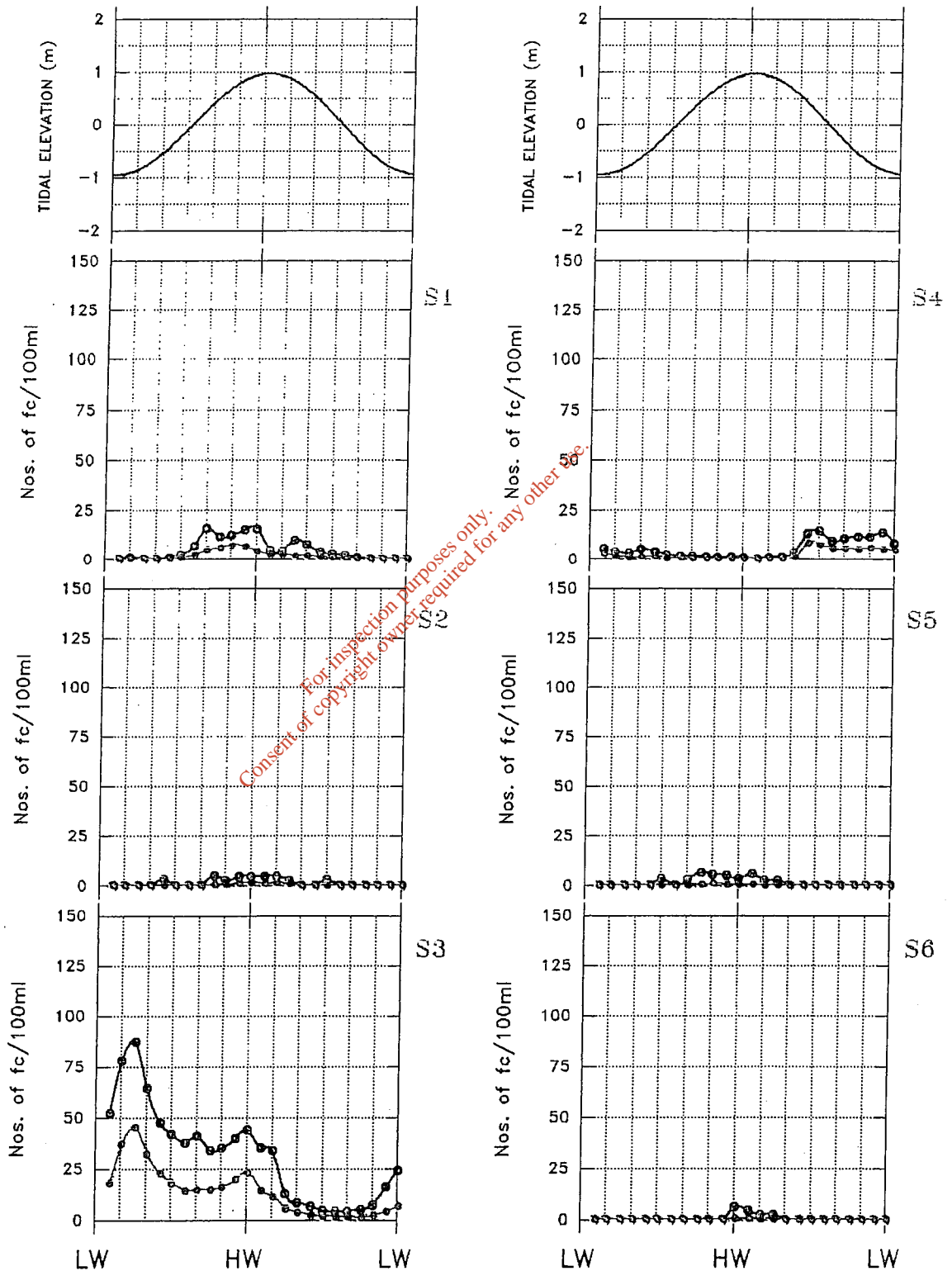
○ PEAK ● AVERAGE

Figure 3.16

MODEL RUN : SC01..Continuous discharge at Middleton on a Spring tide, T_{90} 12 hrs.

MIDDLETON SEWERAGE SCHEME - OUTFALL STUDY

fc/100ml AT FIXED SAMPLING LOCATIONS



○ PEAK ◼ AVERAGE

Figure 3.17

MODEL RUN : NA03..Continuous discharge at Rathcoursey on a Neap tide, T_{90} 6 hrs.

APPENDICES TO IRISH HYDRODATA REPORT

Appendix 1 - Rathcoursey Outfall, Neap Tide, Continuous Discharge

Appendix 2 - Rathcoursey Outfall, Spring Tide, Continuous Discharge

Appendix 3 - Rathcoursey Outfall, Neap Tide, Ebb Discharge

Appendix 4 - Rathcoursey Outfall, Spring Tide, Ebb Discharge

Appendix 5 - Green Point Outfall, Neap Tide, Continuous Discharge

Appendix 6 - Green Point Outfall, Spring Tide, Continuous Discharge

Appendix 7 - Green Point Outfall, Neap Tide, Ebb Discharge

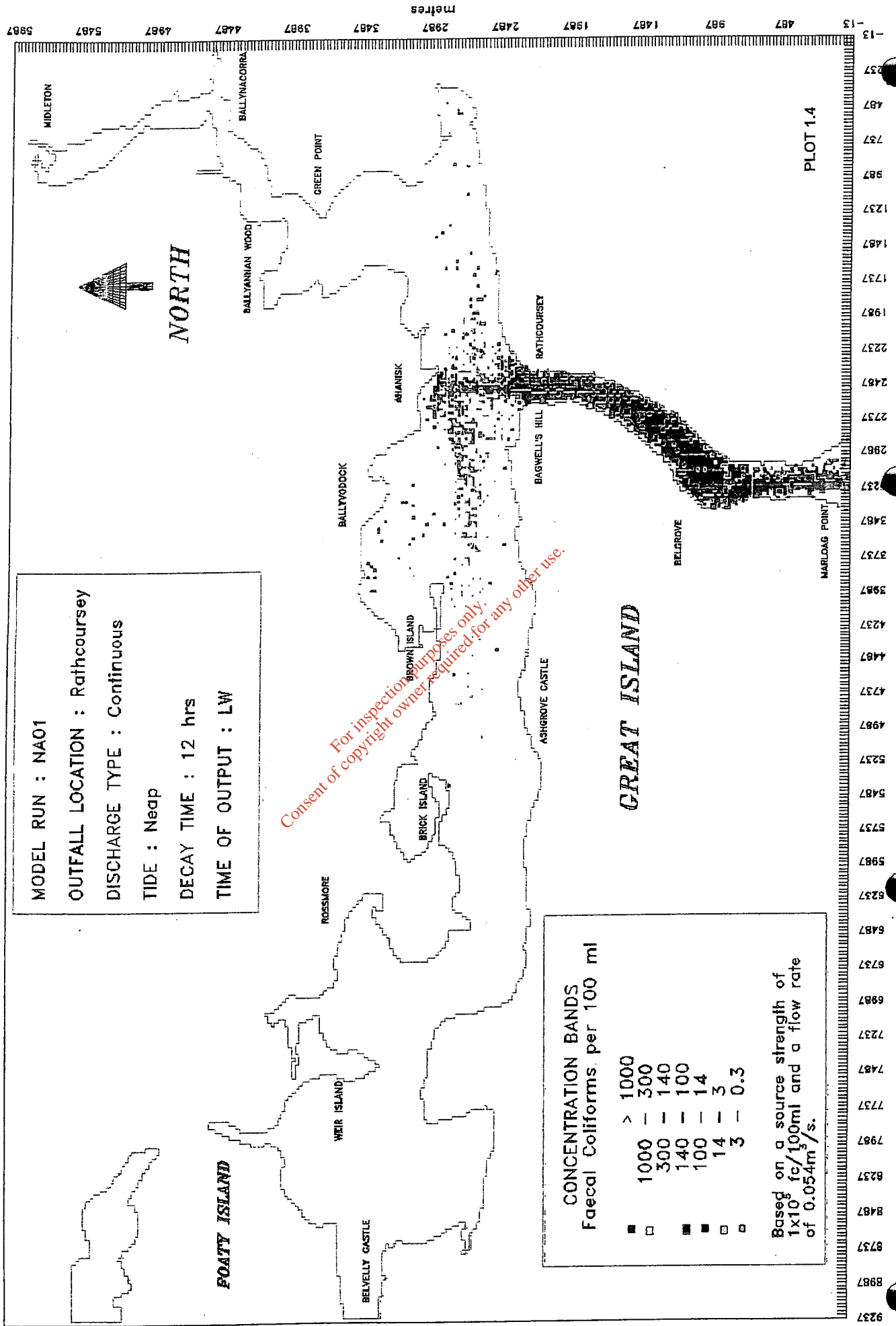
Appendix 8 - Ballinacurra Outfall, Neap Tide, Continuous Discharge

Appendix 9 - Ballinacurra Outfall, Spring Tide, Continuous Discharge

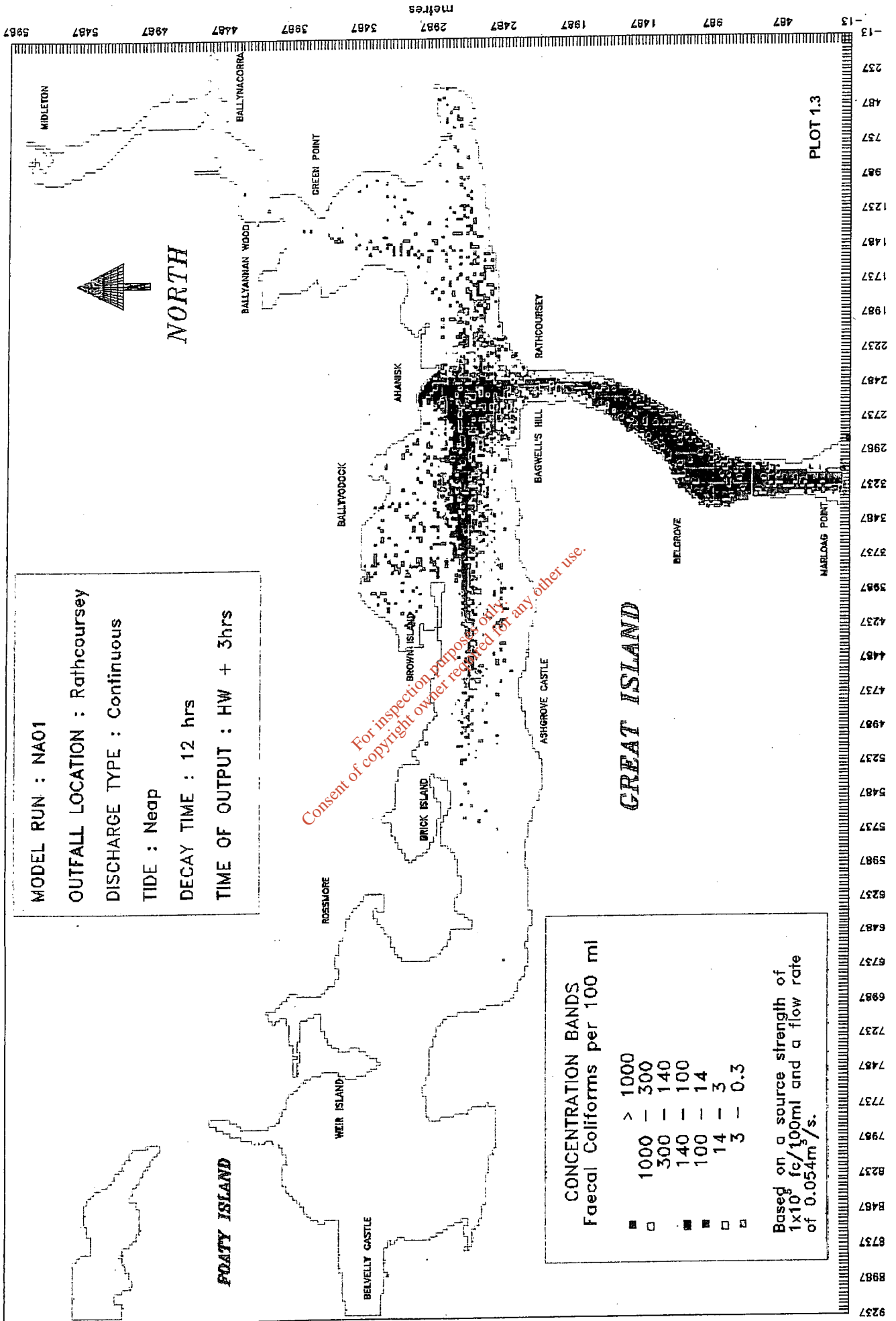
Appendix 10 - Rathcoursey Outfall, Neap Tide, Continuous Discharge, $T_{90} = 6h$

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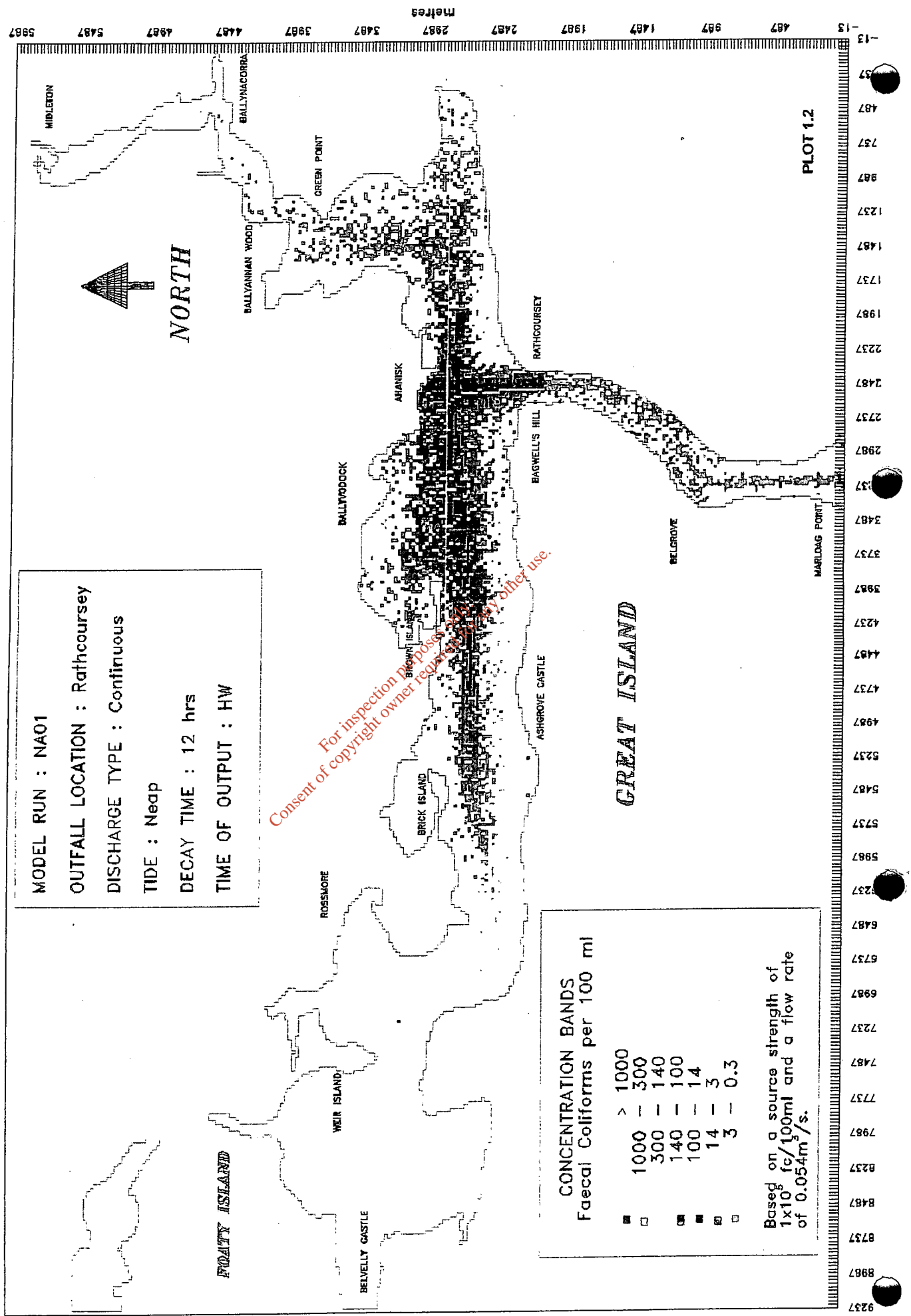
MIDDLETON SEWERAGE SCHEME - OUTFALL STUDY



MIDDLETON SEWERAGE SCHEME - OUTFALL STUDY



MIDDLETON SEWERAGE SCHEME - OUTFALL STUDY



MODEL RUN : NA01
 OUTFALL LOCATION : Rathcoursey
 DISCHARGE TYPE : Continuous
 TIDE : Neap
 DECAY TIME : 12 hrs
 TIME OF OUTPUT : HW

CONCENTRATION BANDS
 Faecal Coliforms per 100 ml

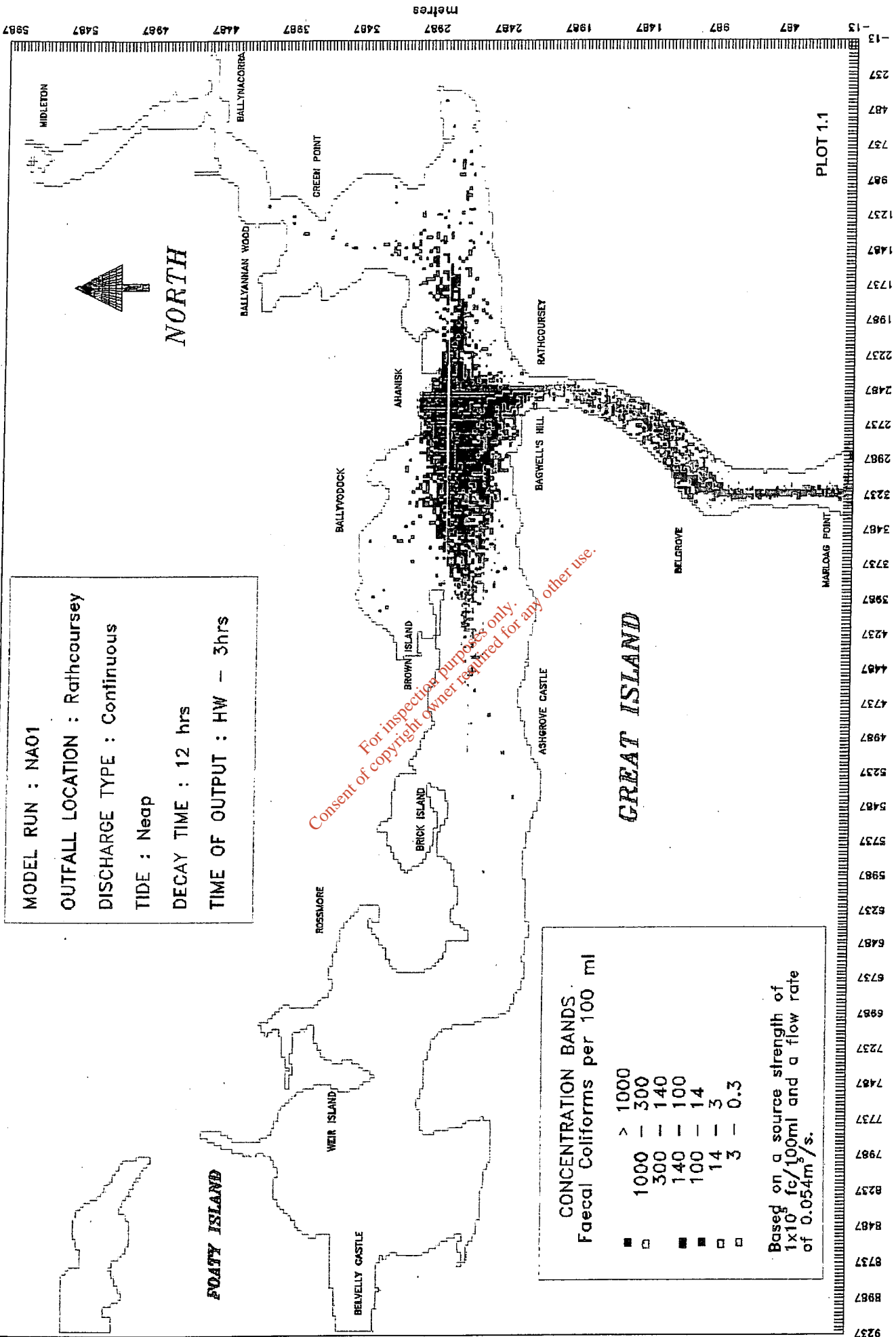
■	> 1000
□	1000
□	300
□	140
□	100
□	14
□	3
□	0.3

Based on a source strength of 1×10^8 fc/100ml and a flow rate of 0.054m³/s.

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PLOT 1.2

MIDDLETON TOWERAGE SCHEME - OUTFALL SUDY



MODEL RUN : NAO1
 OUTFALL LOCATION : Rathcoursey
 DISCHARGE TYPE : Continuous
 TIDE : Neap
 DECAY TIME : 12 hrs
 TIME OF OUTPUT : HW - 3hrs

CONCENTRATION BANDS
 Faecal Coliforms per 100 ml

■	> 1000
□	1000 - 300
■	300 - 140
■	140 - 100
■	100 - 14
□	14 - 3
□	3 - 0.3

Based on a source strength of 1×10^8 fc/100ml and a flow rate of $0.054 \text{ m}^3/\text{s}$.

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13
 257
 487
 737
 987
 1237
 1487
 1737
 1987
 2237
 2487
 2737
 2987
 3237
 3487
 3737
 3987
 4237
 4487
 4737
 4987
 5237
 5487
 5737
 5987
 6237
 6487
 6737
 6987
 7237
 7487
 7737
 7987
 8237
 8487
 8737
 8987
 9237

metres

MIDDLETON WERAGE SCHEME - OUTFALL STUDY

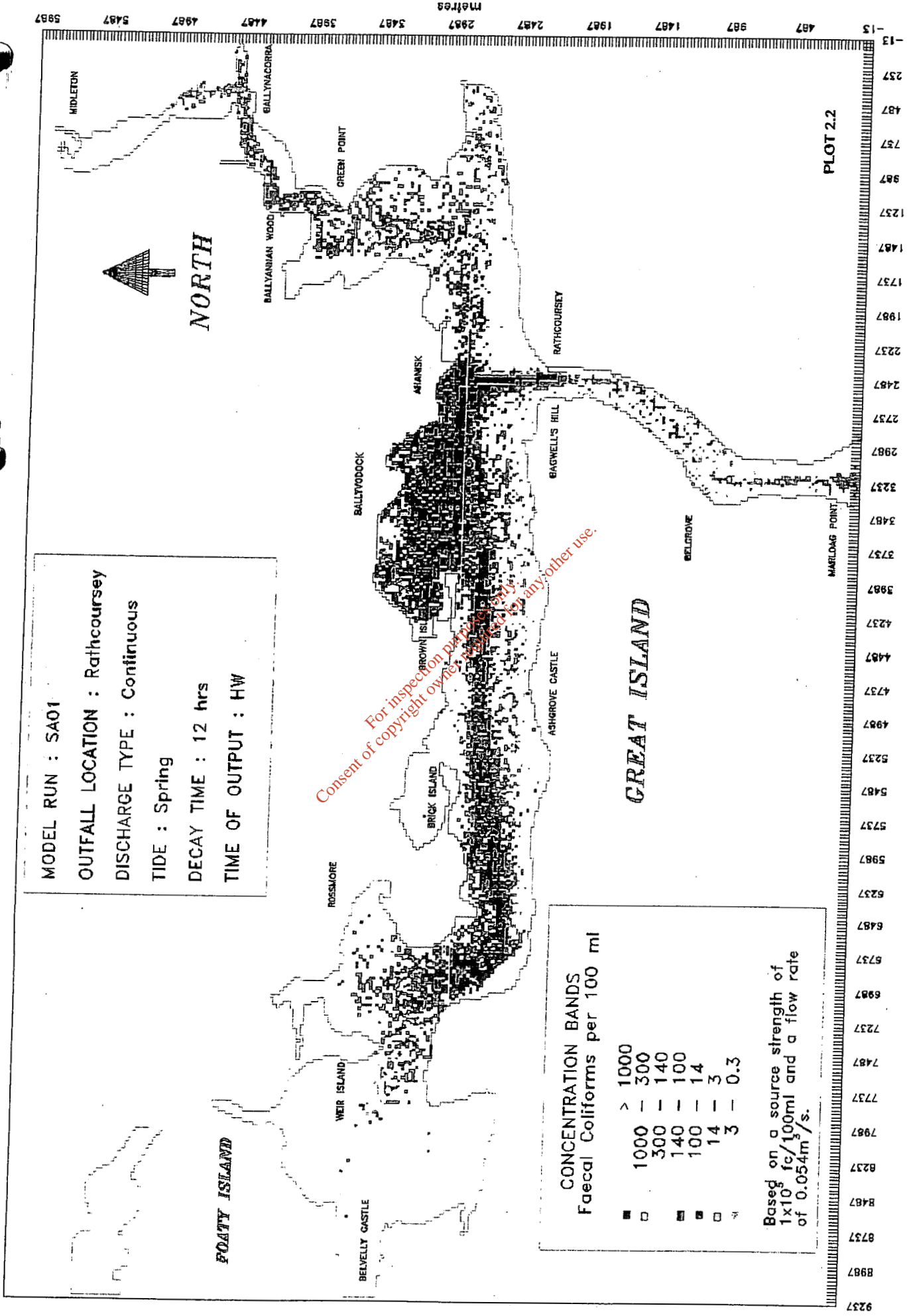
MODEL RUN : SA01
 OUTFALL LOCATION : Rathcoursey
 DISCHARGE TYPE : Continuous
 TIDE : Spring
 DECAY TIME : 12 hrs
 TIME OF OUTPUT : HW

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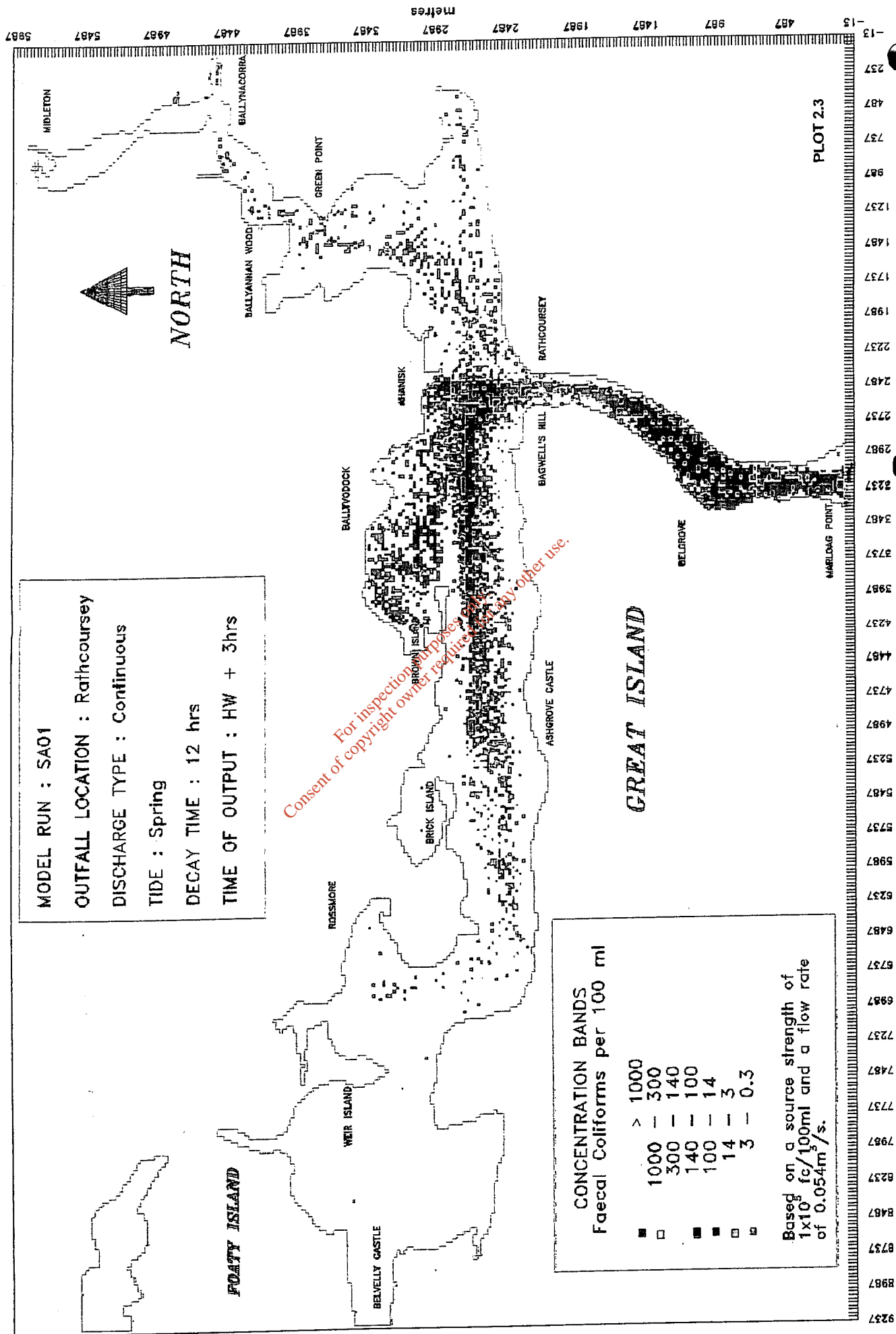
CONCENTRATION BANDS
 Faecal Coliforms per 100 ml

■	> 1000
□	1000 - 300
■	300 - 140
■	140 - 100
■	100 - 14
■	14 - 3
■	3 - 0.3

Based on a source strength of 1x10⁶ fc/100ml and a flow rate of 0.054m³/s.



MIDDLETON SEWERAGE SCHEME - OUTFALL STUDY



MODEL RUN : SA01
 OUTFALL LOCATION : Rathcoursey
 DISCHARGE TYPE : Continuous
 TIDE : Spring
 DECAY TIME : 12 hrs
 TIME OF OUTPUT : HW + 3hrs

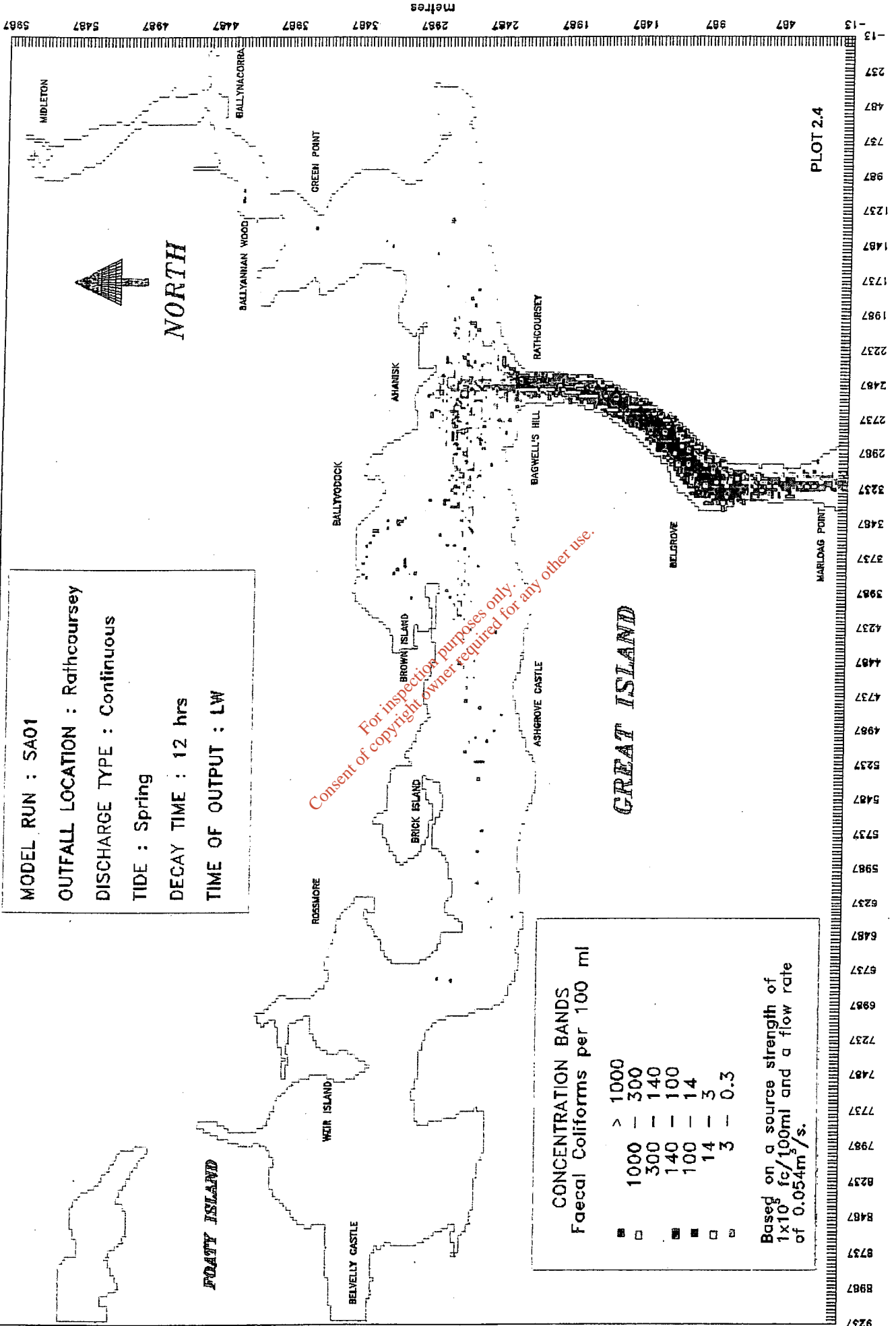
CONCENTRATION BANDS
 Faecal Coliforms per 100 ml

■	> 1000
□	1000 - 300
■	300 - 140
■	140 - 100
■	100 - 14
□	14 - 3
□	3 - 0.3

Based on a source strength of 1×10^5 fc/100ml and a flow rate of 0.054m³/s.

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MIDDLETON SEWERAGE SCHEME - OUTFALL STUDY



MODEL RUN : SA01
OUTFALL LOCATION : Rathcoursey
DISCHARGE TYPE : Continuous
TIDE : Spring
DECAY TIME : 12 hrs
TIME OF OUTPUT : LW

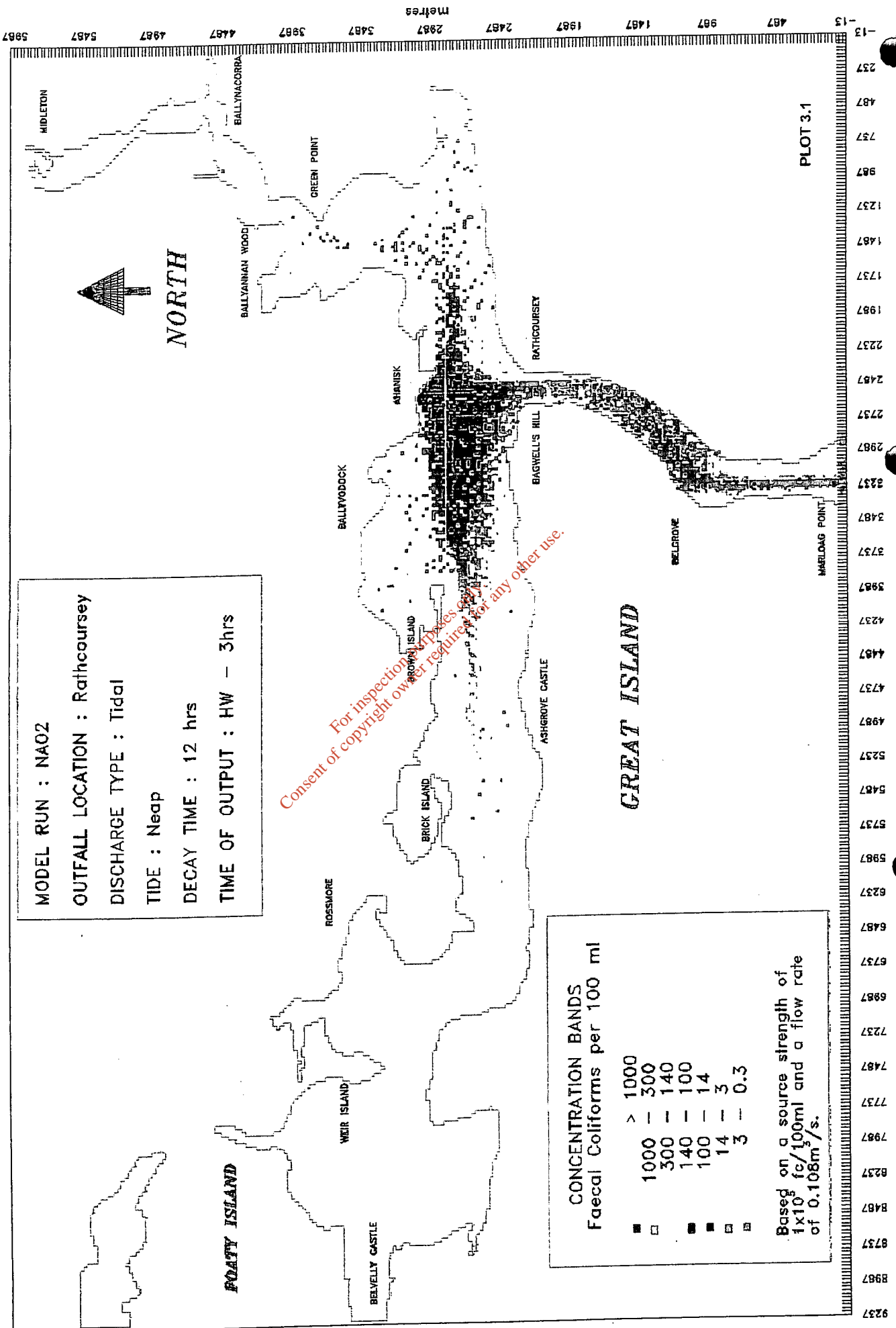
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CONCENTRATION BANDS
Faecal Coliforms per 100 ml

■	> 1000
□	1000 - 300
□	300 - 140
■	140 - 100
■	100 - 14
□	14 - 3
□	3 - 0.3

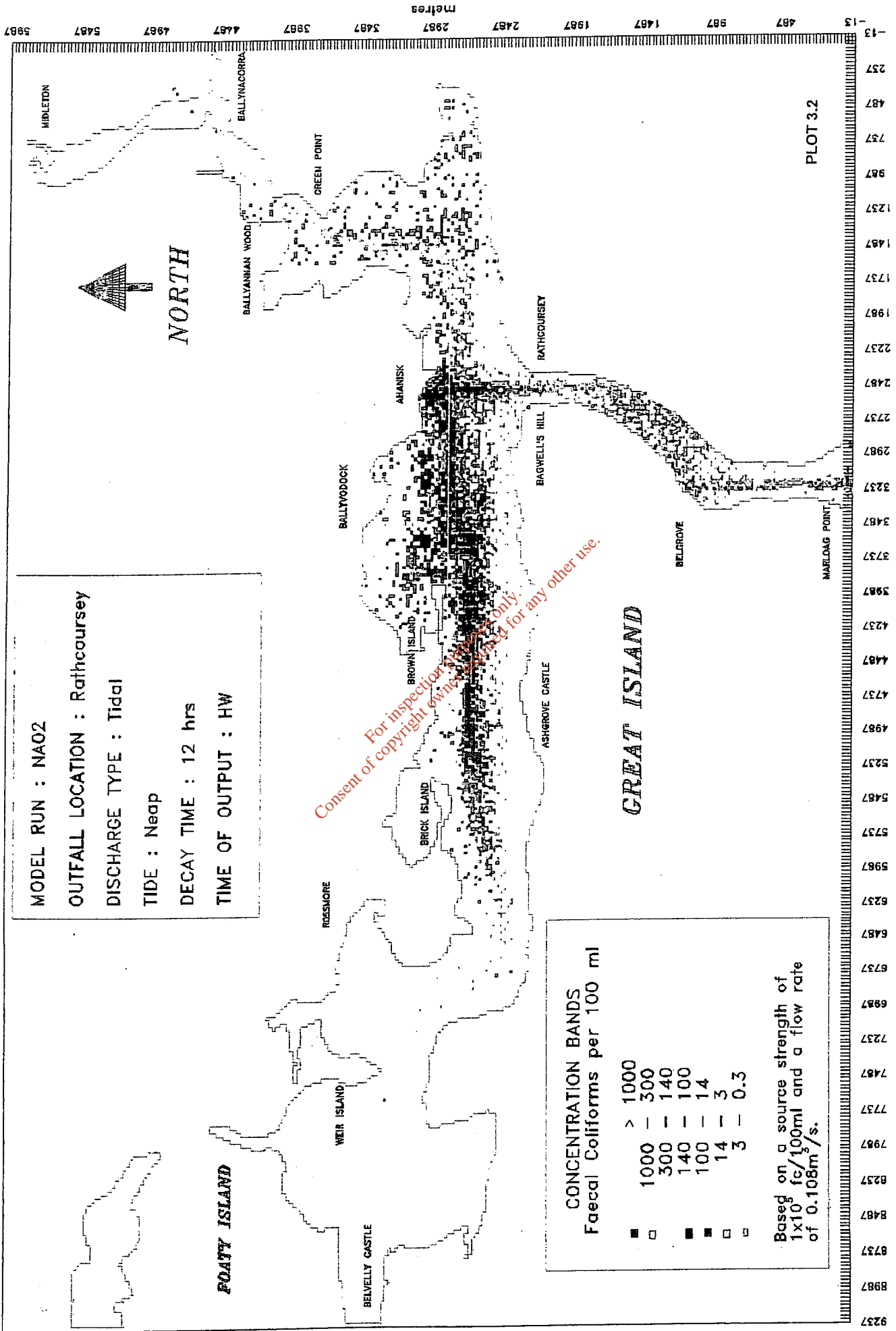
Based on a source strength of
 1×10^6 fc/100ml and a flow rate
 of 0.054m³/s.

MIDLETON SEWERAGE SCHEME - OUTFALL ST-DY



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MIDDLETON WERAGE SCHEME - OUTFALL STUDY



MODEL RUN : NAO2

OUTFALL LOCATION : Rathcoursey

DISCHARGE TYPE : Tidal

TIDE : Neap

DECAY TIME : 12 hrs

TIME OF OUTPUT : HW

CONCENTRATION BANDS
Faecal Coliforms per 100 ml

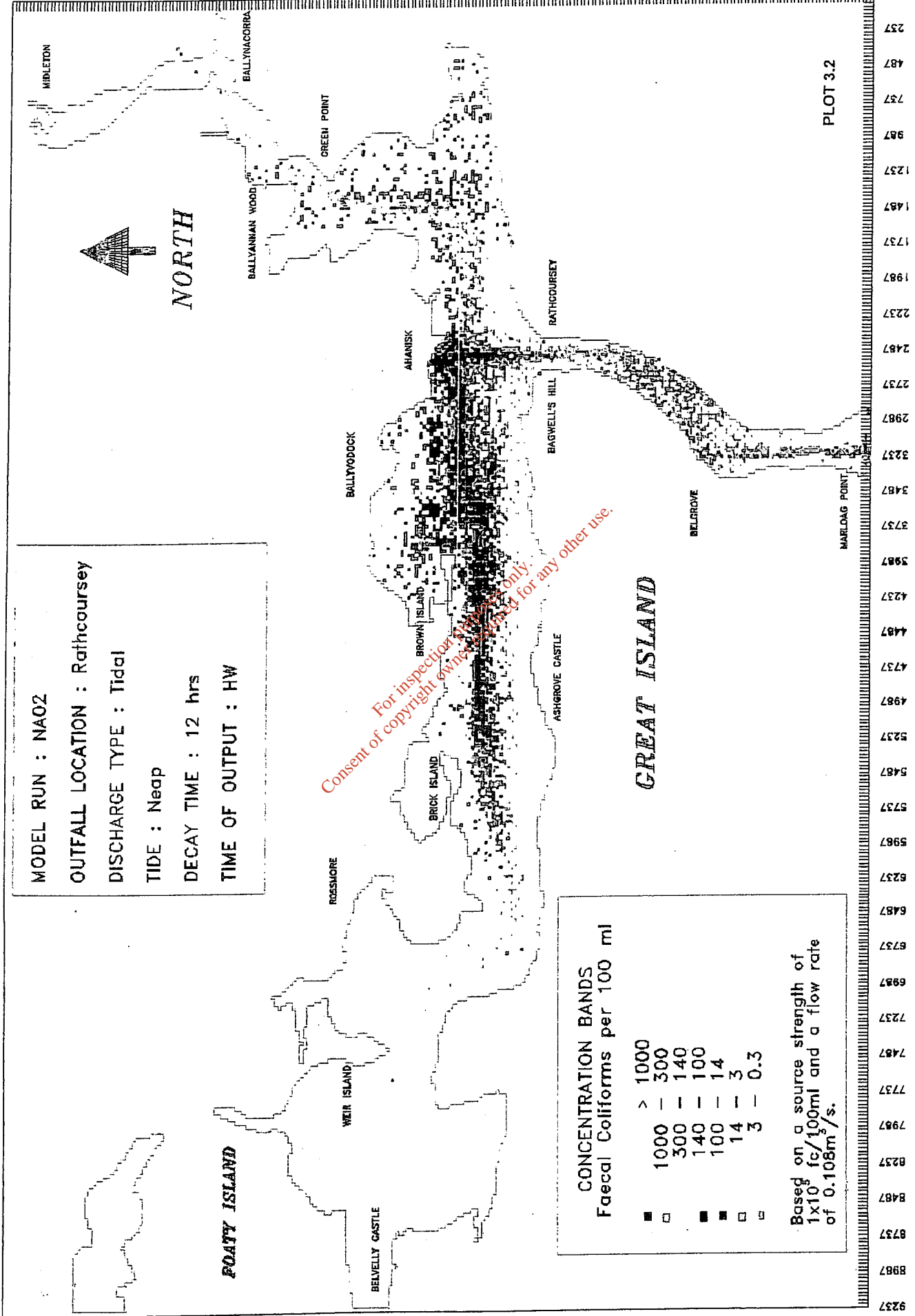
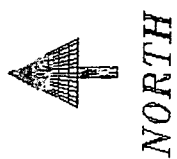
- > 1000
- 1000 - 300
- 300 - 140
- 140 - 100
- 100 - 14
- 14 - 3
- 3 - 0.3

Based on a source strength of 1×10^8 fc/100ml and a flow rate of 0.108m³/s.

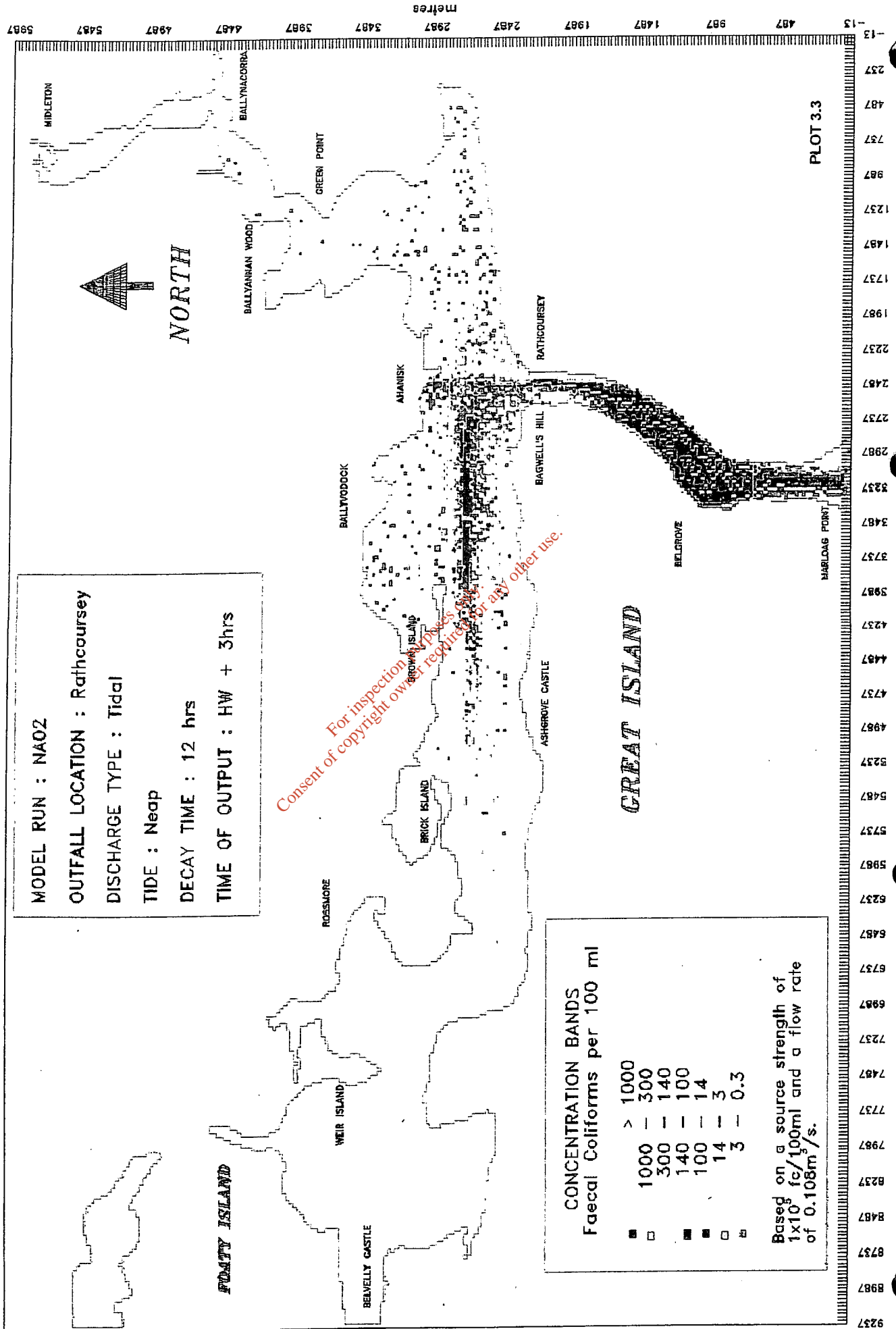
For inspection only. Consent of copyright owner required for any other use.

