Attachment B.12

Attachment B12

- Foreshore Licence – Specific Conditions

Comhairle Chontae Chorcaí
Cork County Council

Courthouse,
Skibbereen,
Co. Cork.
Tel No: (028)21299
Fax No: (028)21995

Web:http://www.corkcoco.com/

Tadhg O'Connor
Department of Environment,
Heritage & Local Government.
Floor 4,
Irish Life Building,
1A South Mall,
Cork.

02/06/06

R.e... Schull & Dunmanway Sewerage Schemes

Dear Tadhg,

Please find attached drawings of Dunmanway SS sewer network.

Regarding Schull Sewerage Scheme Foreshore Licence, I have made a few comments on your observations about the total daily BOD load discharging from the Treatment Plant Outfall. I will ring you later in the week to discuss this matter.

If you require any further information please contact me at the above address.

Regards,

Ian O'Mahony,
Executive Engineer,
Water Services,
Courthouse,
Skibbereen.
email : ian.omahony@corkcoco.ie

THIRD SCHEDULE

Niall, see my 5bs overlay

Specific Conditions

1. The Licensee shall use that part of the foreshore, the subject matter of this Licence, for the purpose of laying, using and maintaining the aforementioned works in accordance with the plans and drawings submitted to and approved by the Minister for Communications, Marine and Natural Resources and for no other purpose whatsoever.

2. The Licensee may also use the adjacent foreshore but only to the extent necessary for the purpose of laying and maintaining the said works and shall restore the said foreshore to its proper condition immediately after such use.

3. The Licensee shall prior to the commencement of any works on the foreshore:

   (i) provide certification by a Chartered Engineer stating that the works have been designed in accordance with the relevant Irish or British Standard Specifications or Codes of Practice for strength, stability and durability, taking into account building regulations and safety legislation;

   (ii) arrange for the publication of a local marine notice in a locally read newspaper giving a general description of works and approximate dates of commencement and completion;

   (iii) consult with the local Harbour Master with respect to the safety of navigation of marine traffic in the river.

   (iv) Ensure a high visibility float is deployed to indicate the location of the outfall.

   (v) Consult with the Commissioner of Irish Lights regarding the statutory sanction of new aids to navigation.

4. The Licensee shall ensure that the works are carried out in accordance with applicable environmental laws.

5. The Licensee shall consult with the Area Engineer of the Department of Communications, Marine and Natural Resources during all stages of the works.

6. The Licensee shall notify the Irish Coast Guard by telephone immediately at (01) 6782301 or (01) 6782302 in the event of any spillage or accident occurring below the high water mark of ordinary or medium tides or above the high water mark which may impact on the foreshore during the carrying out of the works, or during operations following the completion of these works.

7. The effluent discharged from the treatment plant outfall pipe shall have a maximum 5-day B.O.D. concentration of 25 mg/l and a maximum suspended solids concentration of 35 mg/l, on a 95% basis. The maximum total daily BOD load discharged from the treatment plant outfall shall be 15kg.

8. All works shall be completed within five years of the granting of this Licence.

9. The Licensee shall provide certification by a Chartered Engineer, within two months after completion of the said works, that the works have been completed in accordance with the drawing* approved of by the Minister and with the said Standard Specifications or Codes of Practice.

*(Drawing Numbered 4(SC)-PO1, 4(SC)-PO2, and 4(SC)-P03-1 provided by T.J. O'Connor & Associates.)