13 487 987 1487 1987 2487 2987 3487 3987 4487 4987 5487 5987 metres

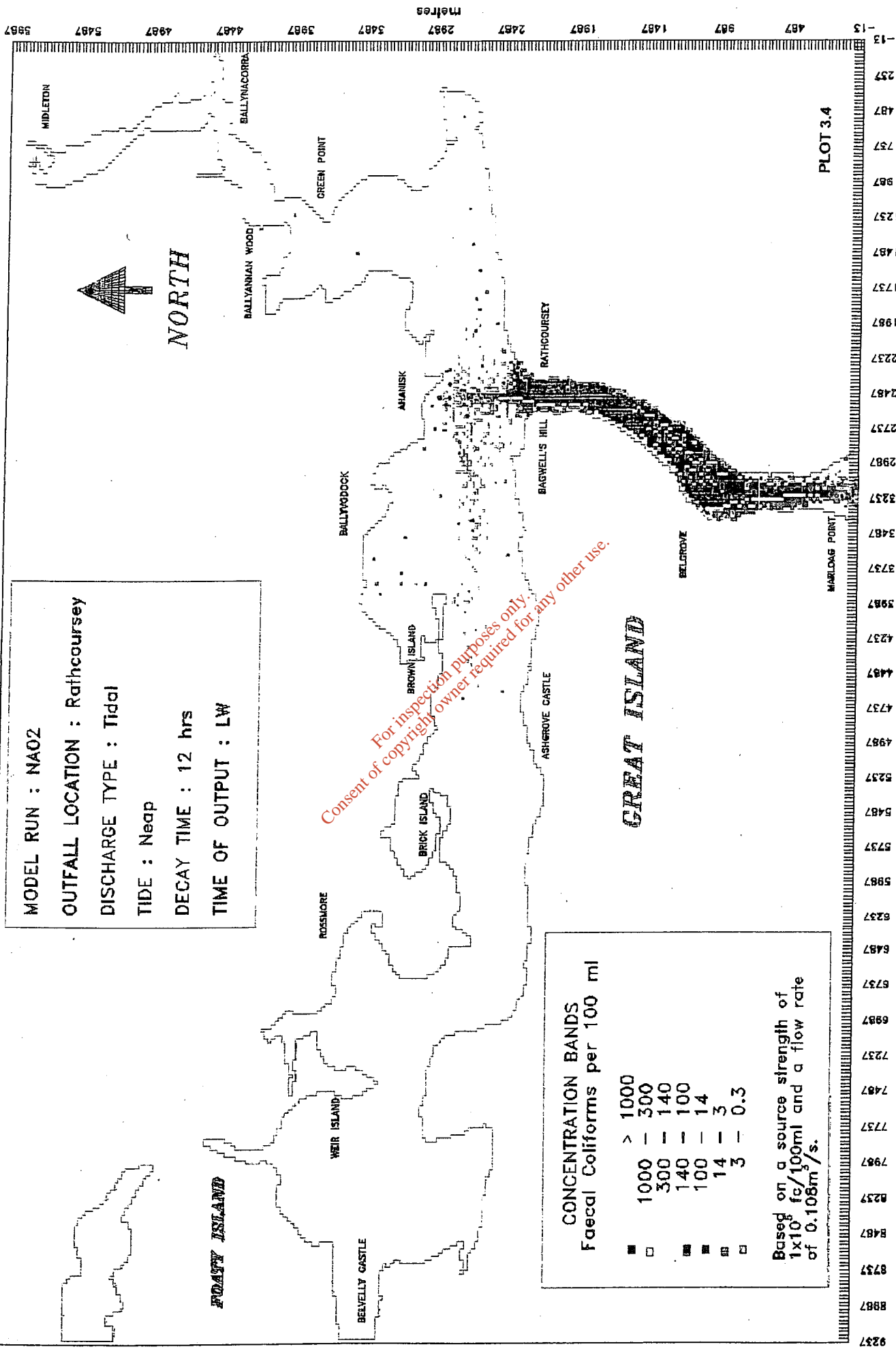
PLOT 3.2



MIDDLETON SEWERAGE SCHEME - OUTFALL STUDY



MIDDLETON ~~S~~ WERAGE SCHEME - OUTFALL ST ~~Y~~



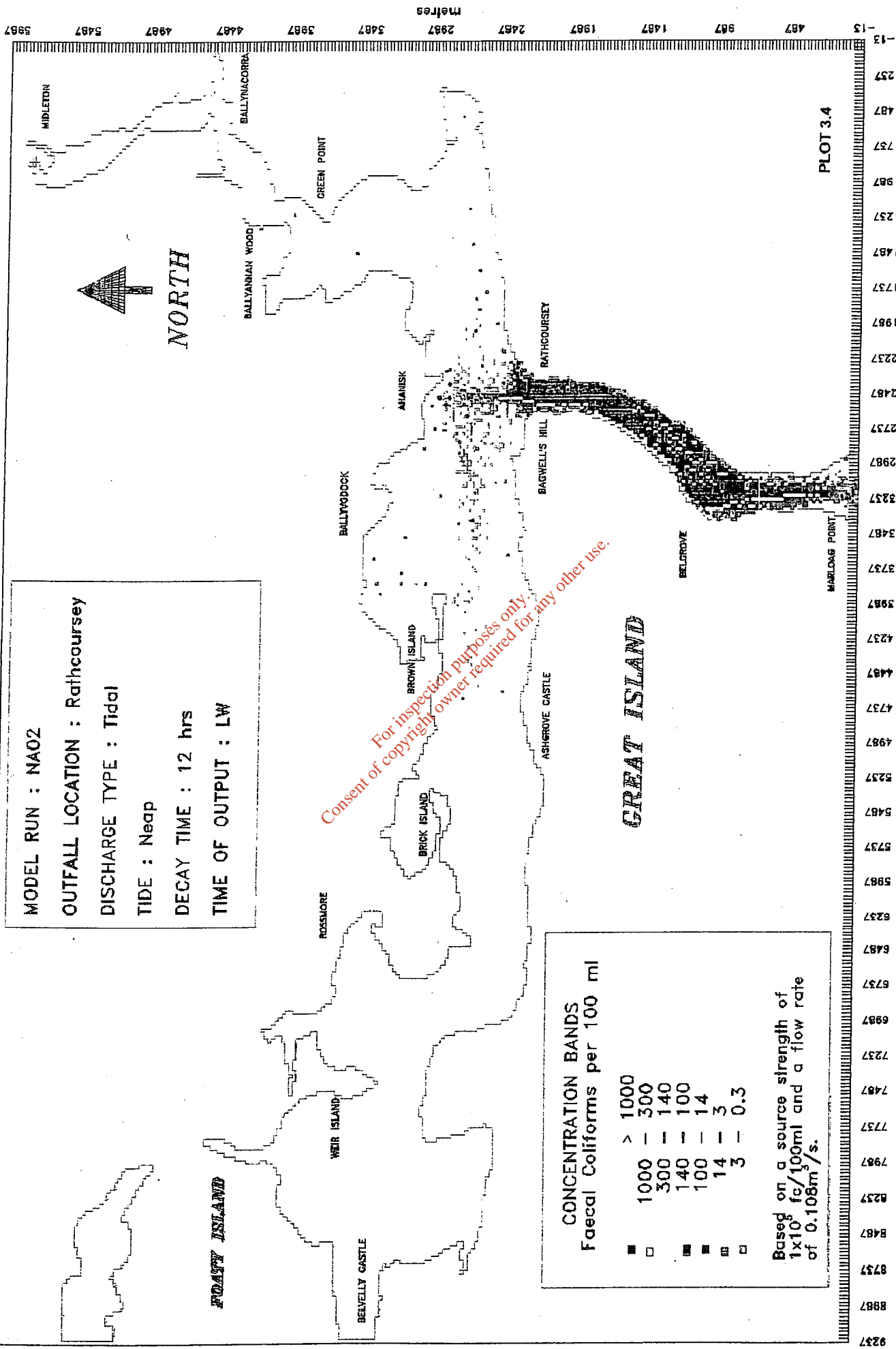
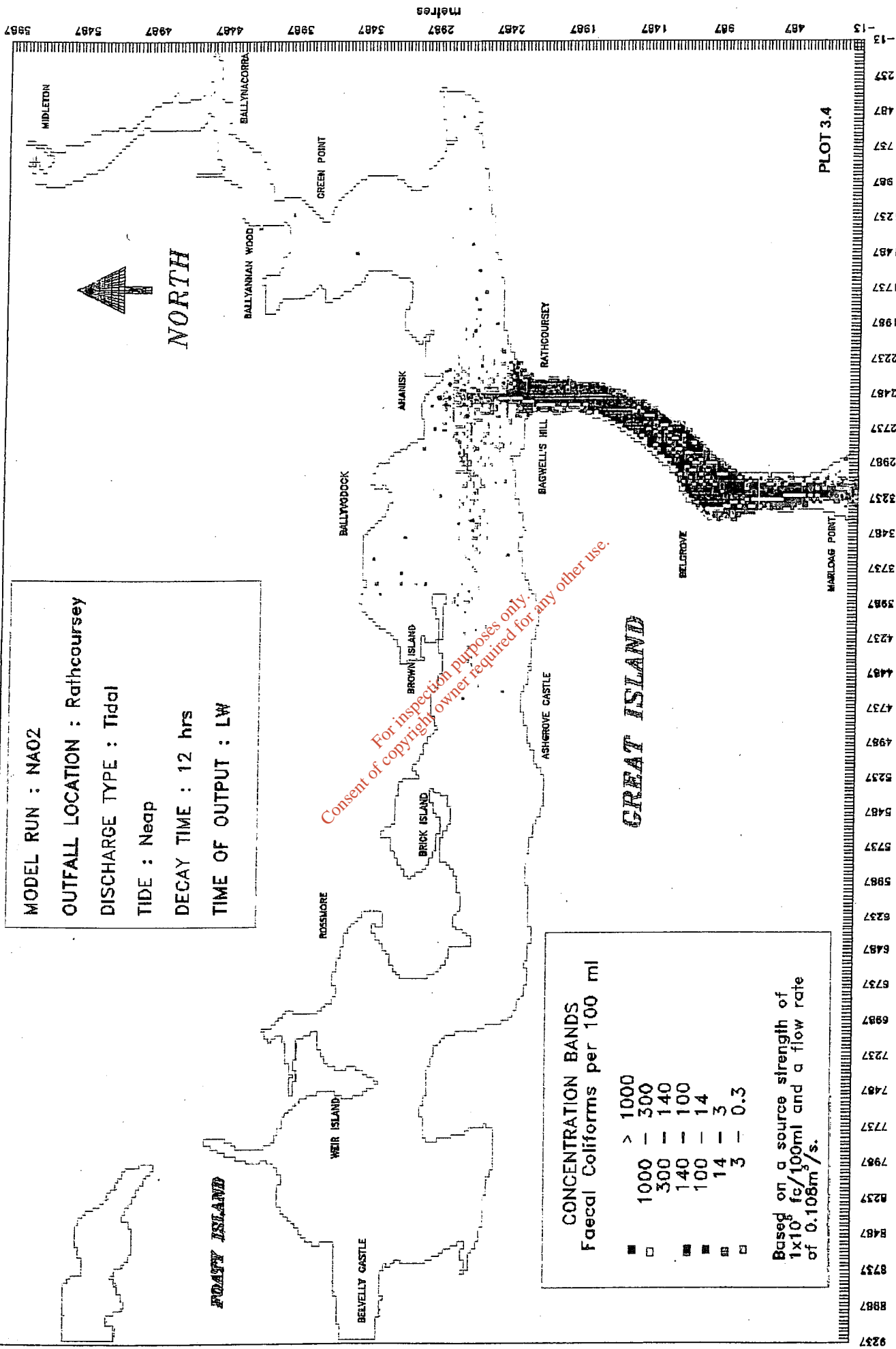
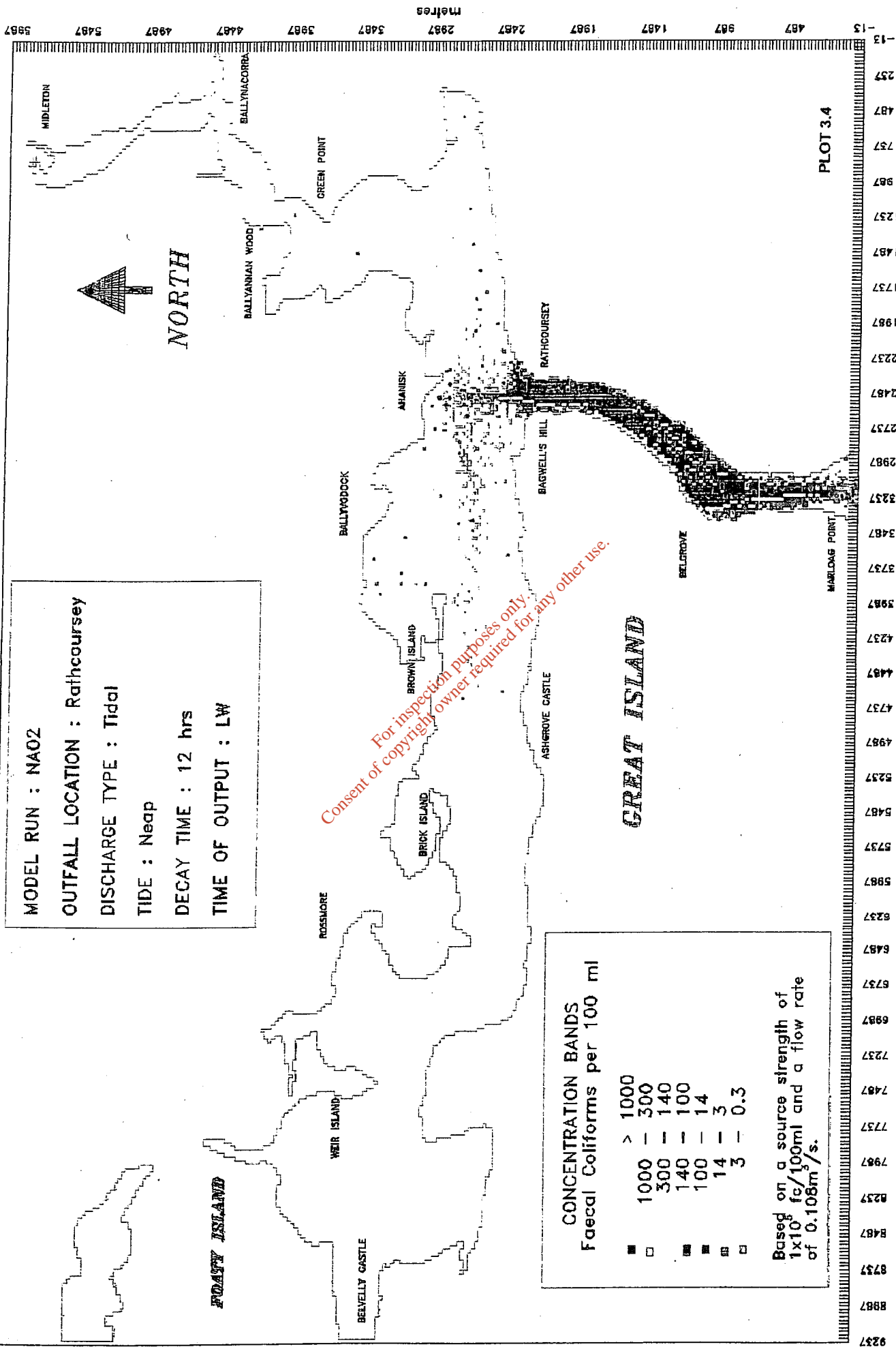
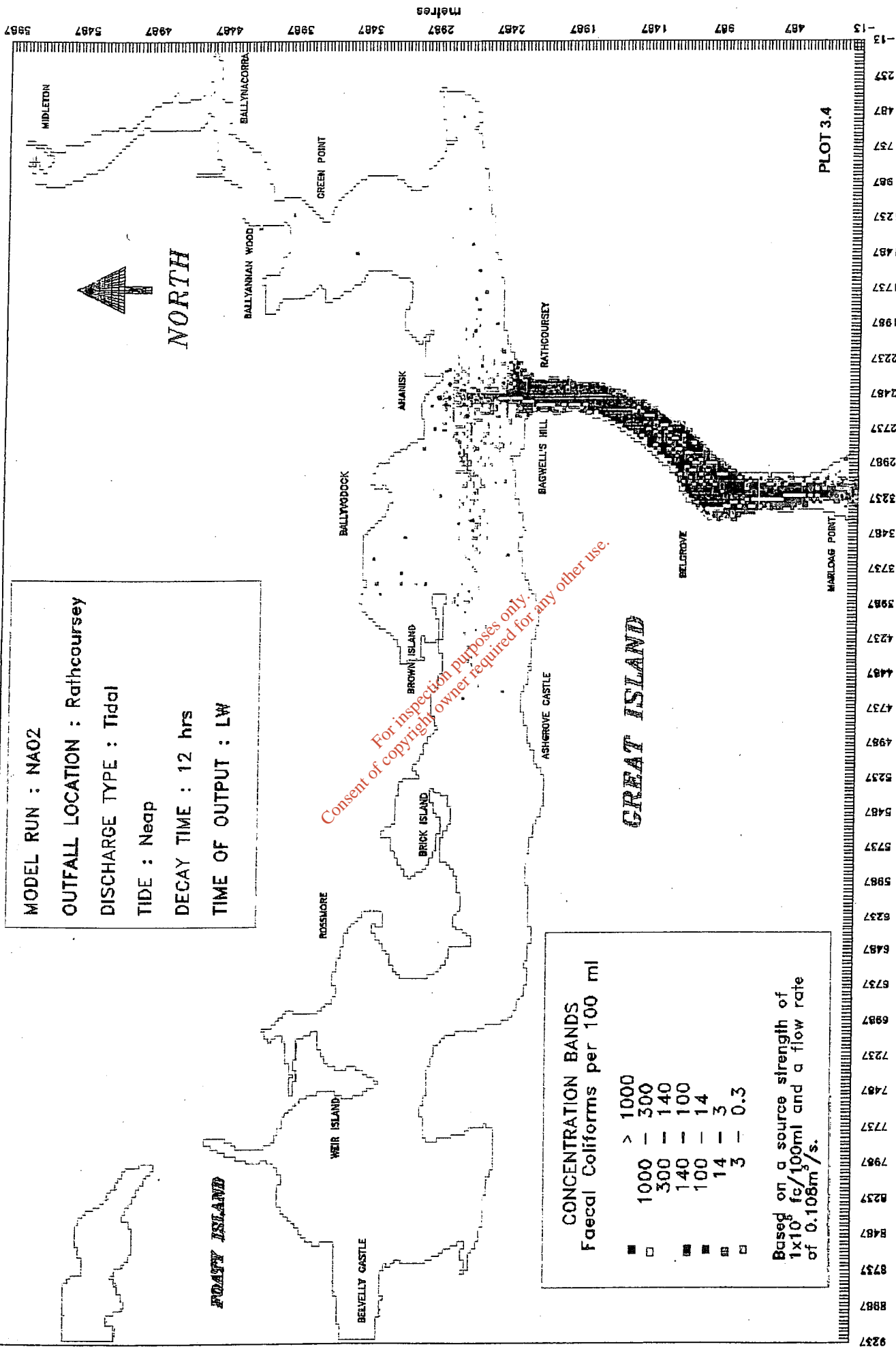
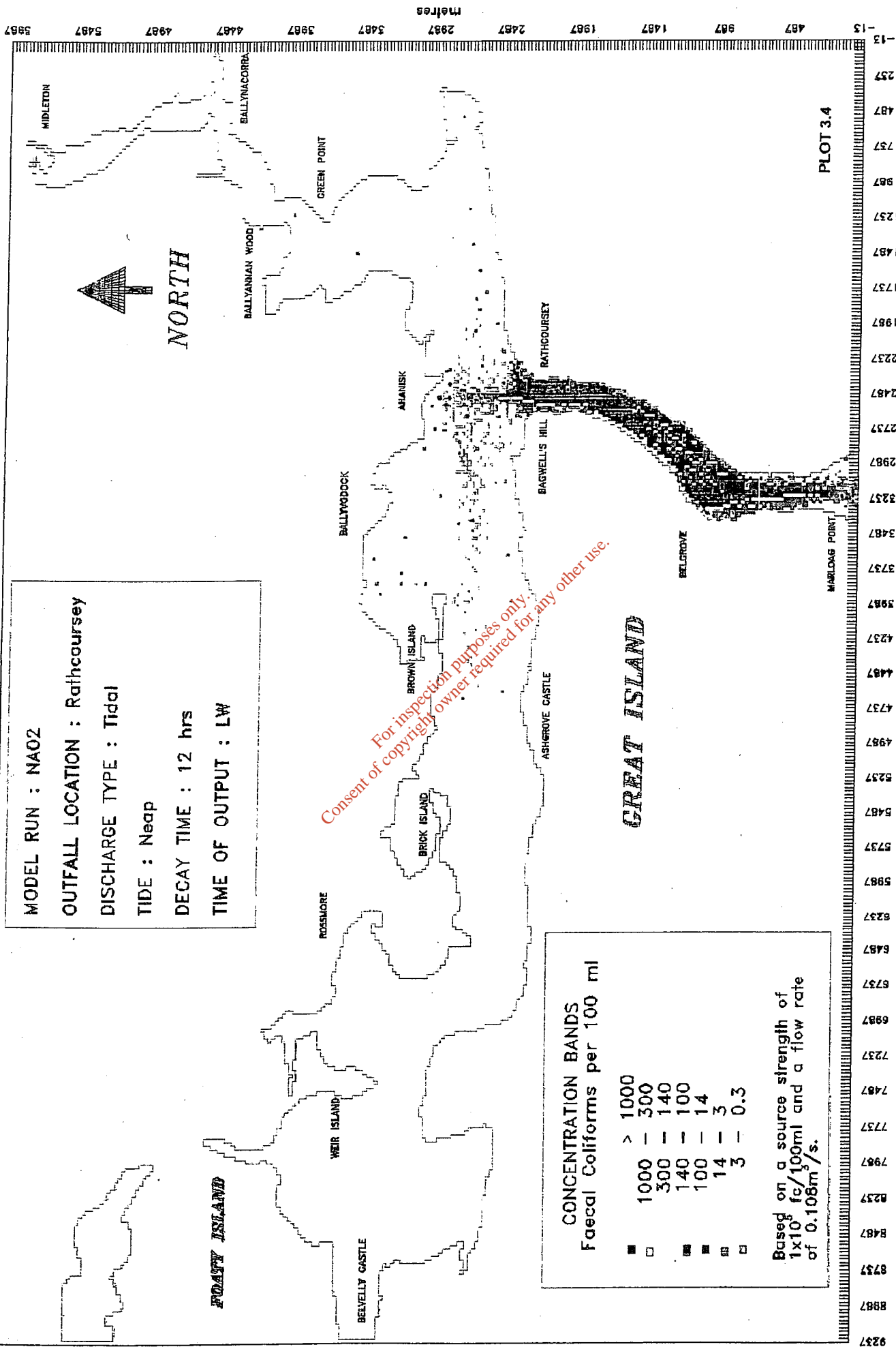
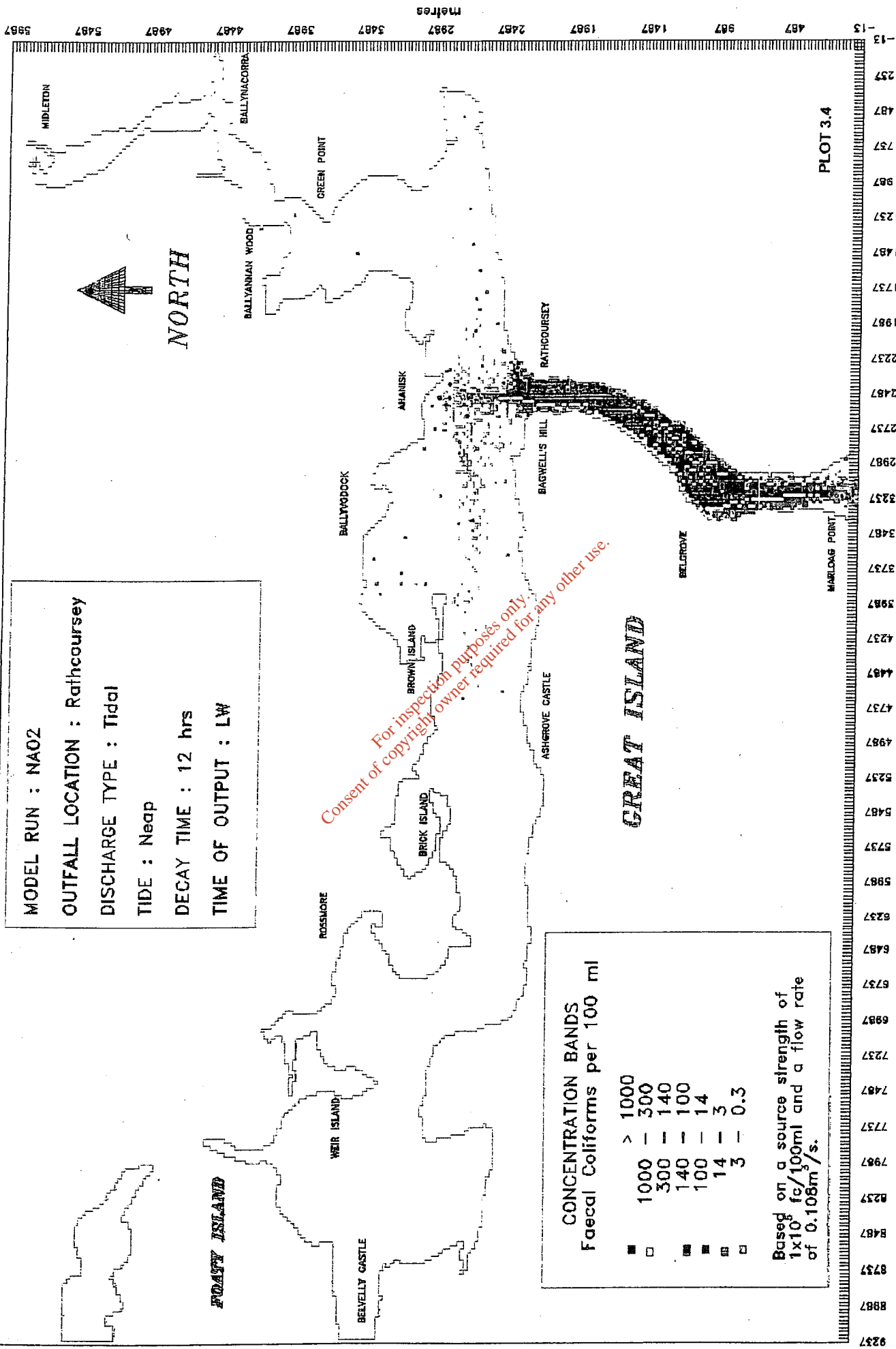
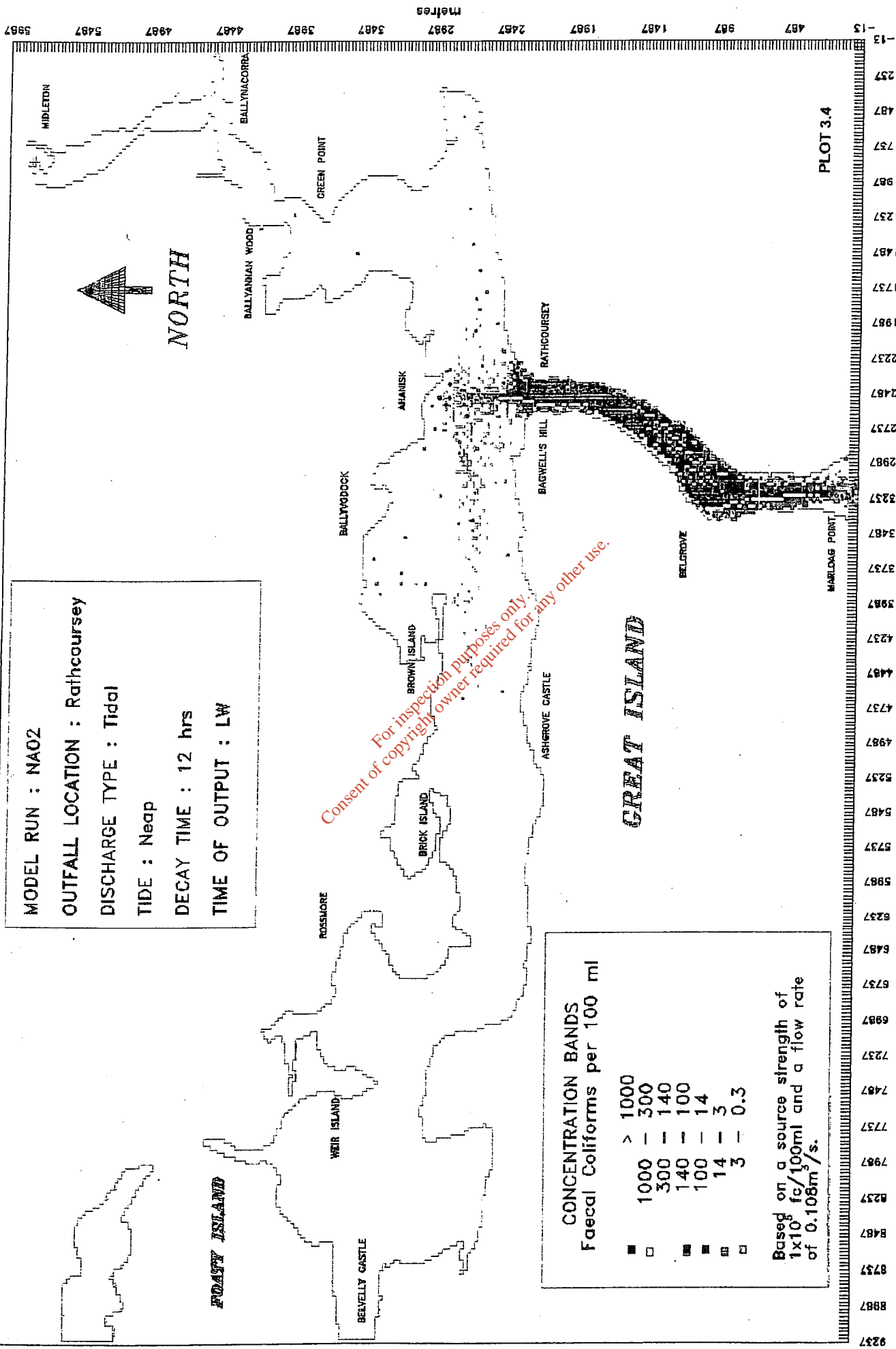
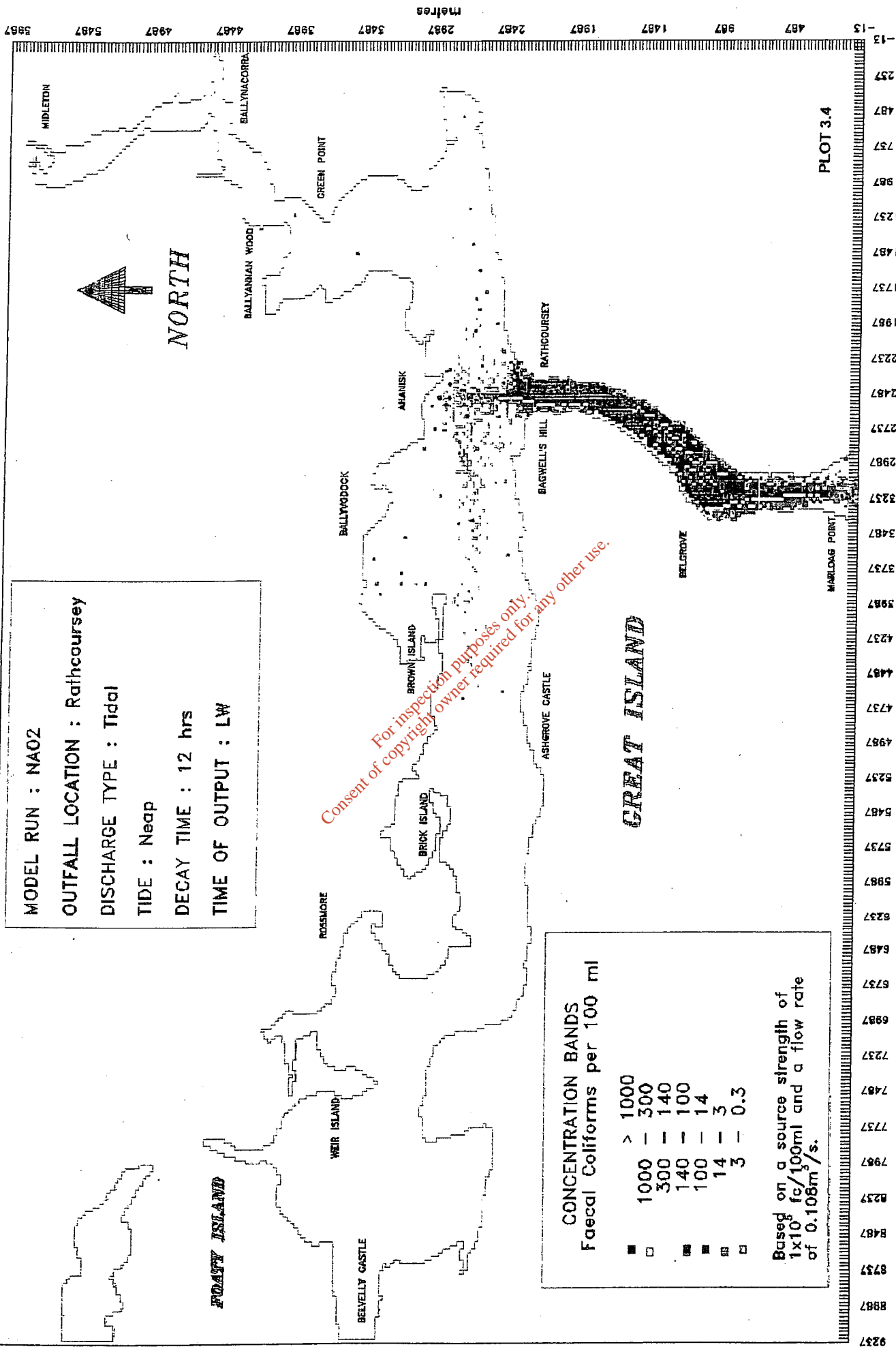
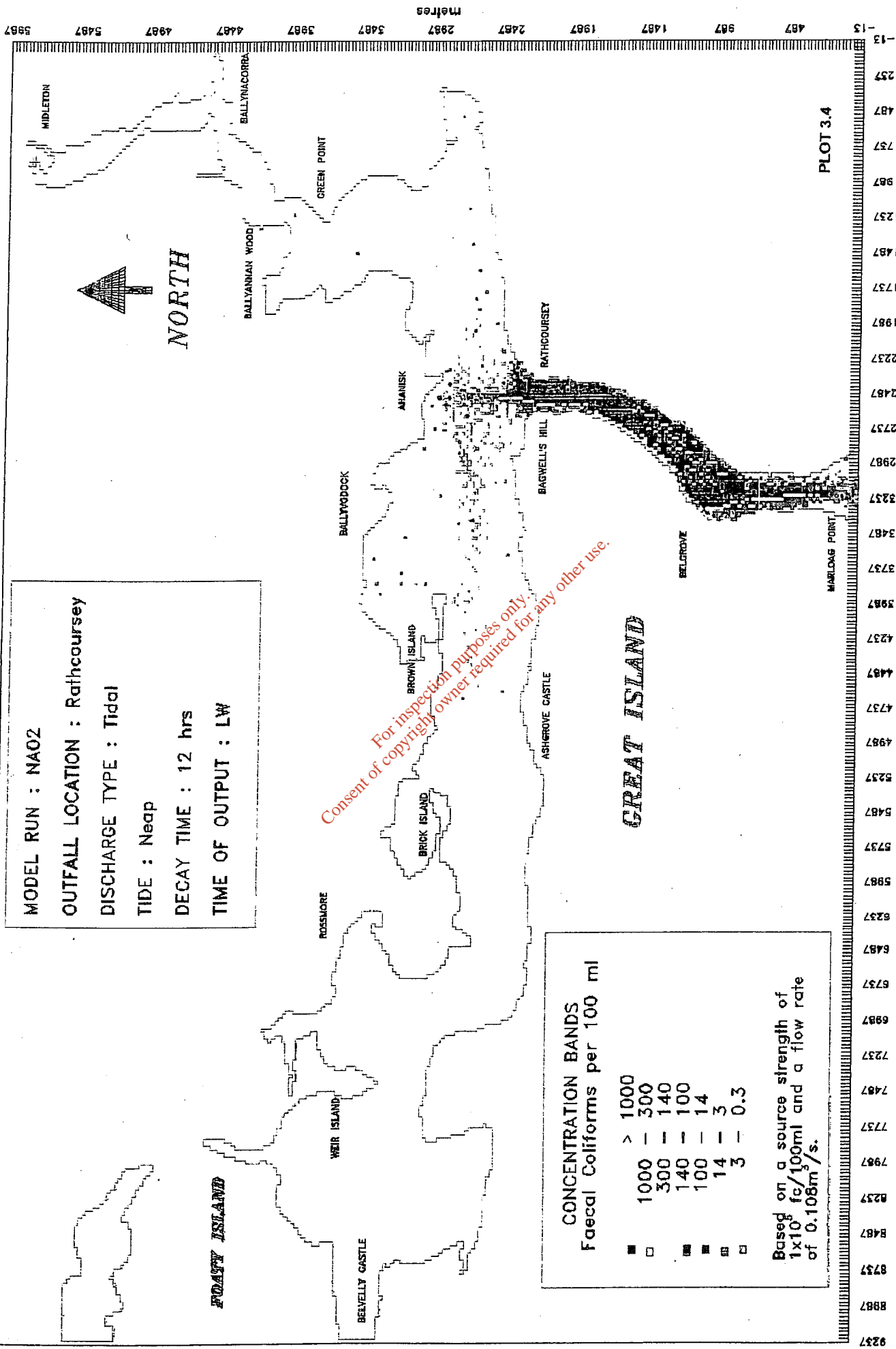
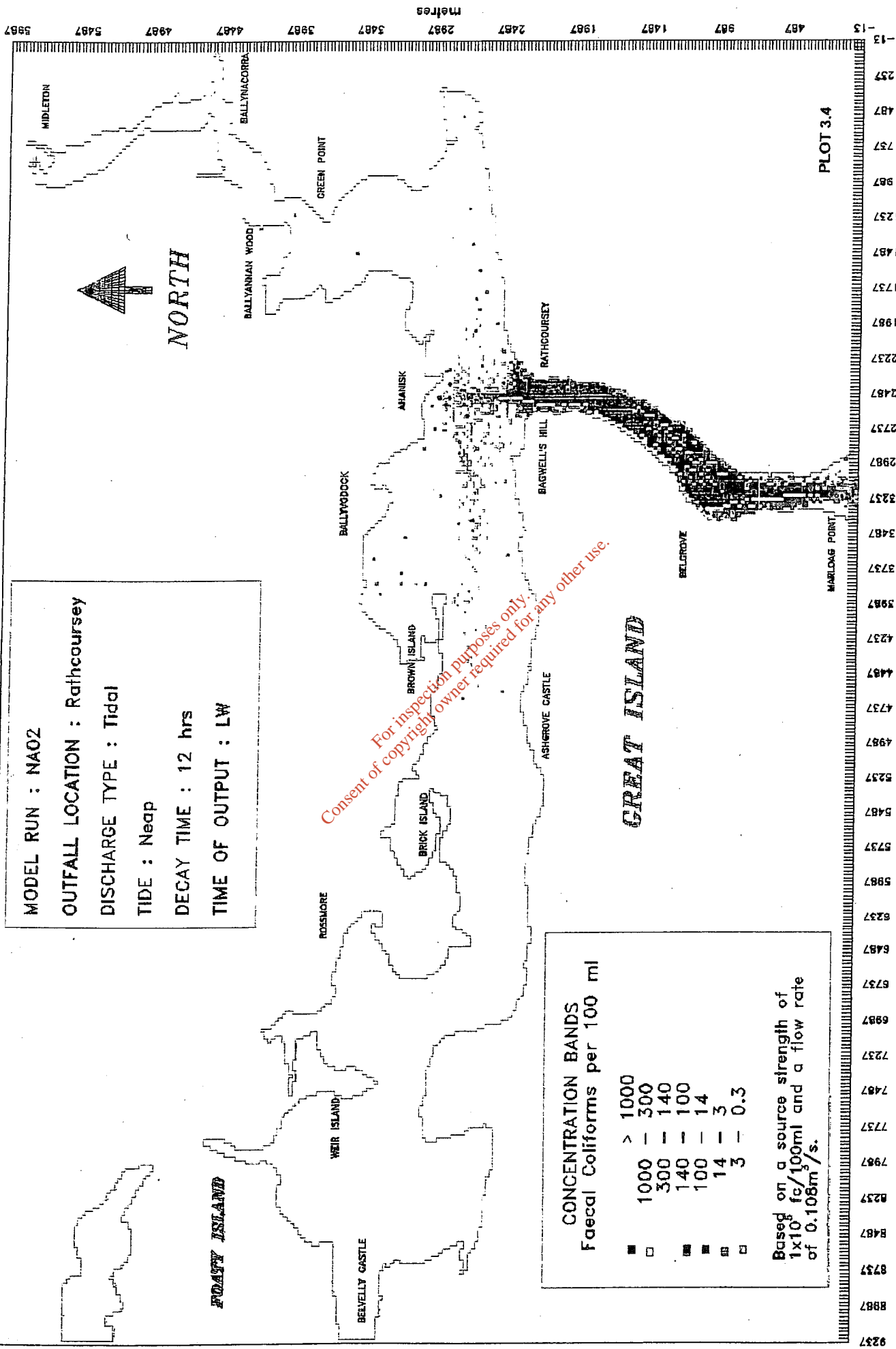
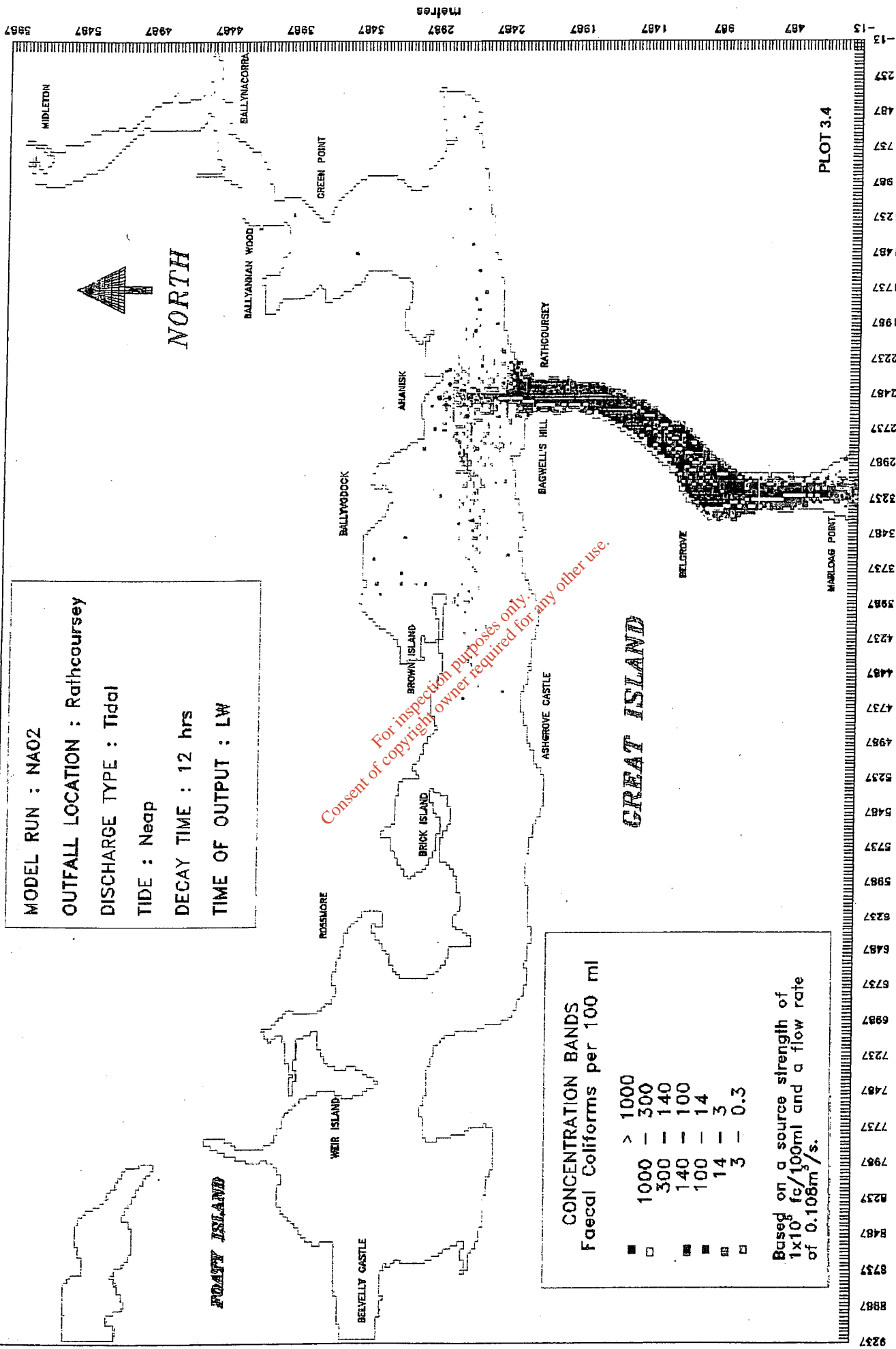
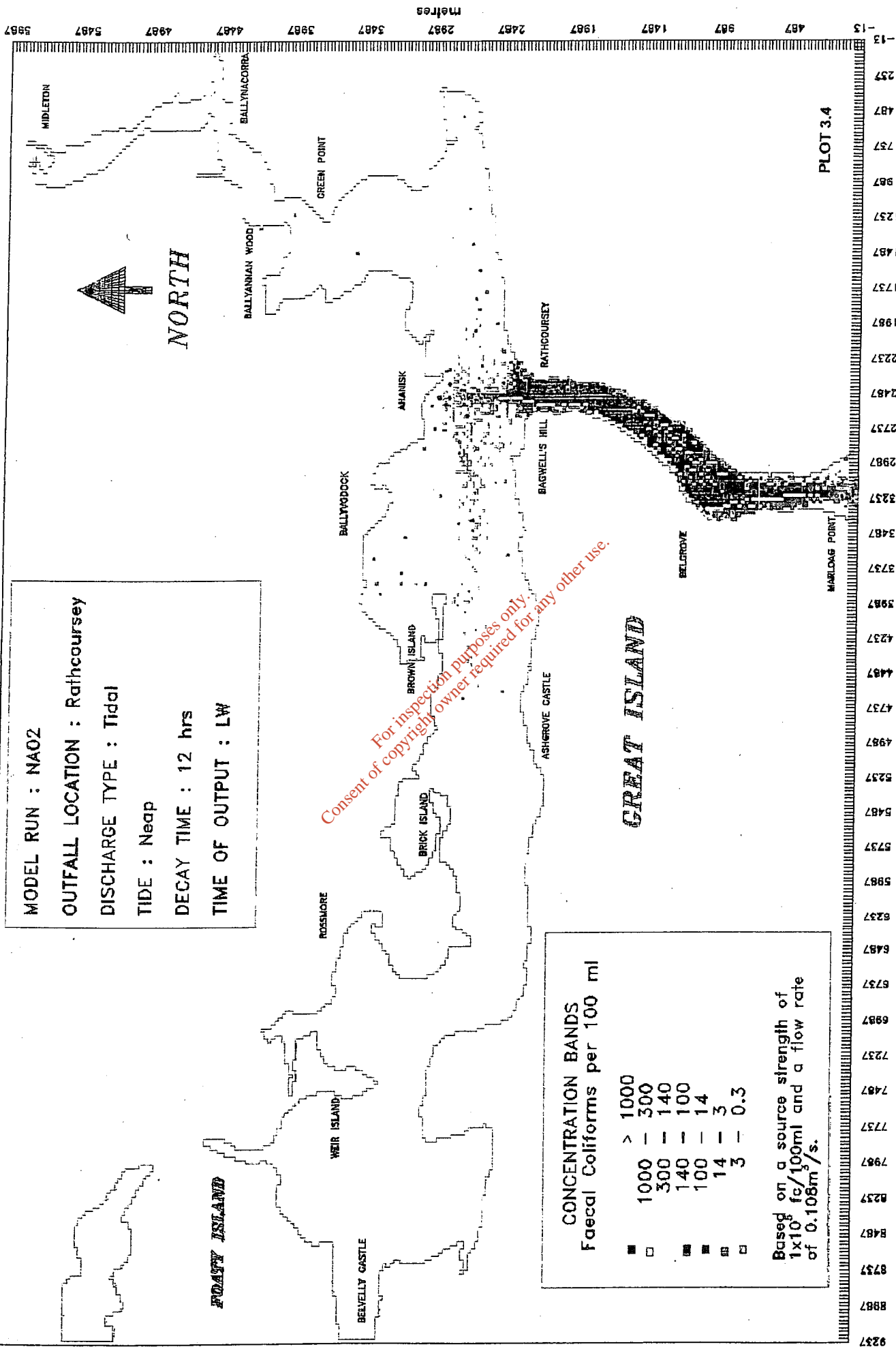
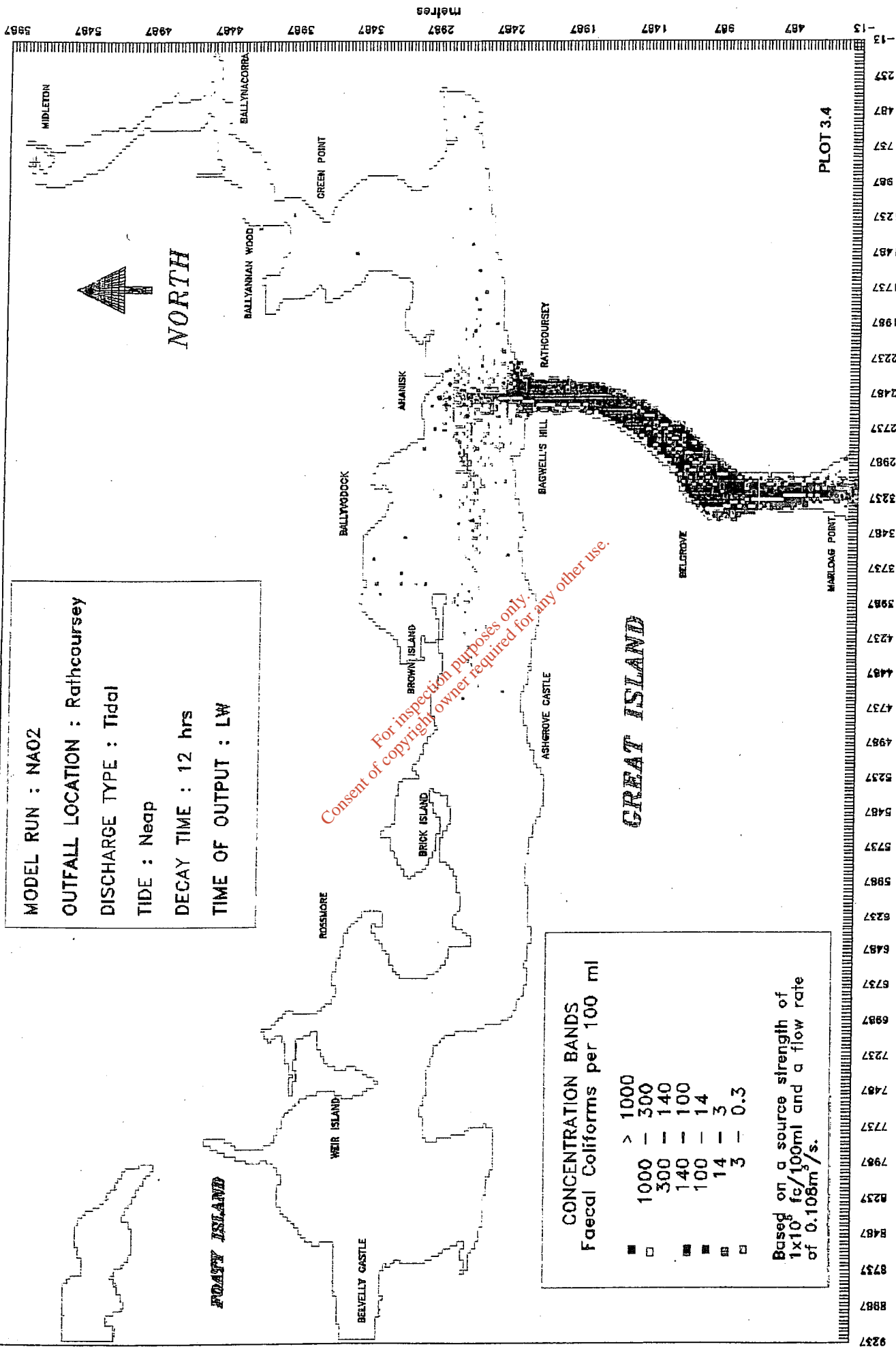
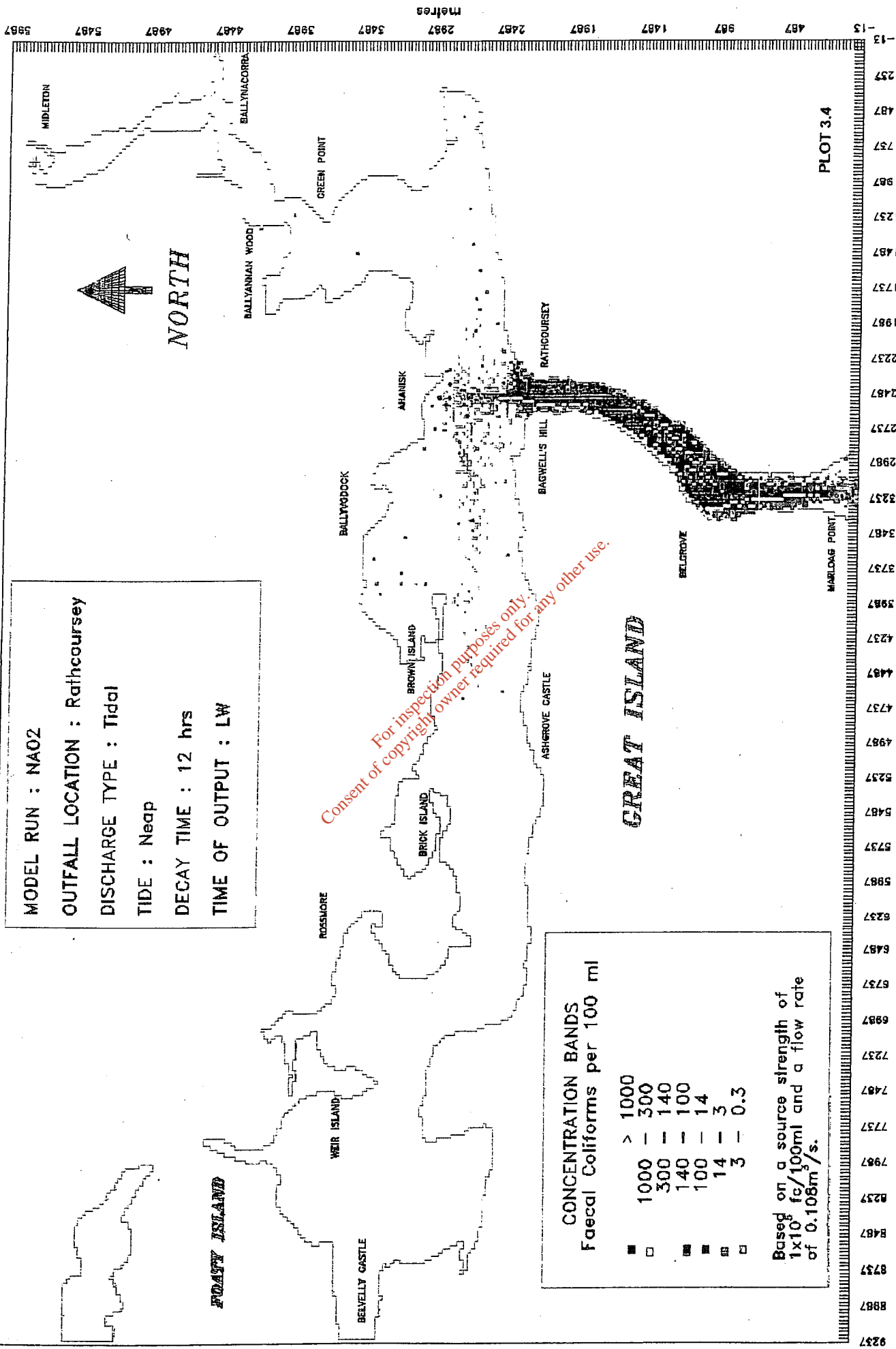