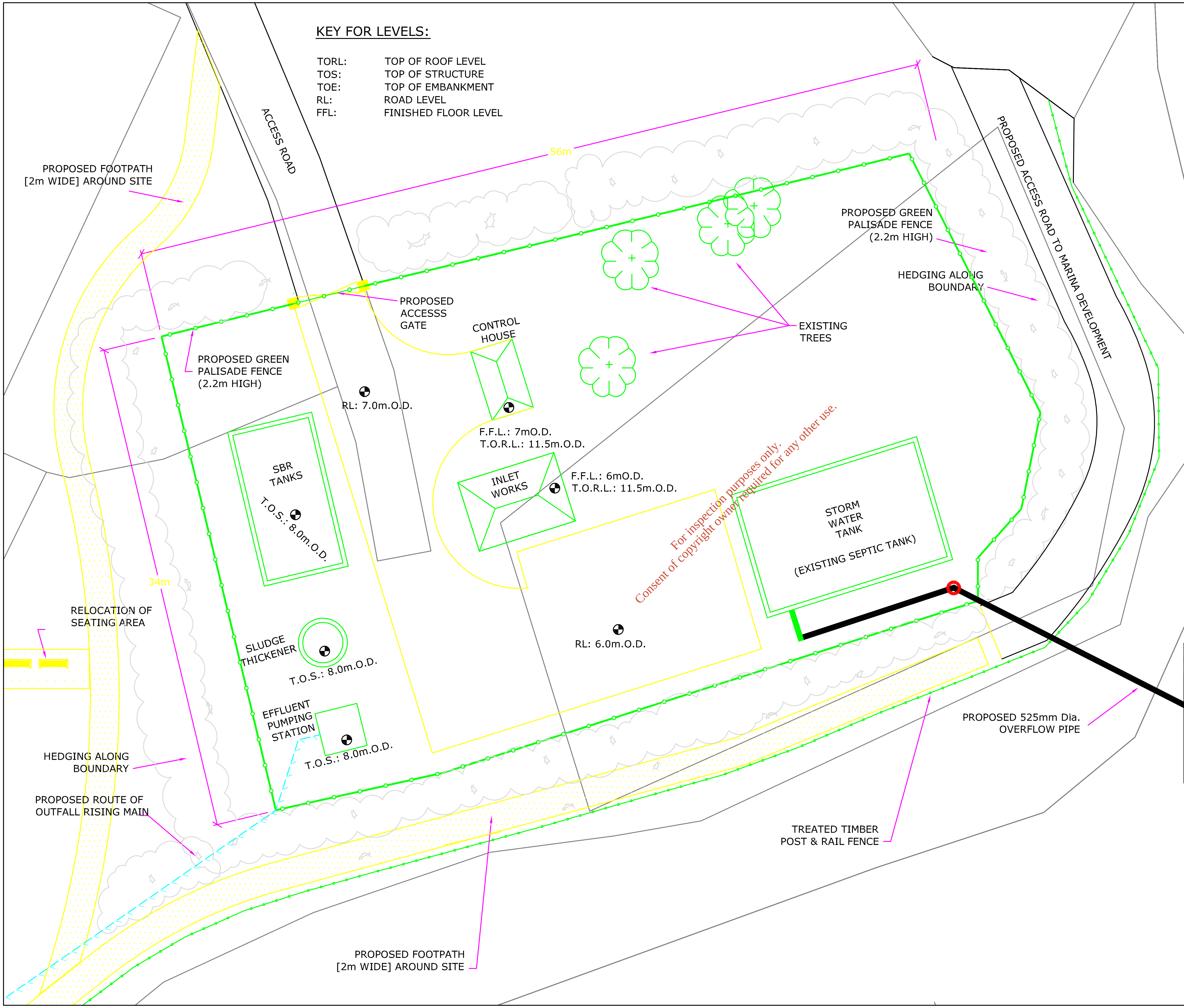
10. The Licensor reserves the right to review and amend the terms of this Licence based on the results of any monitoring programme or other relevant information that becomes available.

Attachment C.1

Attachment C.1

Map:

- **Schull C1.01** – Layout of Proposed WWTP
- **Schull C1.02** – Process Flow Diagram



NOTES

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2. All dimensions to be checked on site
3. Drawings to be read in conjunction with Licence application
4. Includes Ordnance Survey Ireland data reproduced under OSi Licence number Cork County Council CCMA2004/07 Unauthorised reproduction infringes Ordnance Survey Ireland and Government of Ireland

No.	Date	Drwn	Chkd	Revision Description

Cork County Council, Western Division.