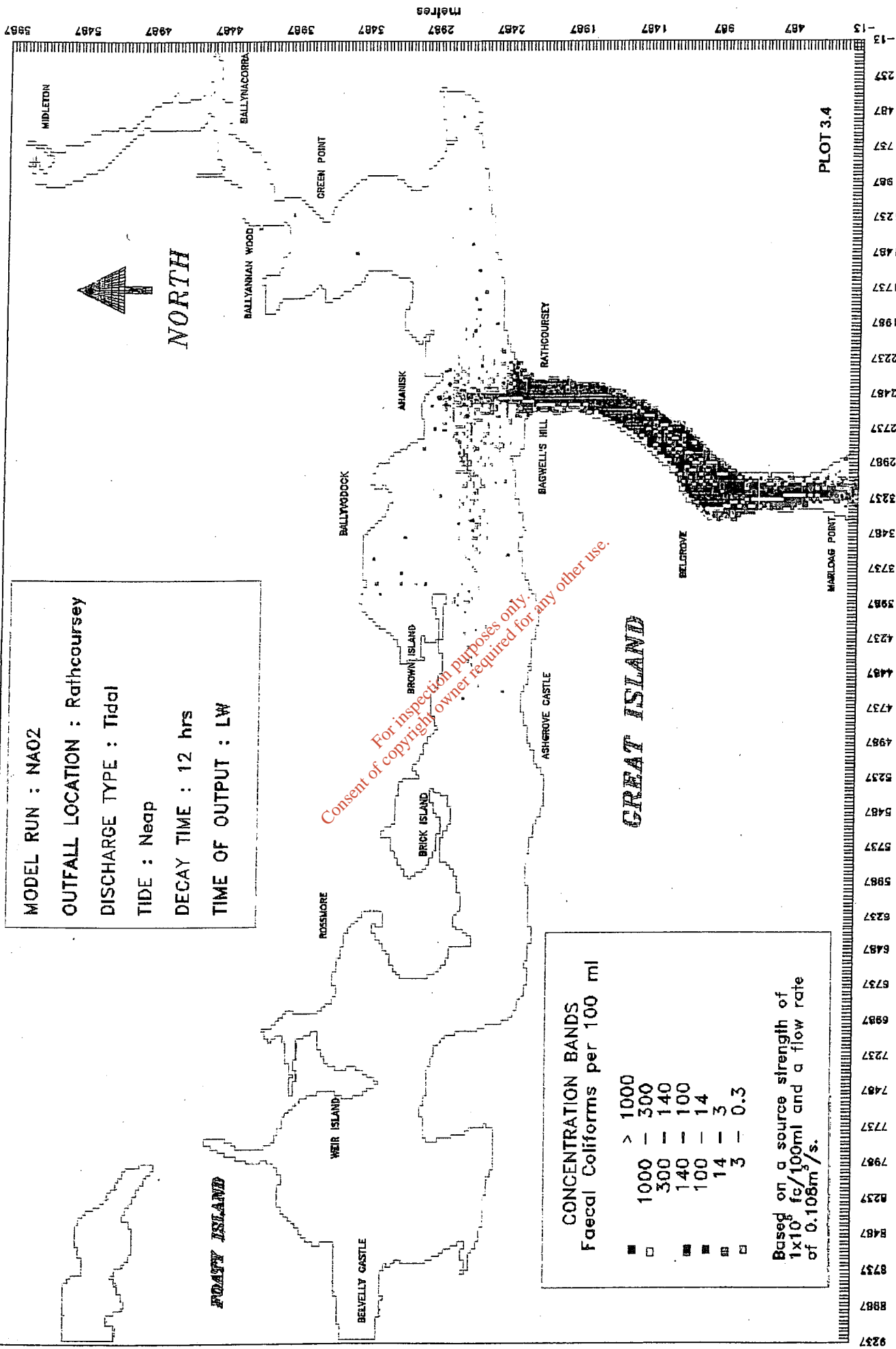
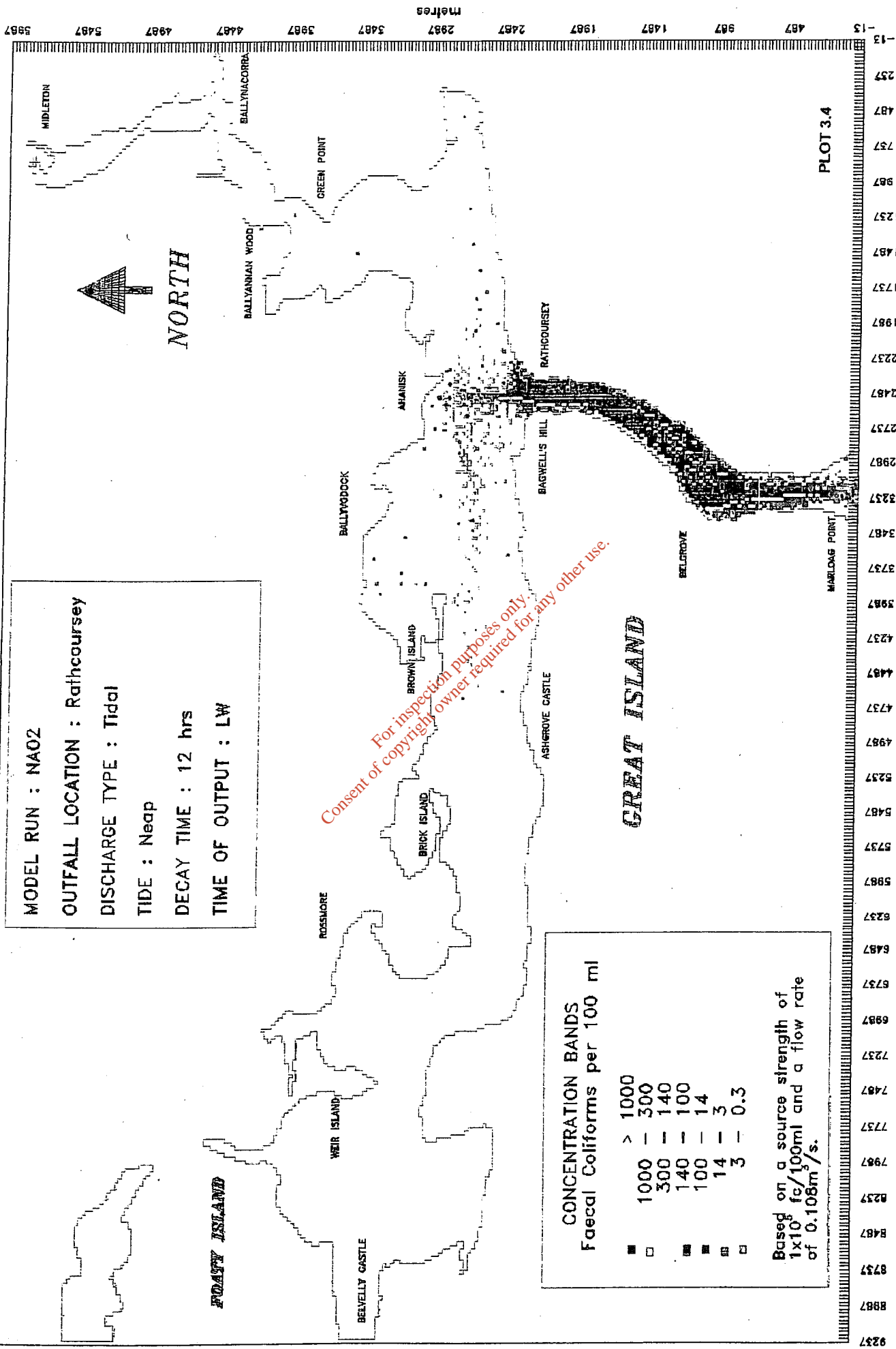
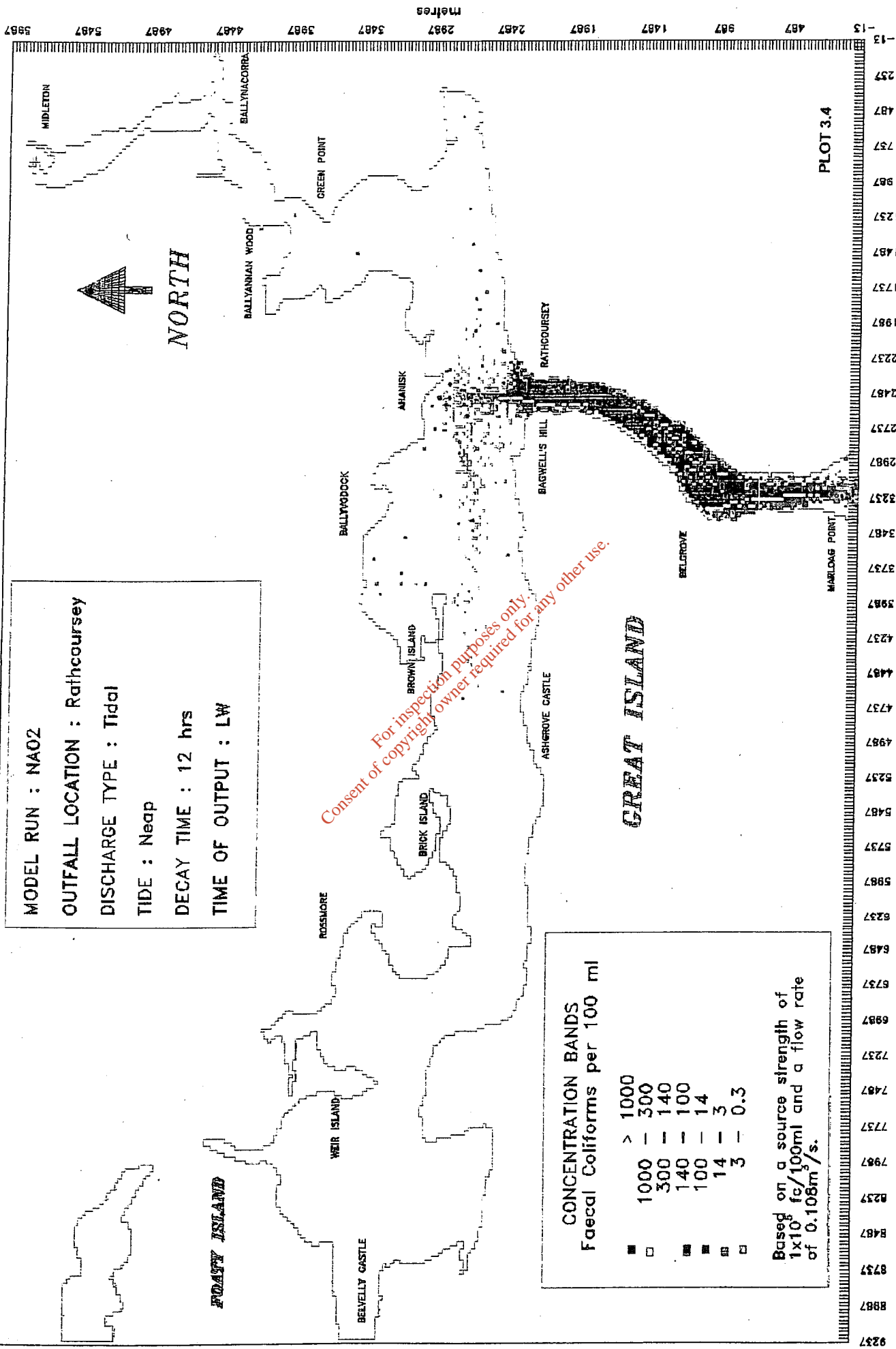
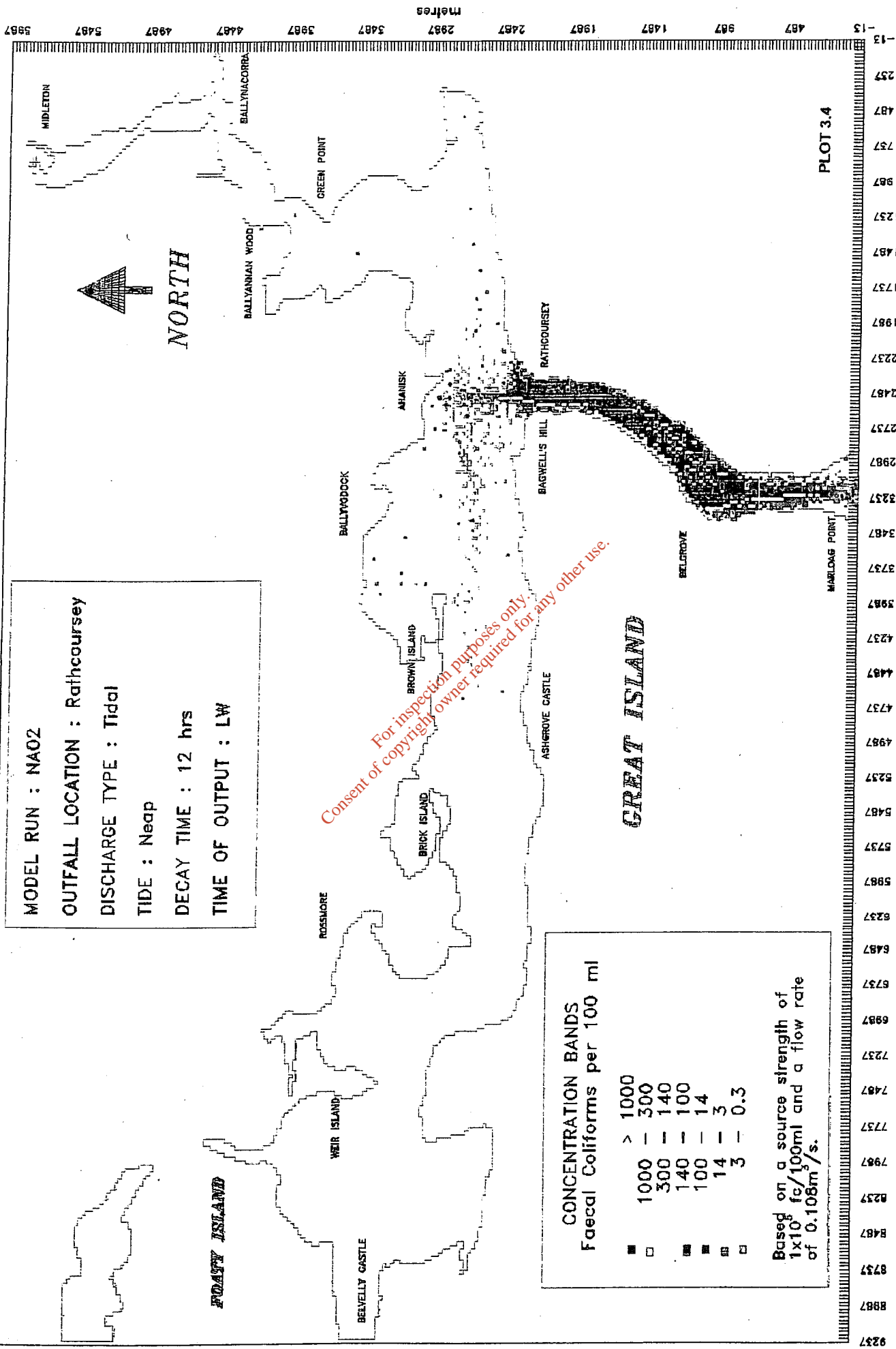
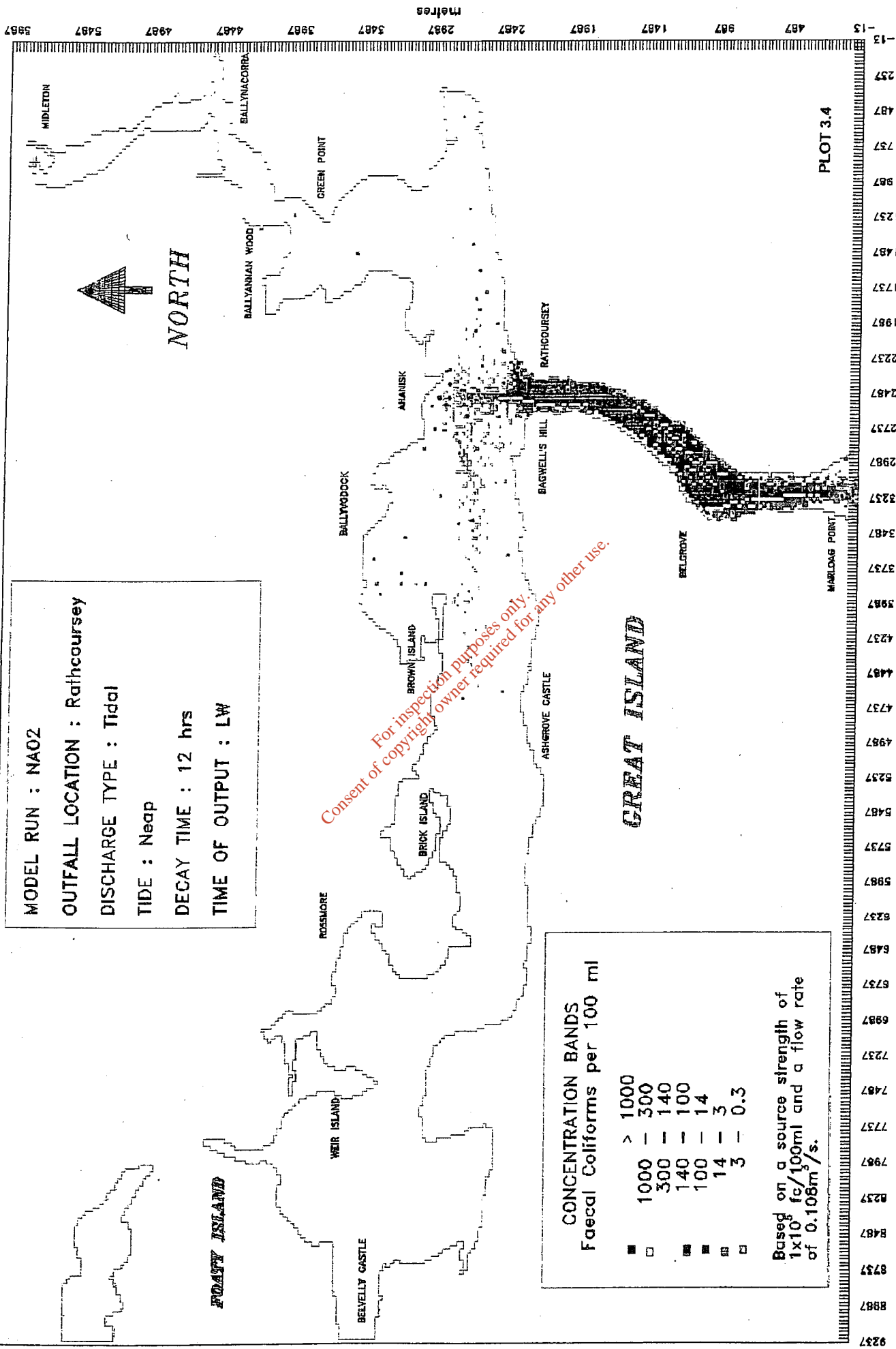
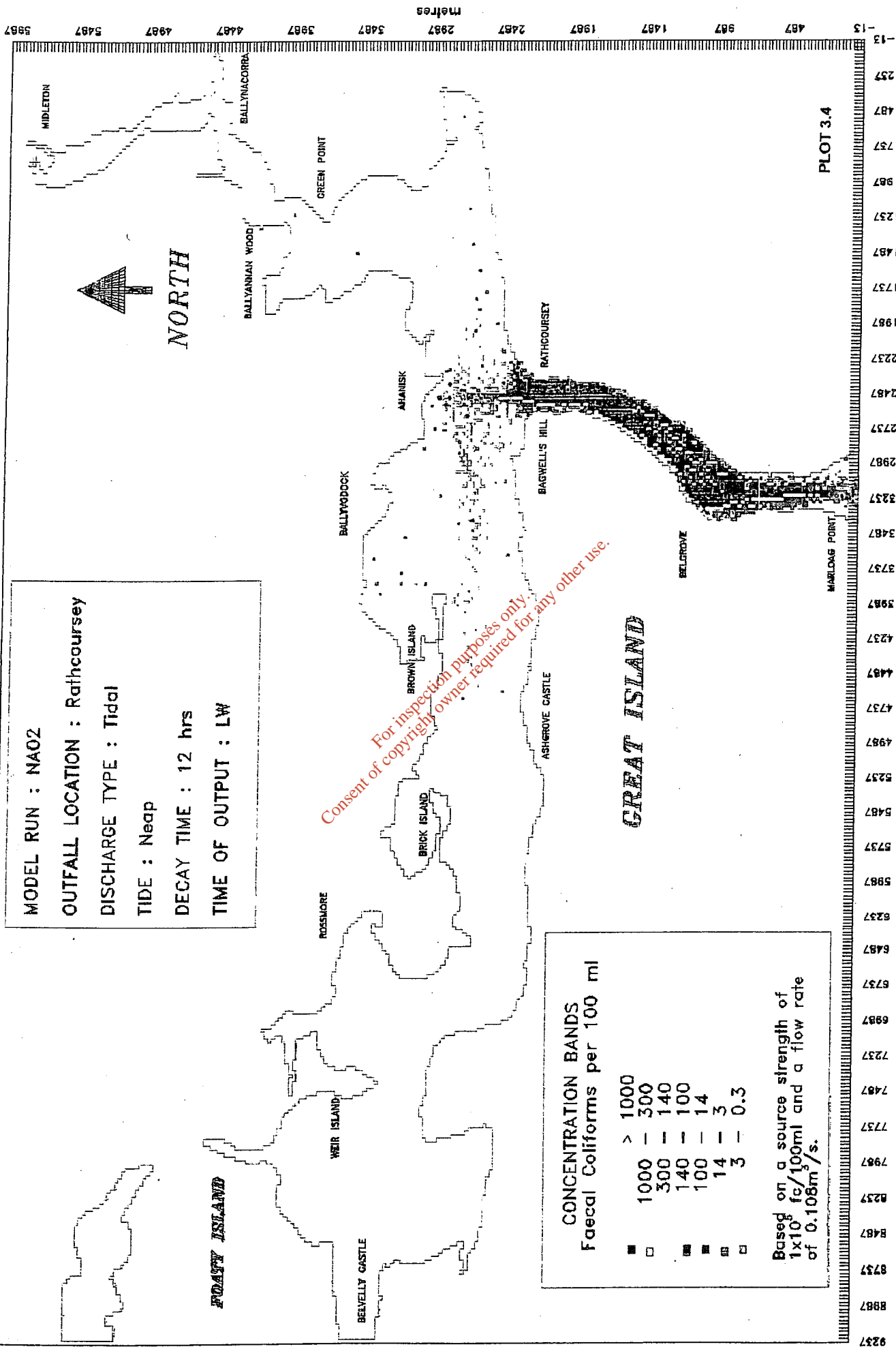
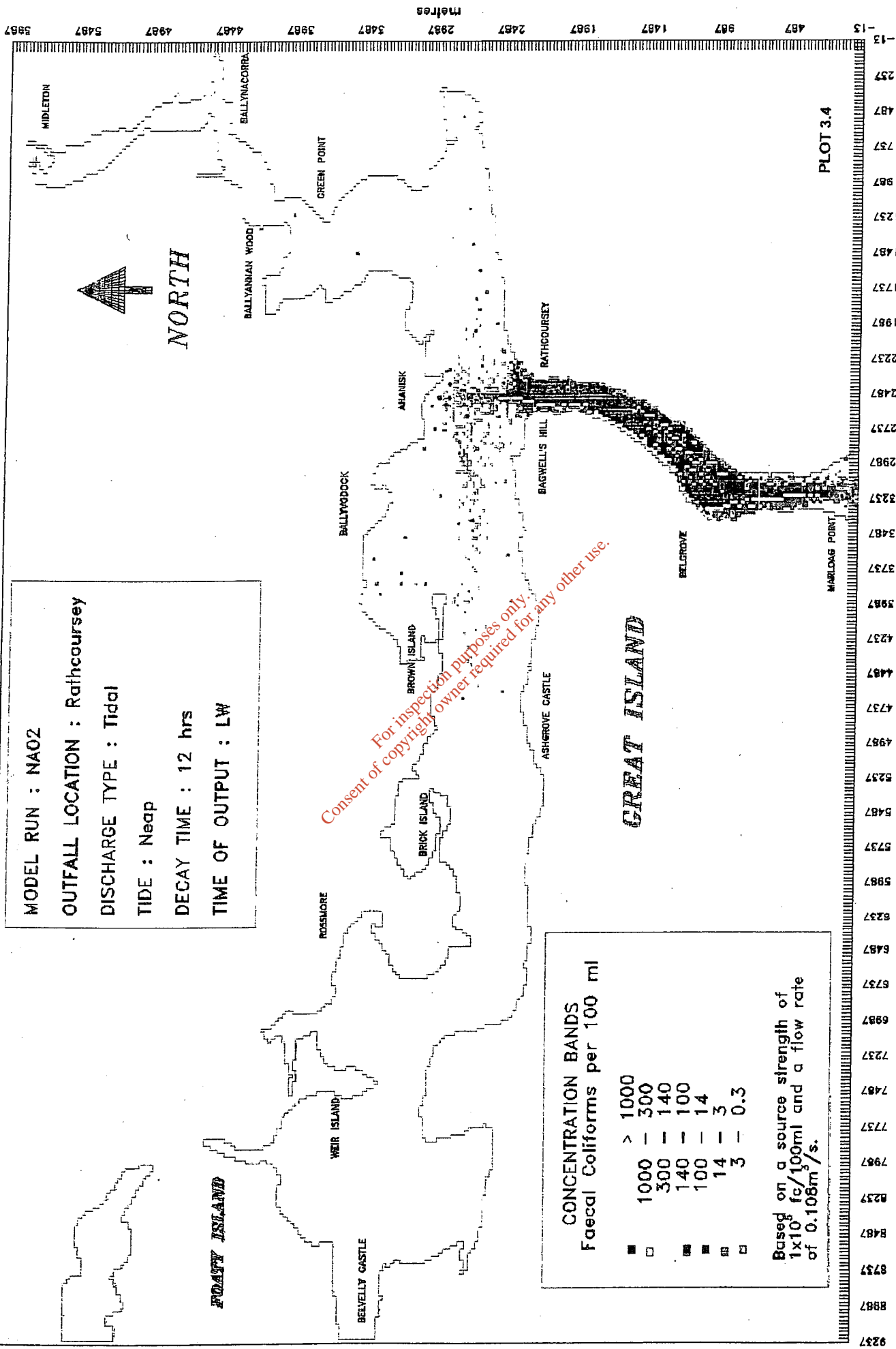
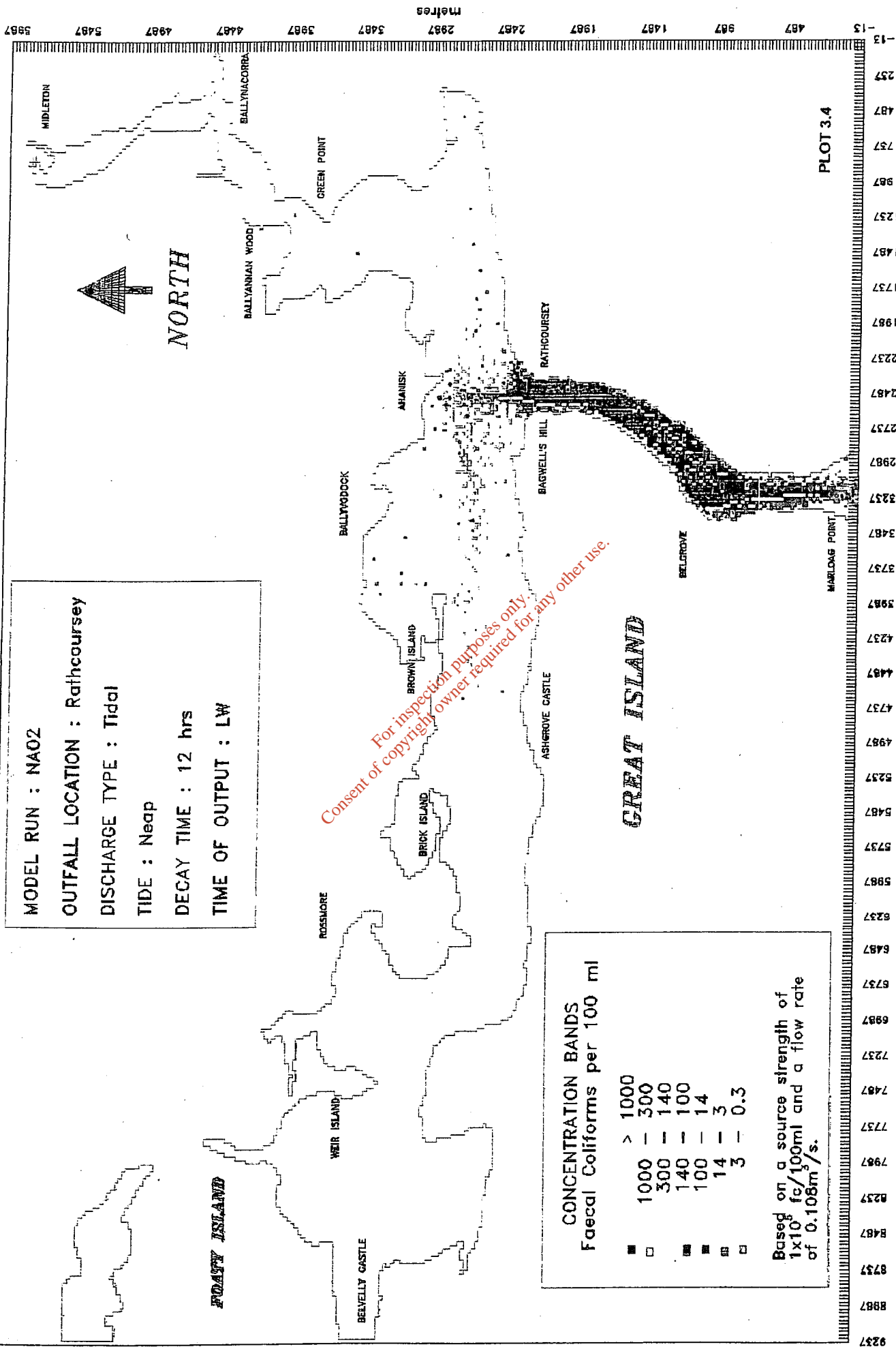
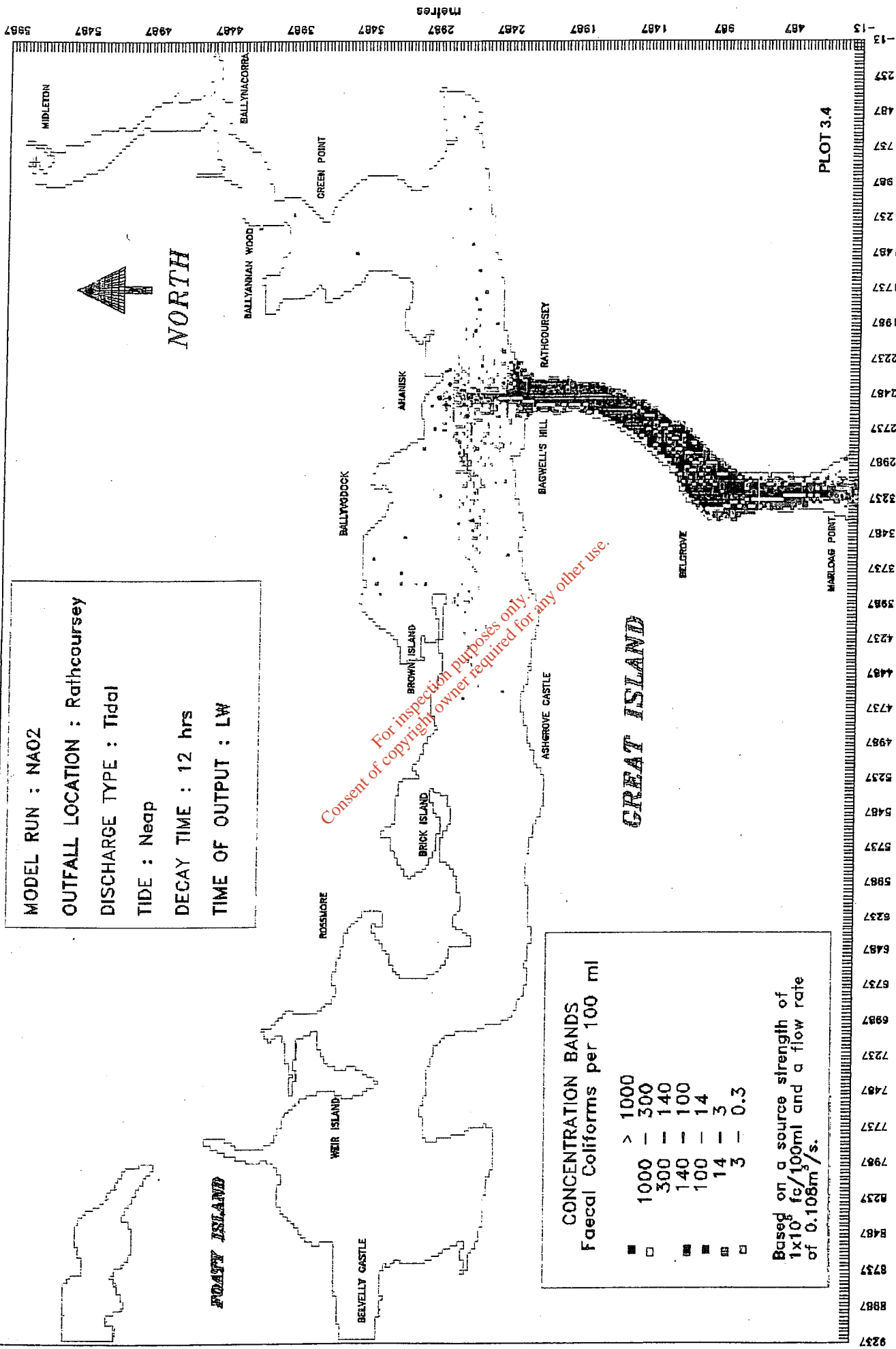
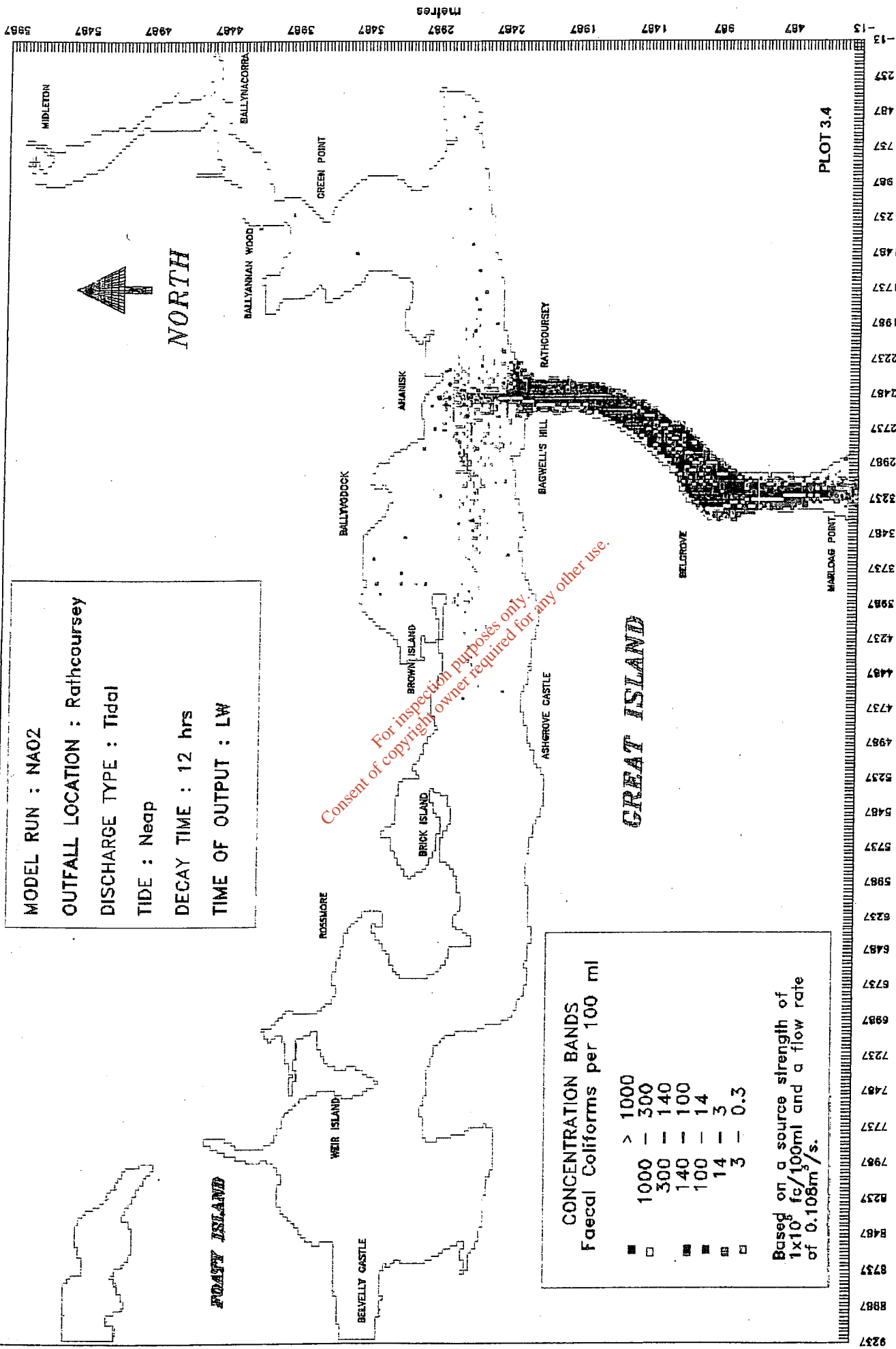
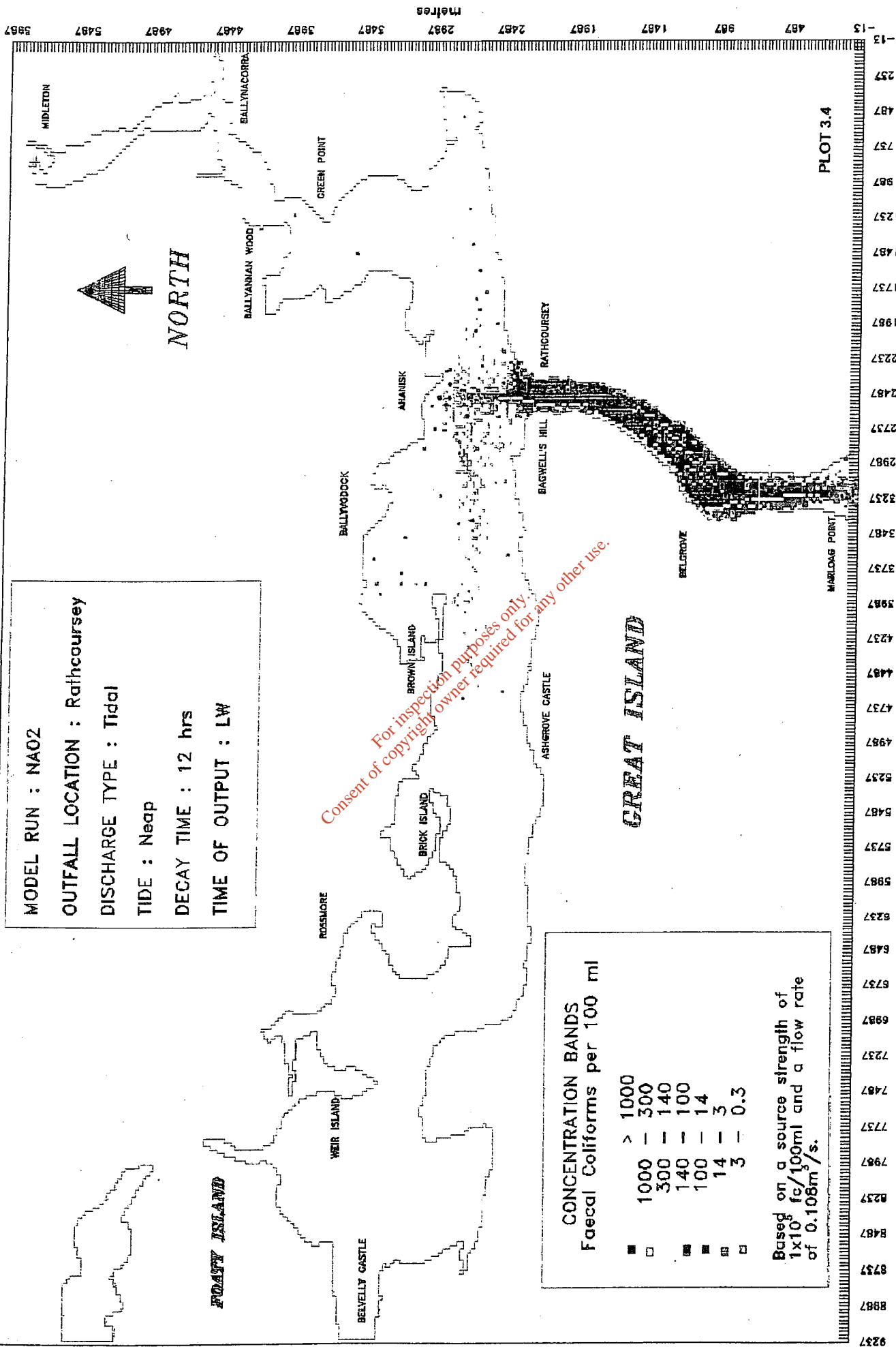
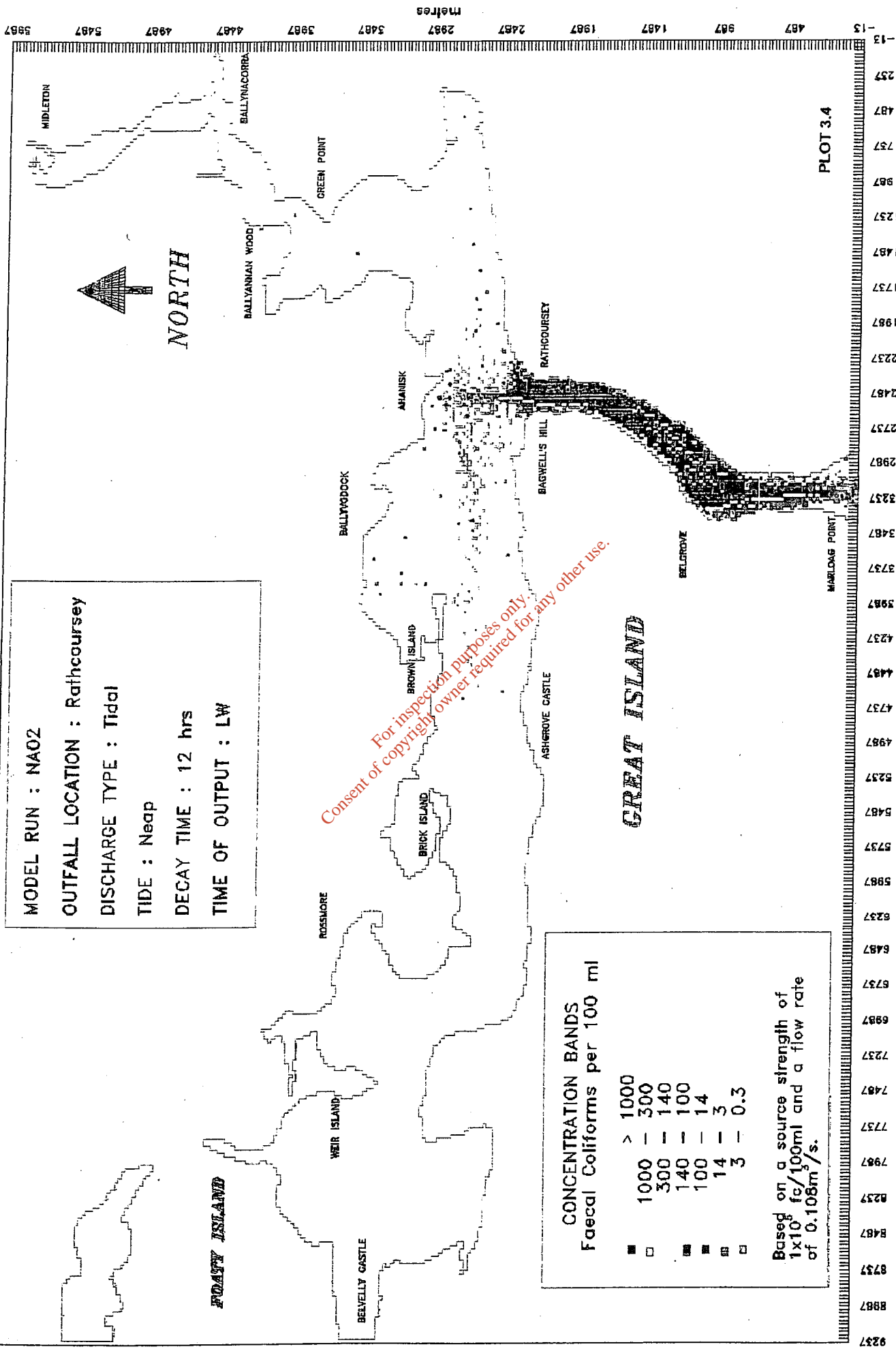
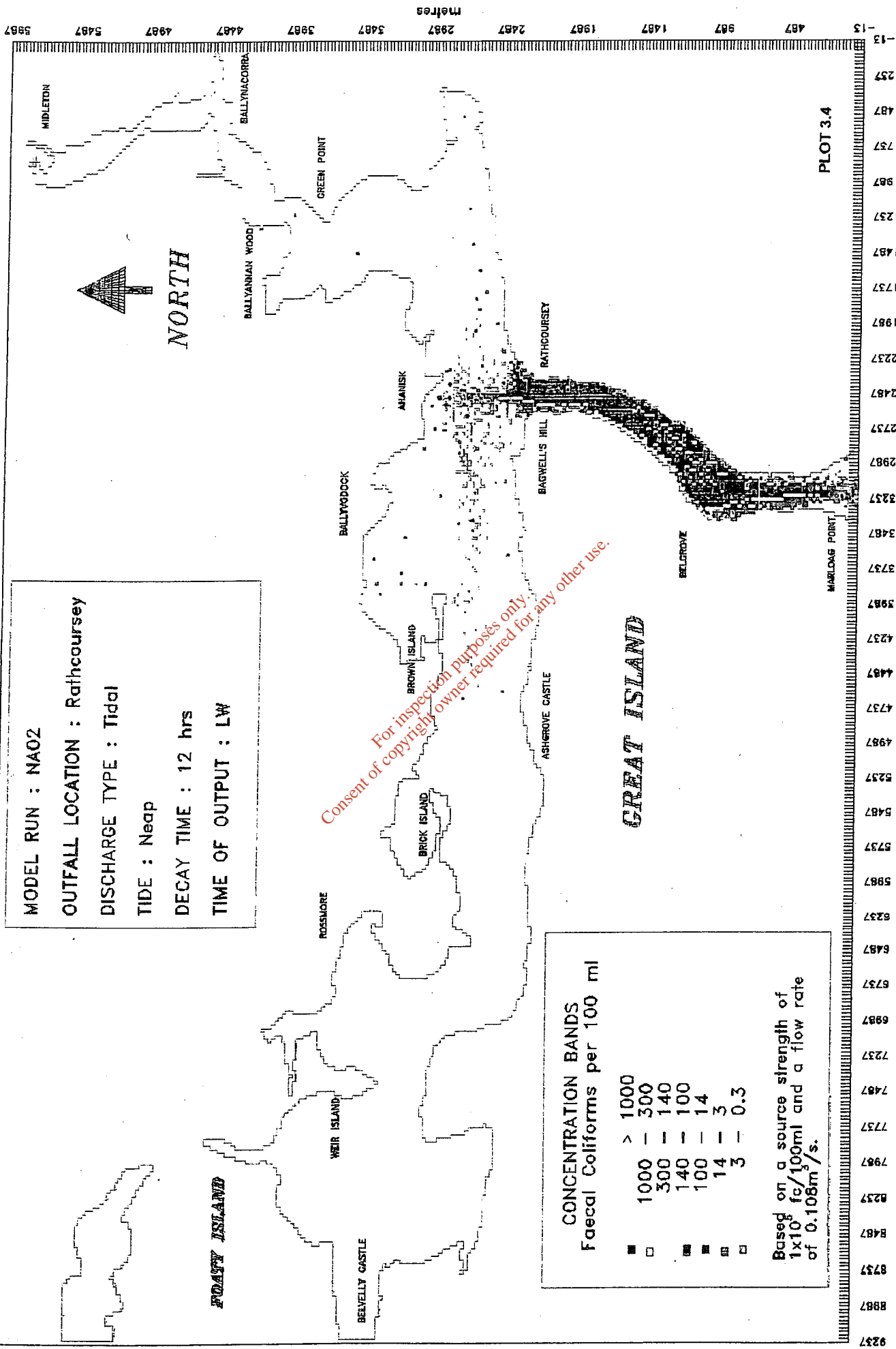
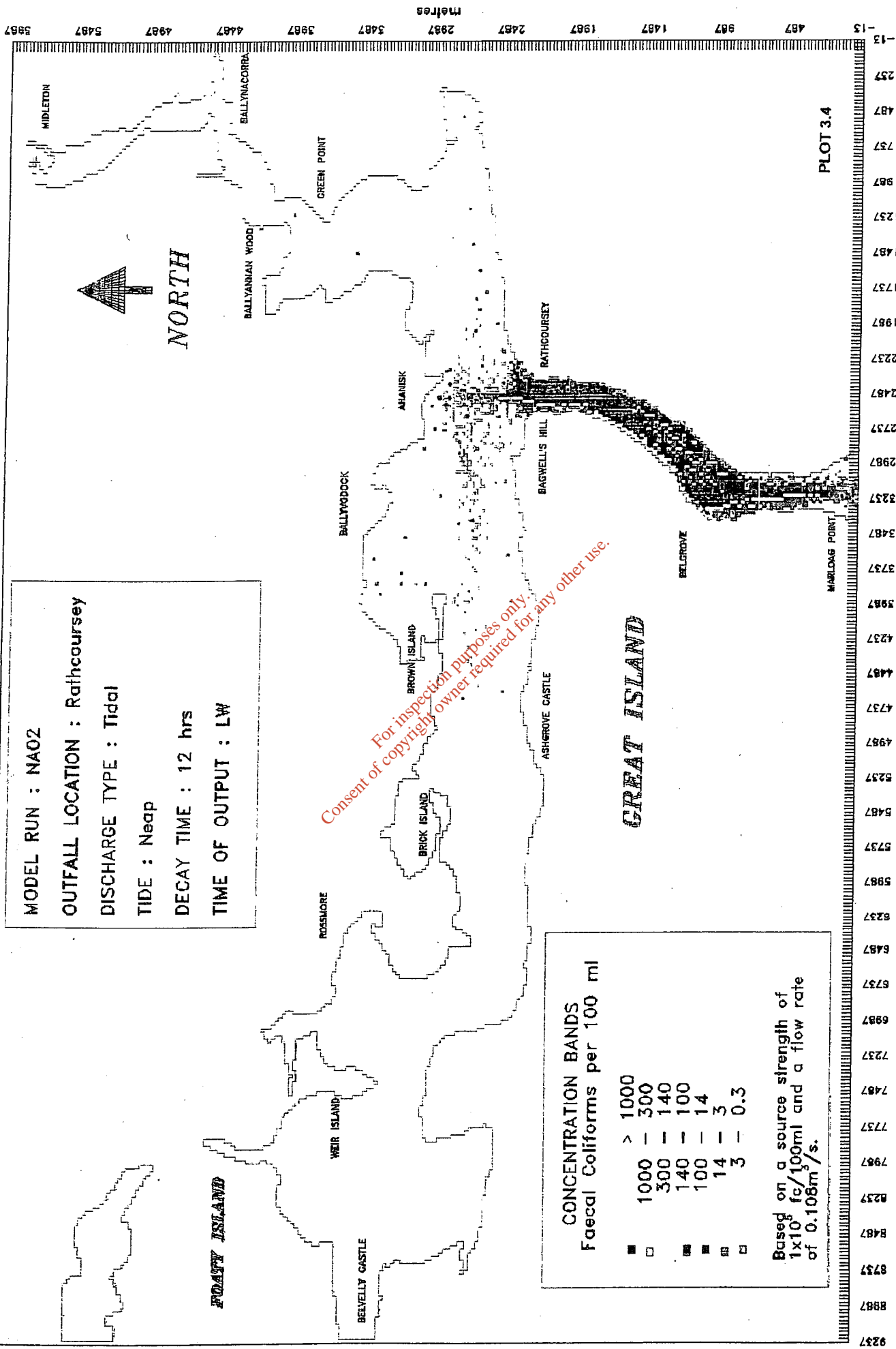
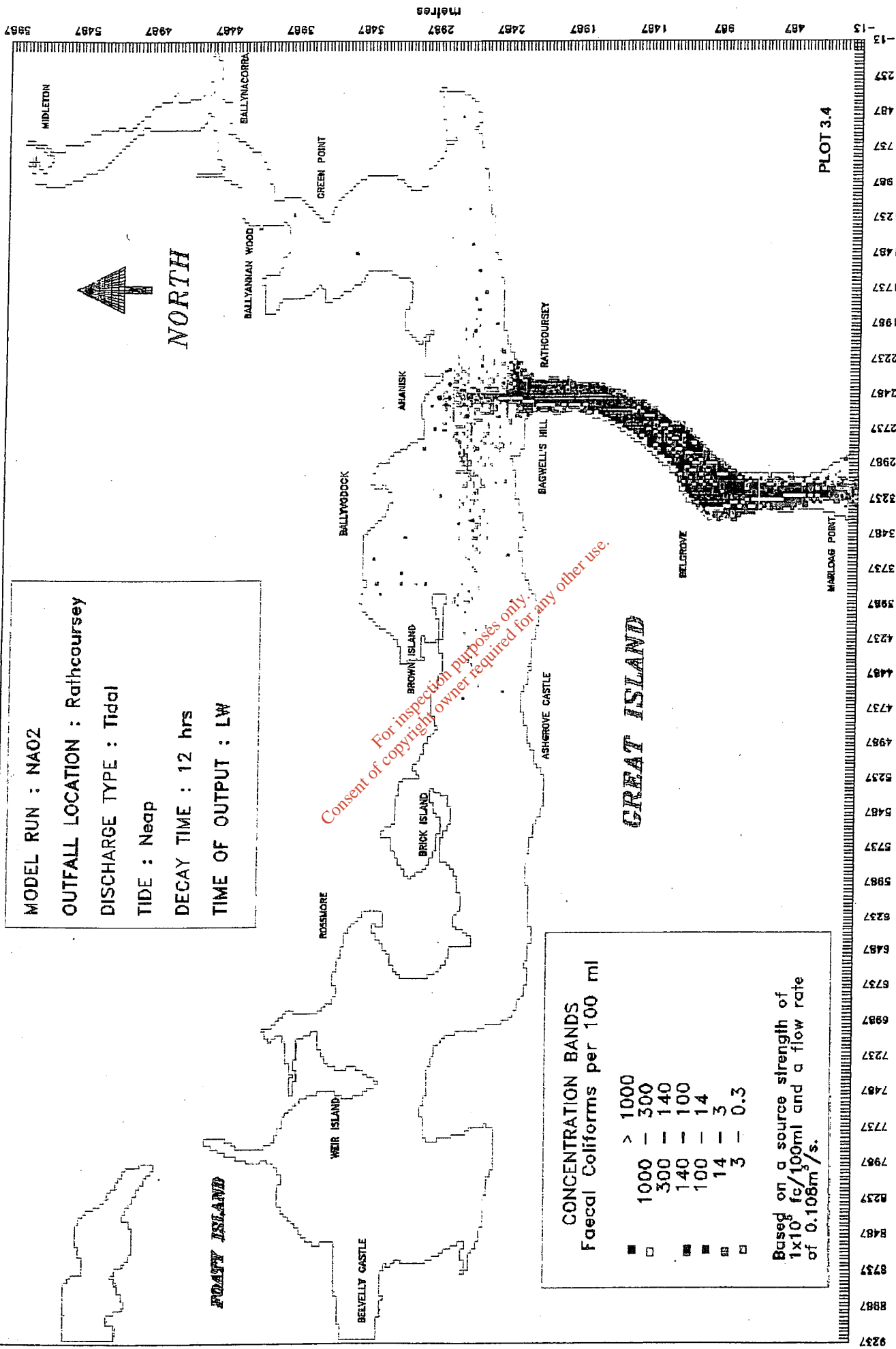
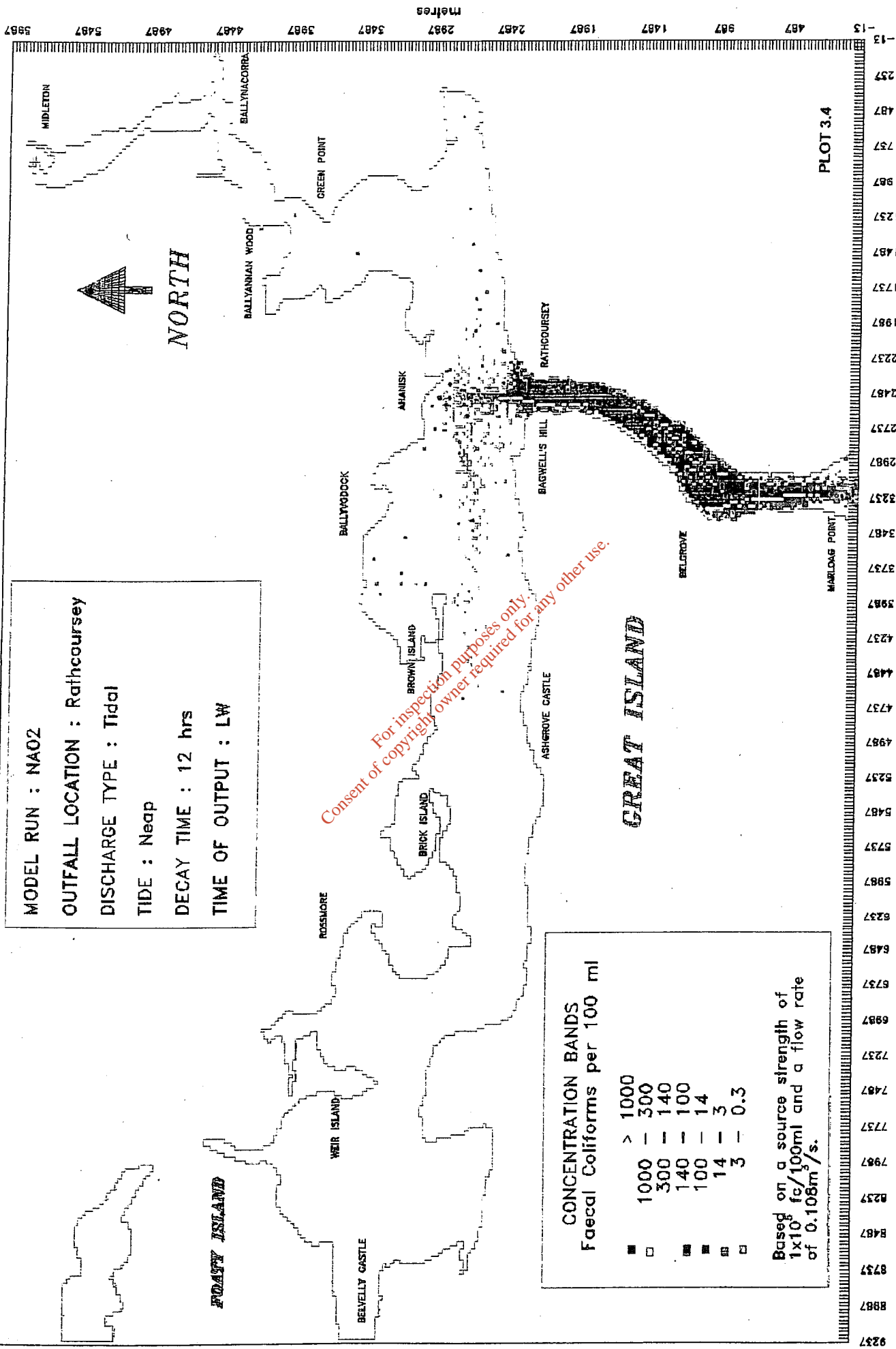
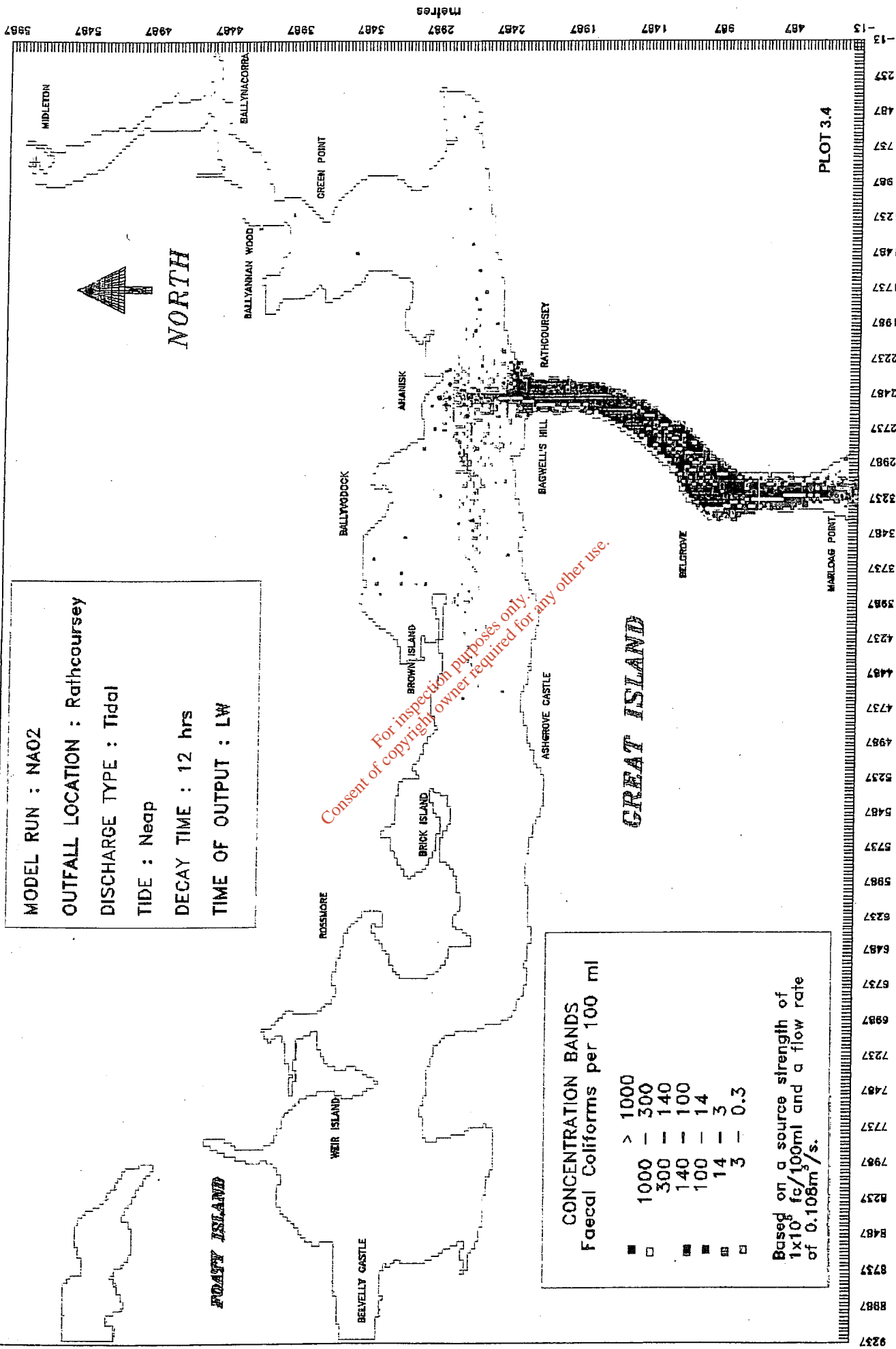
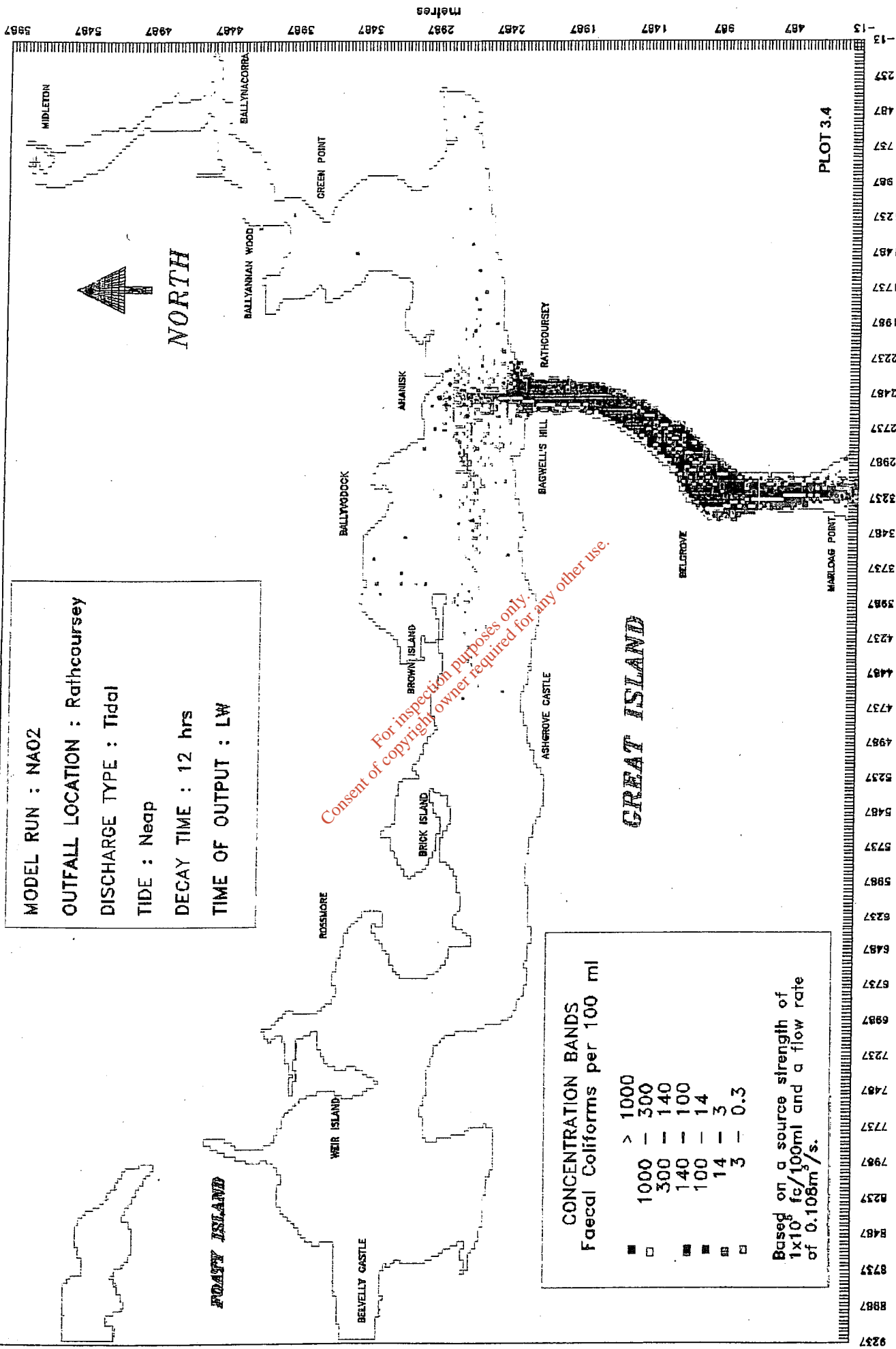
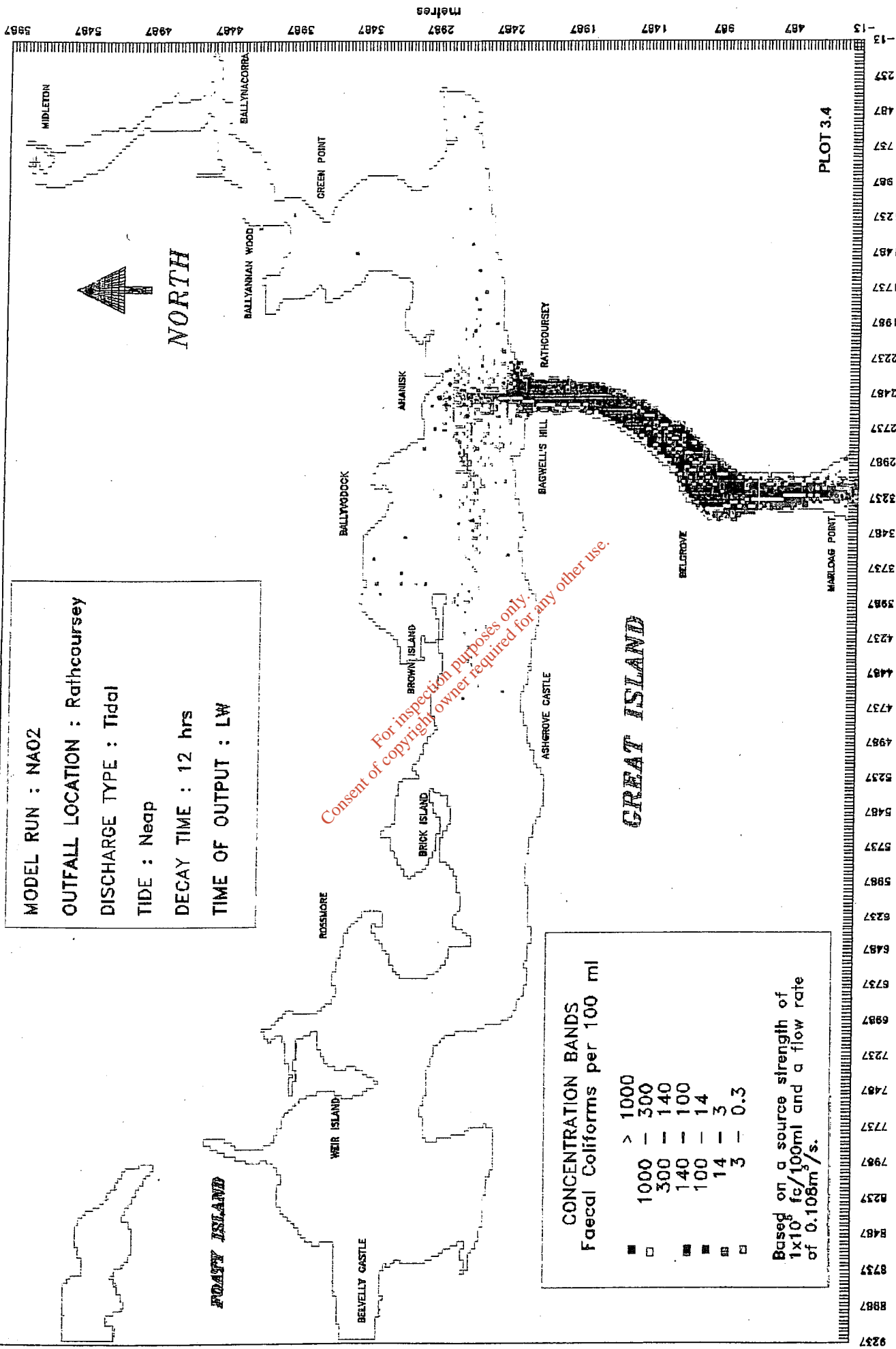
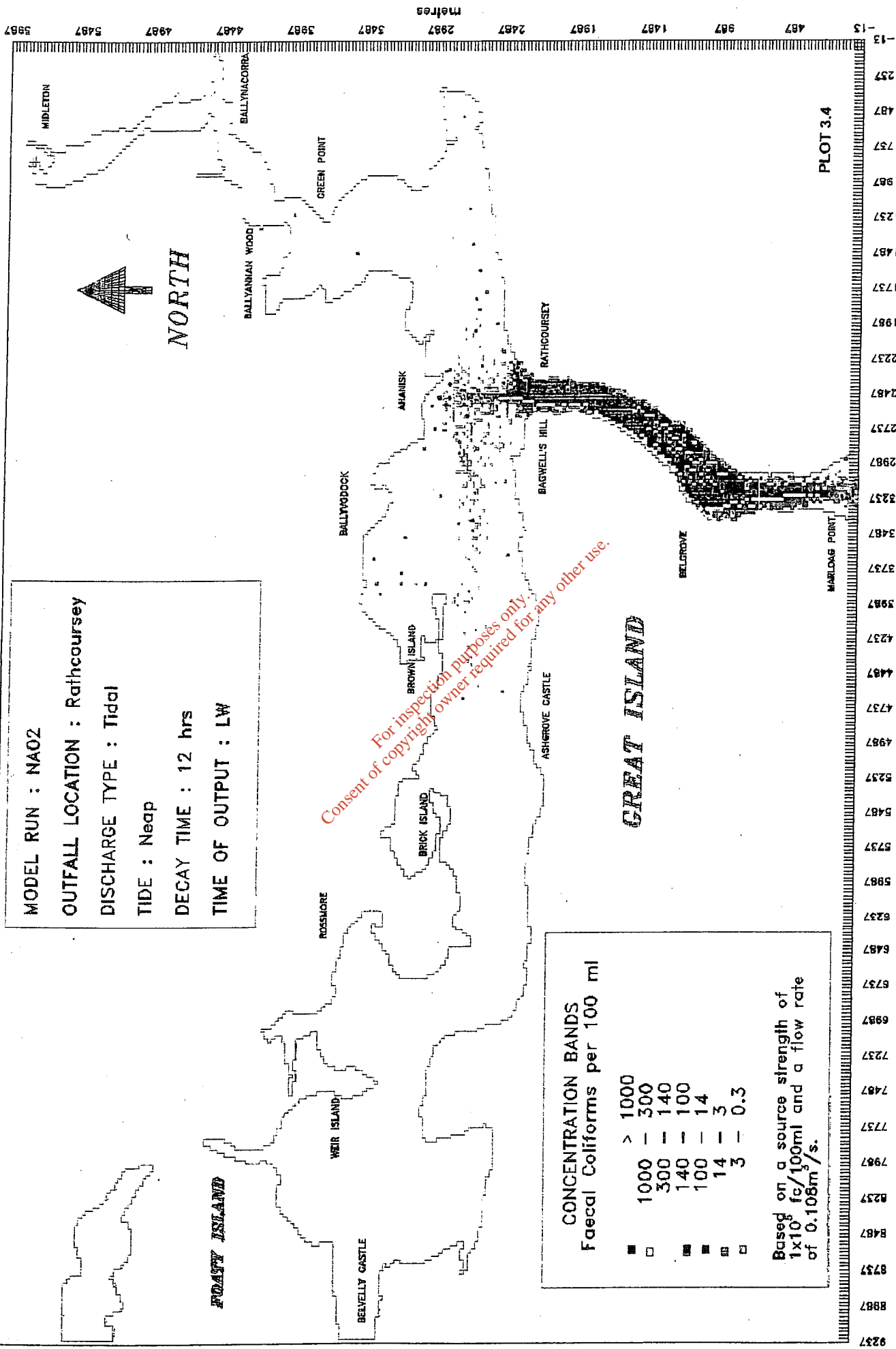
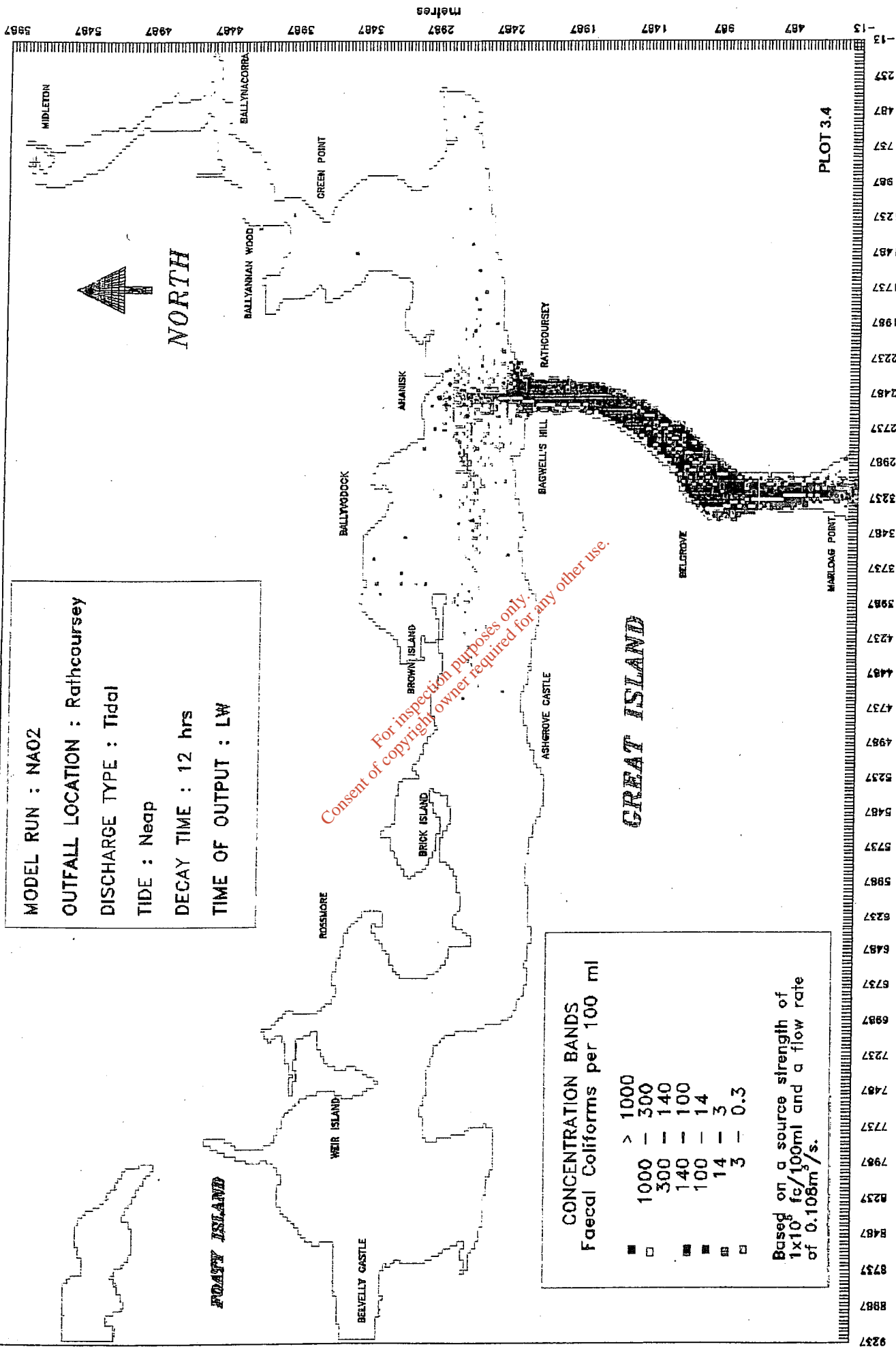
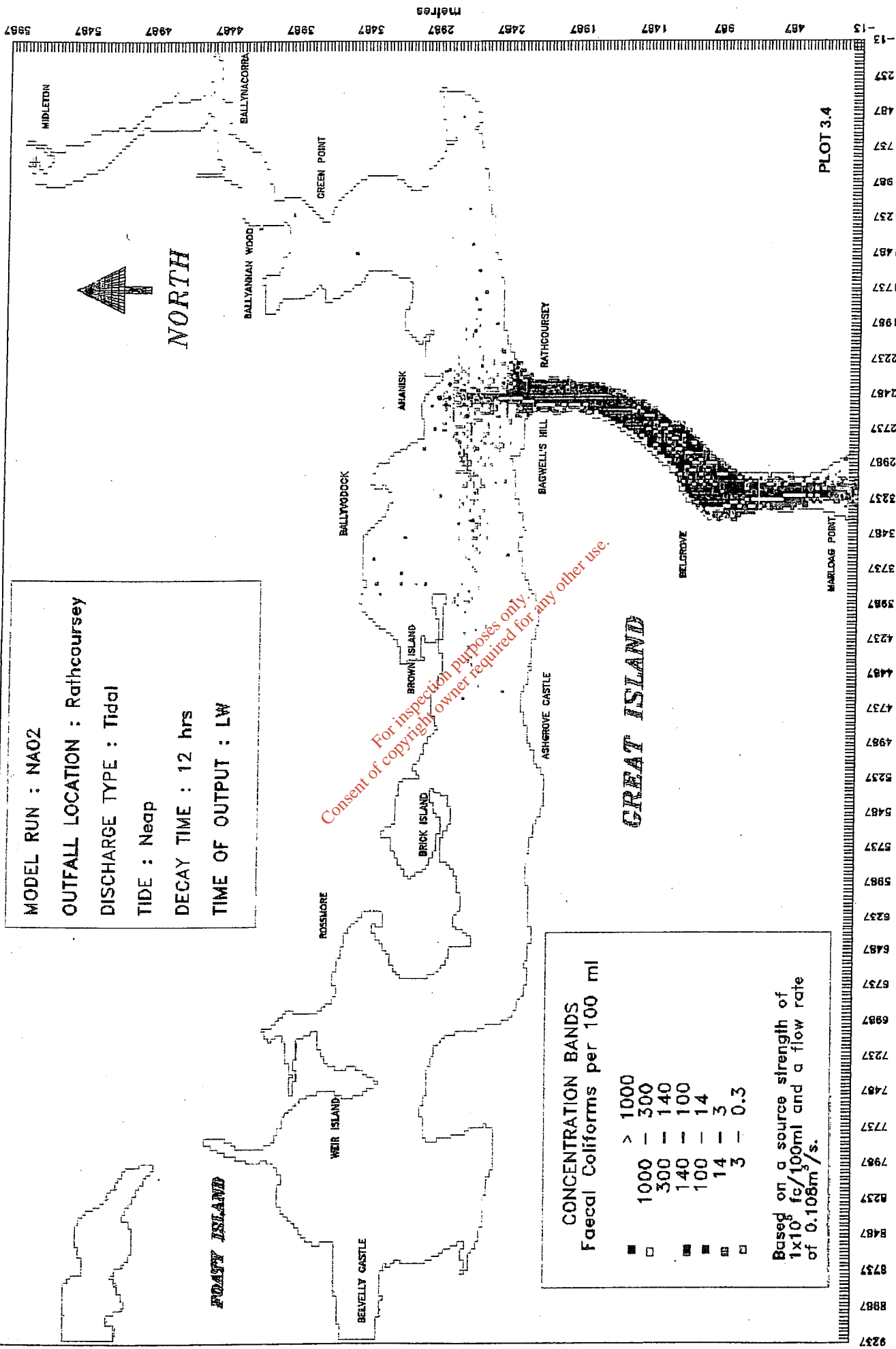
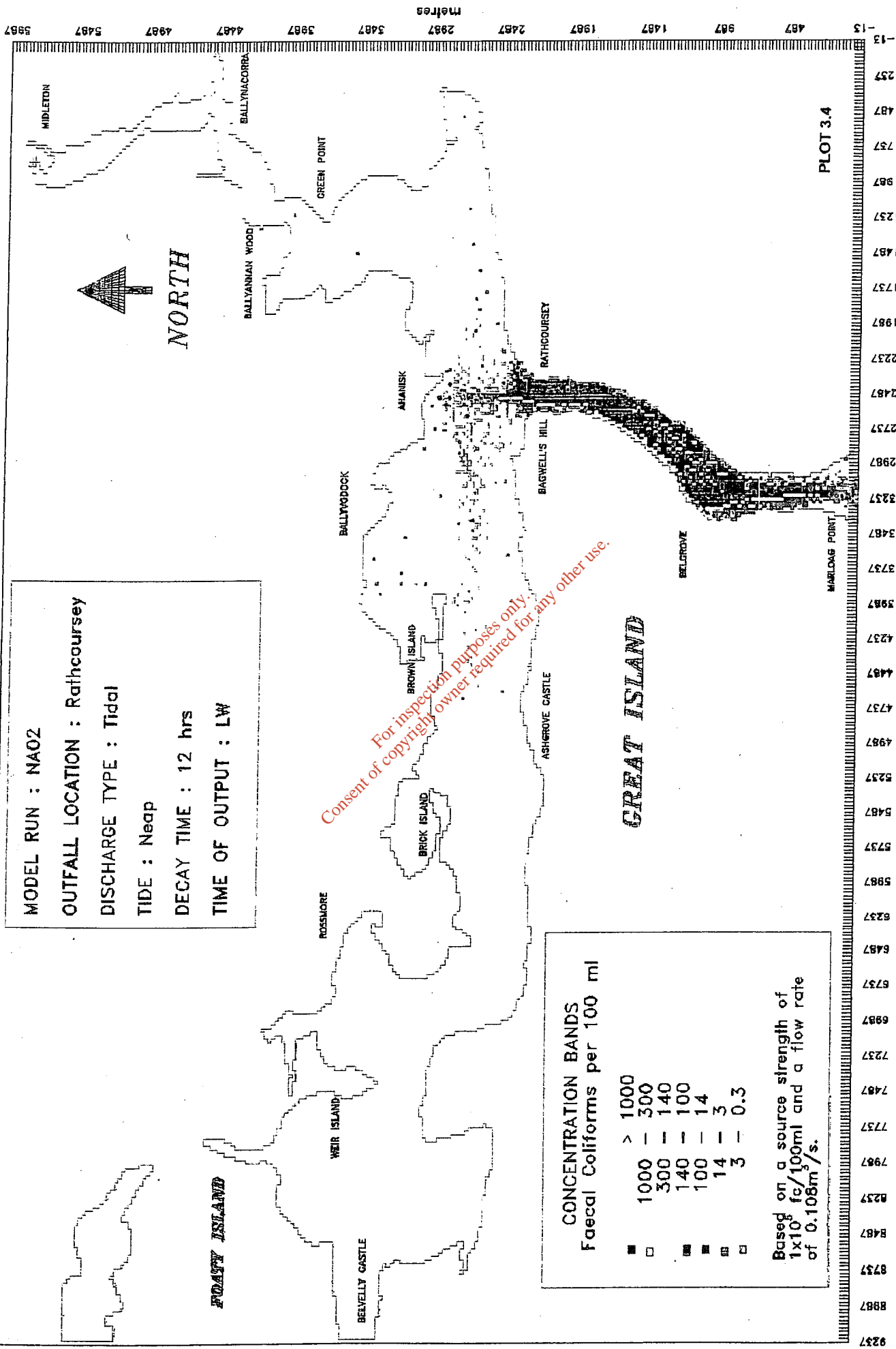
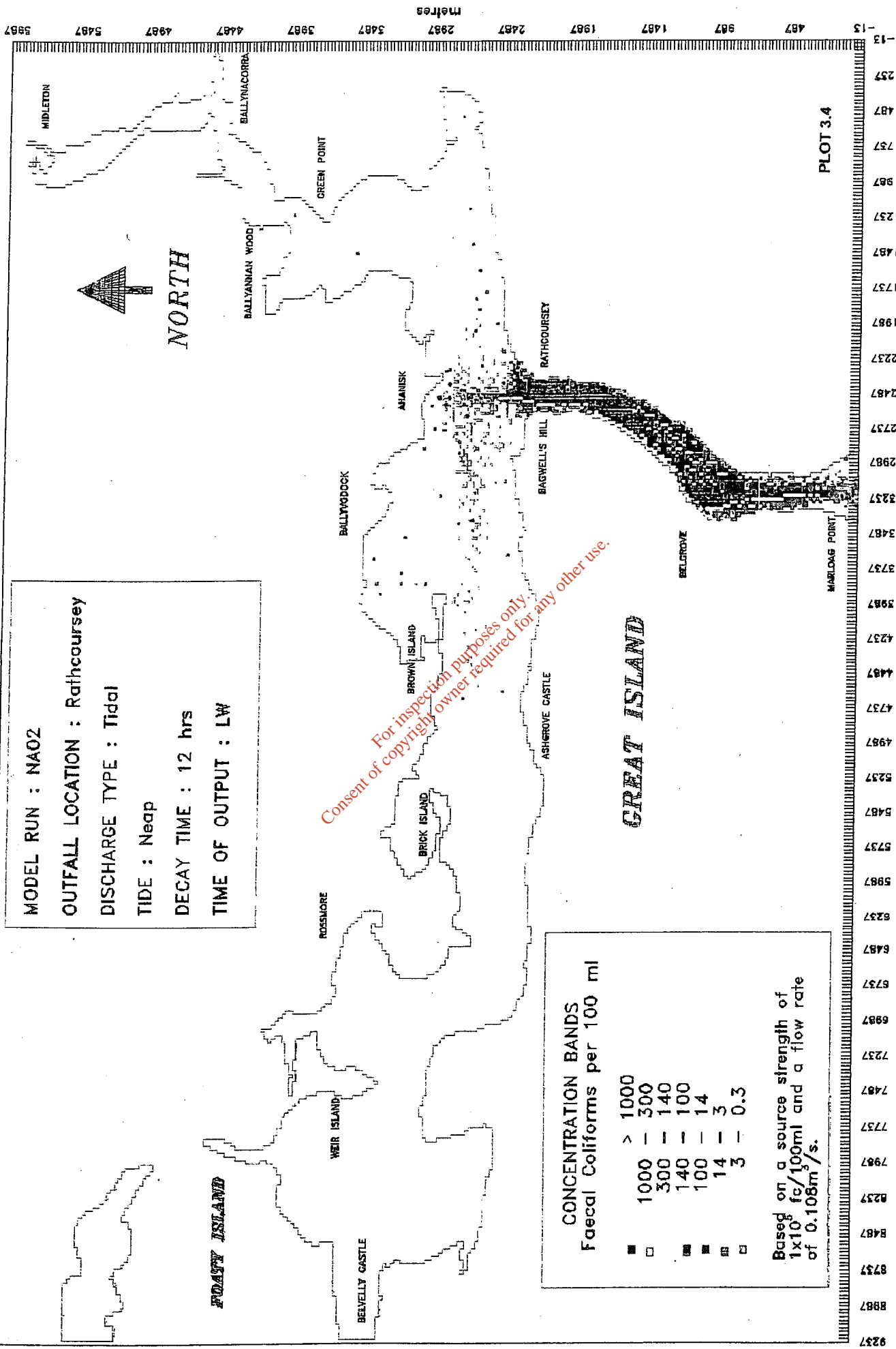
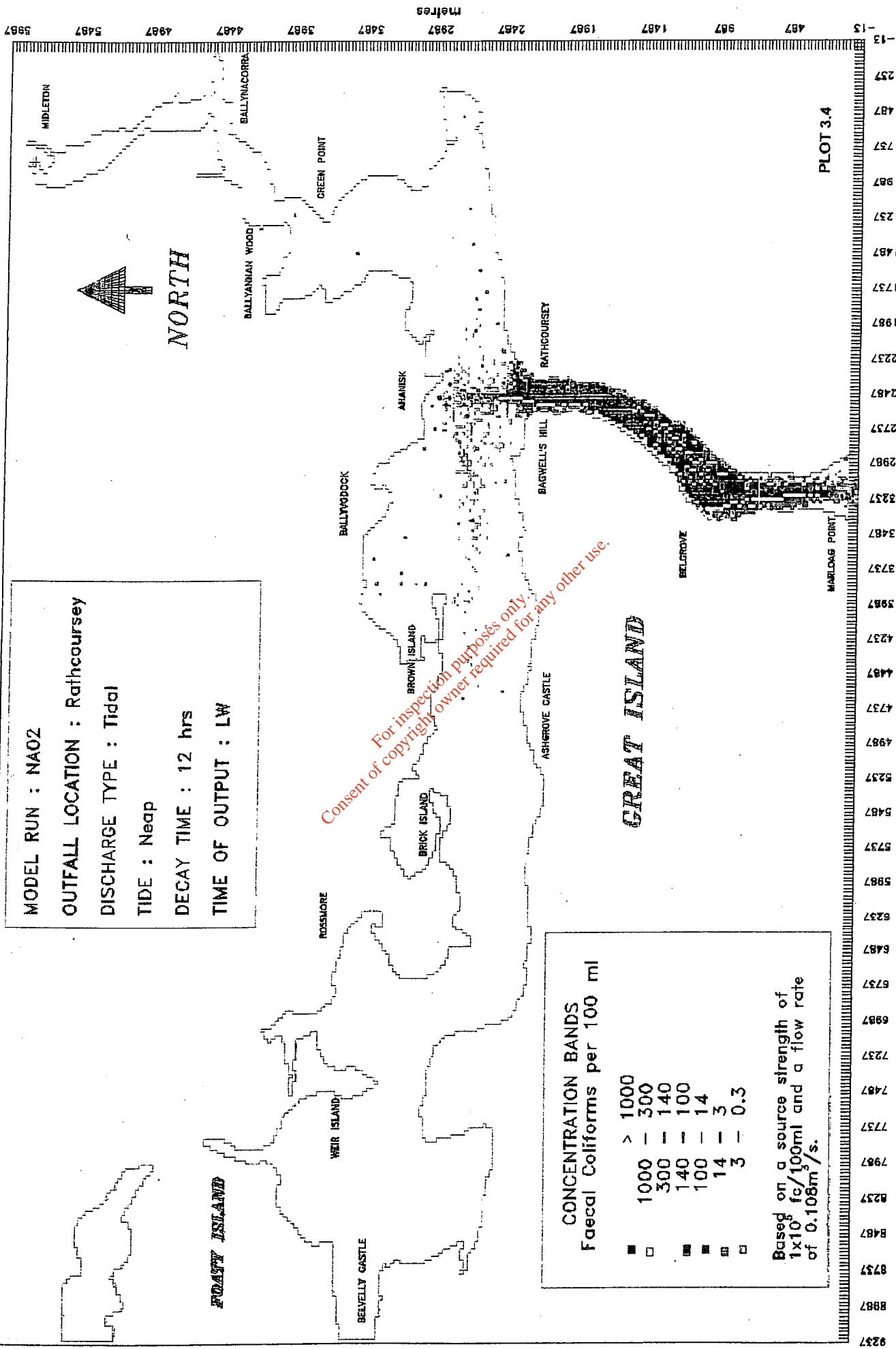
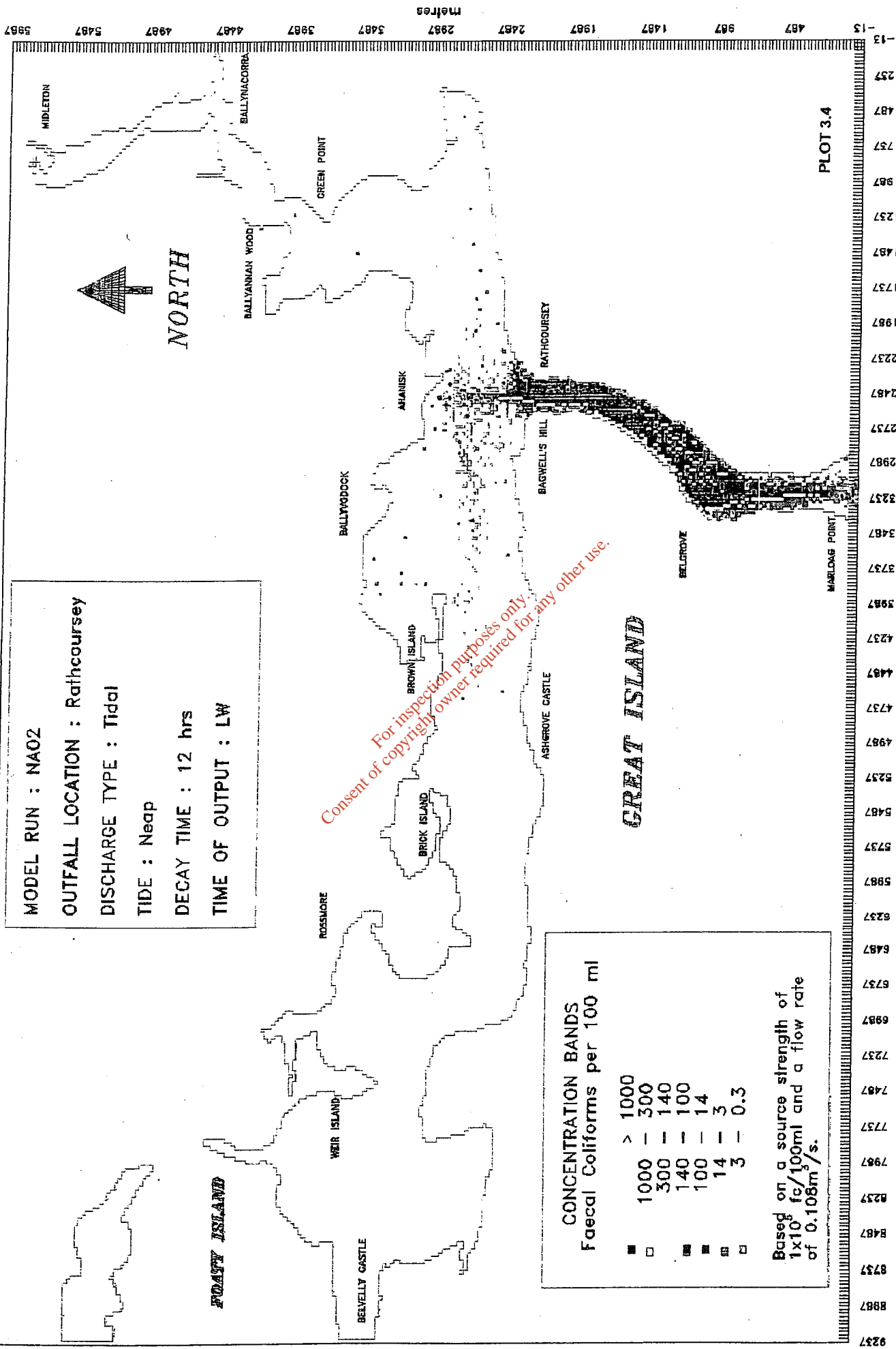
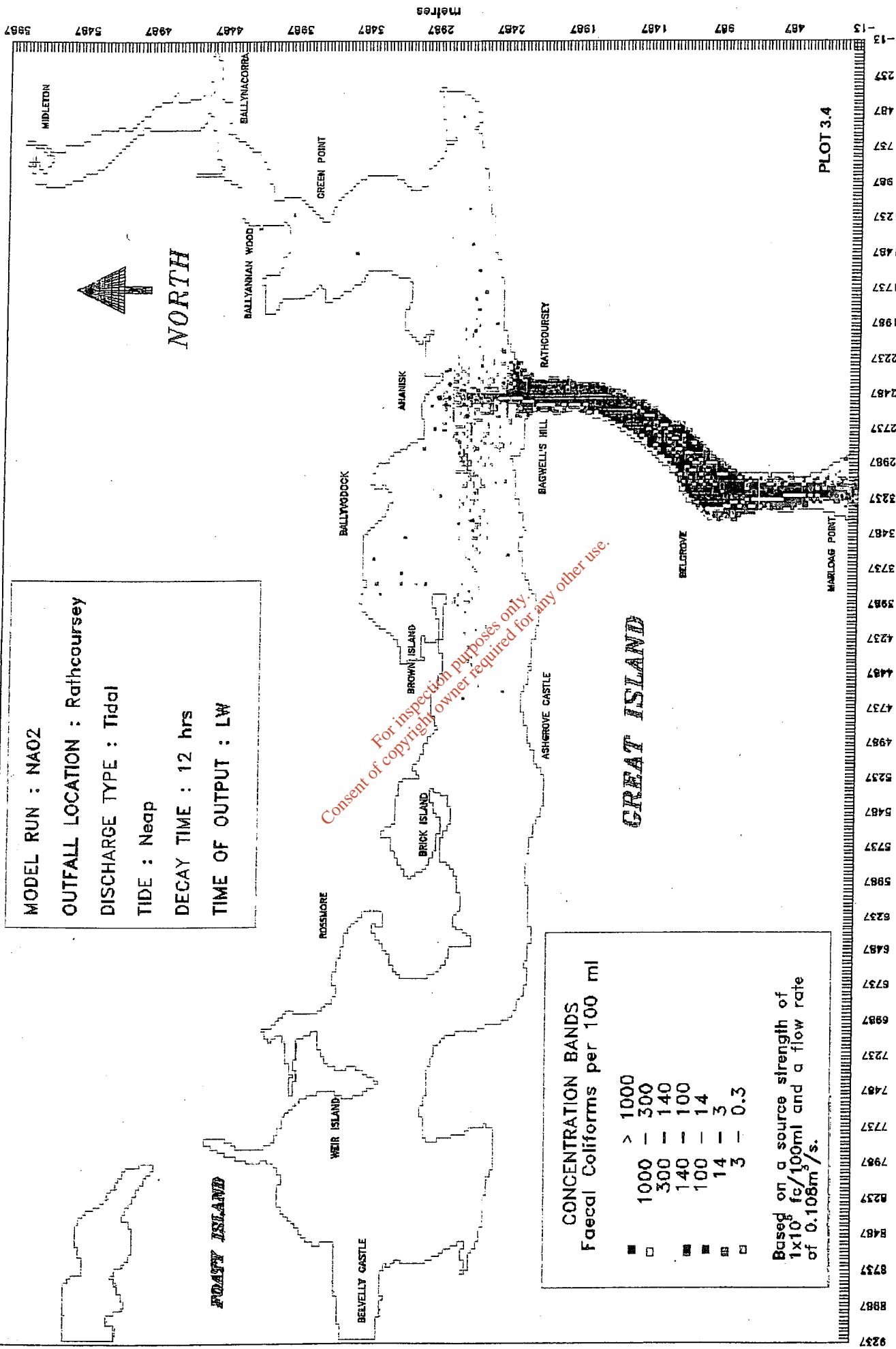
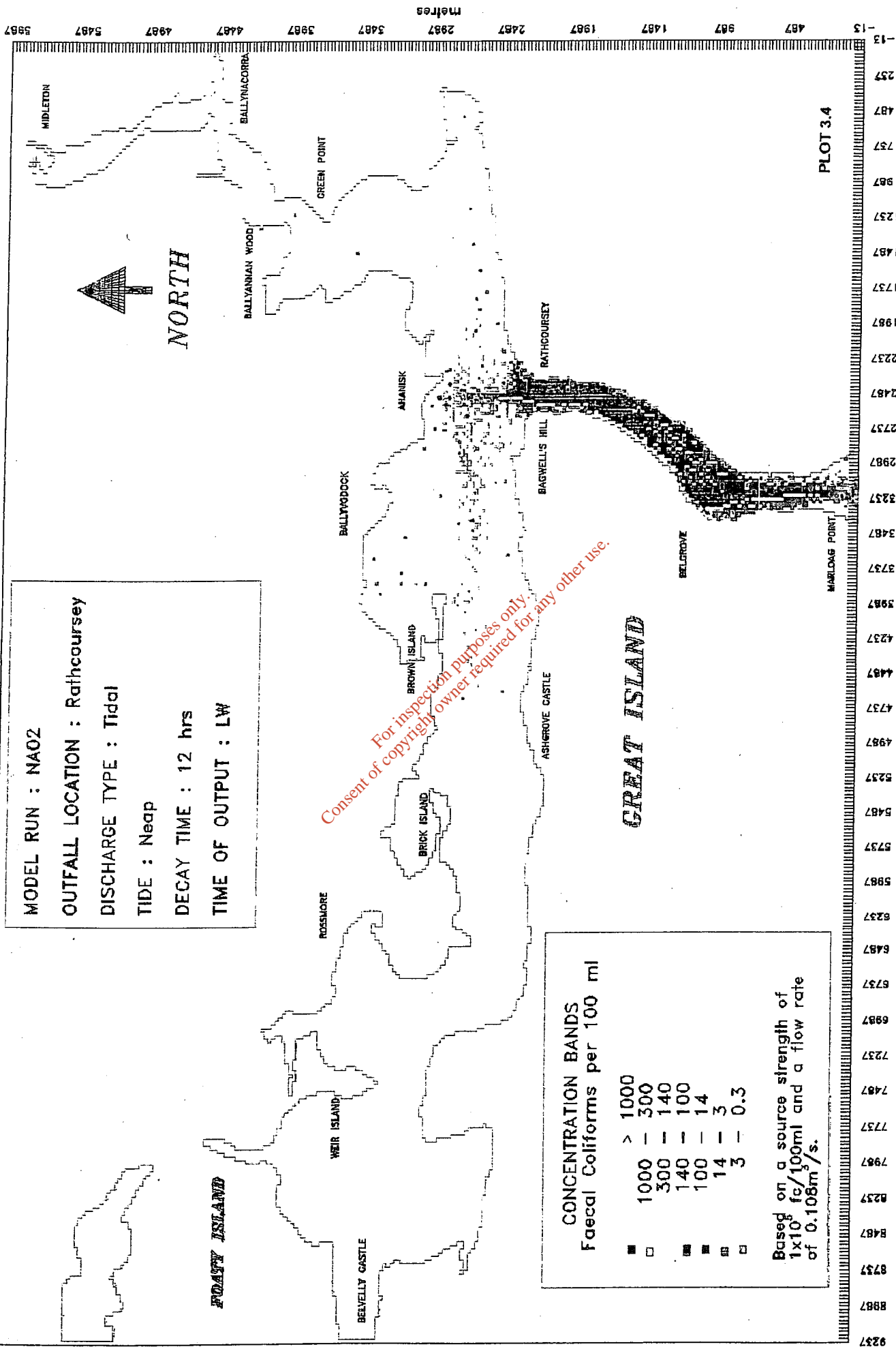
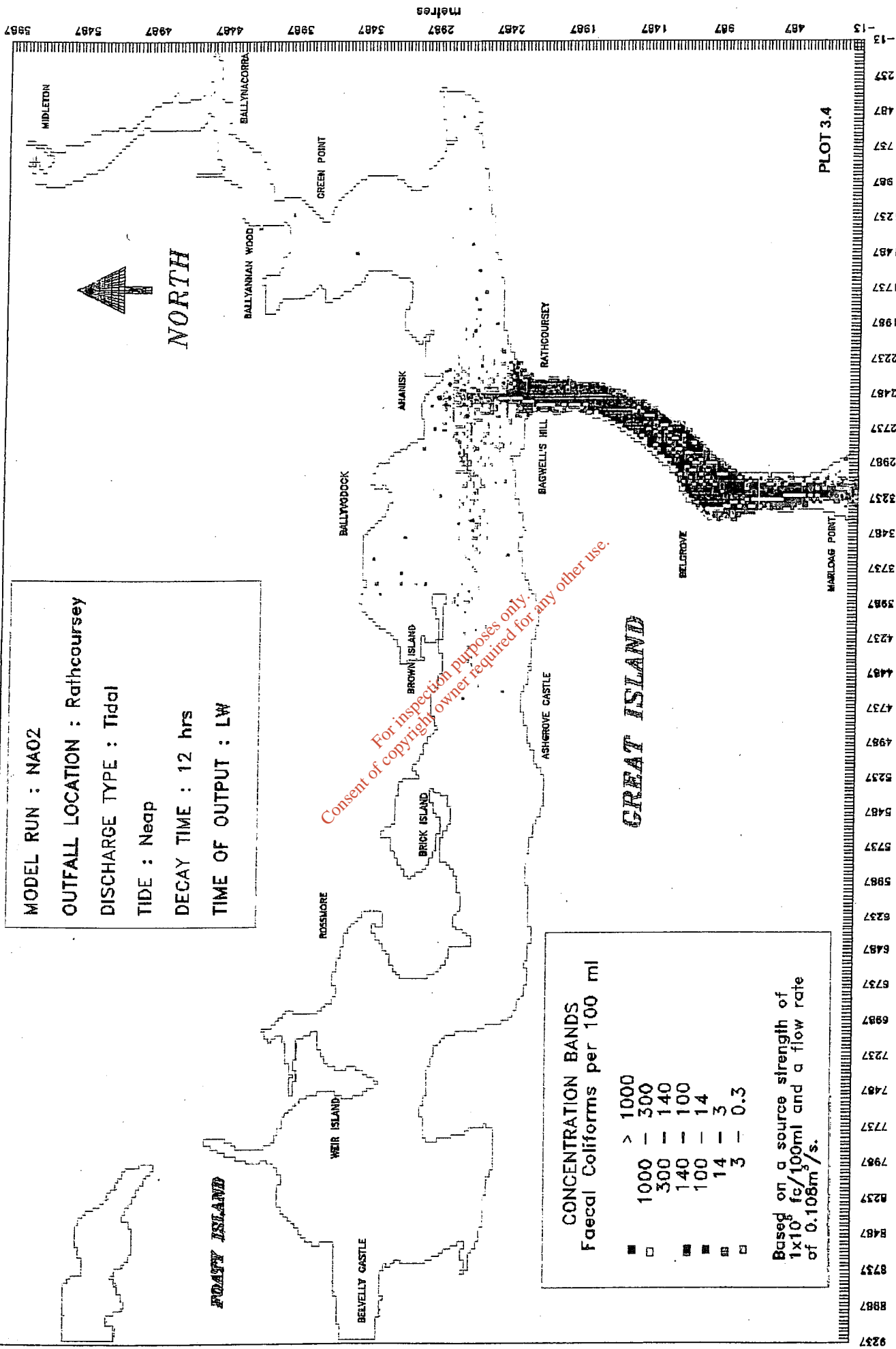
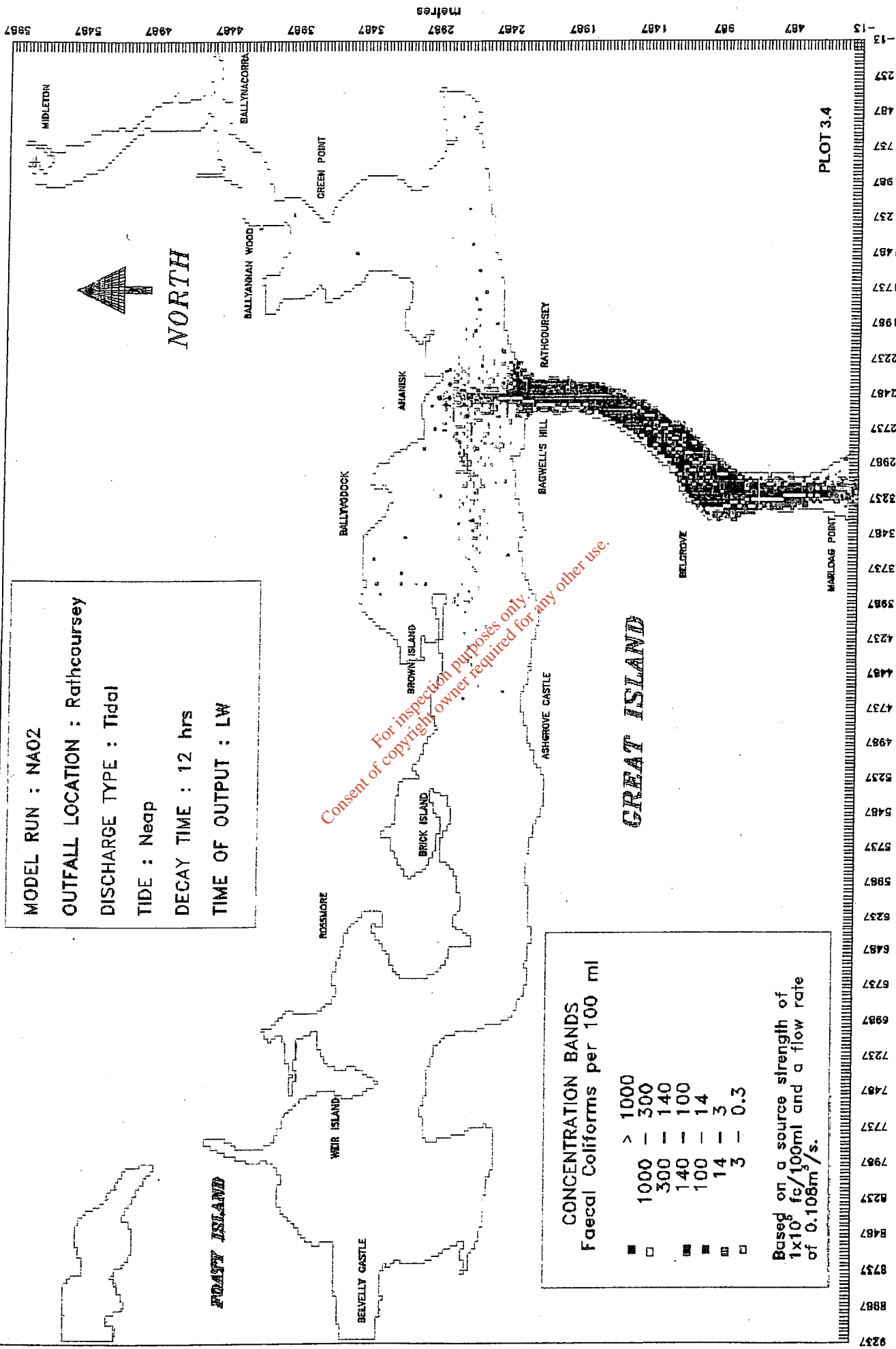
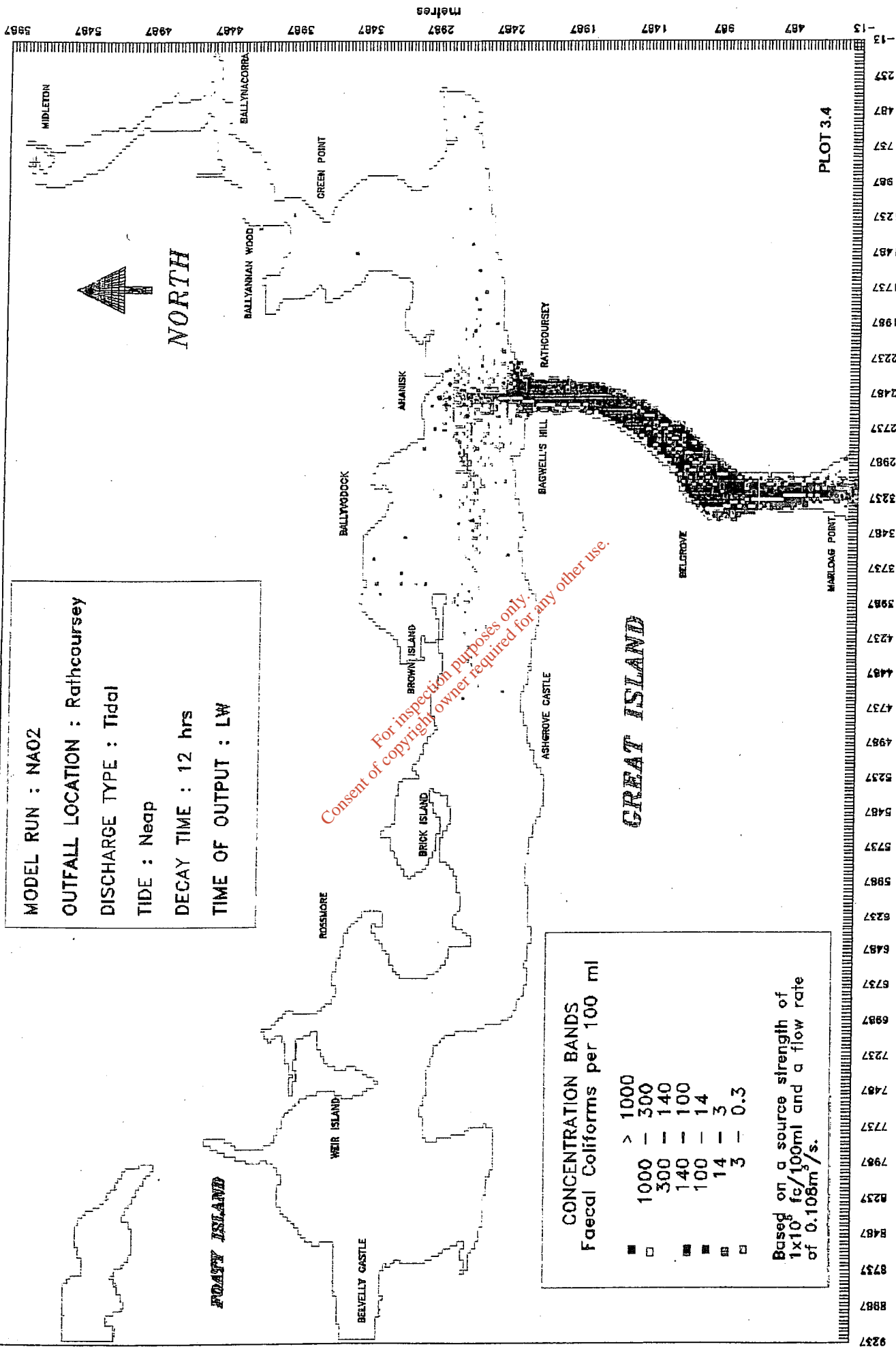
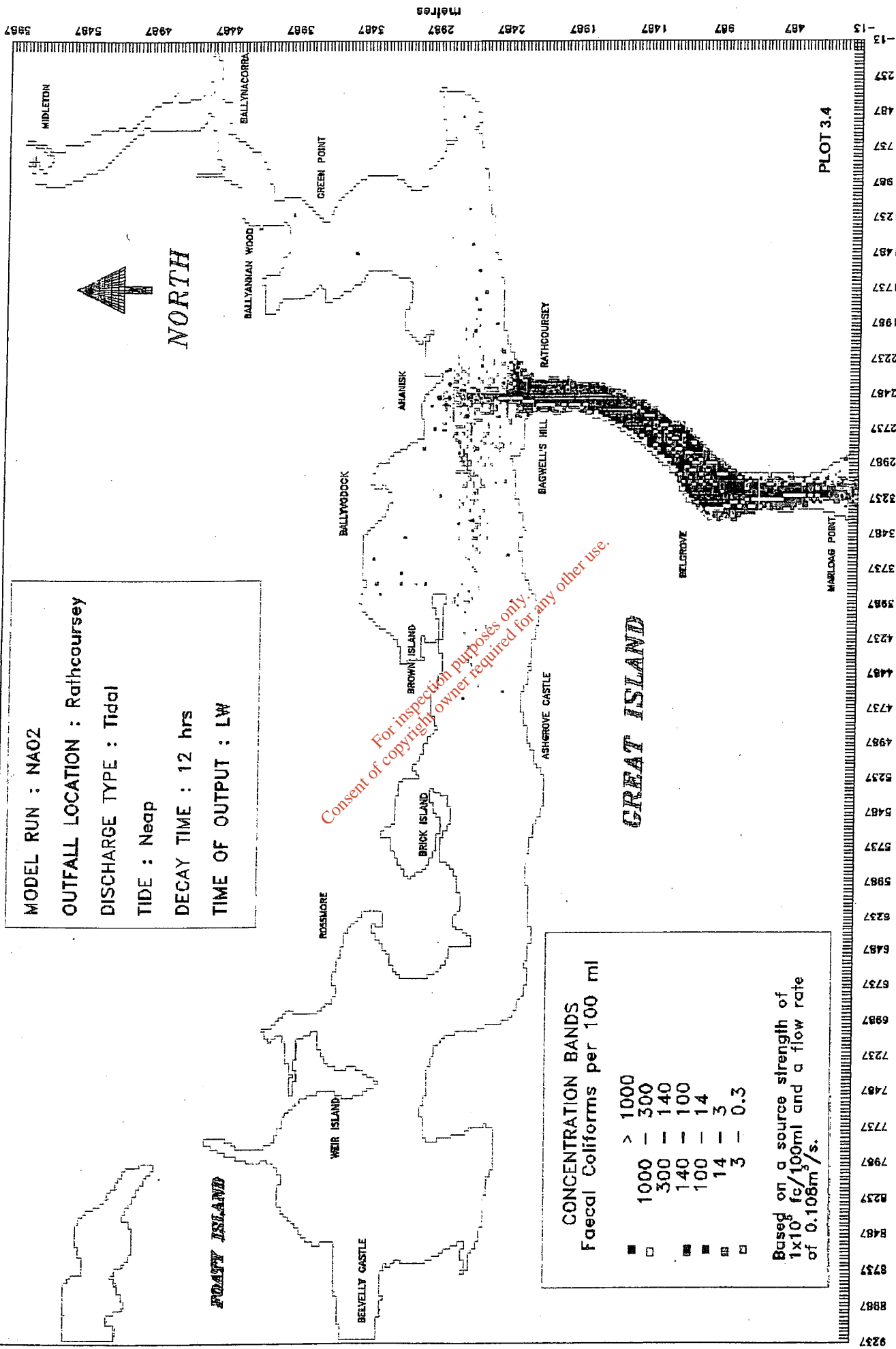
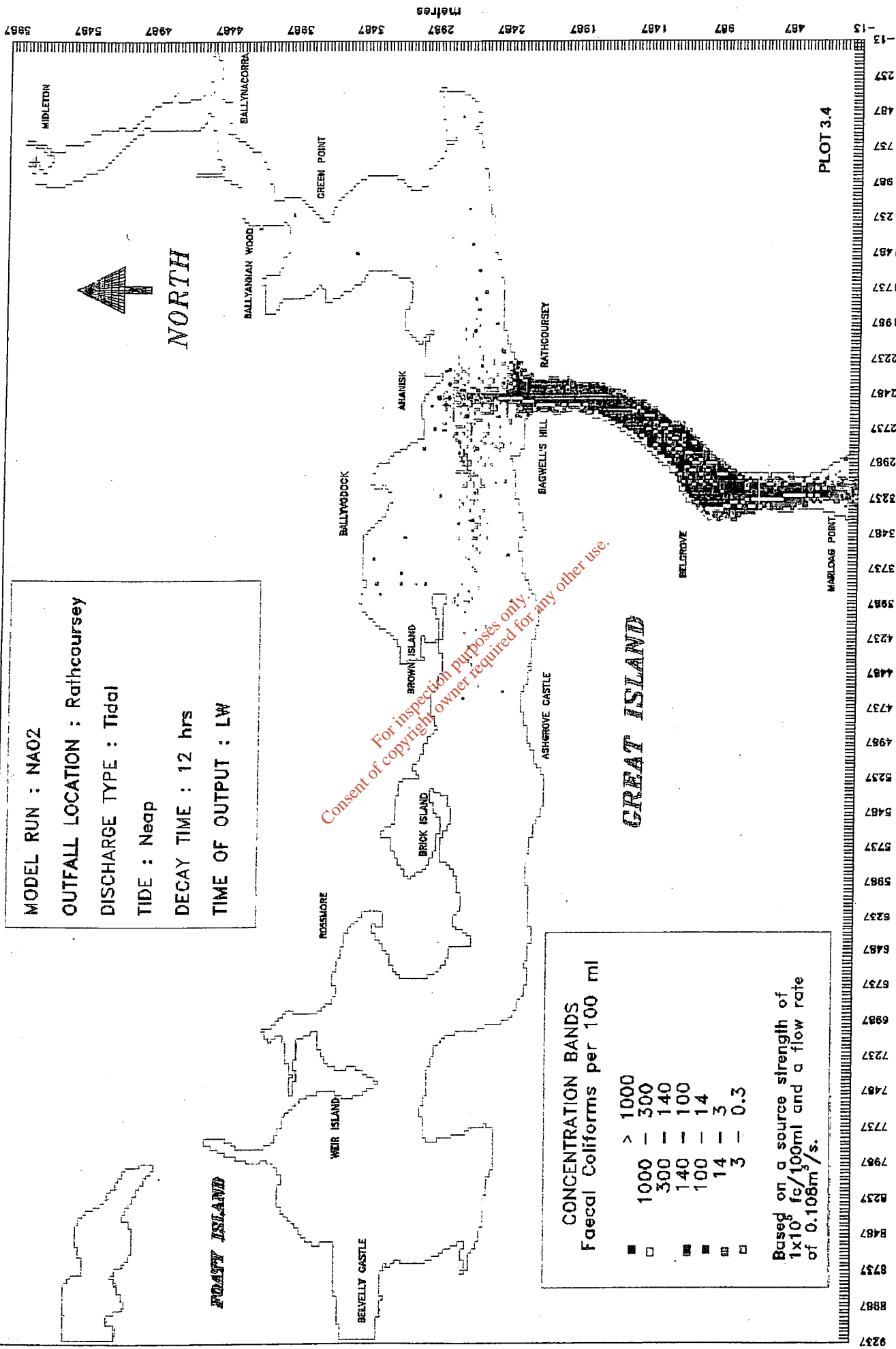
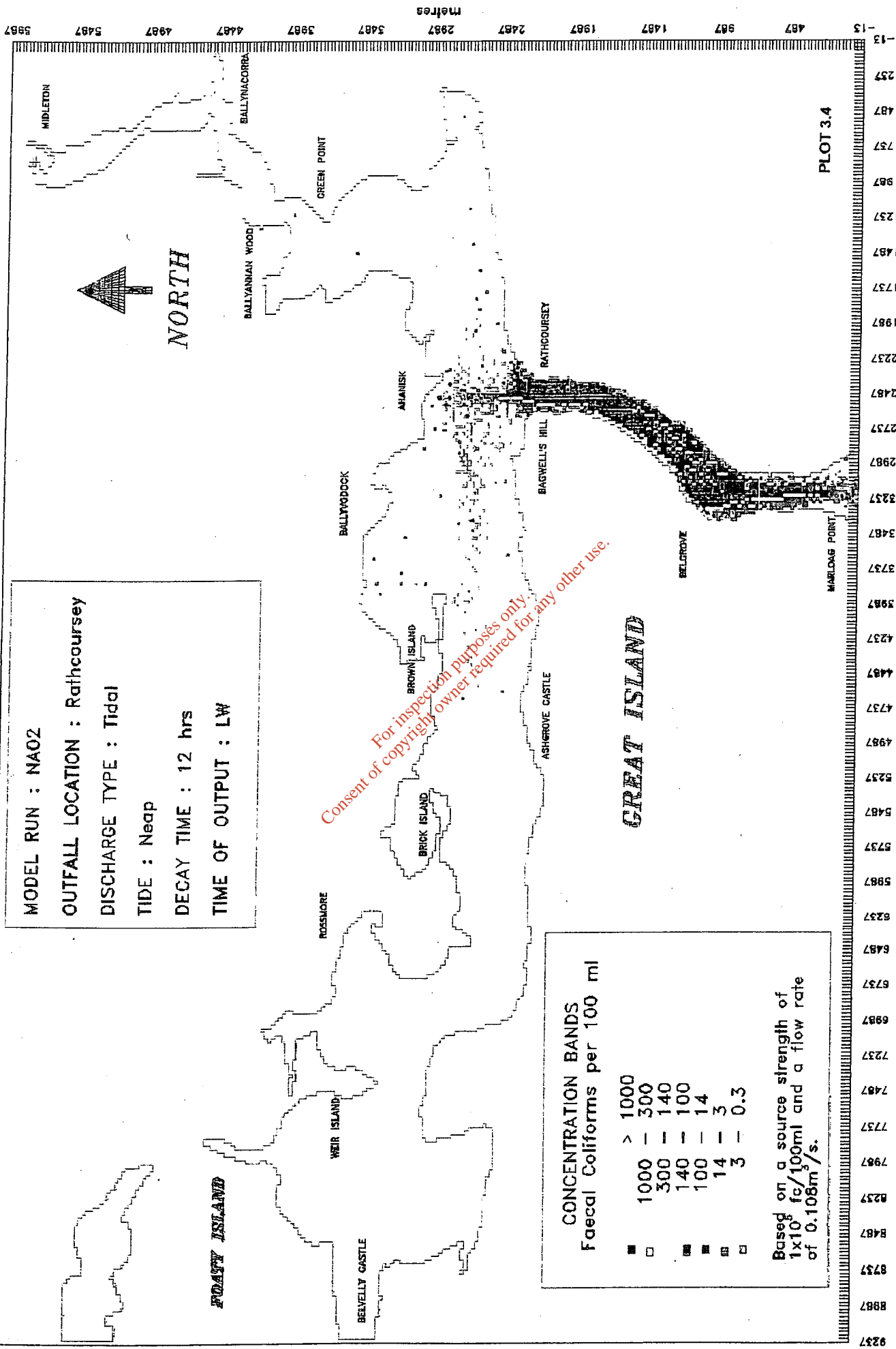
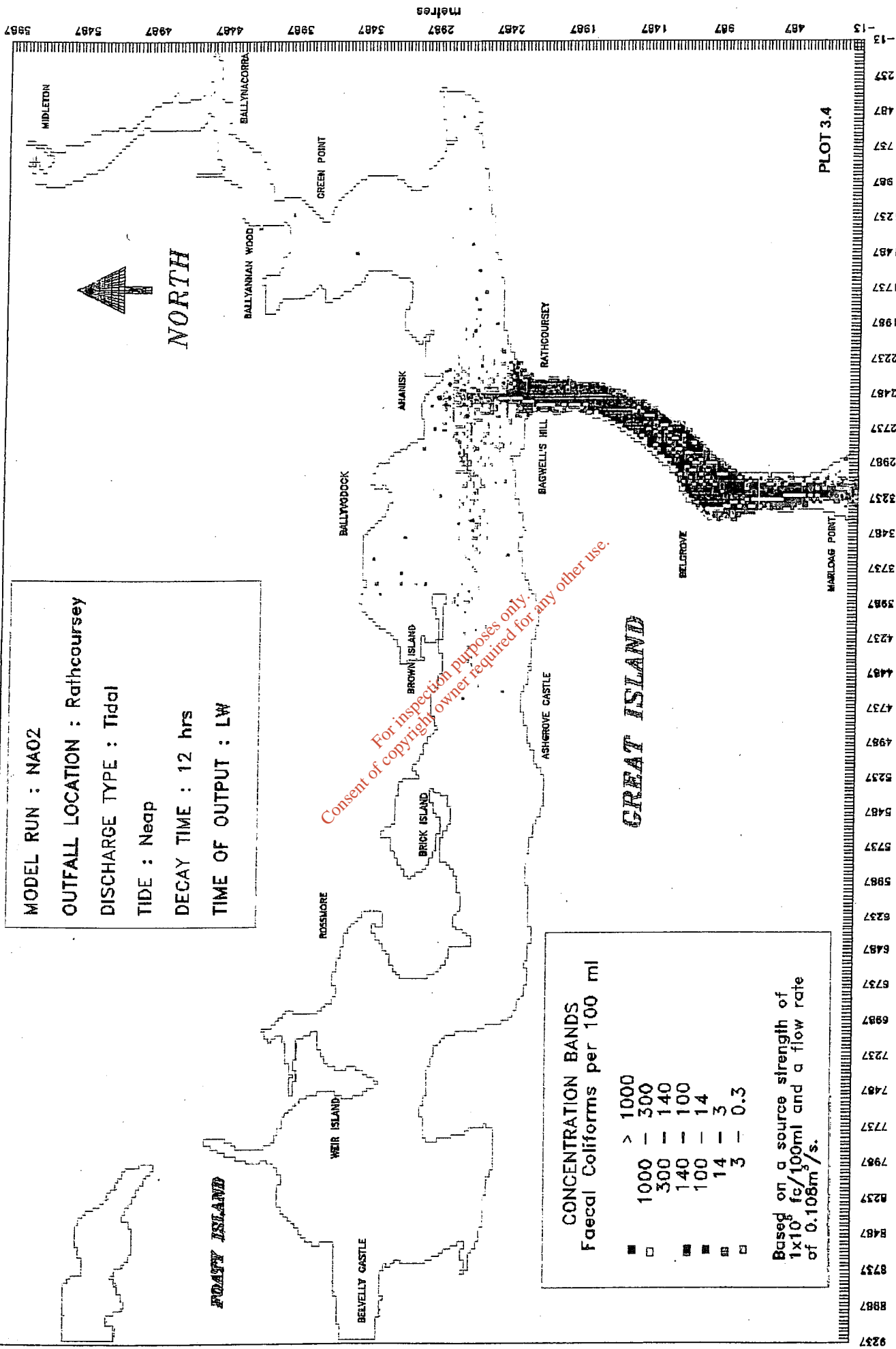
MODEL RUN : NAO2
 OUTFALL LOCATION : Rathcoursey
 DISCHARGE TYPE : Tidal
 TIDE : Neap
 DECAY TIME : 12 hrs
 TIME OF OUTPUT : LW