N.O'MAHONY,B.E., SENR.ENGR. (WATER SERVICES), COURTHOUSE, SKIBBEREEN.

M. MURRELL., DIRECTOR OF SERVICES WEST CORK

Job Title:

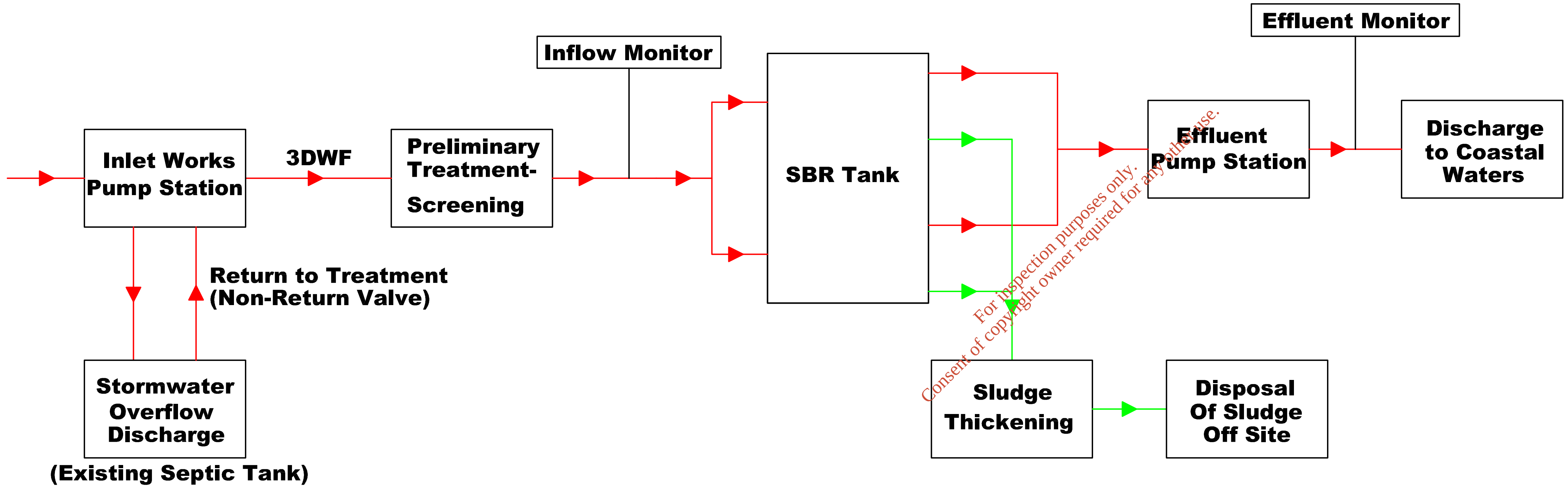
WASTE WATER DISCHARGE LICENCE APPLICATION SCHULL AGGLOMERATION

Drawing Title:

ATTACHMENT C.1 PROPOSED W.W.T.P. LAYOUT PLAN

Prepared By:	Checked By:	Date:
C.HICKEY	A.O'BRIEN	FEB.2009

Drawing number:	Scales:	Rev:
SCHULL_C1.01	1:250	-



NOTES

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COURTHOUSE, SKIBBEREEN.

M. MURRELL.,
DIRECTOR OF SERVICES
WEST CORK

Job Title:

WASTE WATER DISCHARGE
LICENCE APPLICATION
SCHULL AGGLOMERATION

Drawing Title:

ATTACHMENT C.1
PROCESS FLOW DIAGRAM

Prepared By:	Checked By:	Date:
C.HICKEY	A.O'BRIEN	FEB.2009

Drawing number:	Scales:	Rev:
SCHULL_C1.02	NTS	-

Attachment C.2

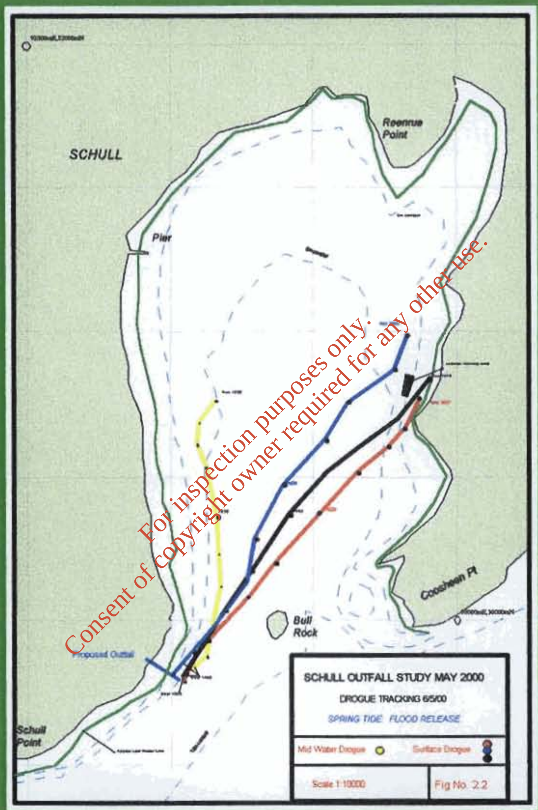
Attachment C.2

Document:

- Report on Proposed Marine Outfall at Schull Harbour, County Cork, 2000.
- Report on Proposed Marine Outfall at Schull Harbour, County Cork, 2001.

Document Reference 822/1/00

REPORT
ON
PROPOSED MARINE OUTFALL
AT
SCHULL HARBOUR
COUNTY CORK



Prepared by :

Irish Hydrodata Limited,
Rathmacullig West,
Ballygarvan,
Co. Cork.

Ph. 021-4311255
Fax. 021-4311740

Prepared for:

M.C.O'SULLIVAN & Co.
Consulting Engineers,
Inishmore,
Ballincollig.
Cork.

Ph. 021-870200

May 2000

Document Ref 822/00

Report
on
Proposed Marine Outfall
at
Schull Harbour
Co. Cork

Prepared for:

M.C. O' Sullivan & Co.,
Consulting Engineers,
Inishmore,
Ballincollig,
Co. Cork.

Prepared by:

Irish Hydrodata Limited,
Ballygarvan,
Co. Cork.

May 2000

1. Introduction

M.C. O' Sullivan & Co. commissioned Irish Hydrodata Limited to investigate the bacterial impact on the marine environment of treated wastewater discharges from a proposed sea outfall at Schull Harbour, Co. Cork.

The outfall will serve the town and immediate environs of Schull. It will replace an existing outfall which discharges into the northern end of Schull Harbour.

The proposed outfall site lies on an open stretch of coastline and is approx. 1.5km due south of the town at Schull Point.

A number of field measurements were made at the proposed location to assist with the study. These included drogue and dye tracking, current metering and depth profiling.

This data was analysed and then incorporated into computer models to simulate the impacts of the proposed discharges for a range of conditions. The results indicate likely levels of bacterial contamination of the surrounding waters.

2. Field Measurements

Field measurements were all made simultaneously on 6/5/00. The tidal range on the day corresponded to approx. mean springs. Weather conditions were excellent with calm conditions prevailing.

Drogue Data

A drogue tracking exercise was conducted on the 6th May 2000. The drogues, cruciform shaped canvas sails set to track the water mass at 0.0-1.0m and 2.5-3.0m, were released in the vicinity of the proposed outfall. As they moved with the water mass they were followed by the survey boat and the position recorded at regular intervals. The drogue data in the form of trajectory plots are presented in Figures 2.1 to 2.2. Tides corresponded to mean spring conditions and the wind was calm to light for the duration of the track.