CONCENTRATION BANDS
 Faecal Coliforms per 100 ml

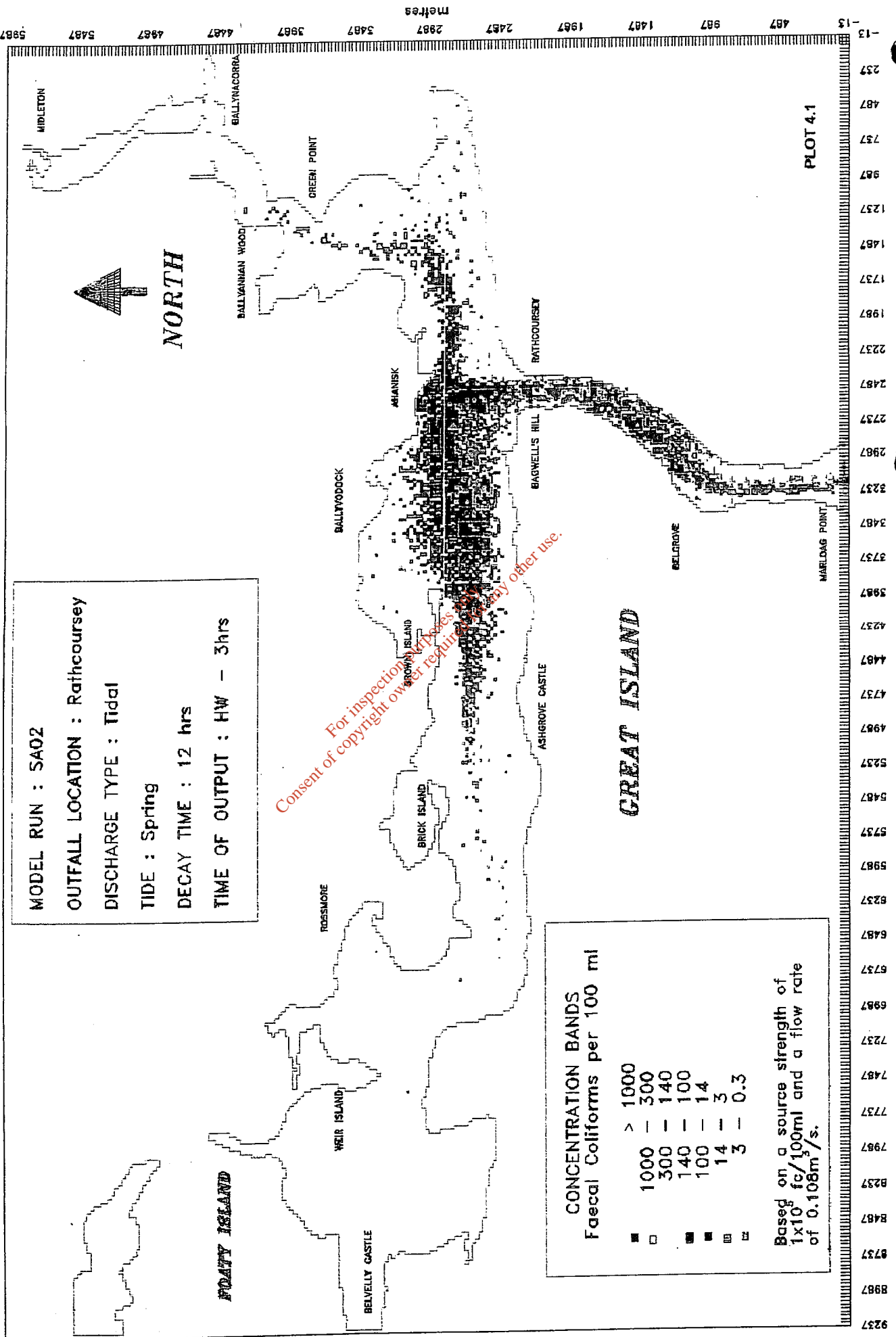
- > 1000
- 1000 - 300
- ▨ 300 - 140
- ▩ 140 - 100
- ▧ 100 - 14
- ▦ 14 - 3
- ▥ 3 - 0.3

Based on a source strength of 1×10^8 fc/100ml and a flow rate of 0.108m³/s.

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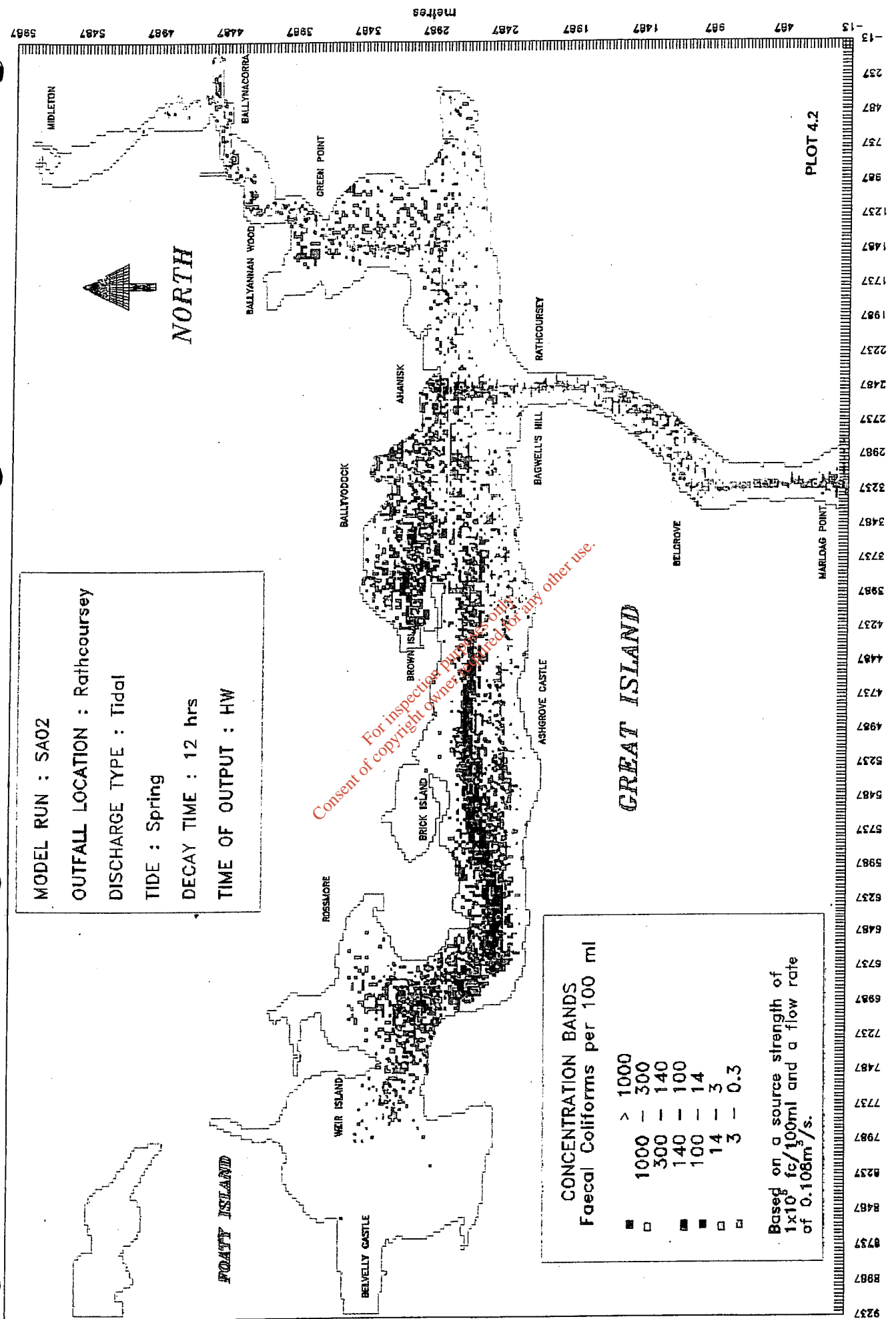


MIDDLETON SLURRY TREATMENT SCHEME - OUTFALL ST. Y



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MIDDLETON WERAGE SCHEME - OUTFALL STUDY



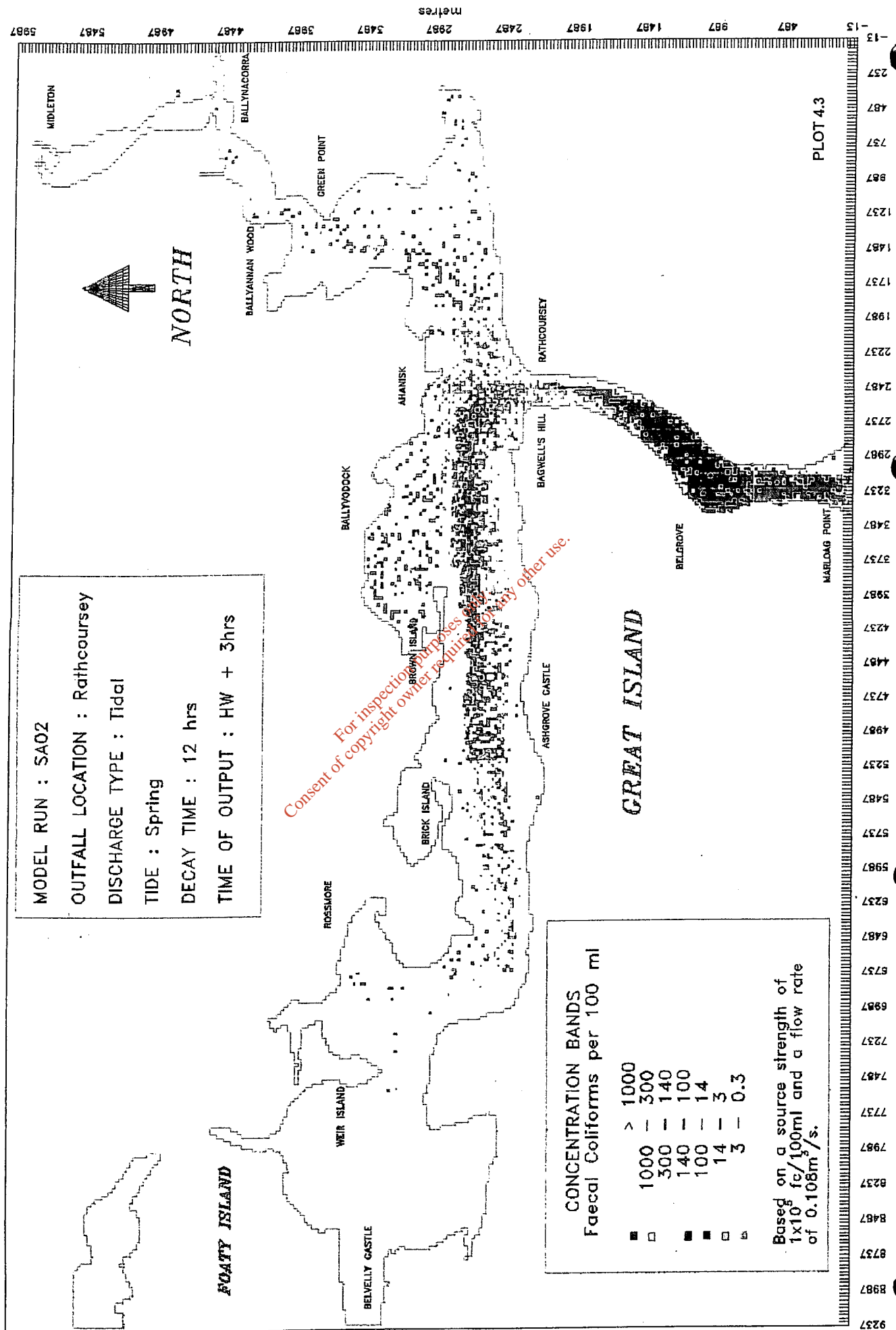
MODEL RUN : SA02
 OUTFALL LOCATION : Rathcoursey
 DISCHARGE TYPE : Tidal
 TIDE : Spring
 DECAY TIME : 12 hrs
 TIME OF OUTPUT : HW

CONCENTRATION BANDS
 Faecal Coliforms per 100 ml

■	> 1000
□	1000 - 300
■	300 - 140
■	140 - 100
■	100 - 14
□	14 - 3
□	3 - 0.3

Based on a source strength of 1x10⁶ fc/100ml and a flow rate of 0.106m³/s.

MIDDLETON S.WERAGE SCHEME - OUTFALL ST. DY



MODEL RUN : SA02
 OUTFALL LOCATION : Rathcoursey
 DISCHARGE TYPE : Tidal
 TIDE : Spring
 DECAY TIME : 12 hrs
 TIME OF OUTPUT : HW + 3hrs

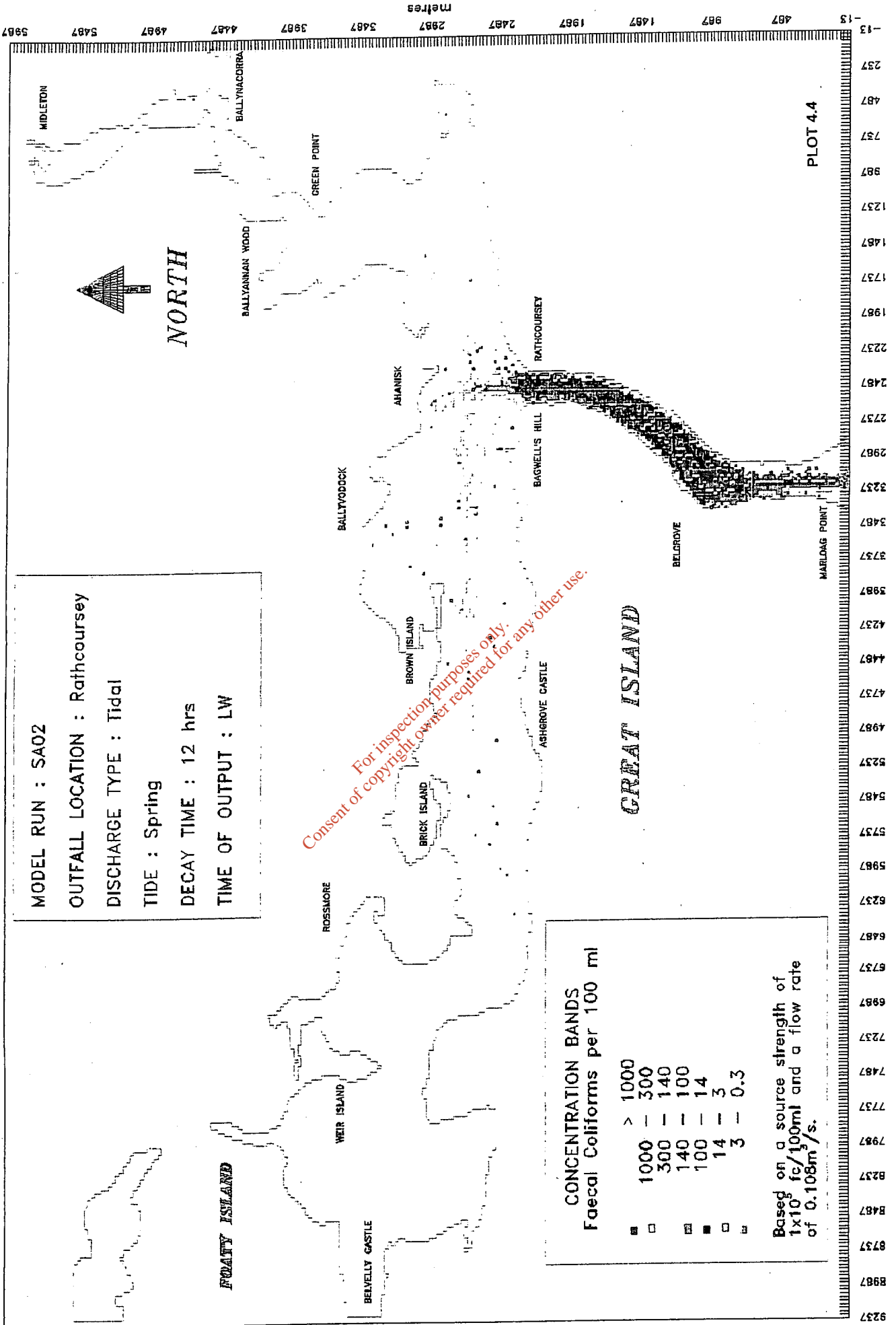
CONCENTRATION BANDS
 Faecal Coliforms per 100 ml

■	> 1000
□	1000 - 300
■	300 - 140
■	140 - 100
■	100 - 14
■	14 - 3
□	3 - 0.3

Based on a source strength of 1×10^5 fc/100ml and a flow rate of 0.108m³/s.

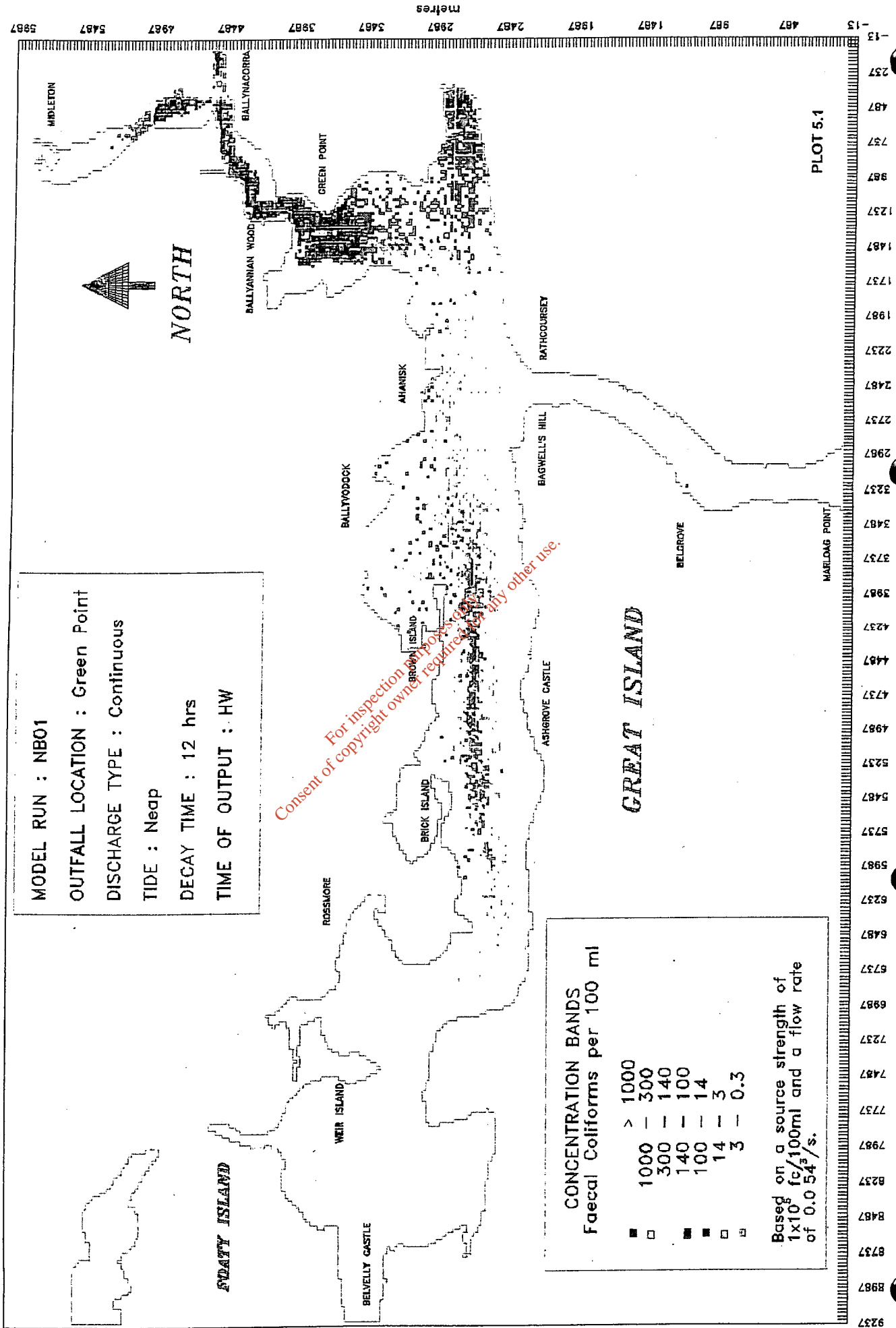
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MIDLETON SEWERAGE SCHEME - OUTFALL STUDY



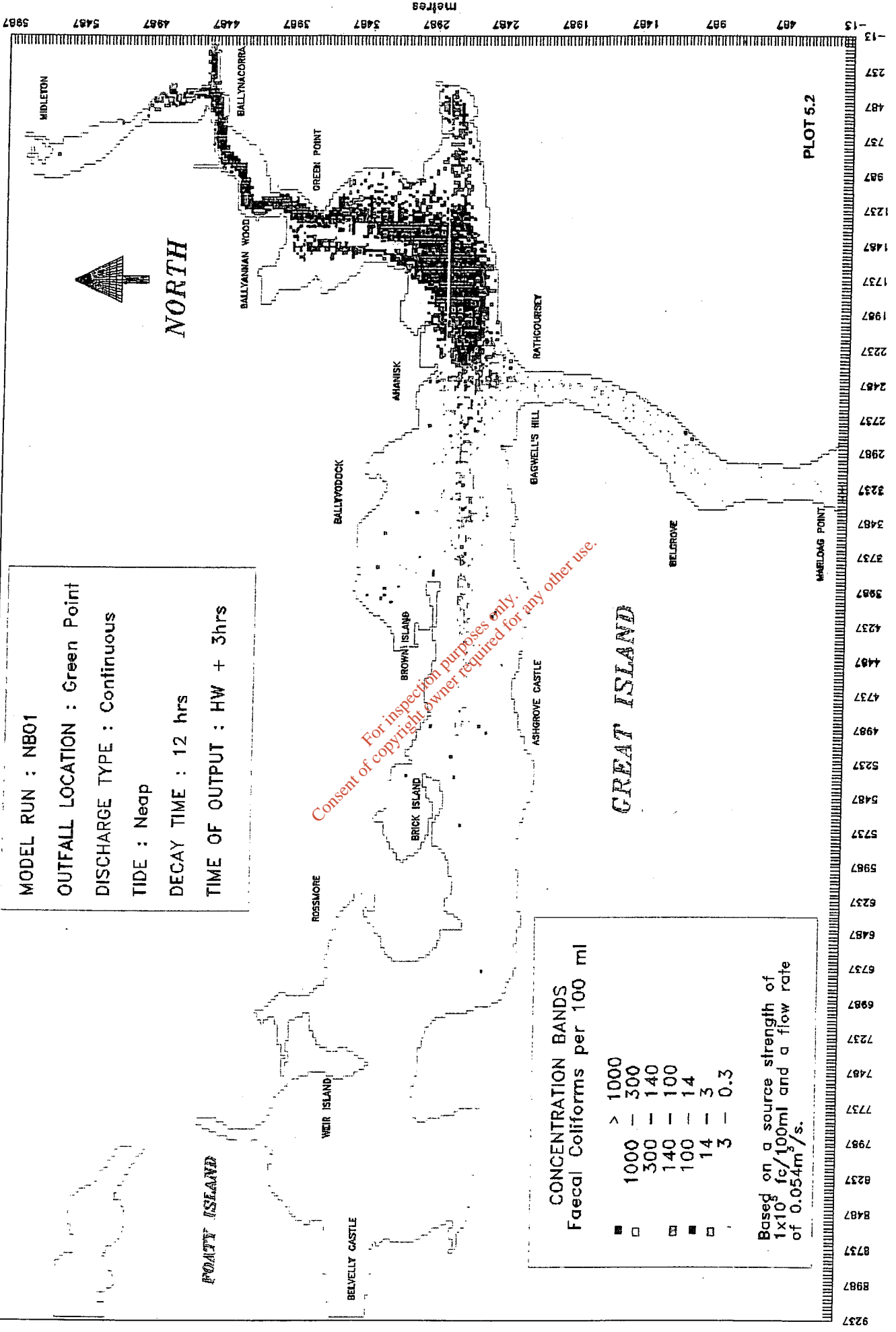
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MIDDLETON SEWERAGE SCHEME - OUTFALL STUDY



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MIDDLETON WERAGE SCHEME - OUTFALL STUDY



MODEL RUN : NB01

OUTFALL LOCATION : Green Point

DISCHARGE TYPE : Continuous

TIDE : Neap

DECAY TIME : 12 hrs

TIME OF OUTPUT : HW + 3hrs

CONCENTRATION BANDS
Faecal Coliforms per 100 ml

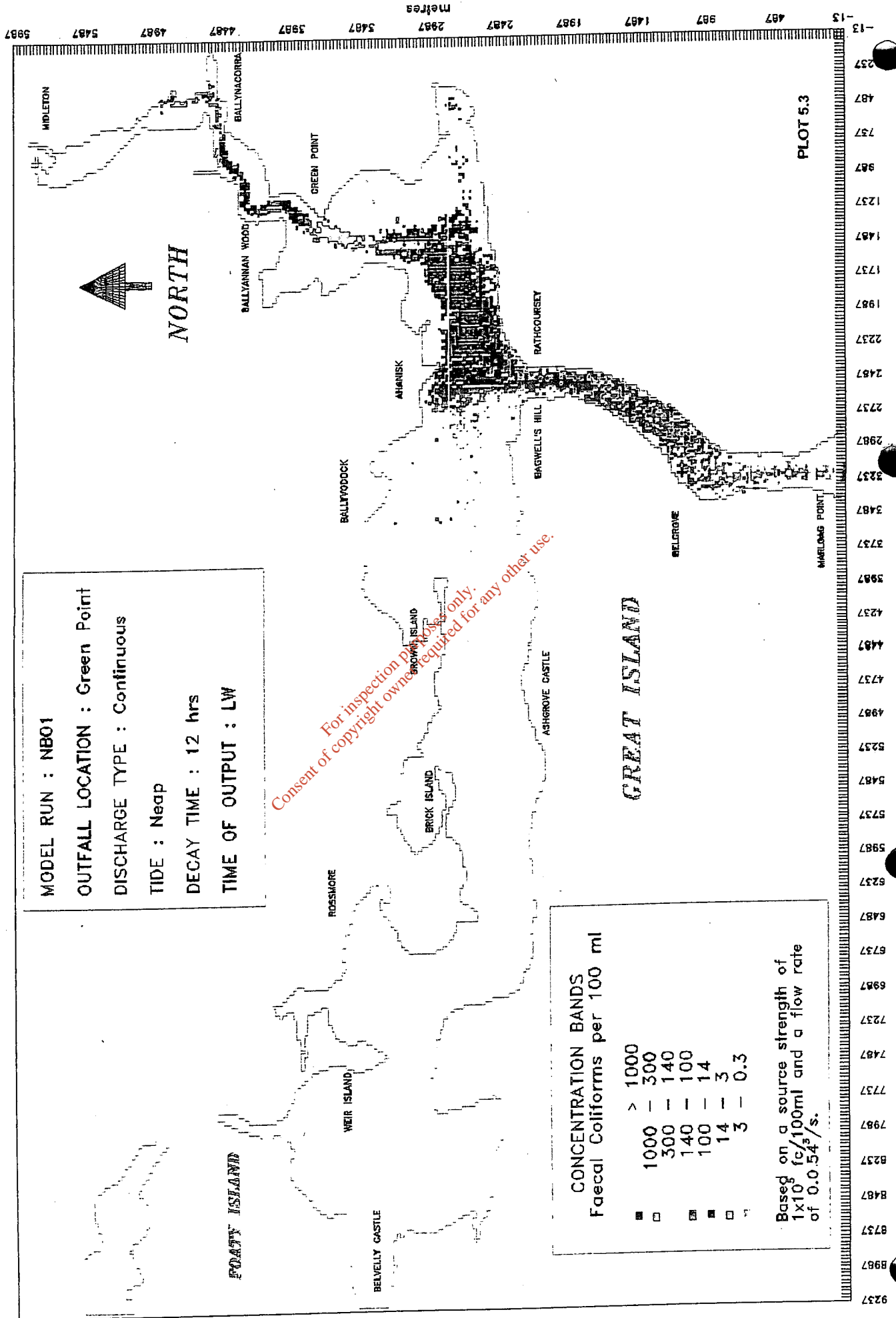
- > 1000
- 1000 - 300
- 300 - 140
- 140 - 100
- 100 - 14
- 14 - 3
- 3 - 0.3

Based on a source strength of 1×10^5 fc/100ml and a flow rate of 0.054m³/s.