For the ebbing tide the drogues were released at high water (0710hrs) by which time the ebb had already commenced at the outfall location. They travelled in a south westerly direction through Long Island Sound. The surface water drogues followed a path that took them along the centre of the Sound with a typical average speed of 0.3m/s. The mid water drogues remained closer to the northern shore and travelled slower with a typical average speed of 0.2m/s.

For the flooding tide the release was made at 1400 hrs, approx ½ hours after low water. Surface currents appeared slack at the outfall location at low water (1321hrs) and remained so until approx. low water +1 hour. (based on observation of the current meter marker buoy which was lying shoreward of the mooring). When the flood commenced the surface water drogues travelled in a northeasterly direction across Schull harbour. Typical average speeds recorded over the track were 0.08m/s. A mid depth drogue followed a different path, travelling in a northerly direction along the western shoreline with an average speed of 0.05m/s.

Dye Track Data

Releases of Rhodamine WT tracer dye were made at the proposed outfall location at three times on the 6th. For the ebb tide a 1 litre slug of dye solution was released while on the flood slugs of 0.25 litre were used. For a period of time after release the dye was tracked visually. Subsequently as the concentrations reduced tracking continued with a continuous flow-through fluorometer fitted to the survey vessel.

Dye Release 1: This was made at high water, at which time the ebb tide had commenced at the outfall location. The patch moved steadily to the southwest, along the centre of Long Island Sound, elongating and dispersing. Two hours after release it had travelled a distance of 1600m was ellipsoidal in shape and had major axes dimensions of approx. 450m x 170m. Tracking continued until Release + 5½ hours by which time the patch had travelled some 5.5km and expanded to cover a wide area (approx. 1300m x 400m) with low concentrations. (Figure 2.3).

Dye Release 2: This release was made at low water + 1h, by which time the flood tide had commenced in the surface waters at the outfall location. The patch moved slowly towards the north east. By Release + 2 hours it had travelled 700m. At release + 4 hours the patch had reached the eastern shoreline and was substantially contained within a rocky embayment. (Figure 2.4).

Dye Release 3: This release was made at low water + 3 hours at which time surface currents at the outfall location appeared to have slackened. The patch was monitored ½ hours after release and found to have travelled to the south west. (Figure 2.5).

Depth Data

Echo-sounding was conducted throughout the survey as the survey vessel recorded drogue and dye patch positions. Depths were stored in digital format and then reduced to Chart Datum using predicted tides for Schull Harbour. Results are presented in Figure 2.6 and show depths that compare well with existing Admiralty Chart data. A profile section along the proposed outfall line is shown in Figure 2.7.

Current Meter Data

A recording current meter (Interocean S4) was deployed at the outfall site for a 12 hour period coincident with the drogue and dye tests. The meter was installed on a subsurface mooring at a height of 3.0m above the seabed and at a distance of approx. 100m from the shoreline.(Figure 2.7). Measured current speed and direction data are shown in Figure 2.8 and indicate a rectilinear flow parallel to the shoreline with a peak flood speed of 0.10m/s and a peak ebb speed of 0.15m/s.

3. Modelling of Effluent Discharges

The onsite measurements described previously together with general oceanographic data were used to develop numerical models of the likely fate of effluent discharging from the outfall. Only bacterial contamination is considered as its impact is by the far the most significant in view of concentrations in the treated effluent source.

The models simulate the fate of the effluent in three distinct regions:

- the *near-field* region, adjacent to the discharge point, where the effluent plume exits the pipe and rises to the surface;
- the *mid-field* where the effluent plume spreads and mixing takes place in the vertical typically within a specific distance (i.e. 100 x local water depth) from the discharge point and;
- the *far-field* where vertical mixing is complete and further mixing takes place in the offshore/onshore direction.

Effluent Characteristics

Domestic effluent from the town will be subjected to comprehensive treatment before being discharged to the sea via the proposed outfall. Design flow rates and bacterial concentrations are as follows:

Flow Rate: 18 to 48 litres /second;
Faecal Coliforms at outfall: 1 x 10^5 to 1 x 10^6 fc /100ml;
Bacterial Decay Time: 12 hours.