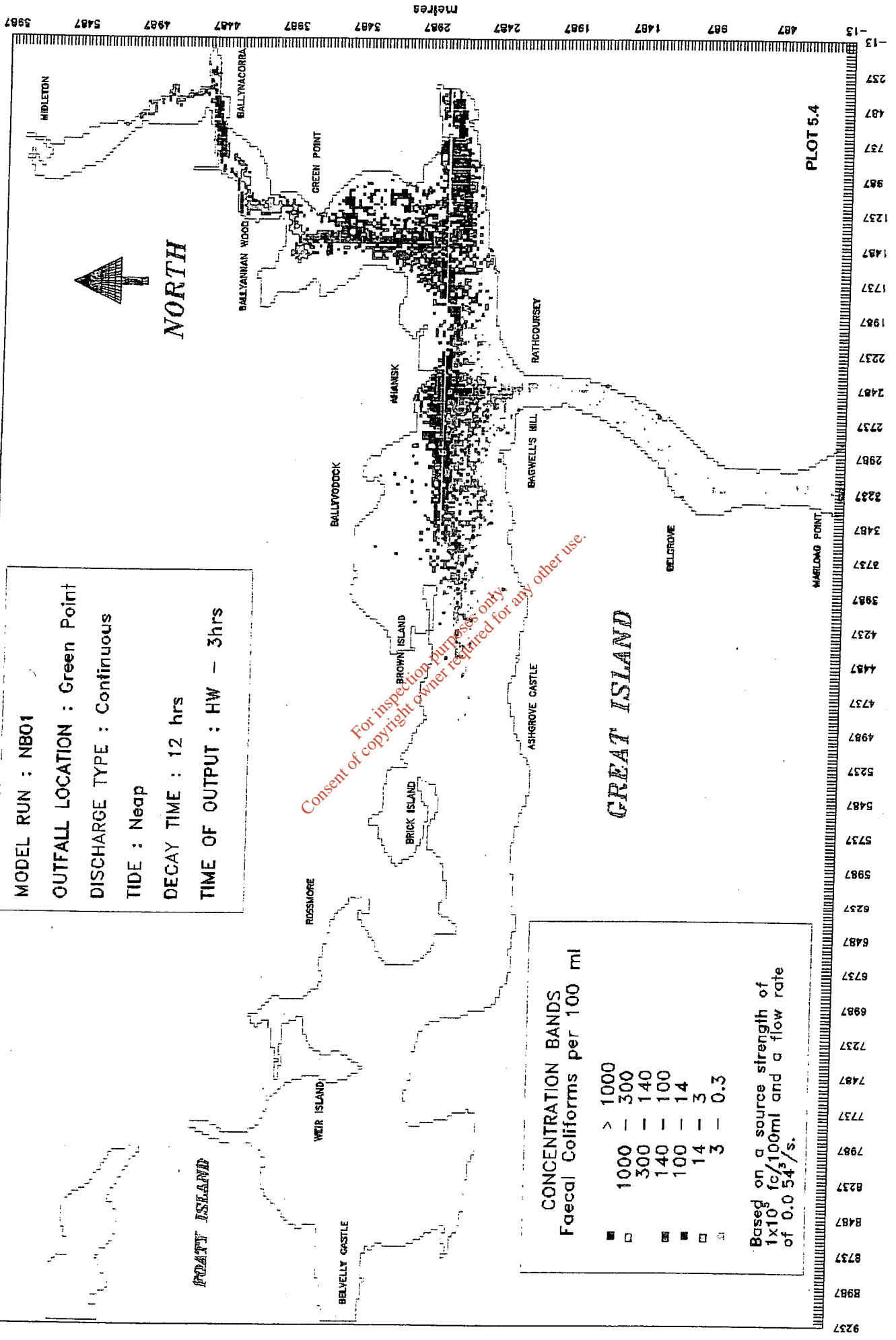
Consent of copyright owner required for any other use.
For inspection purposes only.

PLOT 5.2

MIDDLETON SEWERAGE SCHEME - OUTFALL STUDY



MIDDLETON WERAGE SCHEME - OUTFALL STUDY



MODEL RUN : NBO1
OUTFALL LOCATION : Green Point
DISCHARGE TYPE : Continuous
TIDE : Neap
DECAY TIME : 12 hrs
TIME OF OUTPUT : HW - 3hrs

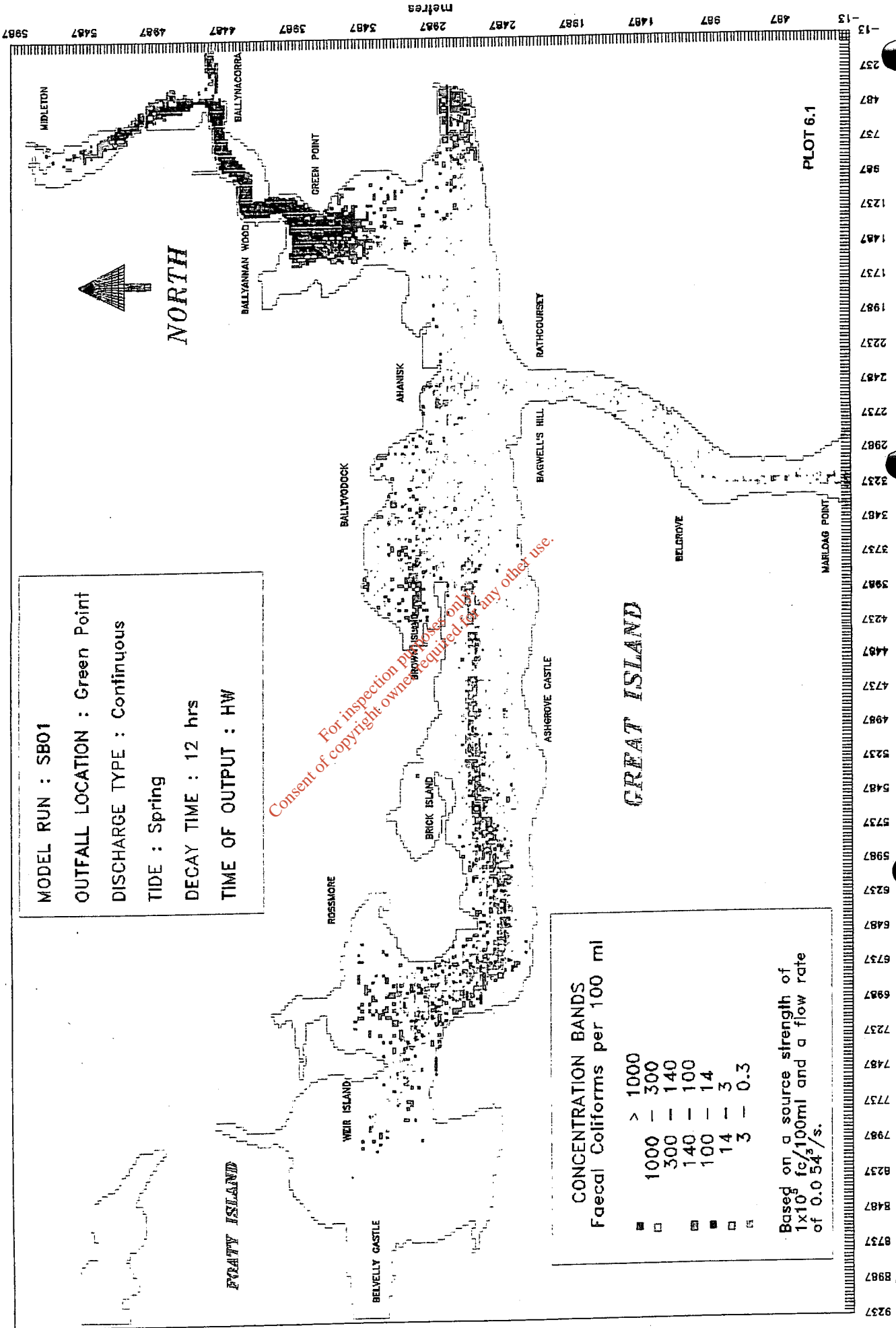
For inspection purposes only
 Consent of copyright owner required for any other use.

CONCENTRATION BANDS
 Faecal Coliforms per 100 ml

■	> 1000
■	1000 - 300
■	300 - 140
■	140 - 100
■	100 - 14
■	14 - 3
■	3 - 0.3

Based on a source strength of 1×10^6 fc/100ml and a flow rate of $0.054^3/s$.

MIDDLETON SEWERAGE SCHEME - OUTFALL STUDY



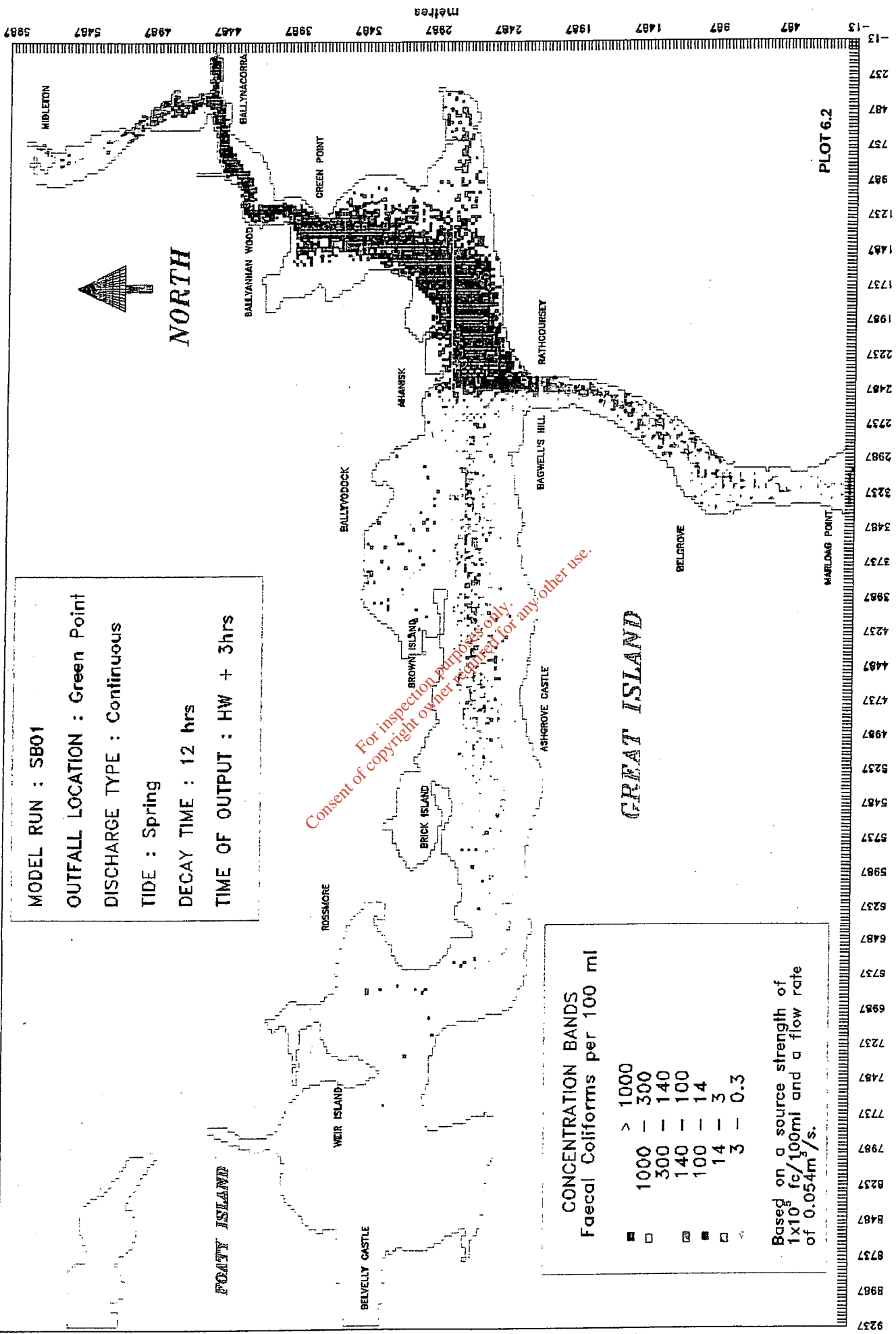
MODEL RUN : SB01
 OUTFALL LOCATION : Green Point
 DISCHARGE TYPE : Continuous
 TIDE : Spring
 DECAY TIME : 12 hrs
 TIME OF OUTPUT : HW

CONCENTRATION BANDS
 Faecal Coliforms per 100 ml

■	> 1000
□	1000 - 300
□	300 - 140
□	140 - 100
□	100 - 14
□	14 - 3
□	3 - 0.3

Based on a source strength of
 1×10^5 fc/100ml and a flow rate
 of 0.054/s.

MIDDLETON AVERAGE SCHEME - OUTFALL STUDY



MODEL RUN : SB01
 OUTFALL LOCATION : Green Point
 DISCHARGE TYPE : Continuous
 TIDE : Spring
 DECAY TIME : 12 hrs
 TIME OF OUTPUT : HW + 3hrs

CONCENTRATION BANDS
 Faecal Coliforms per 100 ml

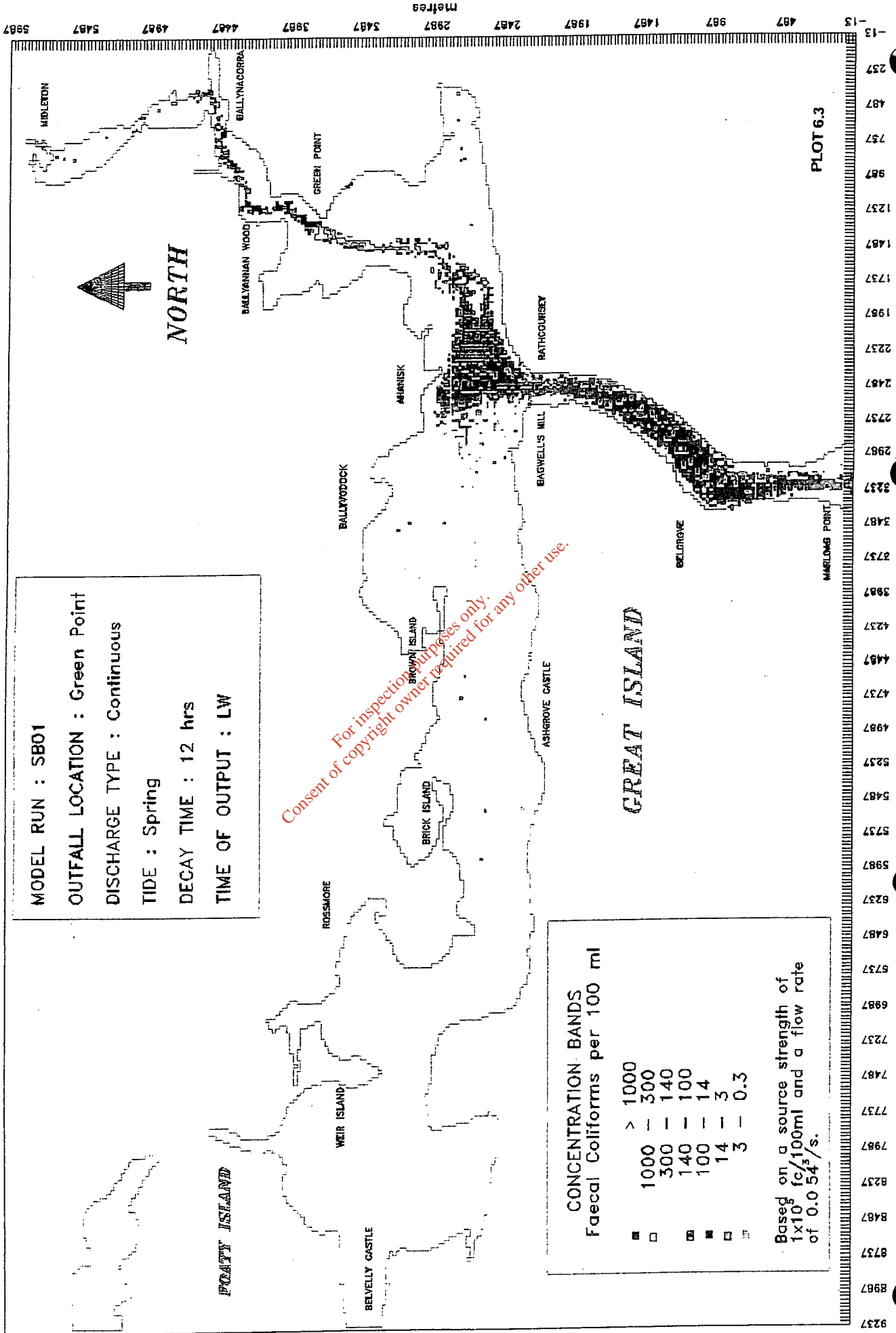
■	> 1000
□	1000 - 300
▣	300 - 140
▤	140 - 100
▥	100 - 14
▦	14 - 3
▧	3 - 0.3

Based on a source strength of 1×10^6 fc/100ml and a flow rate of 0.054m³/s.

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PLOT 6.2

MIDDLETON SEWERAGE SCHEME - OUTFALL STUDY



MODEL RUN : SB01
OUTFALL LOCATION : Green Point
DISCHARGE TYPE : Continuous
TIDE : Spring
DECAY TIME : 12 hrs
TIME OF OUTPUT : LW

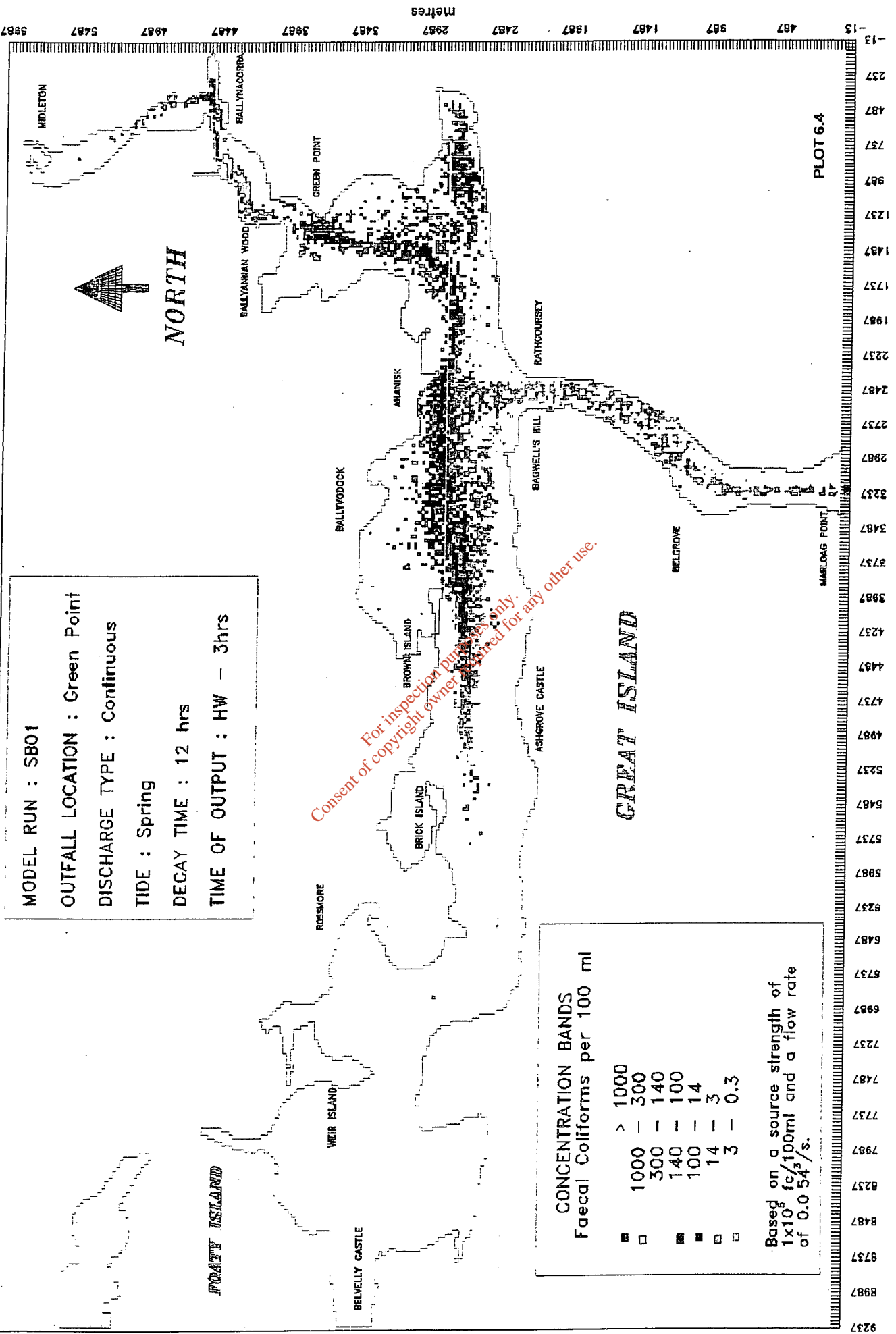
CONCENTRATION BANDS
Faecal Coliforms per 100 ml

■	> 1000
□	1000 - 300
▣	300 - 140
▤	140 - 100
▥	100 - 14
▦	14 - 3
▧	3 - 0.3

Based on a source strength of 1×10^5 fc/100ml and a flow rate of 0.054 m³/s.

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MIDDLETON WERAGE SCHEME - OUTFALL STUDY



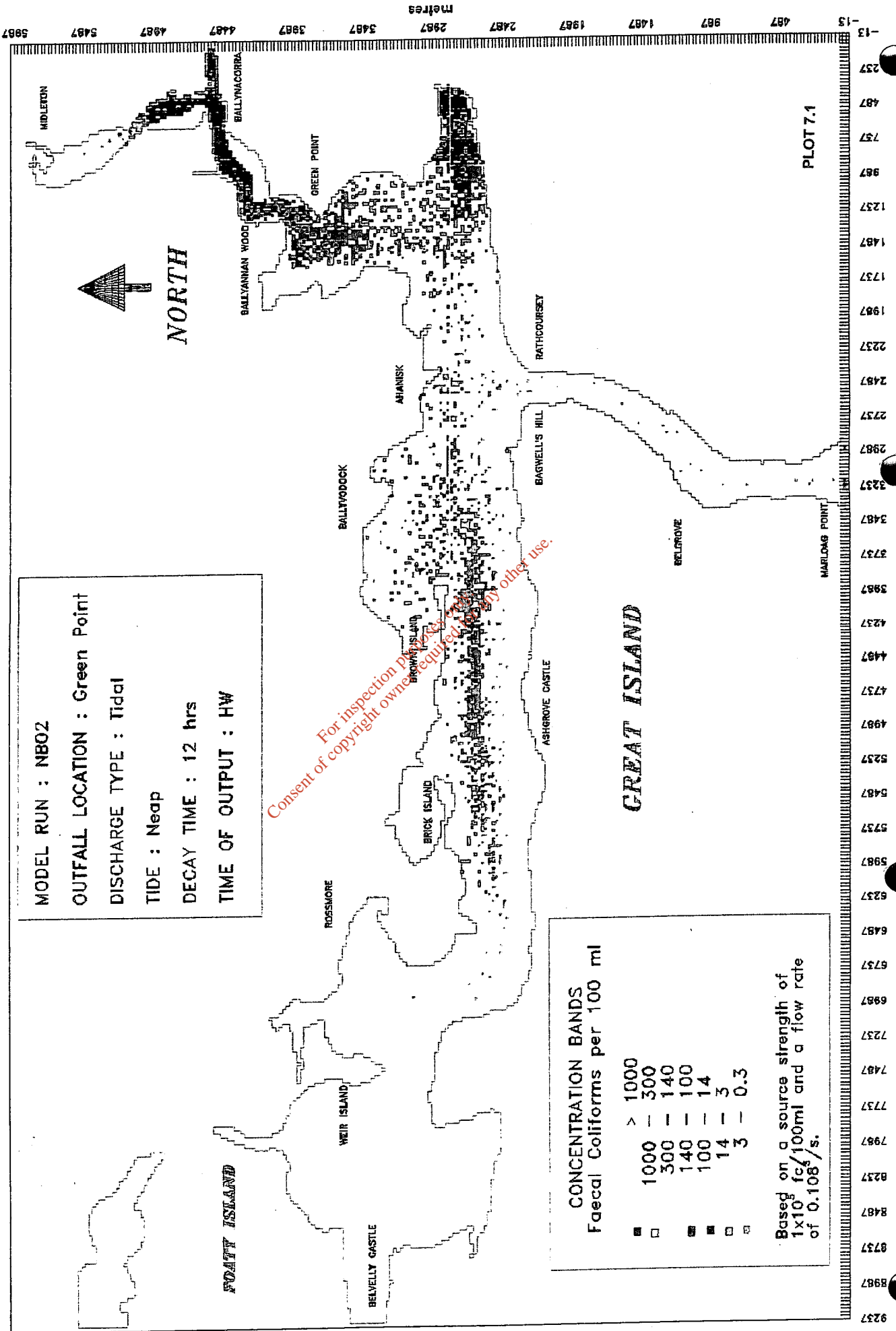
MODEL RUN : SB01
 OUTFALL LOCATION : Green Point
 DISCHARGE TYPE : Continuous
 TIDE : Spring
 DECAY TIME : 12 hrs
 TIME OF OUTPUT : HW - 3hrs

CONCENTRATION BANDS
 Faecal Coliforms per 100 ml

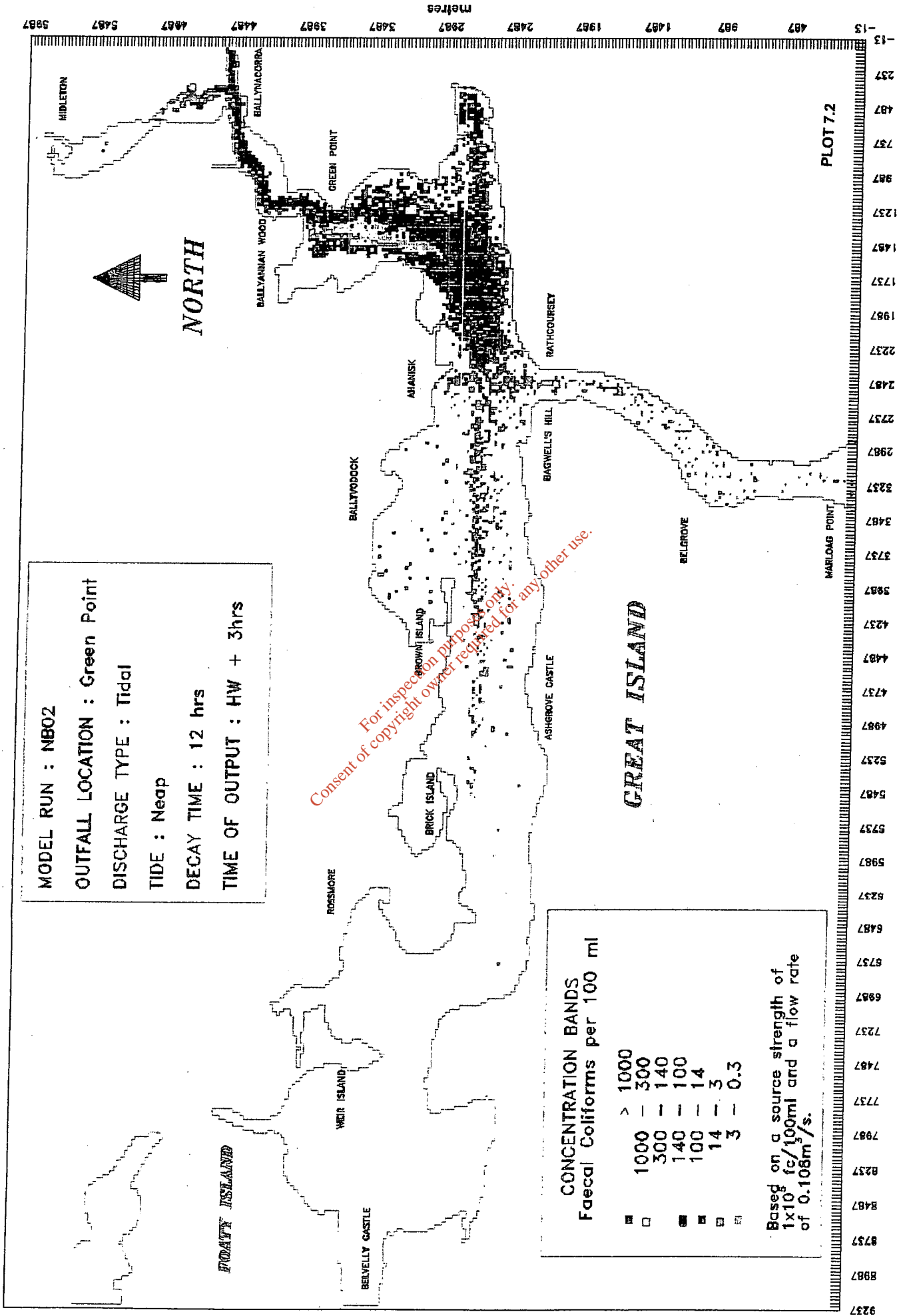
■	> 1000
□	1000 - 300
■	300 - 140
■	140 - 100
■	100 - 14
□	14 - 3
□	3 - 0.3

Based on a source strength of 1×10^8 fc/100ml and a flow rate of 0.054/s.

MIDDLETON SEWERAGE SCHEME - OUTFALL STUDY



MIDDLETON WERAGE SCHEME - OUTFALL STUDY



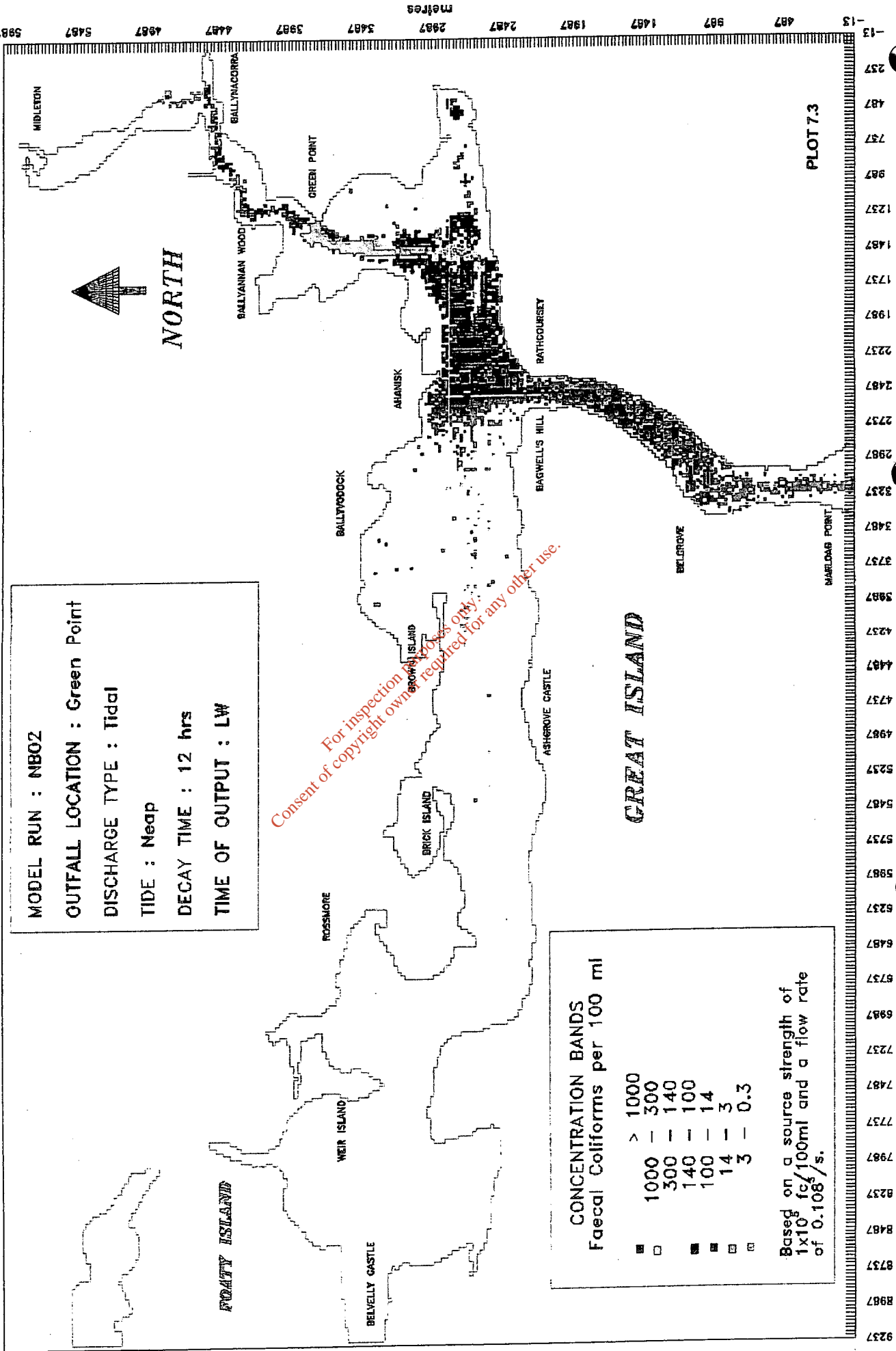
MODEL RUN : NB02
OUTFALL LOCATION : Green Point
DISCHARGE TYPE : Tidal
TIDE : Neap
DECAY TIME : 12 hrs
TIME OF OUTPUT : HW + 3hrs

CONCENTRATION BANDS
Faecal Coliforms per 100 ml

■	> 1000
□	1000 - 300
■	300 - 140
■	140 - 100
■	100 - 14
■	14 - 3
■	3 - 0.3

Based on a source strength of 1×10^6 fc/100ml and a flow rate of 0.108m³/s.

MIDDLETON SEWERAGE SCHEME - OUTFALL STUDY



MODEL RUN : N802
OUTFALL LOCATION : Green Point
DISCHARGE TYPE : Tidal
TIDE : Neap
DECAY TIME : 12 hrs
TIME OF OUTPUT : LW

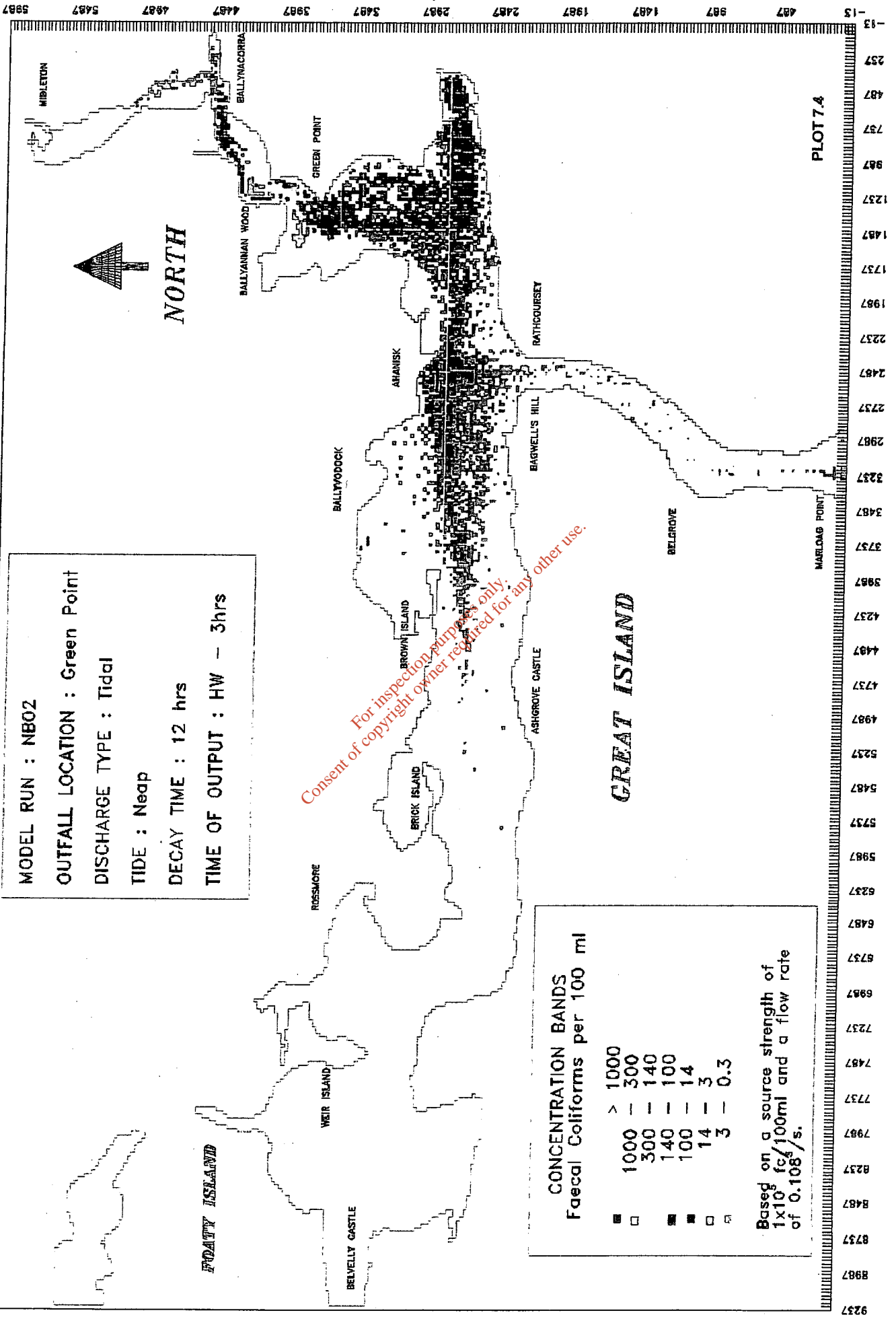
CONCENTRATION BANDS
Faecal Coliforms per 100 ml

■	> 1000
□	1000 - 300
■	300 - 140
■	140 - 100
■	100 - 14
■	14 - 3
■	3 - 0.3

Based on a source strength of
 1×10^5 fc/100ml and a flow rate
 of 0.108 /s.

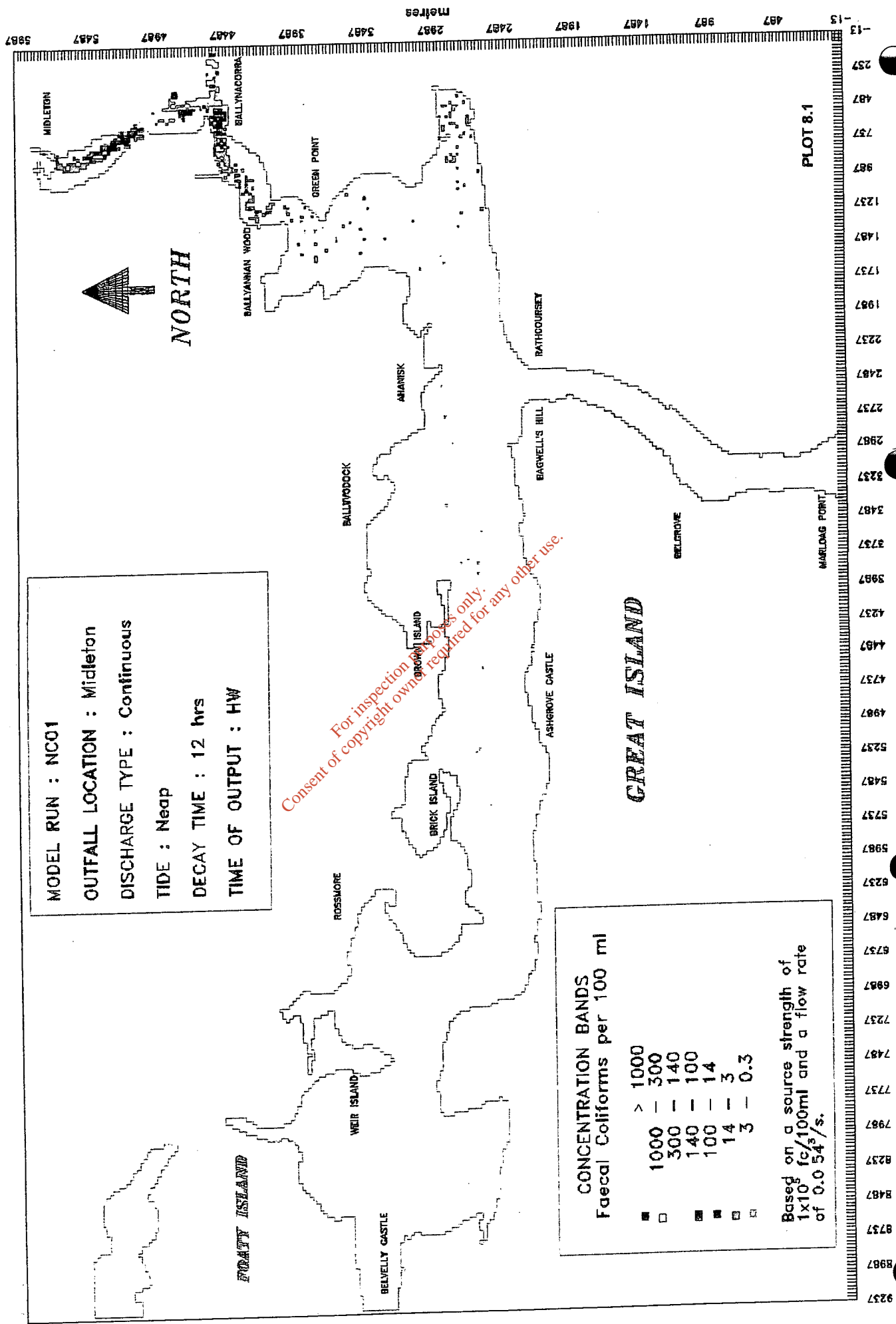
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MIDDLETON WERAGE SCHEME - OUTFALL SCHEME

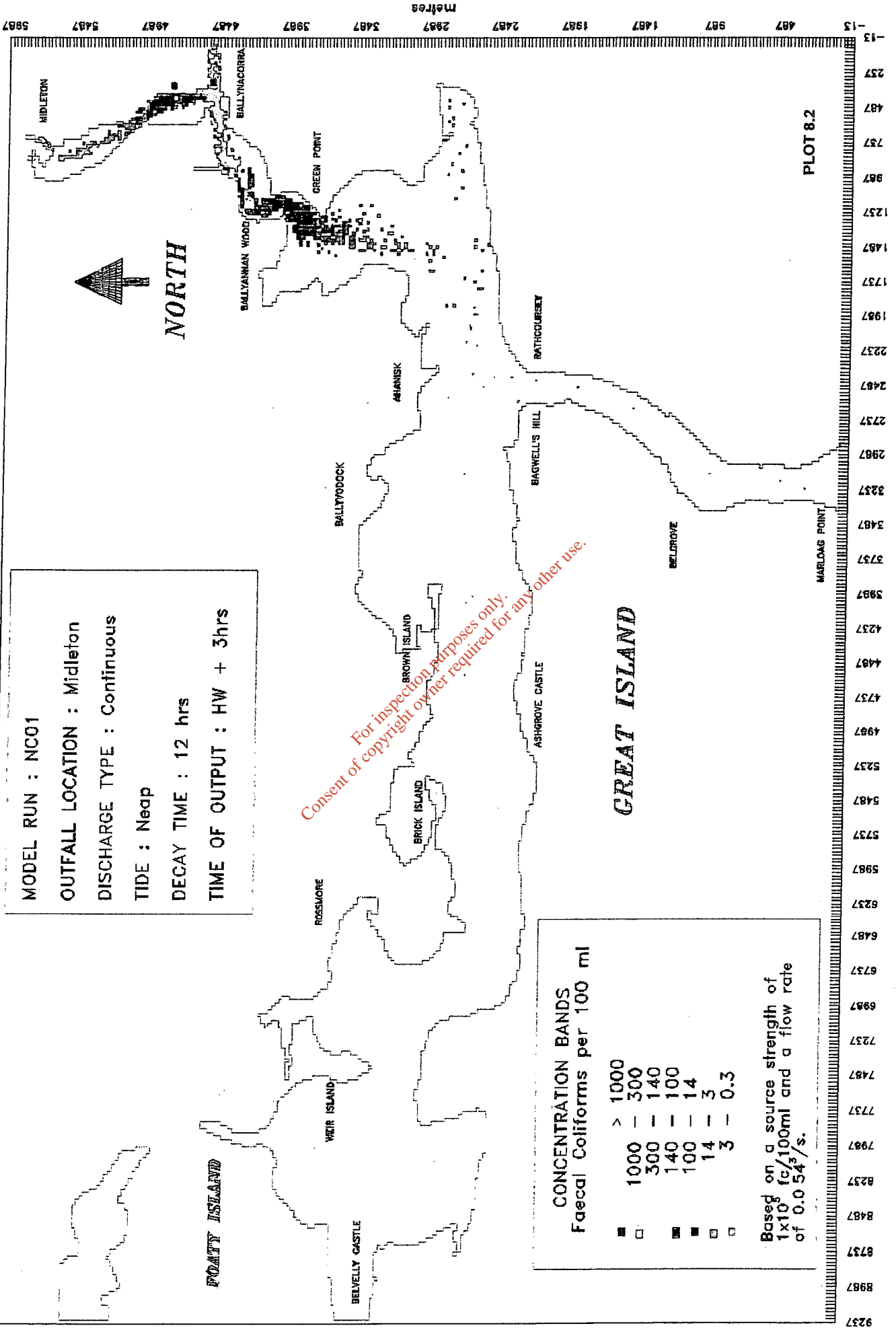


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MIDDLETON SEWERAGE SCHEME - OUTFALL STUDY



MIDDLETON WERAGE SCHEME - OUTFALL STUDY



MODEL RUN : NC01
 OUTFALL LOCATION : Middleton
 DISCHARGE TYPE : Continuous
 TIDE : Neap
 DECAY TIME : 12 hrs
 TIME OF OUTPUT : HW + 3hrs

CONCENTRATION BANDS
 Faecal Coliforms per 100 ml

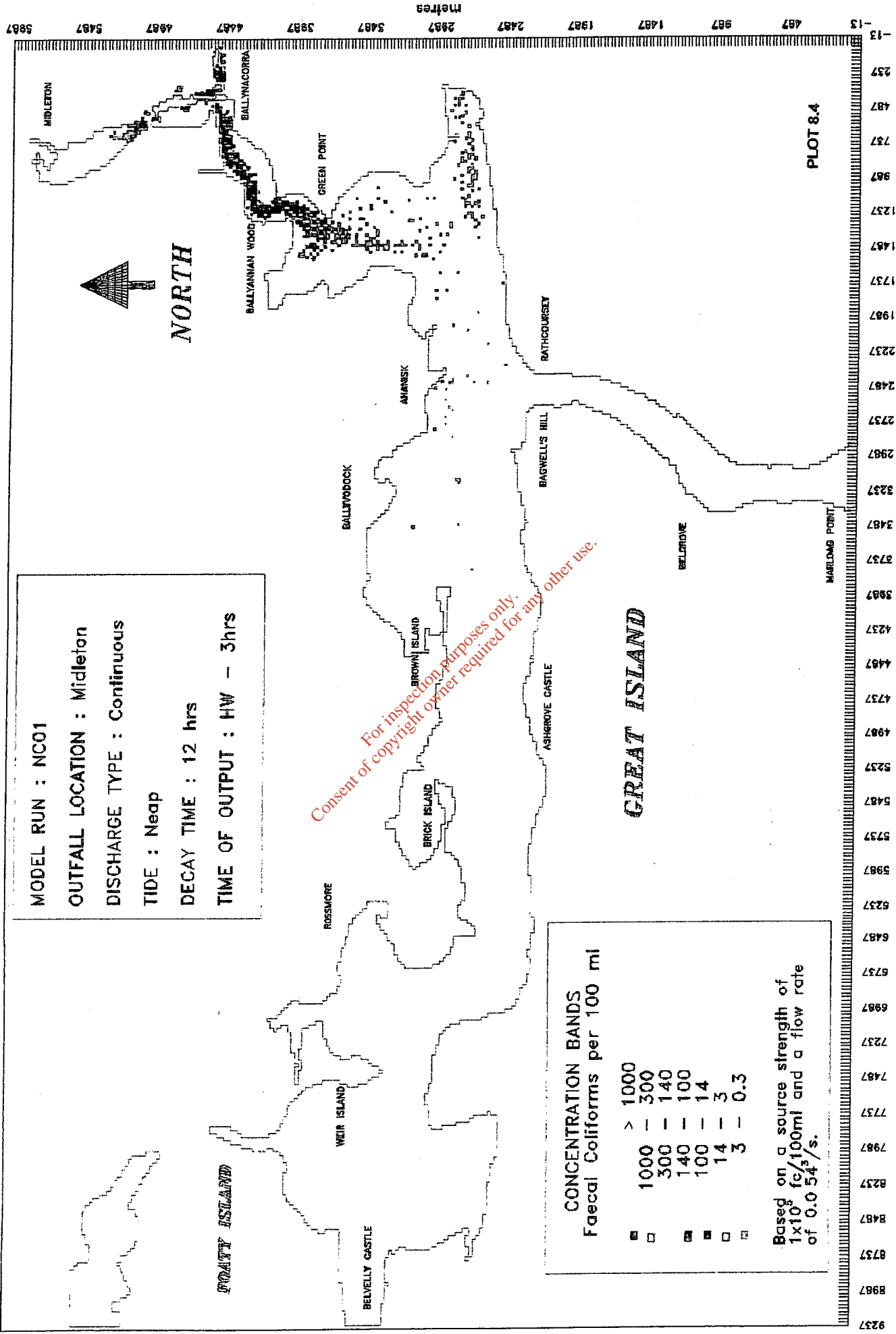
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□	1000 - 300
■	300 - 140
■	140 - 100
■	100 - 14
□	14 - 3
□	3 - 0.3

Based on a source strength of 1×10^5 fc/100ml and a flow rate of $0.054^3/s$.

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PLOT 8.2

MIDDLETON WERAGE SCHEME - OUTFALL STUDY



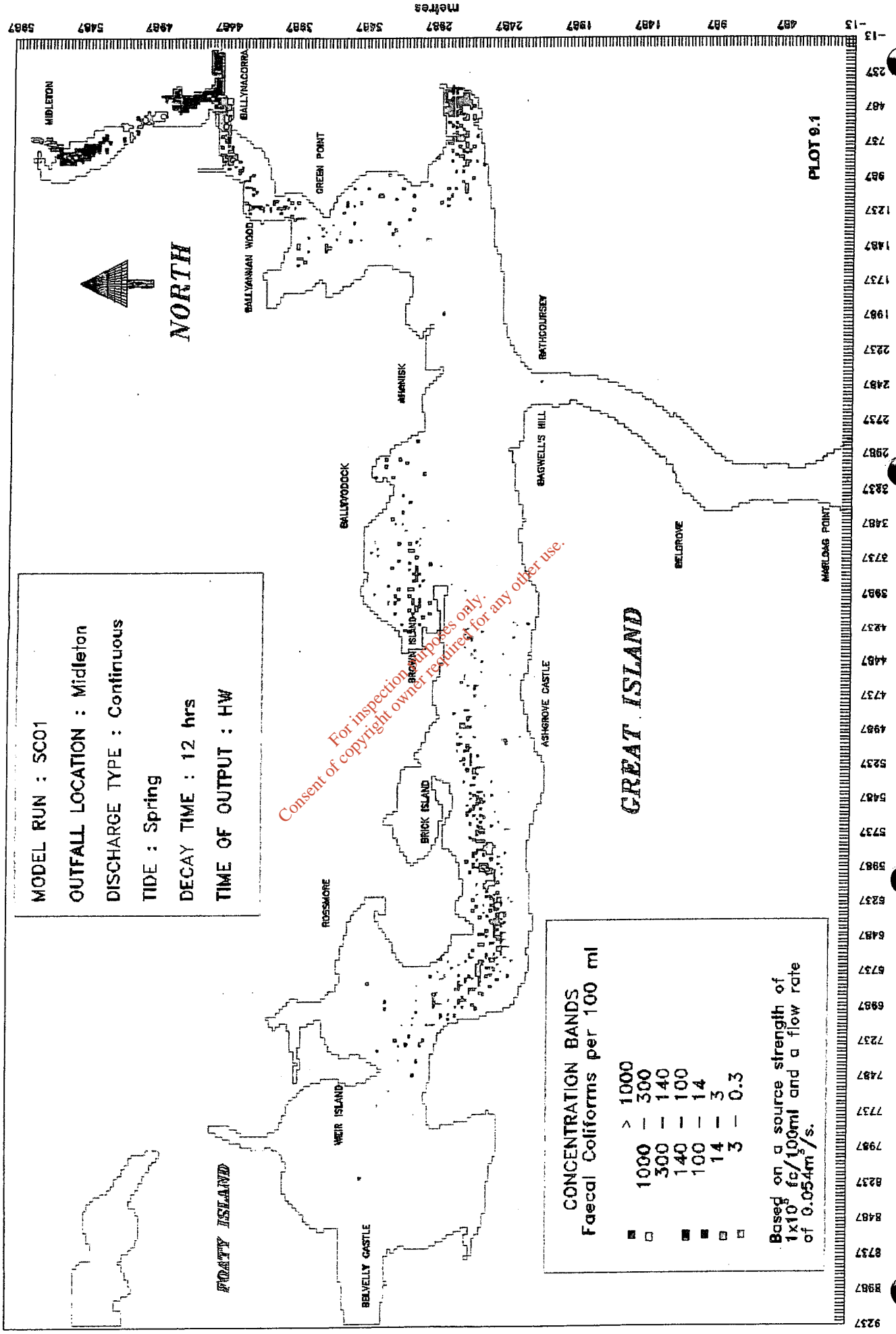
MODEL RUN : NC01
 OUTFALL LOCATION : Middleton
 DISCHARGE TYPE : Continuous
 TIDE : Neap
 DECAY TIME : 12 hrs
 TIME OF OUTPUT : HW - 3hrs

CONCENTRATION BANDS
 Faecal Coliforms per 100 ml

■	> 1000
□	1000 - 300
■	300 - 140
■	140 - 100
■	100 - 14
□	14 - 3
□	3 - 0.3

Based on a source strength of 1×10^5 fc/100ml and a flow rate of 0.054^m/s.

MIDDLETON SEWERAGE SCHEME - OUTFALL STUDY



MODEL RUN : SC01
OUTFALL LOCATION : Middleton
DISCHARGE TYPE : Continuous
TIDE : Spring
DECAY TIME : 12 hrs
TIME OF OUTPUT : HW

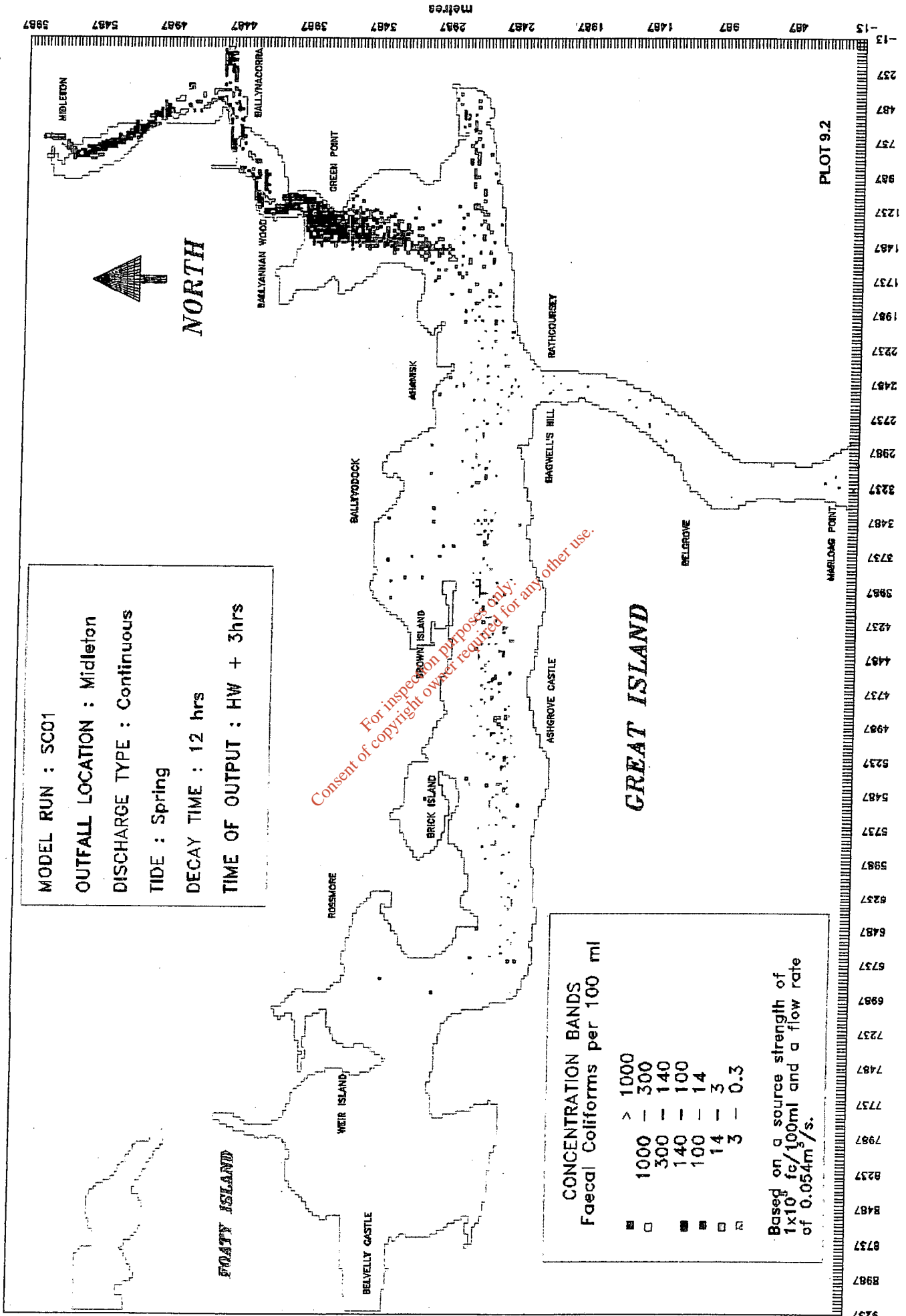
CONCENTRATION BANDS
Faecal Coliforms per 100 ml

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□	1000 - 300
■	300 - 140
■	140 - 100
■	100 - 14
■	14 - 3
□	3 - 0.3

Based on a source strength of 1×10^5 fc/100ml and a flow rate of $0.054 \text{ m}^3/\text{s}$.

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MIDDLETON WERAGE SCHEME - OUTFALL STUDY



MODEL RUN : SC01
OUTFALL LOCATION : Midleton
DISCHARGE TYPE : Continuous
TIDE : Spring
DECAY TIME : 12 hrs
TIME OF OUTPUT : HW + 3hrs

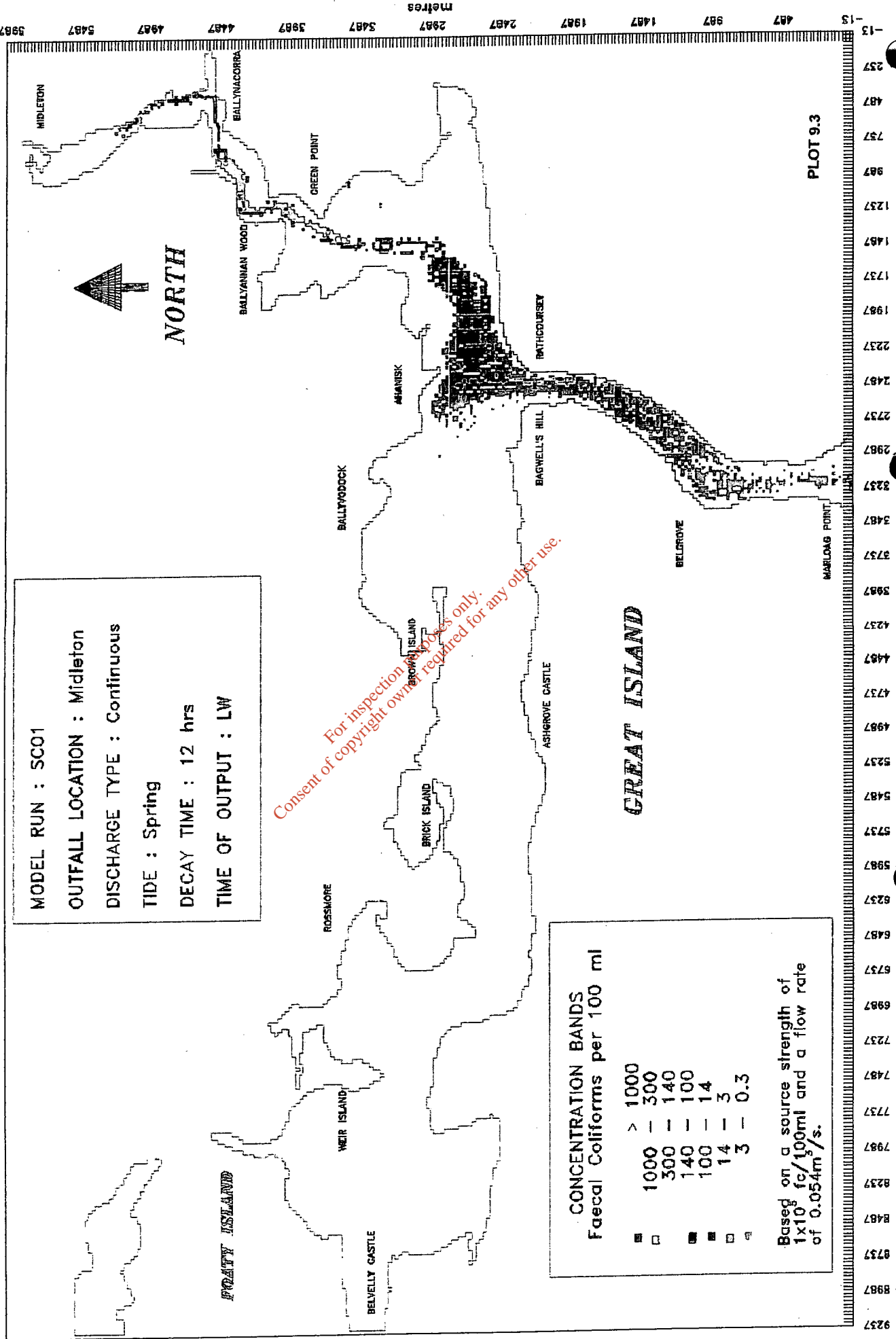
CONCENTRATION BANDS
Faecal Coliforms per 100 ml

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□	1000 - 300
■	300 - 140
■	140 - 100
■	100 - 14
□	14 - 3
□	3 - 0.3

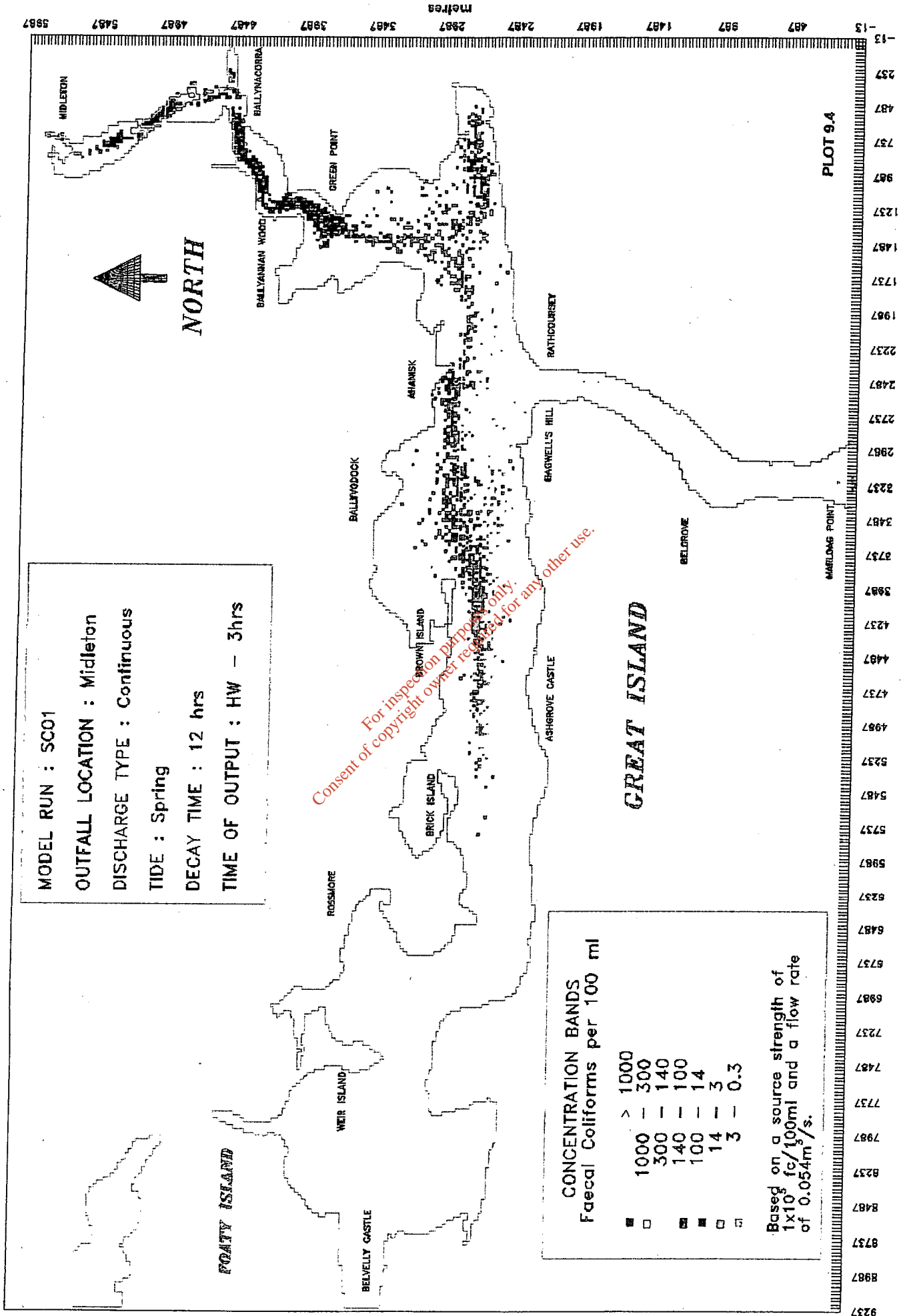
Based on a source strength of
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 of 0.054m³/s.

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MIDDLETON SEWERAGE SCHEME - OUTFALL STUDY

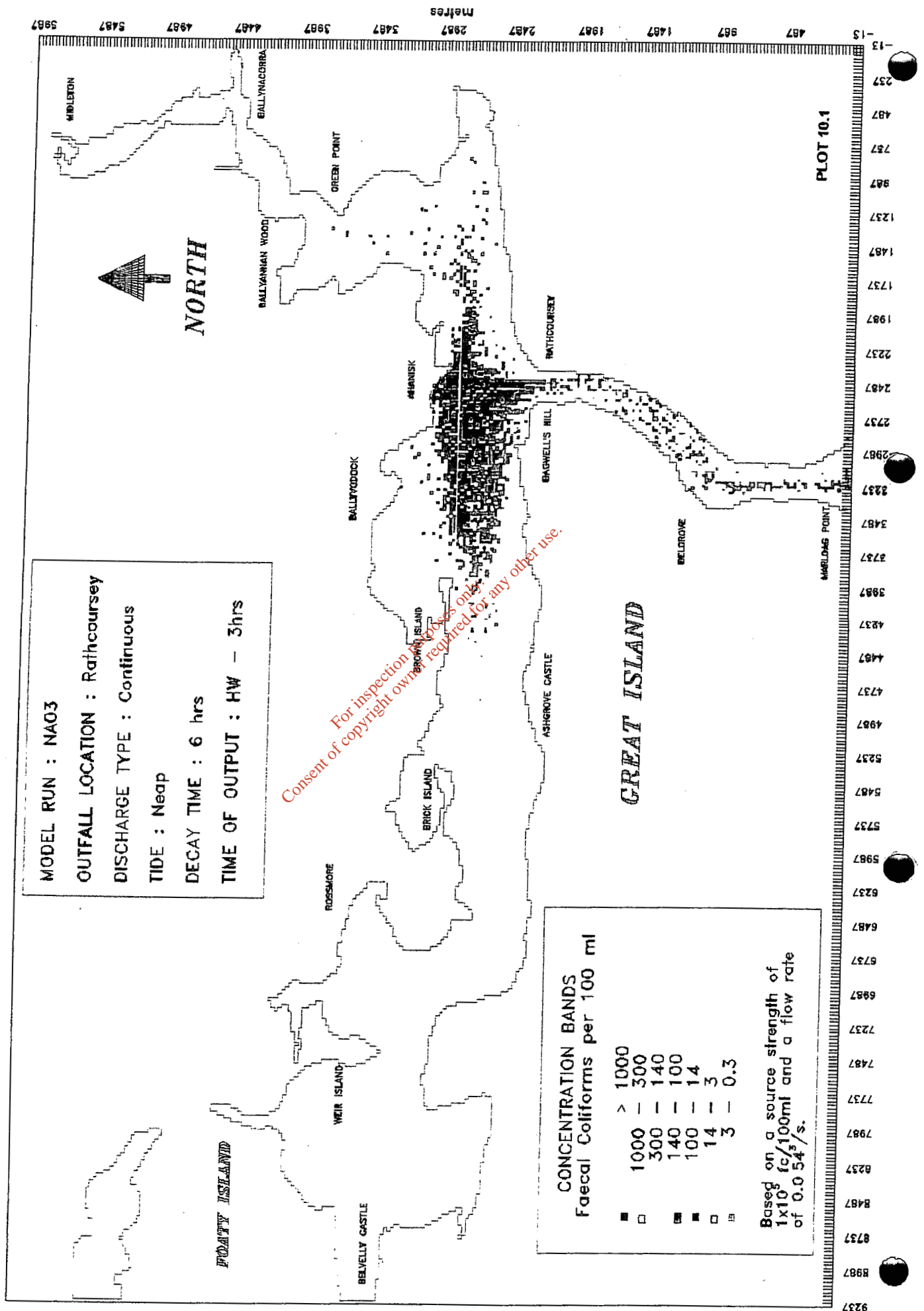


MIDDLETON WERAGE SCHEME - OUTFALL STUDY



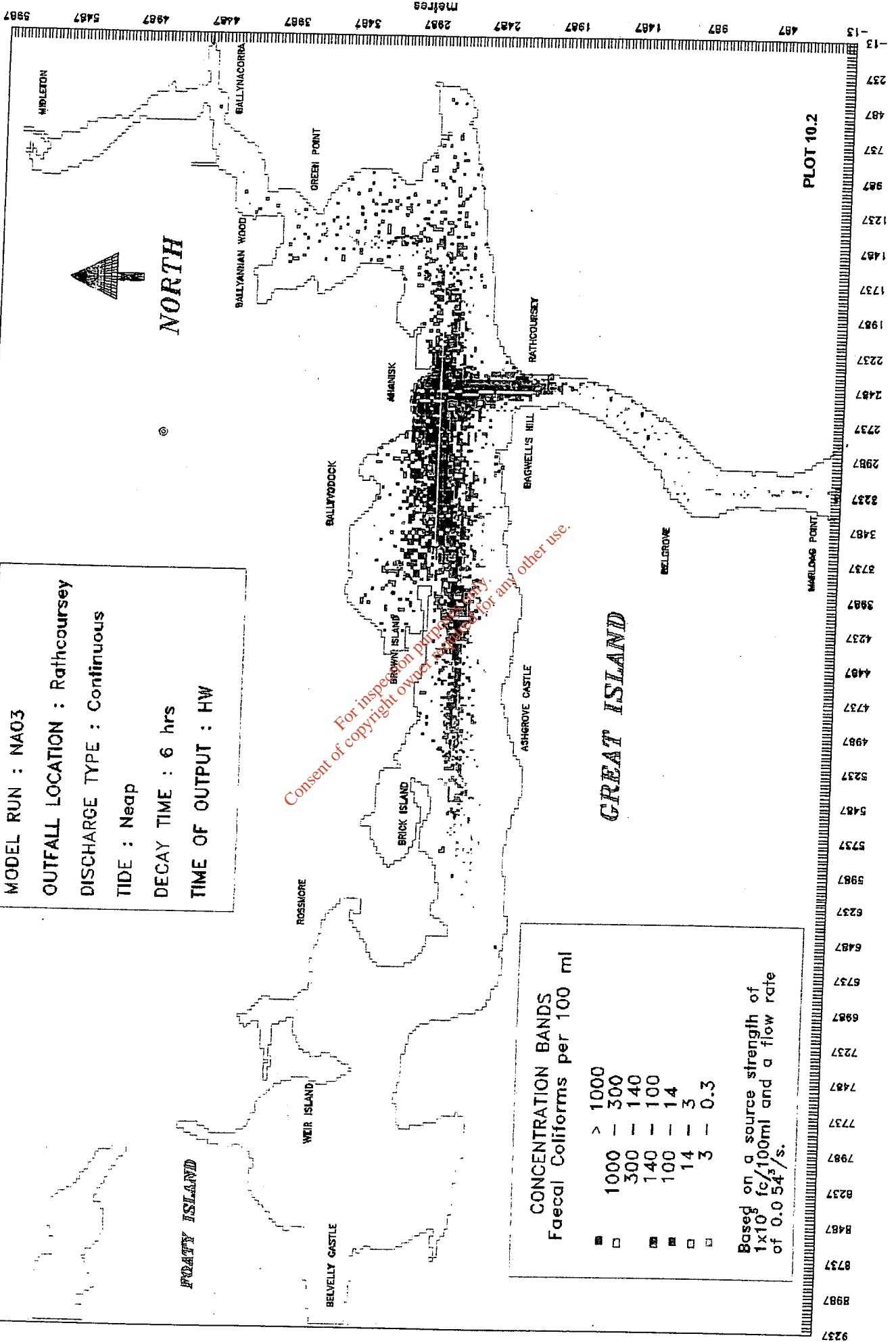
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MIDDLETON SEWERAGE SCHEME - OUTFALL STUDY



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MIDDLETON WERAGE SCHEME - OUTFALL STUDY



MODEL RUN : NAO3
 OUTFALL LOCATION : Rathcoursey
 DISCHARGE TYPE : Continuous
 TIDE : Neap
 DECAY TIME : 6 hrs
 TIME OF OUTPUT : HW

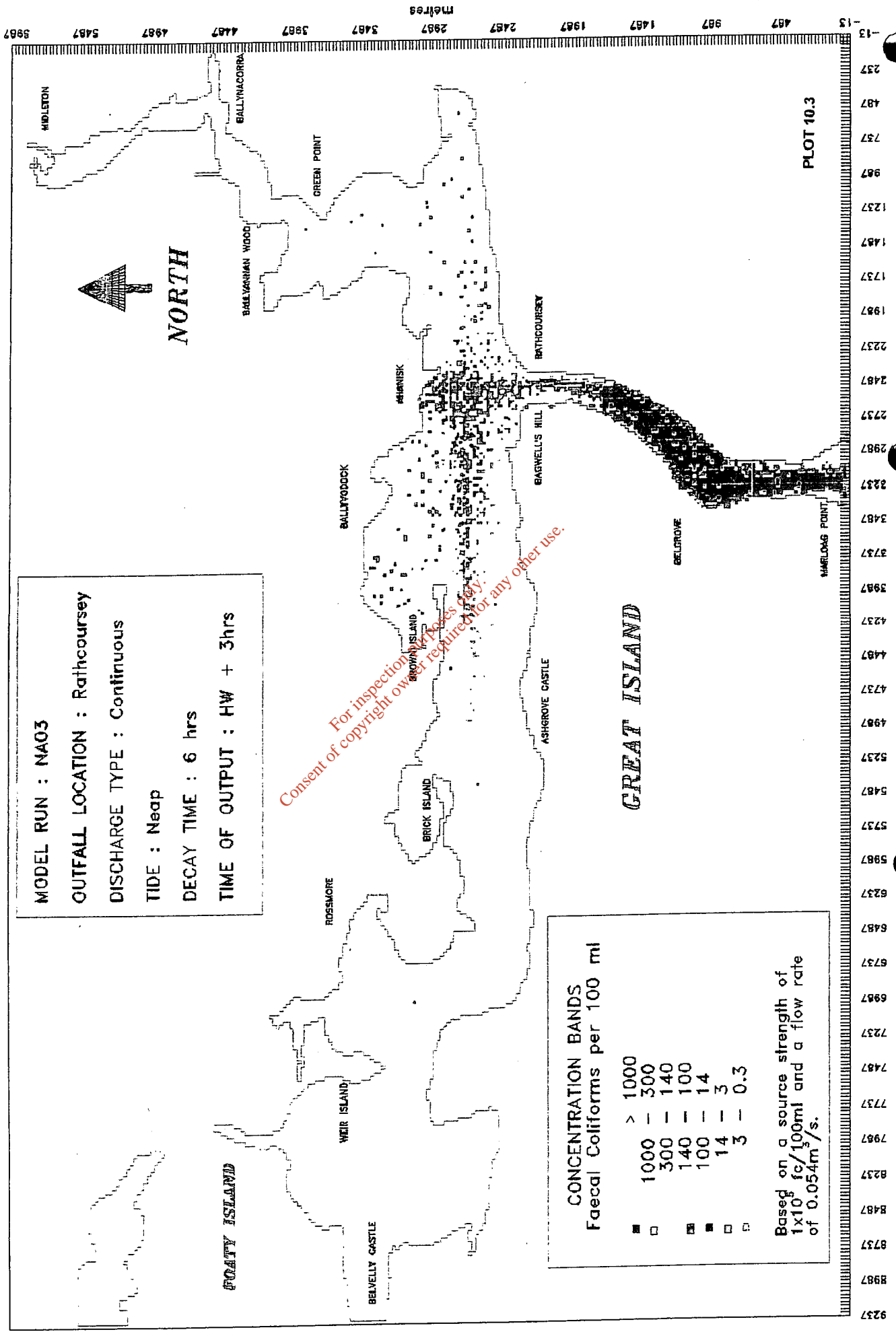
CONCENTRATION BANDS
 Faecal Coliforms per 100 ml

■	> 1000
□	1000 - 300
□	300 - 140
■	140 - 100
■	100 - 14
□	14 - 3
□	3 - 0.3

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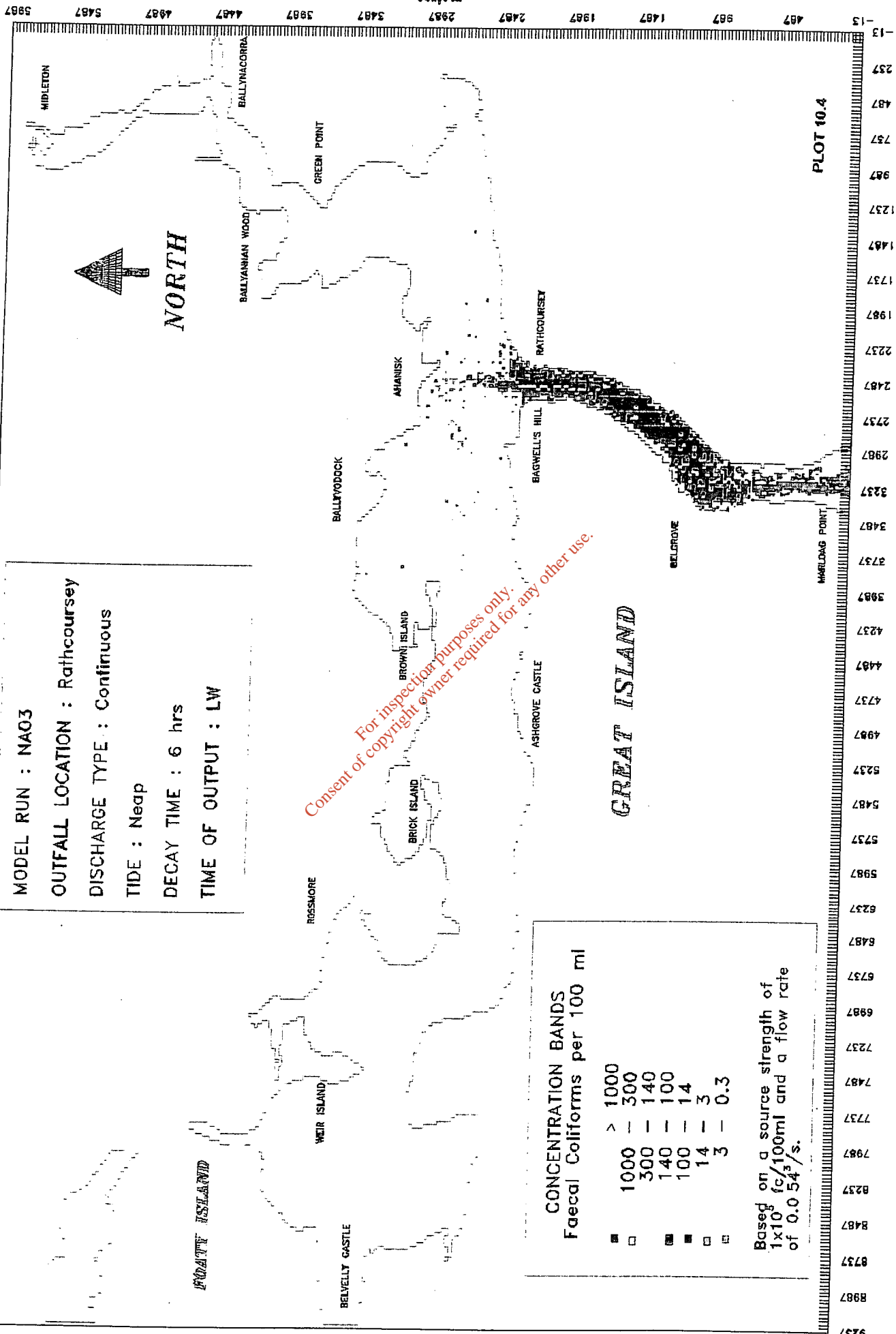
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MIDDLETON S.WERAGE SCHEME - OUTFALL STUDY



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MIDDLETON WERAGE SCHEME - OUTFALL STUDY



MODEL RUN : NAO3
OUTFALL LOCATION : Rathcoursey
DISCHARGE TYPE : Continuous
TIDE : Neap
DECAY TIME : 6 hrs
TIME OF OUTPUT : LW

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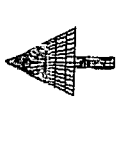
CONCENTRATION BANDS
 Faecal Coliforms per 100 ml

■	> 1000
□	1000 - 300
■	300 - 140
■	140 - 100
■	100 - 14
□	14 - 3
□	3 - 0.3

Based on a source strength of 1×10^5 fc/100ml and a flow rate of $0.054^3/s$.

9237 8987 8737 8487 8237 7987 7737 7487 7237 6987 6737 6487 6237 5987 5737 5487 5237 4987 4737 4487 4237 3987 3737 3487 3237 2987 2737 2487 2237 1987 1737 1487 1237 987 757 487 257 -13

metres



PLOT 10.4

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TABLES, FIGURES AND APPENDICES

Relating to

EXISTING HABITAT

by

NATURAL

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TABLES

Table 1: Measurements of Salinity, Dissolved Oxygen and BOD (July - August 1981) at Proposed and Existing Outfall Sites.

Table 2: Lat/Long Co-Ordinates for Benthic Sampling Stations

Table 3: Total Organic Carbon (TOC%) at Rathcoursey Sampling Stations and at Intertidal Sampling Points at Sites 1 and 2

Table 4: Ecological Evaluation of Hedgerows on Proposed Sites for Sewage Treatment Works at Midleton, Co. Cork.

Table 5: Notes on Bottom Type at Benthic Sampling Stations

Table 6: Total Number of Waterfowl Counted in the North Channel Area of Cork Harbour, 1991/92 and 1992/93

Table 7: Peak Counts of Waterfowl Species in the North Channel Area of Cork Harbour.

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TABLE 1: MEASUREMENTS OF SALINITY, DISSOLVED OXYGEN AND BOD (JULY-AUGUST 1981) AT PROPOSED AND EXISTING OUTFALL SITES

STATION	TIDE	DEPTH (m)	SALINITY (%)			D.O. (% saturation)			B.O.D. (ppm)					
			9-Jul	30-Jul	11-Aug	18-Aug	9-Jul	30-Jul	11-Aug	18-Aug	9-Jul	30-Jul	11-Aug	18-Aug
M4	HW	Surface	20.04	5.90	11.23	31.39	80	59	0	99	2.80	5.40	16.00	3.10
	LW	Surface	3.56	0.00	2.34	4.00	120	3	0	39	1.40	9.50	31.00	8.00
M9	HW	Surface	27.46	32.32	32.72	31.72	132	98	101	96	3.80	1.50	2.20	1.70
	HW	2	31.08	32.15	32.88	31.41	104	93	92	96	1.70	1.00	3.20	1.40
	LW	Surface	14.92	22.79	13.72	22.85	101	59	0	63	2.70	3.80	13.00	3.20
M15	HW	Surface	31.37	32.42	32.94	31.72	110	103	103	95	2.10	2.00	1.90	0.80
	HW	4 to 5	31.46	31.94	32.91	31.84	103	101	100	97	1.90	1.40	2.10	1.30
	HW	8 to 10	31.55	31.77	32.82	31.61	101	98	101	92	1.70	2.20	1.80	1.30
	LW	Surface	27.13	31.87	32.34	31.65	118	85	87	70	2.70	1.00	2.70	0.90
	LW	5 to 6	30.13	32.75	32.70	32.58	137	81	84	89	4.80	0.80	2.20	1.60

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TIDAL INFORMATION

DATE	9-Jul	30-Jul	11-Aug	18-Aug
Tide	Neap	Spring	Neap	Spring
Tidal Range (m)	2.20	3.60	2.00	3.70
High Water (m)	3.40	4.10	3.30	4.20
Low Water (m)	1.20	0.50	1.30	0.50

LOCATION OF STATIONS

M4	Ballynacorra Estuary: 300m downstream of proposed outfall for Site 1
M9	Ballynacorra Estuary: Channel at proposed outfall for Site 2
M15	North Channel: about 300m north of Rathcoursey outfall

Source: M.C. O'Sullivan, 1981

TABLE 2: LAT/LONG CO-ORDINATES FOR BENTHIC SAMPLING STATIONS.

Station Number	Latitude	Longitude
M1	51° 52.52N	08° 12.06W
M2	51° 52.59N	08° 12.04W
M3	51° 52.63N	08° 12.05W
M4	51° 52.70N	08° 12.03W
M5	51° 52.74N	08° 12.15W
M6	51° 52.74N	08° 12.06W
M7	51° 52.75N	08° 11.98W
M8	51° 52.80N	08° 12.24W
M9	51° 52.82N	08° 11.95W
M10	51° 52.84N	08° 11.95W
M11	51° 52.87N	08° 12.24W
M12	51° 52.86N	08° 12.14W
M13	51° 52.85N	08° 12.00W
M14	51° 52.85N	08° 11.89W
M15	51° 52.86N	08° 11.86W
M16	51° 52.88N	08° 12.21W
M17	51° 52.88N	08° 12.19W
M18	51° 52.90N	08° 11.93W
M19	51° 52.89N	08° 11.79W
M20	51° 52.92N	08° 12.33W

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TABLE 3: TOTAL ORGANIC CARBON (TOC%) AT RATHCOURSEY SAMPLING STATIONS AND AT INTERTIDAL SAMPLING POINTS AT SITES 1 AND 2.

SUBTIDAL STATIONS - RATHCOURSEY OUTFALL

Station	TOC %
M1/M2	1.33
M3/M4	1.24
M9	2.04
M10	1.69
M11	1.73
M12	0.95
M14	2.70
M15	2.52
M16	1.71
M17	1.78
M18	1.90
M19	2.53
M20	1.51

INTERTIDAL SAMPLING POINTS

Site	Station	TOC %
1	1	0.93
2	2a	1.89
	2b	2.28
	2c	2.34
	2d	1.46
	2e	2.73

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TABLE 4. ECOLOGICAL EVALUATION OF HEDGEROWS ON PROPOSED SITES FOR SEWAGE TREATMENT WORKS AT MIDLETON, CO CORK.

Site	Hedge No.	Length (m)	No of tree & shrub species	Grade*
1. Garryduff	1	320	3	2+
	2	450	5	2+
2. Ballynacorra	3	200	12	2+
	4	190	> 14	2
	5	270	5	1-
	6	390	2	3+

* Hedges are graded on a scale of 1 to 4 with the following levels of ecological value:
 Grade 1: High to very high value
 Grade 2: Moderately high to high value
 Grade 3: Moderate value
 Grade 4: Low value

Each grade is subdivided into three, with the use of + or - symbols

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TABLE 5: NOTES ON BOTTOM TYPE AT BENTHIC SAMPLING STATIONS

STATION NUMBER	DESCRIPTION
M1	Hard bottom (dredge sample); dead shells, small stones (2-11cm)
M2	Hard bottom (dredge sample); dead shells, small stones (2-11cm)
M3	Hard bottom (dredge sample); dead shells, small stones (< 15cm), gravel and shell fragments
M4	Hard bottom (dredge sample); dead shells, small stones (< 15cm), gravel and shell fragments
M5	Hard bottom (dredge sample unsuccessful)
M6	Hard bottom (dredge sample unsuccessful)
M7	Hard bottom (dredge sample unsuccessful)
M8	Hard bottom, gravel
M9	Mud (grab sample, 15cm penetration)
M10	Mud (grab sample, 20cm penetration)
M11	Mud (grab sample, 10cm penetration)
M12	Mud, stones, fine gravel and shell debris (poor grab sample)
M13	Fluid mud on gravel (dredge sample); large mussel shells and stones (5-13cm)
M14	Mud (grab sample; 20cm penetration)
M15	Mud (grab sample; full penetration - possibly sub-surface sample)
M16	Mud (grab sample; 15cm penetration)
M17	Mud (grab sample; 20cm penetration)
M18	Mud (grab sample; 15cm penetration)
M19	Mud (grab sample for PSA and TOC only)
M20	Mud (grab sample for PSA and TOC only)

TABLE 6: TOTAL NUMBER OF WATERFOWL COUNTED IN THE NORTH CHANNEL AREA OF CORK HARBOUR, 1991/92 AND 1992/93.

Month	1991/92	1992/3	Mean
Aug	550	913	732
Sep	NC	992	992
Oct	1858	2383	2121
Nov	3655	NC	3655
Dec	6921	4897	5909
Jan	6718	4489	5604
Feb	NC	5017	5017
Mar	1422	896	1159
Peak Count	6921	5017	5969

NC: Not Counted

Source: Irish Wildbird Conservancy

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TABLE 7: PEAK COUNTS OF WATERFOWL SPECIES IN THE NORTH CHANNEL AREA OF CORK HARBOUR

Scientific Name	Common Name	Peak Count 1991-92	Peak Count 1992-93	Mean Peak
<i>Tachybaptus ruficollis</i>	Little Grebe	9	6	8
<i>Podiceps cristatus</i>	Great Crested Grebe	31	95	63
<i>Phalacrocorax carbo</i>	Cormorant	66	125	96
<i>Ardea cinerea</i>	Grey Heron	26	15	21
<i>Cygnus olor</i>	Mute Swan	6	13	10
<i>Tadorna tadorna</i>	Shelduck	1235	1068	1152
<i>Anas penelope</i>	Wigeon	883	794	839
<i>Anas crecca</i>	Teal	253	184	219
<i>Anas platyrhynchos</i>	Mallard	156	109	133
<i>Anas acuta</i>	Pintail	10	13	12
<i>Anas clypeata</i>	Shoveler	0	4	2
<i>Aythya fuligula</i>	Tufted Duck	2	0	1
<i>Bucephala clangula</i>	Goldeneye	44	35	40
<i>Mergus serrator</i>	Red-breasted Merganser	74	87	81
<i>Haemotopus ostralegus</i>	Oystercatcher	137	254	196
<i>Charadrius hiaticula</i>	Ringed Plover	6	9	8
<i>Pluvialis apricaria</i>	Golden Plover	412	600	506
<i>Pluvialis squatarola</i>	Grey Plover	28	61	45
<i>Vanellus vanellus</i>	Capwing	2417	929	1673
<i>Calidris canutus</i>	Knot	0	2	1
<i>Calidris alpina</i>	Dunlin	1599	2256	1928
<i>Gallinago gallinago</i>	Snipe	13	33	23
<i>Limosa limosa</i>	Black-tailed Godwit	108	36	72
<i>Limosa lapponica</i>	Bar-tailed Godwit	10	0	5
<i>Numenius phaeopus</i>	Whimbrel	1	1	1
<i>Numenius arquata</i>	Curlew	285	1054	670
<i>Tringa totanus</i>	Redshank	772	921	847
<i>Tringa nebularia</i>	Greenshank	17	6	12
<i>Actitis hypoleucos</i>	Common Sandpiper	5	0	3
<i>Arenaria interpres</i>	Turnstone	31	31	31
All species		6921	5017	5969

Source: Irish Wildbird Conservancy, Cork Branch

FIGURES

Figure 1: Site 1 (Garryduff) - Field Boundaries and Position of Intertidal Sample Points

Figure 2: Site 2 (Ballynacorra) - Field Boundaries and Position of Intertidal Transect

Figure 3: Count Sectors and High Tide Roost Sites for Waterfowl, N. Channel, Cork Harbour

Figure 4: Marine Sampling Stations

Figure 5: Sediments

Figure 6: North Channel - Oyster Licensed Areas and Oyster Layings.

Figure 7: Oyster Licensed Area & Oyster Layings - Atlantic Shellfish Ltd., Lower Harbour

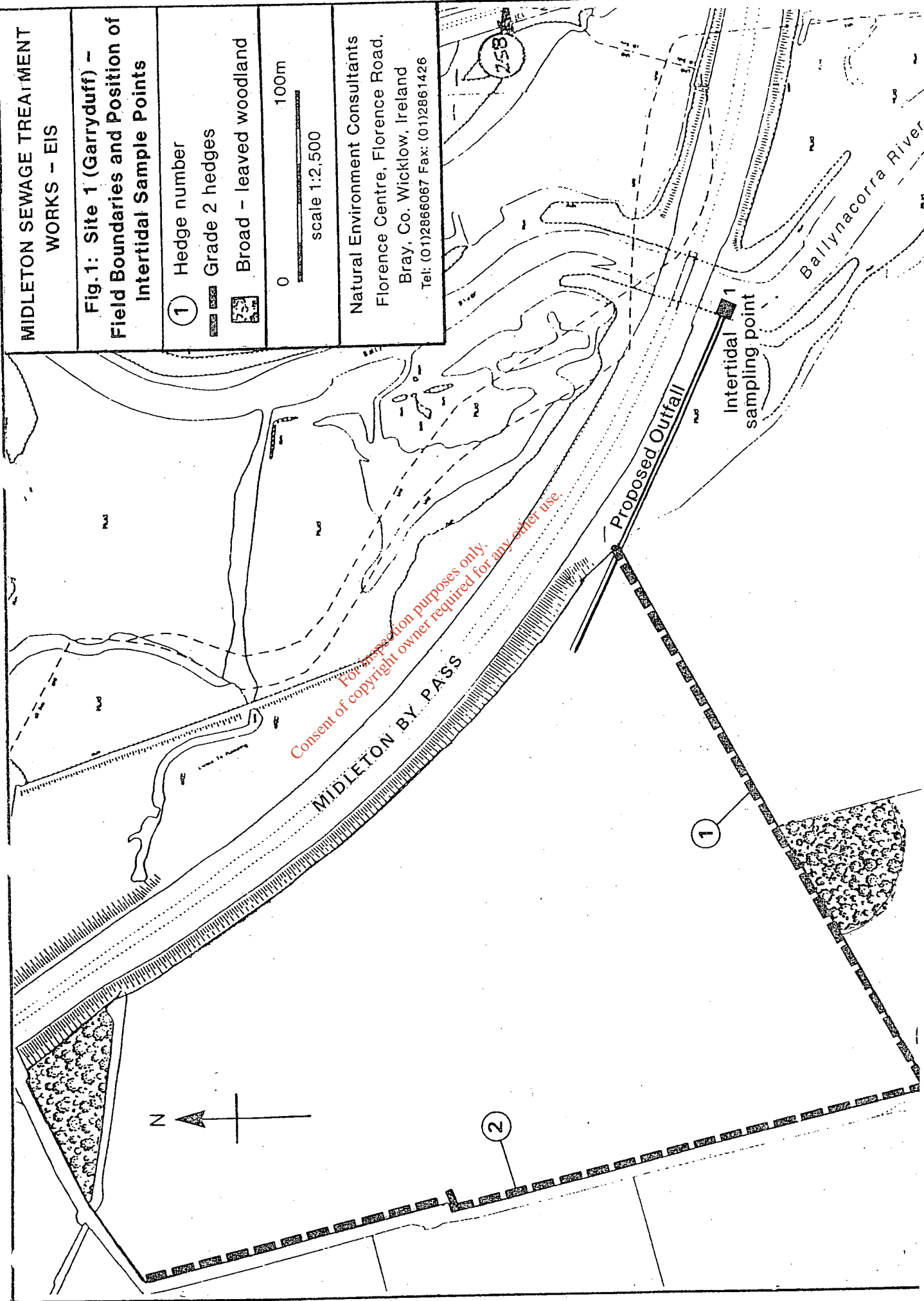
MIDDLETON SEWAGE TREATMENT
WORKS - EIS

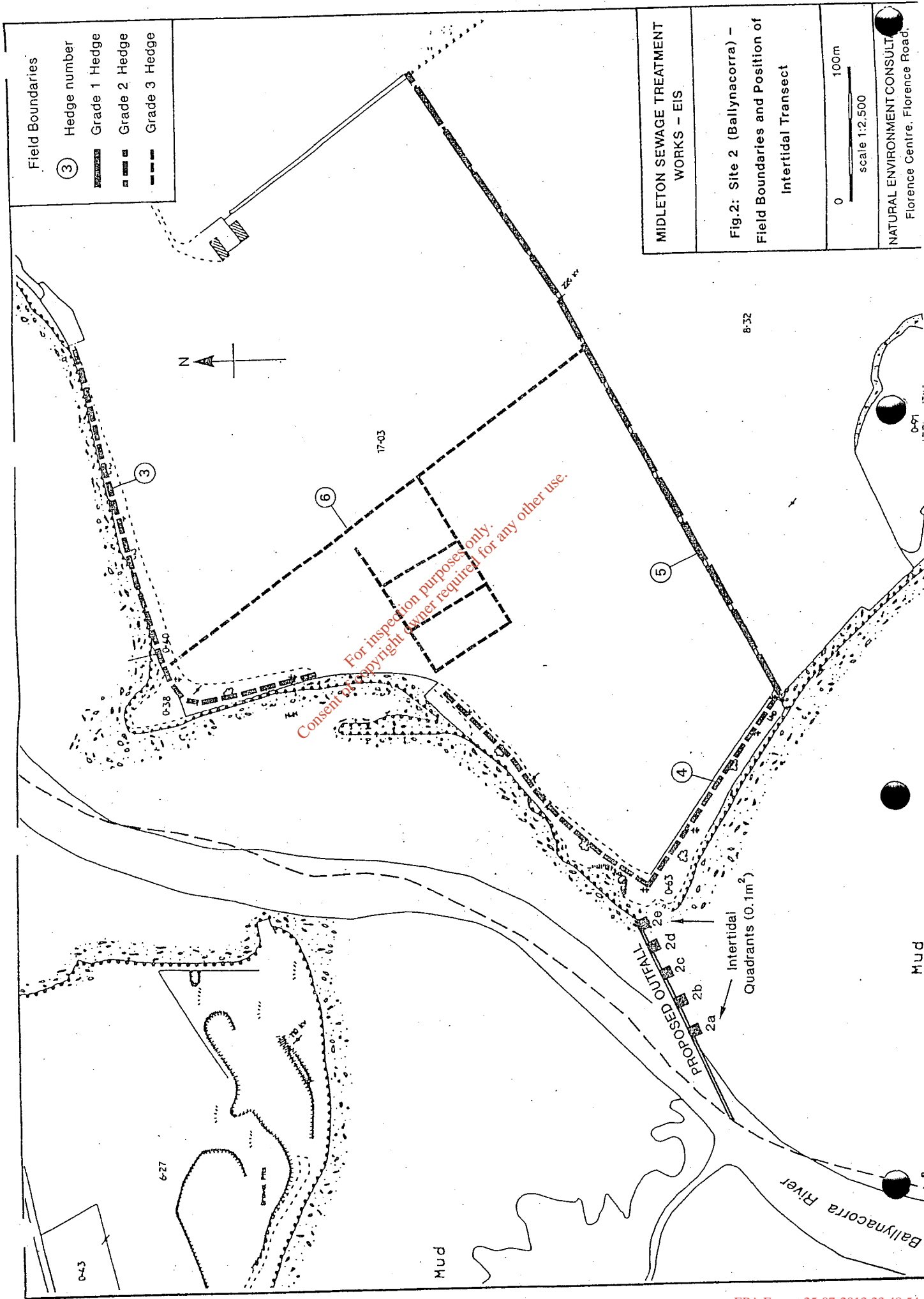
Fig.1: Site 1 (Garryduff) -
Field Boundaries and Position of
Intertidal Sample Points

- ① Hedge number
- Grade 2 hedges
- Broad - leaved woodland

0 100m
scale 1:2,500

Natural Environment Consultants
Florence Centre, Florence Road,
Bray, Co. Wicklow, Ireland
Tel: (01)2866067 Fax: (01)2861426





Field Boundaries

- ③ Hedge number
- ▬▬▬ Grade 1 Hedge
- ▬▬▬ Grade 2 Hedge
- ▬▬▬ Grade 3 Hedge

MIDDLETON SEWAGE TREATMENT WORKS - EIS

Fig.2: Site 2 (Ballynacorra) - Field Boundaries and Position of Intertidal Transect

0 100m
scale 1:2,500

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PROPOSED OUTFALL

Intertidal Quadrants (0.1m²)

2a

2b

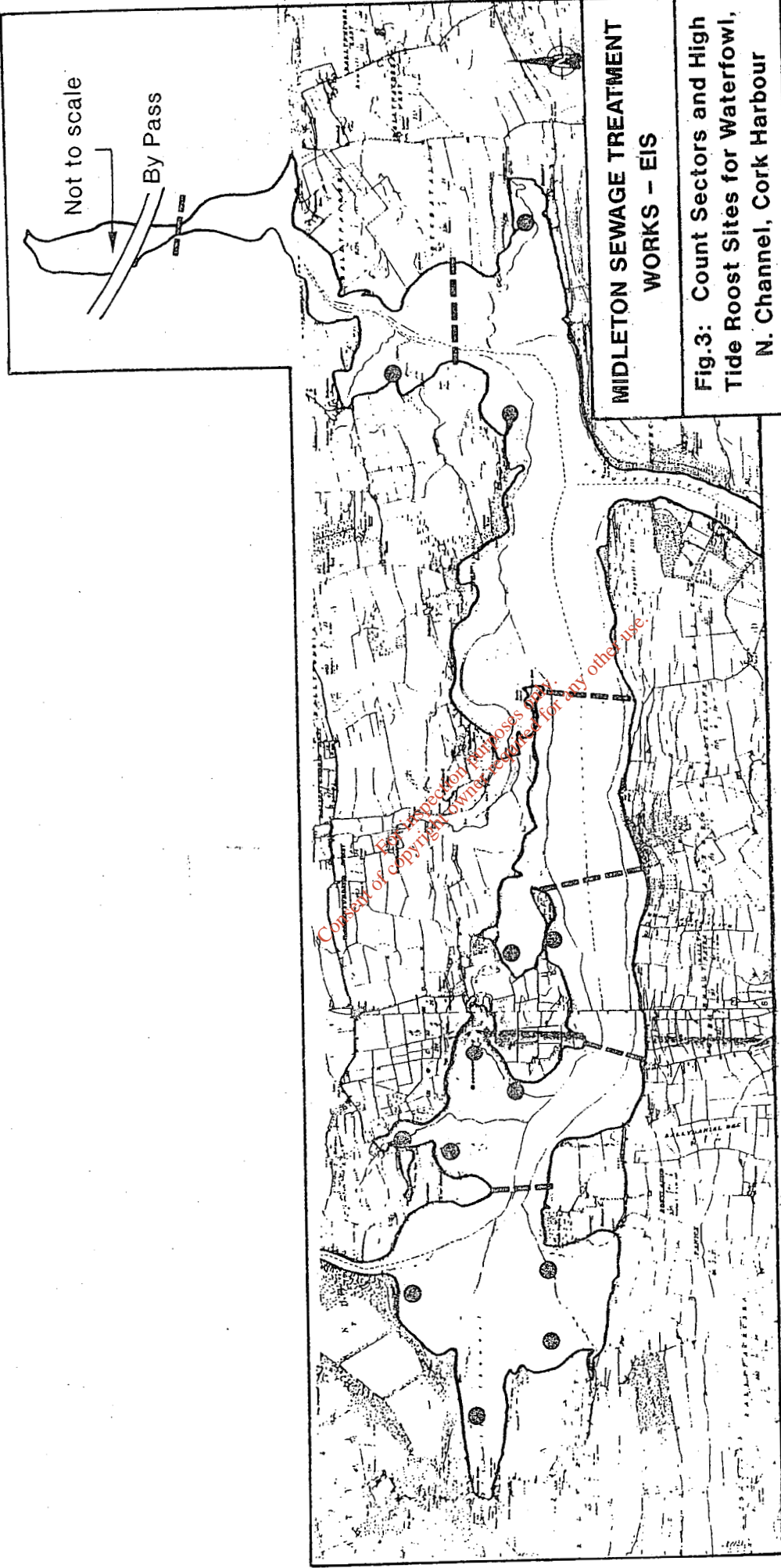
2c

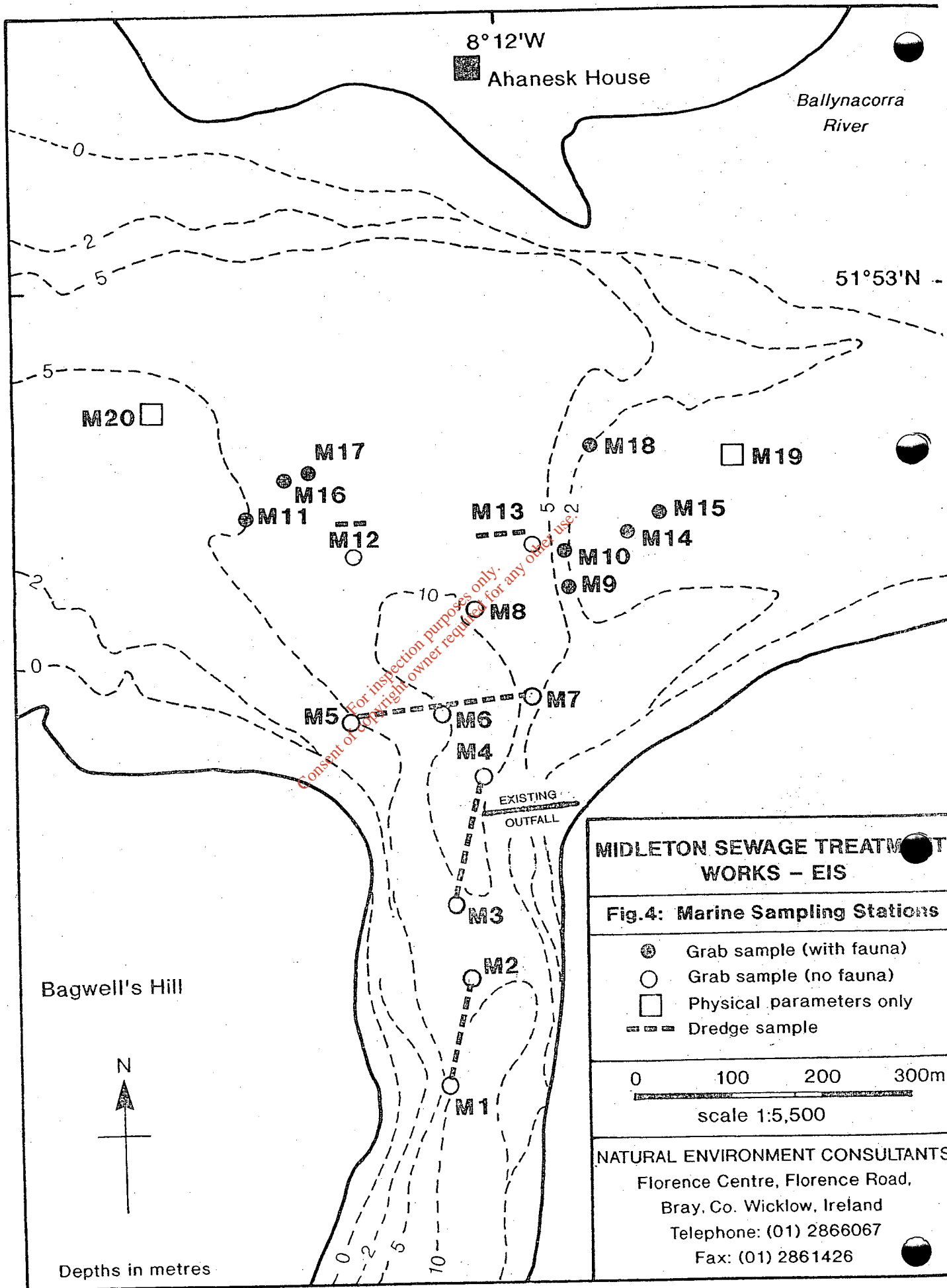
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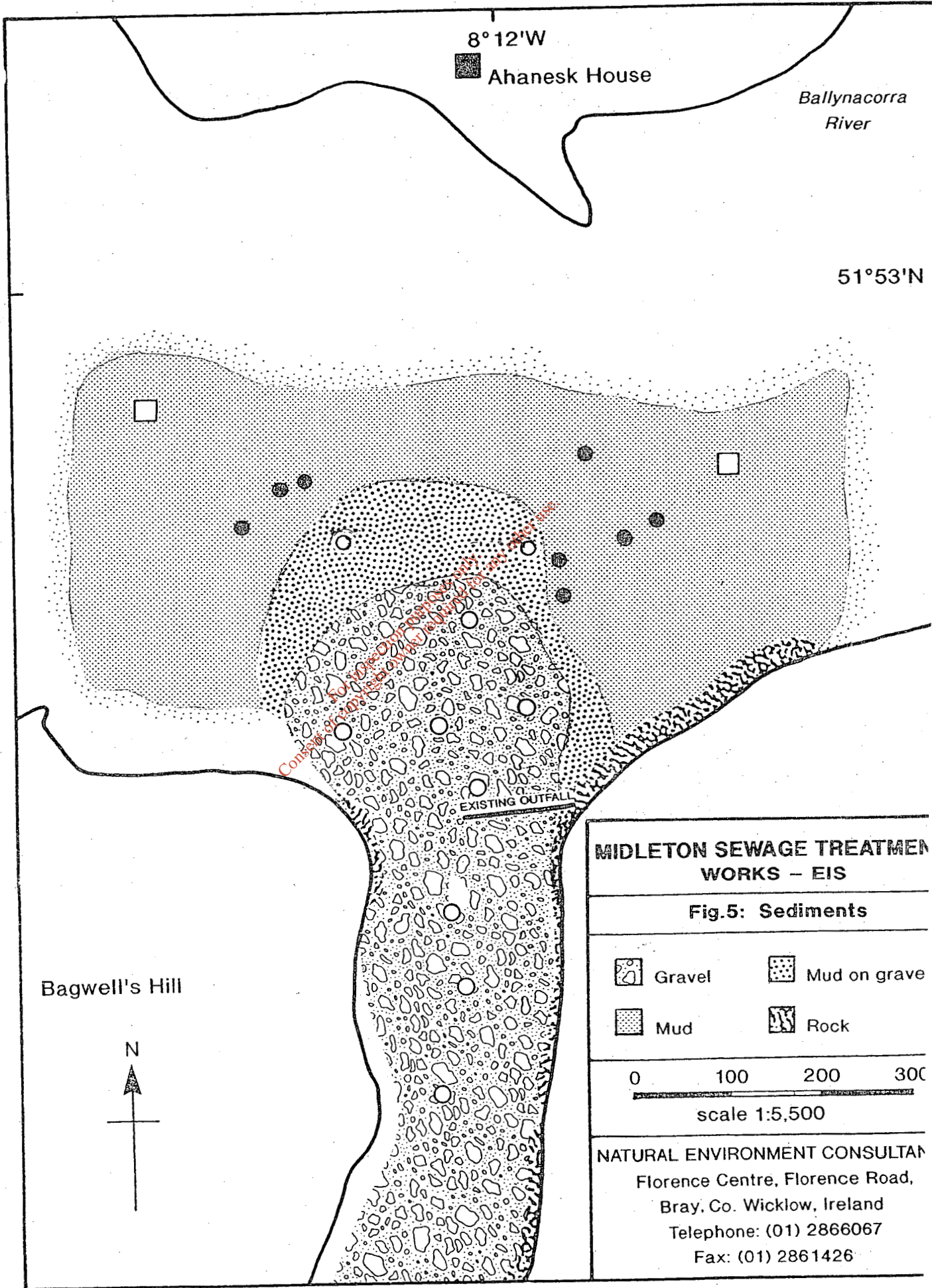
Ballynacorra River

Mud

Mud







8° 12' W

Ahanesk House

Ballynacorra River

51° 53' N

Bagwell's Hill



EXISTING OUTFALL

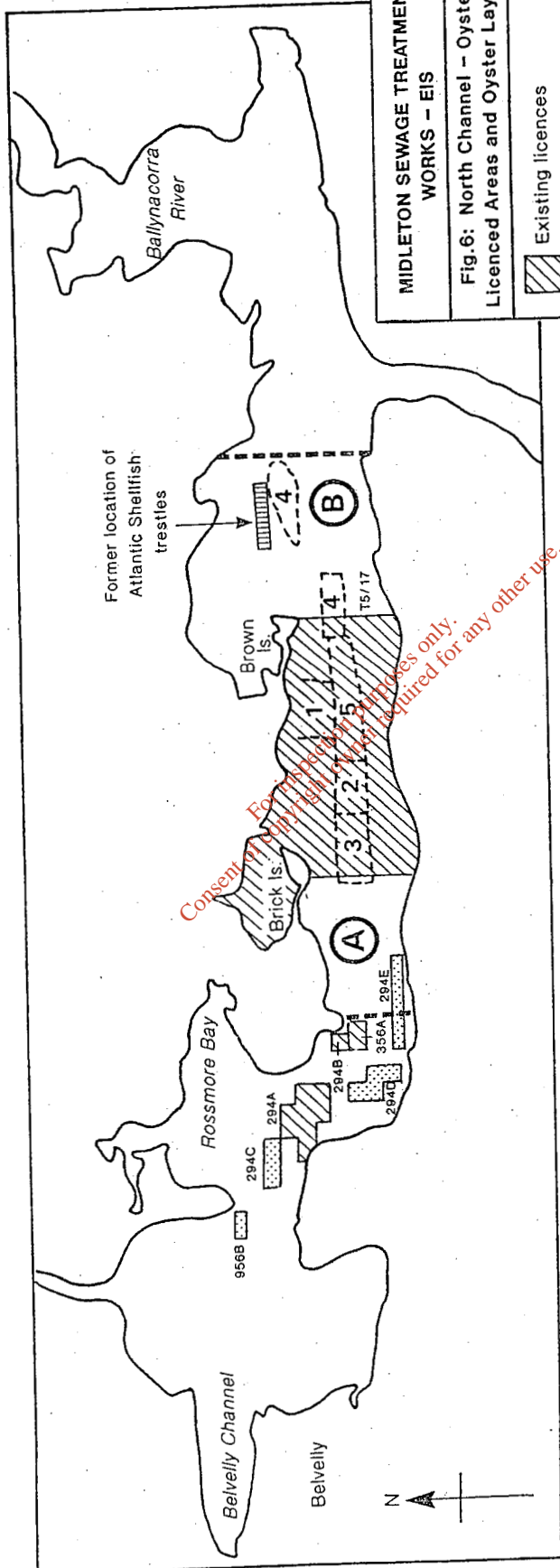
MIDDLETON SEWAGE TREATMENT WORKS – EIS

Fig.5: Sediments

- Gravel
- Mud on grave
- Mud
- Rock

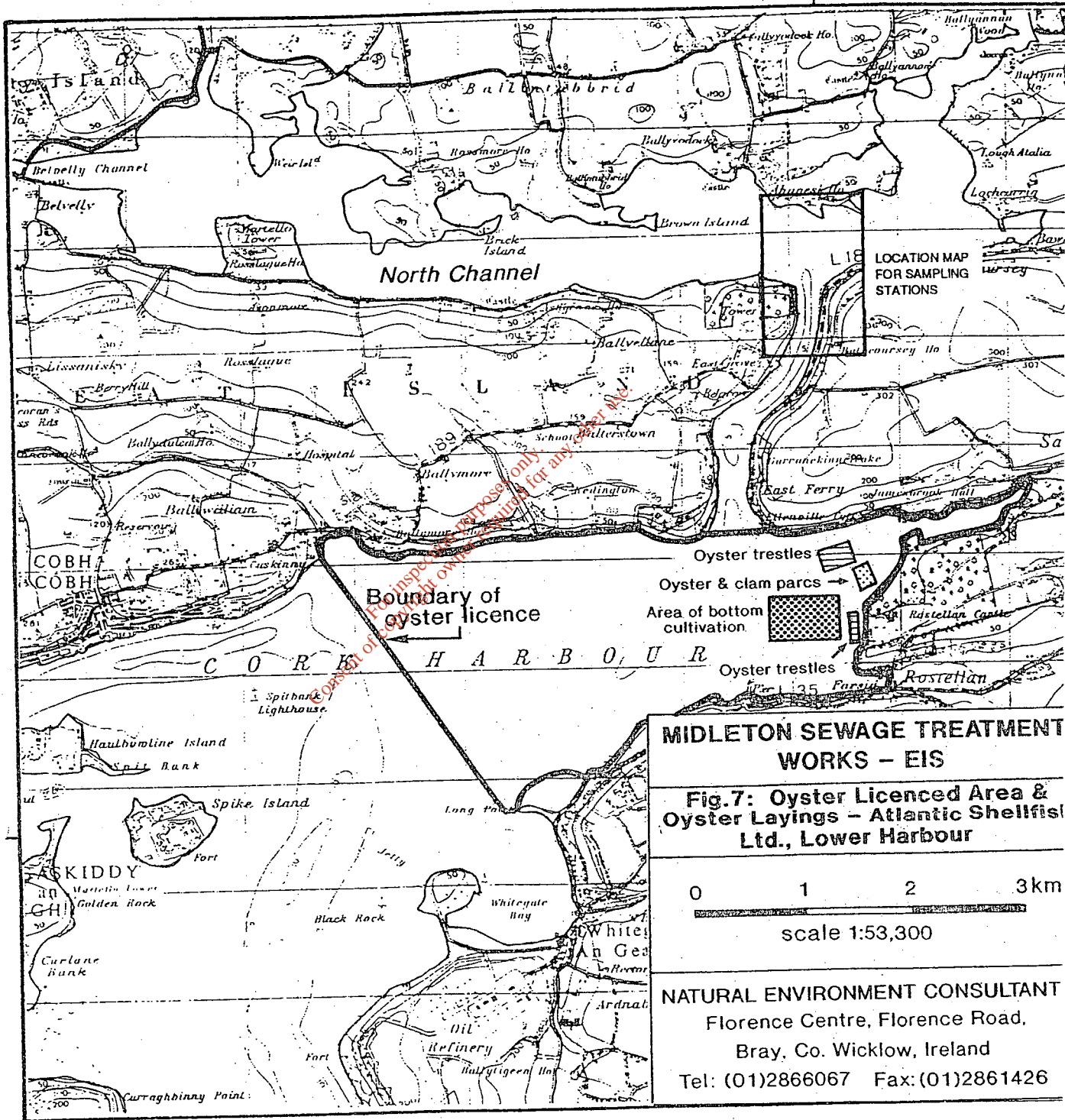
0 100 200 300
 scale 1:5,500

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MIDDLETON SEWAGE TREATMENT WORKS - EIS	
Fig.6: North Channel - Oyster Licenced Areas and Oyster Layings	
	Existing licences
	Licences applied for
	Areas claimed by Atlantic Shellfish
	Atlantic Shellfish bottom cultivation
 0 1500m scale c.1:30,000	
NATURAL ENVIRONMENT CONSULTANTS Florence Centre, Florence Road, Bray, Co. Wicklow, Ireland Tel: (0)12866067 Fax: (0)12861428	

8°12'W



MIDLETON SEWAGE TREATMENT WORKS - EIS

Fig.7: Oyster Licenced Area & Oyster Layings - Atlantic Shellfish Ltd., Lower Harbour

0 1 2 3km
scale 1:53,300

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Bray, Co. Wicklow, Ireland
Tel: (01)2866067 Fax: (01)2861426

APPENDICES

Appendix I: Rathcoursey Outfall Site - Species Lists, Diversity Indices, Rarefaction Curves, Group Average Clustering and MDS Plots for Grab Samples

Appendix II: Species List for Dredge Samples at Rathcoursey Outfall Site and Intertidal Stations at STW Site 1 and STW Site 2

Appendix III: Results of Particle Size Analysis (PSA) for Intertidal and Sub-Tidal (Rathcoursey) Stations

Appendix IV: Species Lists for Benthic Sampling Stations in the North Channel (S6, S7 and S8) from 1991 Aquafact Study

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APPENDIX I:

**RATHCOURSEY OUTFALL SITE - SPECIES LISTS, DIVERSITY
INDICES, RAREFACTION CURVES, GROUP AVERAGE
CLUSTERING AND MDS PLOTS FOR GRAB SAMPLES**

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Species abundances, Midleton samples.

Taxon	M9†	M10	M11	M14	M15	M16	M17	M18*
Anthozoa indet	-	3	-	-	-	-	1	-
Nemertea indet.	-	-	-	1	-	-	-	-
Nematoda indet.	6	-	-	4	-	1	5	24
Polychaeta sp. M93.#37	-	-	-	1	-	-	-	-
Polynoidae indet.	-	-	-	1	-	-	-	-
Lepidonotus squamatus (Linn.)[juv]	-	-	-	-	-	-	-	8
Pholoe inornata Johnston	-	2	-	6	-	-	-	-
Eteone longa (Fabricius)	2	2	-	-	-	-	-	-
Anaitides sp	-	-	-	-	-	-	1	-
Syllidae indet	-	-	-	-	-	-	-	4
Exogone hebes (Webster & Benedict)	-	-	1	-	-	-	-	-
Autolytus langerhansi Gidholm	-	1	-	1	-	-	-	-
?Proceraea sp.	-	-	-	1	-	-	-	-
Nereid juv] ?P. dumerilii (Aud&M-E)	-	-	-	-	-	-	2	4
Nephtys caeca (Fabricius)	-	-	-	-	1	-	-	-
Nephtys ?hombergi Savigny	2	7	17	11	-	10	11	4
Scoloplos armiger (O.F. Muller)	6	55	60	30	4	100	7	-
Polydora sp	-	-	-	-	-	-	-	4
Streblospio shrubsolii (Buchanan)	-	-	7	1	-	3	-	-
Caulleriella	10	38	32	11	10	87	24	4
Tharyx sp.	1726	503	61	121	4	122	455	1108
Cossura sp.	-	-	6	-	-	1	-	-
Capitella capitata (Fabricius)	-	-	-	-	-	-	-	4
Mediomastus fragilis Rasmussen	-	10	-	-	-	-	-	16
Myriochele sp	48	1	-	-	-	-	2	-
Lagis koreni Malmgren	-	-	-	-	-	1	-	-
Melinna palmata Grube	6	46	7	11	-	3	15	92
Ampharete ?lindstroemi Malmgren	-	1	-	1	-	-	-	4
?Sabella sp	-	-	-	-	-	-	-	12
Oligochaeta indet.	6	30	19	2	5	9	69	44
Endeis charybdaea (Dohrn)	-	-	-	1	-	-	-	-
Gammaridea indet. [damaged]	-	-	-	-	-	1	-	-
Ampelisca tenuicornis Lilleborg	-	-	1	-	-	-	3	-
Microtopopus maculatus Norman	-	-	-	2	-	-	-	-
Erichthonius punctatus (Bate)	-	-	-	2	-	-	-	-
Aoridae indet. [female]	-	2	-	6	-	-	-	-
Microdeutopus anomalus (Rathke)	-	-	-	3	-	-	-	-
Corophium sp. M93.#27	-	-	-	2	-	-	-	-
Corophium volutator (Pallas)	6	74	-	-	-	-	-	128
Pariambus typicus (Kroyer)	-	1	-	1	-	-	1	16
Phtisica marina Slabber	-	3	-	-	-	-	-	-
Pseudoprotella phasma (Montagu)	-	3	-	39	-	-	-	-
?Arcturella sp. [juv.]	-	-	1	-	-	-	-	-
?Aplysia sp.	-	-	-	1	-	-	-	-
?Parvicardium scabrum (Philippi)	-	-	-	-	-	1	-	-
Abra nitida (Muller)	-	-	3	1	2	1	5	-
Venerupis senegalensis (Gmelin)	-	-	-	-	-	-	-	4
Phoronis sp	24	28	5	11	-	3	3	12
Amphiura sp. [juv.]	-	1	-	-	-	-	-	-

* multiplied up from a 25% sub-sample

†

multiplied up from a 50% sub-sample

Ranked list of taxa, Middleton samples.

Station M9

Taxon	Density	%	Cum. %
Tharyx sp.	17260	93.7	93.7
Myriochele sp	480	2.6	96.3
Phoronis sp	240	1.3	97.6
Caulleriella	100	0.5	98.2
Scoloplos armiger (O.F. Muller)	60	0.3	98.5
Corophium volutator (Pallas)	60	0.3	98.8
Nematoda indet.	60	0.3	99.1
Melinna palmata Grube	60	0.3	99.5
Oligochaeta indet.	60	0.3	99.8
Eteone longa (Fabricius)	20	0.1	99.9
Nephtys ?hombergi Savigny	20	0.1	100.0

Station M10

Taxon	Density	%	Cum. %
Tharyx sp.	5030	62.0	62.0
Corophium volutator (Pallas)	740	9.1	71.1
Scoloplos armiger (O.F. Muller)	550	6.8	77.9
Melinna palmata Grube	460	5.7	83.6
Caulleriella	380	4.7	88.3
Oligochaeta indet.	300	3.7	92.0
Phoronis sp	280	3.5	95.4
Mediomastus fragilis Rasmussen	100	1.2	96.7
Nephtys ?hombergi Savigny	70	0.9	97.5
Pseudoprotella phasma (Montagu)	30	0.4	97.9
Anthozoa indet	30	0.4	98.3
Phtisica marina Slabber	30	0.4	98.6
Pholoe inornata Johnston	20	0.2	98.9
Aoridae indet. [female]	20	0.2	99.1
Eteone longa (Fabricius)	20	0.2	99.4
Autolytus langerhansi Gidholm	10	0.1	99.5
Ampharete ?lindstroemi Malmgren	10	0.1	99.6
Pariambus typicus (Kroyer)	10	0.1	99.8
Myriochele sp	10	0.1	99.9
Amphiura sp. [juv.]	10	0.1	100.0

Ranked list of taxa, Middleton samples (Continued).

Station M11

Taxon	Density	%	Cum. %
Tharyx sp.	610	27.7	27.7
Scoloplos armiger (O.F. Muller)	600	27.3	55.0
Caulleriella	320	14.5	69.5
Oligochaeta indet.	190	8.6	78.2
Nephtys ?hombergi Savigny	170	7.7	85.9
Streblospio shrubsolii (Buchanan)	70	3.2	89.1
Melinna palmata Grube	70	3.2	92.3
Cossura sp.	60	2.7	95.0
Phoronis sp	50	2.3	97.3
Abra nitida (Muller)	30	1.4	98.6
?Arcturella sp. [juv.]	10	0.5	99.1
Ampelisca tenuicornis Lilleborg	10	0.5	99.5
Exogone hebes (Webster & Benedict)	10	0.5	100.0

Station M14

Taxon	Density	%	Cum. %
Tharyx sp.	1210	44.5	44.5
Pseudoprotella phasma (Montagu)	390	14.3	58.8
Scoloplos armiger (O.F. Muller)	300	11.0	69.9
Phoronis sp	110	4.0	73.9
Melinna palmata Grube	110	4.0	77.9
Nephtys ?hombergi Savigny	110	4.0	82.0
Caulleriella	110	4.0	86.0
Pholoe inornata Johnston	60	2.2	88.2
Aoridae indet. [female]	60	2.2	90.4
Nematoda indet.	40	1.5	91.9
Microdeutopus anomalous (Rathke)	30	1.1	93.0
Ericthonius punctatus (Bate)	20	0.7	93.8
Microprotopus maculatus Norman	20	0.7	94.5
Oligochaeta indet.	20	0.7	95.2
Corophium sp. M93.#27	20	0.7	96.0
Autolytus langerhansi Gidholm	10	0.4	96.3
Endeis charybdaea (Dohrn)	10	0.4	96.7
Ampharete ?lindstroemi Malmgren	10	0.4	97.1
Polychaeta sp. M93.#37	10	0.4	97.4
Polynoidae indet.	10	0.4	97.8
Nemertea indet.	10	0.4	98.2
Pariambus typicus (Kroyer)	10	0.4	98.5
?Proceraea sp.	10	0.4	98.9
?Aplysia sp.	10	0.4	99.3
Abra nitida (Muller)	10	0.4	99.6
Streblospio shrubsolii (Buchanan)	10	0.4	100.0

Ranked list of taxa, Midleton samples (Continued).

Station M15

Taxon	Density	%	Cum. %
Caulleriella	100	38.5	38.5
Oligochaeta indet.	50	19.2	57.7
Scoloplos armiger (O.F. Muller)	40	15.4	73.1
Tharyx sp.	40	15.4	88.5
Abra nitida (Muller)	20	7.7	96.2
Nephtys caeca (Fabricius)	10	3.8	100.0

Station M16

Taxon	Density	%	Cum. %
Tharyx sp.	1220	35.6	35.6
Scoloplos armiger (O.F. Muller)	1000	29.2	64.7
Caulleriella	870	25.4	90.1
Nephtys ?hombergi Savigny	100	2.9	93.0
Oligochaeta indet.	90	2.6	95.6
Melinna palmata Grube	30	0.9	96.5
Streblospio shrubsolii (Buchanan)	30	0.9	97.4
Phoronis sp	30	0.9	98.3
Cossura sp.	10	0.3	98.5
Nematoda indet.	10	0.3	98.8
Gammaridea indet. [damaged]	10	0.3	99.1
Lagis koreni Malmgren	10	0.3	99.4
Abra nitida (Muller)	10	0.3	99.7
?Parvicardium scabrum (Philippi)	10	0.3	100.0

Station M17

Taxon	Density	%	Cum. %
Tharyx sp.	4550	75.3	75.3
Oligochaeta indet.	690	11.4	86.8
Caulleriella	240	4.0	90.7
Melinna palmata Grube	150	2.5	93.2
Nephtys ?hombergi Savigny	110	1.8	95.0
Scoloplos armiger (O.F. Muller)	70	1.2	96.2
Nematoda indet.	50	0.8	97.0
Abra nitida (Muller)	50	0.8	97.8
Phoronis sp	30	0.5	98.3
Ampelisca tenuicornis Lilleborg	30	0.5	98.8
Myriochele sp	20	0.3	99.2
Nereid[juv]?P.dumerilii(Aud&M-E)	20	0.3	99.5
Anthozoa indet	10	0.2	99.7
Pariambus typicus (Kroyer)	10	0.2	99.8
Anaitides sp	10	0.2	100.0

Ranked list of taxa, Midleton samples (Continued).

Station M18

Taxon	Density	%	Cum. %
Tharyx sp.	11080	74.3	74.3
Corophium volutator (Pallas)	1280	8.6	82.8
Melinna palmata Grube	920	6.2	89.0
Oligochaeta indet.	440	2.9	92.0
Nematoda indet.	240	1.6	93.6
Mediomastus fragilis Rasmussen	160	1.1	94.6
Pariambus typicus (Kroyer)	160	1.1	95.7
?Sabella sp	120	0.8	96.5
Phoronis sp	120	0.8	97.3
Lepidonotus squamatus (Linn.)[juv]	80	0.5	97.9
Capitella capitata (Fabricius)	40	0.3	98.1
Syllidae indet	40	0.3	98.4
Nephtys ?hombergi Savigny	40	0.3	98.7
Nereid[juv]?P.dumerilii(Aud&M-E)	40	0.3	98.9
Caulleriella	40	0.3	99.2
Ampharete ?lindstroemi Malmgren	40	0.3	99.5
Venerupis senegalensis (Gmelin)	40	0.3	99.7
Polydora sp	40	0.3	100.0

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Community description parameters and diversity indices, Middleton samples.

Station No.	M9	M10	M11	M14	M15	M16	M17	M18
No. individuals	1842†	811	220	272	26	343	604	1492*
No. taxa	11††	20	13	26	6	14	15	18**
Shannon-Wiener function H(s)	0.50††	2.14	2.79	2.96	2.28	2.16	1.45	1.59**
Pielou's evenness index (j)	0.15††	0.50††	0.76	0.63	0.88	0.57	0.37	0.38**
Simpson's index of dominance (c)	0.88††	0.41††	0.19	0.24	0.24	0.28	0.58	0.56**
Numerically dominant taxa (50%)	1††	1		2	2	2	1	1**

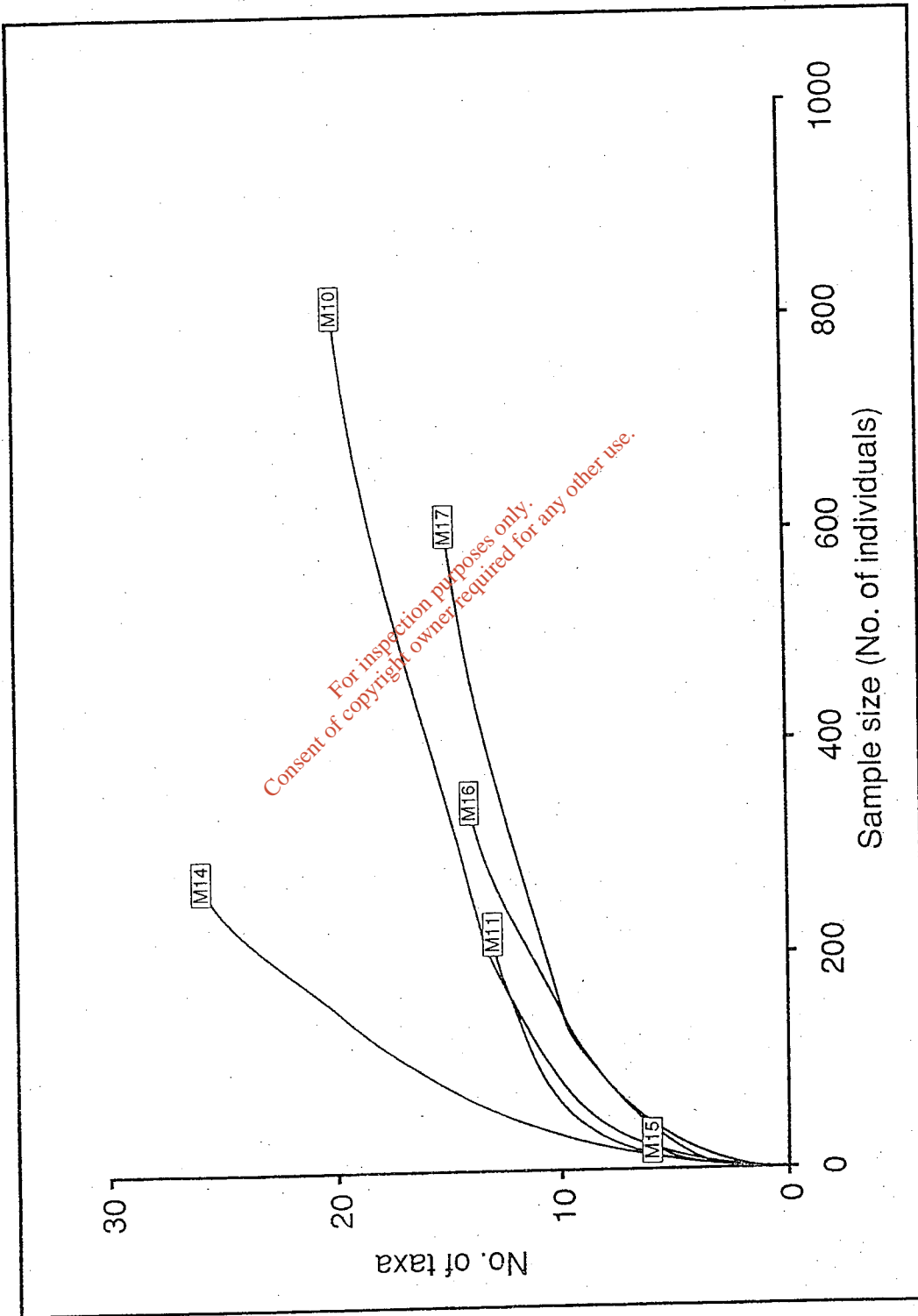
* multiplied up from a 25% sub-sample

** value calculated using 25% subsample

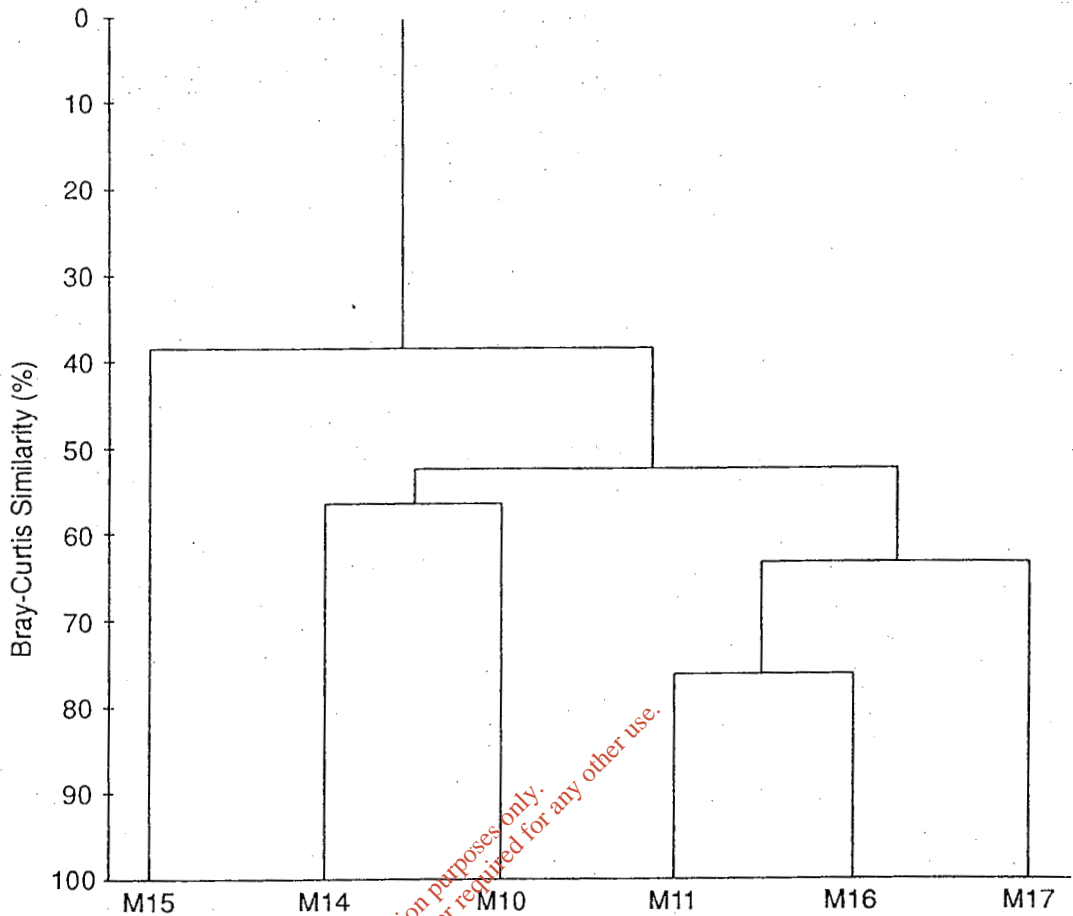
† multiplied up from a 50% sub-sample

†† value calculated using 50% subsample

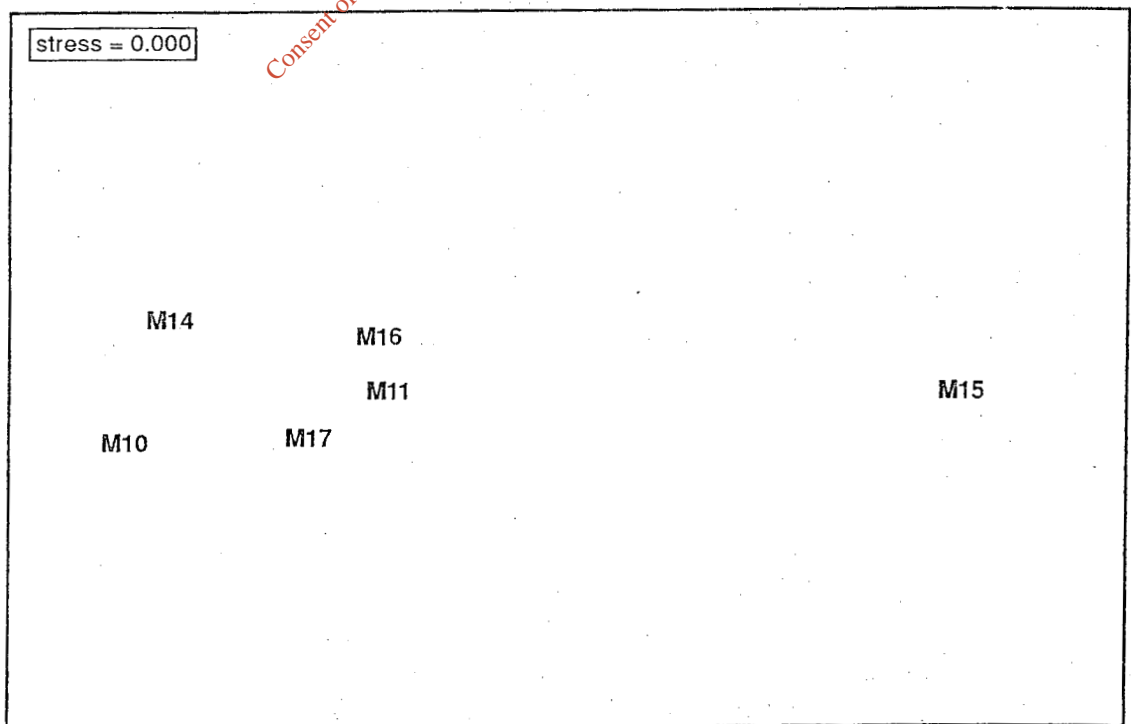
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Rarefaction curves for Midleton sampling stations



Group average clustering of stations based on Bray-Curtis similarities derived from $\sqrt{1}$ -transformed macrofaunal abundances.



MDS plot of stations based on Bray-Curtis similarities derived from $\sqrt{1}$ -transformed macrofaunal abundances.

APPENDIX II:

**SPECIES LIST FOR DREDGE SAMPLES AT RATHCOURSEY
OUTFALL SITE AND INTERTIDAL STATIONS AT STW SITE 1 AND
STW SITE 2**

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Species abundances in Middleton samples analysed for Environment Plus by the Field Studies Council Research Centre, October 1993.

MCS Code	Name of taxon	M1/M2	M3/M4	M12	M13a	M13b	1	2a	2b	2c	2d	2e	2e(TS)
C 0	Porifera indet.	-	P	P	-	P	-	-	-	-	-	-	-
D 677	Sertularia cupressina L.	P	-	-	-	-	-	-	-	-	-	-	-
D 1006	Anthozoa indet.	P	P	P	P	P	-	-	-	-	-	-	-
H 0	Nematoda indet.	-	P	P	P	-	-	-	-	-	-	-	-
P 42	Polynoidae indet.	-	-	P	P	-	-	-	-	-	-	-	-
P 102	Harmothoe extenuata (Grube)	P	P	P	-	P	-	-	-	-	-	-	-
P 133	Lepidonotus squamatus (L.) [juv.]	-	-	P	-	-	-	-	-	-	-	-	-
P 251	Anatides spp. indet.	-	-	P	P	-	-	-	-	-	-	-	-
P 257	Anatides mucosa (Orsted)	-	P	-	-	-	-	-	-	-	-	-	-
P 269	Eulalia aurea Gravier	-	P	P	-	-	-	-	-	-	-	-	-
P 635	Syllidae indet.	-	-	P	-	-	-	-	-	-	-	-	-
P 667	Typosyllis armillaris (Muller)	-	-	P	-	-	-	-	-	-	-	-	-
P 744	Exogone hebes (Webster & Benedict)	-	-	-	P	-	-	-	-	-	-	-	-
P 810	Hediste diversicolor (O. F. Muller)	-	-	-	-	-	P	-	12	6	1	8	P
P 849	Nereid [juv.] ?P. dumerilii (Aud & M-E)	-	-	-	-	P	-	-	-	-	-	-	-
P 867	Nephtys spp. [juv.]	-	-	-	-	P	-	1	-	-	-	-	-
P 871	Nephtys ?homberti Savigny	-	-	-	-	P	-	-	-	-	-	-	-
P 1351	Streblospio shrubsolli (Buchanan)	-	-	-	-	-	-	-	-	1	-	-	-
P 1423	Tharyx sp. indet.	-	-	-	-	-	-	-	-	-	-	-	-
P 1530	Capitella capitata (Fabricius)	-	P	-	-	-	-	-	-	-	-	-	-
P 1886	Melinna palmata Grube	-	-	P	-	-	-	-	-	-	-	-	-
P 2304	Pomatoceros triquetra (L.)	P	P	P	P	-	-	-	-	-	-	-	-
P 2355	Spirorbidae indet.	P	P	-	P	-	-	-	-	-	-	-	-
P 2417	Oligochaeta indet.	-	-	-	P	-	-	-	2	1	11	-	-
R 64	Verruca stroemia (O. F. Muller)	-	-	P	-	-	-	-	-	-	-	-	-
R 108	Balanus balanoides (L.)	-	-	-	-	-	P	-	-	-	-	-	P
R 109	Balanus balanus (L.)	P	P	P	P	-	-	-	-	-	-	-	-
S 127	Neomysis integer (Leach)	-	-	-	-	-	P	-	-	-	-	-	-
S 315	Leucothoe procerata Bate	-	-	-	-	-	-	-	-	-	-	-	-
S 508	Lysianassa sp. M93.#64	P	-	-	-	-	-	-	-	-	-	-	-
S 556	Socarnes erythrocephalus Robertson	-	P	P	P	-	-	-	-	-	-	-	-
S 629	Iphimedia perplexa Myers & Costello	P	-	-	-	-	-	-	-	-	-	-	-

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'P' indicates 'Present' in a qualitative sample.

Midleton species abundances (Continued).

MCS Code	Name of taxon	M1/M2	M3/M4	M12	M13a	M13b	I	2a	2b	2c	2d	2e	2e(TS)
S 760	Echinogammarus marinus (Leach)	-	-	-	-	-	P	-	-	-	-	-	P
S 898	Gammaropsis maculata (Johnston)	P	P	-	P	-	-	-	-	-	-	-	-
S 972	Aoridae indet. [female]	-	-	-	P	-	-	-	-	-	-	-	-
S 1017	Corophium sp. M93.#27	P	P	P	P	P	-	-	-	-	-	-	-
S 1027	Corophium volutator (Pallas)	-	-	-	-	-	-	-	-	-	-	I	-
S 1084	Pariambus typicus (Kroyer)	P	P	P	P	P	-	-	-	-	-	-	-
S 1101	Pseudoprotella phasma (Montagu)	-	-	P	-	-	-	-	-	-	-	-	-
S 1451	Sphaeroma rugicauda Leach	P	P	P	P	-	-	-	-	-	-	-	-
S 1484	Janira maculosa Leach	-	-	-	P	-	-	-	-	-	-	-	-
S 1868	Tanaidacea indet.	-	-	-	P	-	-	-	-	-	-	-	-
S 2210	Palaemon serratus (Pennant)	-	-	-	-	-	P	-	-	-	-	-	-
S 2331	Crangon crangon (L.)	-	-	-	-	-	P	-	I	-	-	-	-
S 2444	Paguridae indet.	P	-	-	-	-	-	-	-	-	-	-	-
S 2486	Galathea intermedia Lilljeborg	-	-	-	-	-	-	-	-	-	-	-	-
S 2502	Pisidia longicornis (L.)	-	-	-	-	-	P	-	-	-	-	-	-
S 2667	Liocarcinus arcuatus (Leach)	-	-	-	-	-	-	-	-	-	-	-	-
S 2670	Liocarcinus holsatus (Fabricius)	-	P	-	-	-	-	-	-	-	-	-	-
S 2690	Carcinus maenas (L.)	-	-	-	-	-	-	P	2	1	-	4	P
W 250	Littorina littorea (L.)	-	-	-	-	-	-	-	-	-	-	-	P
W 255	Littorina obtusata (L.)	-	-	-	-	-	-	-	-	-	-	-	P
W 821	Urosalpinx cinerea (Say)	-	P	P	-	-	-	-	-	-	-	-	-
W 1618	Nucula nitidosa Winckworth	-	-	P	-	-	-	-	-	-	-	-	-
W 1669	Modiolarca tumida (Hanley)	-	P	-	-	-	-	-	-	-	-	-	-
W 1815	Anomia ephippium L.	P	P	-	P	-	-	-	-	-	-	-	-
W 1978	?Parvicardium scabrum (Philippi)	-	-	P	-	-	-	-	-	-	-	-	-
W 1990	Cerastoderma spp. [juv.]	-	-	-	-	-	-	-	-	-	I	-	-
W 1991	Cerastoderma edule (L.)	-	-	-	-	-	-	-	-	-	-	-	P
W 2003	Spisula elliptica (Brown)	-	P	-	-	-	-	-	-	-	-	-	-
W 2005	Spisula solida (L.)	P	-	-	-	-	-	-	-	-	-	-	-
W 2106	Abra tenuis (Montagu)	-	-	-	-	-	-	I	-	I	9	-	-
W 2185	Venerupis senegalensis (Gmelin)	-	-	-	-	-	-	-	-	-	-	-	-
W 2251	Hiatella arctica (L.)	P	P	-	-	-	-	-	-	-	-	-	-

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'P' indicates 'Present' in a qualitative sample.

Midleton species abundances (Continued).

MCS Code	Name of taxon	M1/M2	M3/M4	M12	M13a	M13b	1	2a	2b	2c	2d	2e	2e(TS)
Y 0	Bryozoa sp. M93.#76	P	P	P	-	P	-	-	-	-	-	-	-
Y 0	Bryozoa sp. M93.#82	P	P	-	-	-	-	-	-	-	-	-	-
ZB 11	Antedon bifida (Pennant)	-	-	-	-	P	-	-	-	-	-	-	-
ZB 235	Ophiothrix fragilis (Abildgaard)	-	-	P	-	P	-	-	-	-	-	-	-
ZB 286	Amphitura chitajet Forbes	-	P	-	-	-	-	-	-	-	-	-	-
ZG 12	Anguilla anguilla (L.)	-	-	-	-	-	P	-	-	-	-	-	-

'P' indicates 'Present' in a qualitative sample.

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APPENDIX III:

**RESULTS OF PARTICLE SIZE ANALYSIS (PSA) FOR INTERTIDAL
AND SUB-TIDAL (RATHCOURSEY) STATIONS**

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INTERSTITIAL		TRANSECTS					SUBTIDAL STATIONS - RATHCOURSEY OUTFALL				
SITE 1		SITE 2									
1		2A					M 9				
		2B					M 10				
		2C					M 11				
		2D									
		2E									
		2F									
		2G									
		2H									
		2I									
		2J									
		2K									
		2L									
		2M									
		2N									
		2O									
		2P									
		2Q									
		2R									
		2S									
		2T									
		2U									
		2V									
		2W									
		2X									
		2Y									
		2Z									
		2AA									
		2AB									
		2AC									
		2AD									
		2AE									
		2AF									
		2AG									
		2AH									
		2AI									
		2AJ									
		2AK									
		2AL									
		2AM									
		2AN									
		2AO									
		2AP									
		2AQ									
		2AR									
		2AS									
		2AT									
		2AU									
		2AV									
		2AW									
		2AX									
		2AY									
		2AZ									
		2BA									
		2BB									
		2BC									
		2BD									
		2BE									
		2BF									
		2BG									
		2BH									
		2BI									
		2BJ									
		2BK									
		2BL									
		2BM									
		2BN									
		2BO									
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