Worst case conditions are likely to occur when flow rates are at their highest. Therefore a flow rate of 48 litres/second was employed in the simulations. The bacterial concentration will depend on the efficiency of the treatment process and may be lower than the range indicated. For comparative purposes model results are presented with both values.

Initial Mixing & Dilution

Treated effluent discharging from an outfall pipe is primarily fresh water and therefore behaves as a buoyant jet which will rapidly rise to the surface where it forms a spreading plume. The initial dilution, while rising from the seabed to the surface, depends mainly on the local water depth and ambient current.

This stage of the discharge process was simulated with a jet model (ref.2). Results in Table 1 show predicted initial dilutions of the plume at the instant it reaches the sea surface. With a single port outfall (i.e. an open ended pipe, diameter 300mm) the predicted dilutions will lie in the range 25 - 115 depending on the tide level and ambient current speed at the discharge point. Fitting a four port diffuser onto the pipe will increase initial mixing and the model simulations suggest improved dilutions of 80 to 450.

No. Ports	Flood Tide	Ebb Tide	Slack Water
1	45 - 85	65 -115	25 - 40
4	170 -330	230 - 450	80 - 100

Table 1 - Predicted Initial Dilutions at Discharge Point.

Near-Field & Far-Field Mixing

Simulations of the subsequent dispersion of the plume as it leaves the immediate outfall area were made with a gaussian patch model (ref.2). This model assumes that the expanding contaminant plume may be described by a three dimensional Gaussian concentration distribution in which the effects of horizontal boundaries (the sea surface, sea bottom and coastline) are accounted for by using the method of images.

Measured current speed, drogue and dye data were used as the primary input. Directions were modified to account for observed trajectories over the survey area.

Model simulations were made of discharges for spring and neap tide conditions. An output grid of 50m x 100m centred on the discharge point and extending 6km west along the coast and 2km north east was used (the computational grid covered the full extent of tidal excursion). A bacterial decay time of 12 hours was employed and output generated for every hour of the tidal cycle. The results are presented in graphical format in figures 3.1 to 3.8.

The patch model reproduces the gėneral shape of the drogue and dye patch trajectories. For spring tides the excursion is as recorded during the field work while for the neap simulations the excursion is reduced by approx 30 % in line with the change in tidal ranges. It is assumed that plume the trajectories remain the same for spring and neap tides.

For a source bacterial strength of 1 x 10^6 fc/100ml the plume concentrations will exceed 1000fc/100ml in the vicinity of the outfall and 500 fc/100ml for distances from the source of approx 1300m on the ebb tide spring and 600m on the flood (Figures 3.1 to 3.4). Levels below 100fc/100ml will be reached some 5km from the outfall on the ebb and 1.2km on the flood.

Reducing the outfall source bacterial strength to 1 x 10^5 fc/100ml has a dramatic impact on the plume size as seen from Figures 3.5 to 3.8. High values will now only be recorded at the immediate outfall site and levels below 100fc/100 ml will be recorded no more that 1.4km from the outfall on the ebb spring and 600m on the flood.

4. Discussion

This document presents the findings of a study into the impact of a proposed sea outfall on the waters off Schull Point. The proposed discharge will be 48 litres of treated effluent per second with a faecal coliform bacterial level of up to 1×10^5 to 1×10^6 fc/100ml.

Field measurements at the location, including drogue, dye and current meter data, has shown a well defined flow pattern at the site. The ebb tide is the stronger and longer in duration with both drogues and dye carried away from the coastline westward through the middle of Long Island Sound. The flooding tide is weaker and of shorter duration with drogues and dye carried across the harbour towards the eastern shoreline.

Model simulations of the discharge have shown that bacterial concentrations will rapidly decrease away from the outfall and where they reach the coastline will be well within statutory requirements. For a low source concentration (1×10^5 fc/100ml) the impact of the plume is seen to be particularly small.

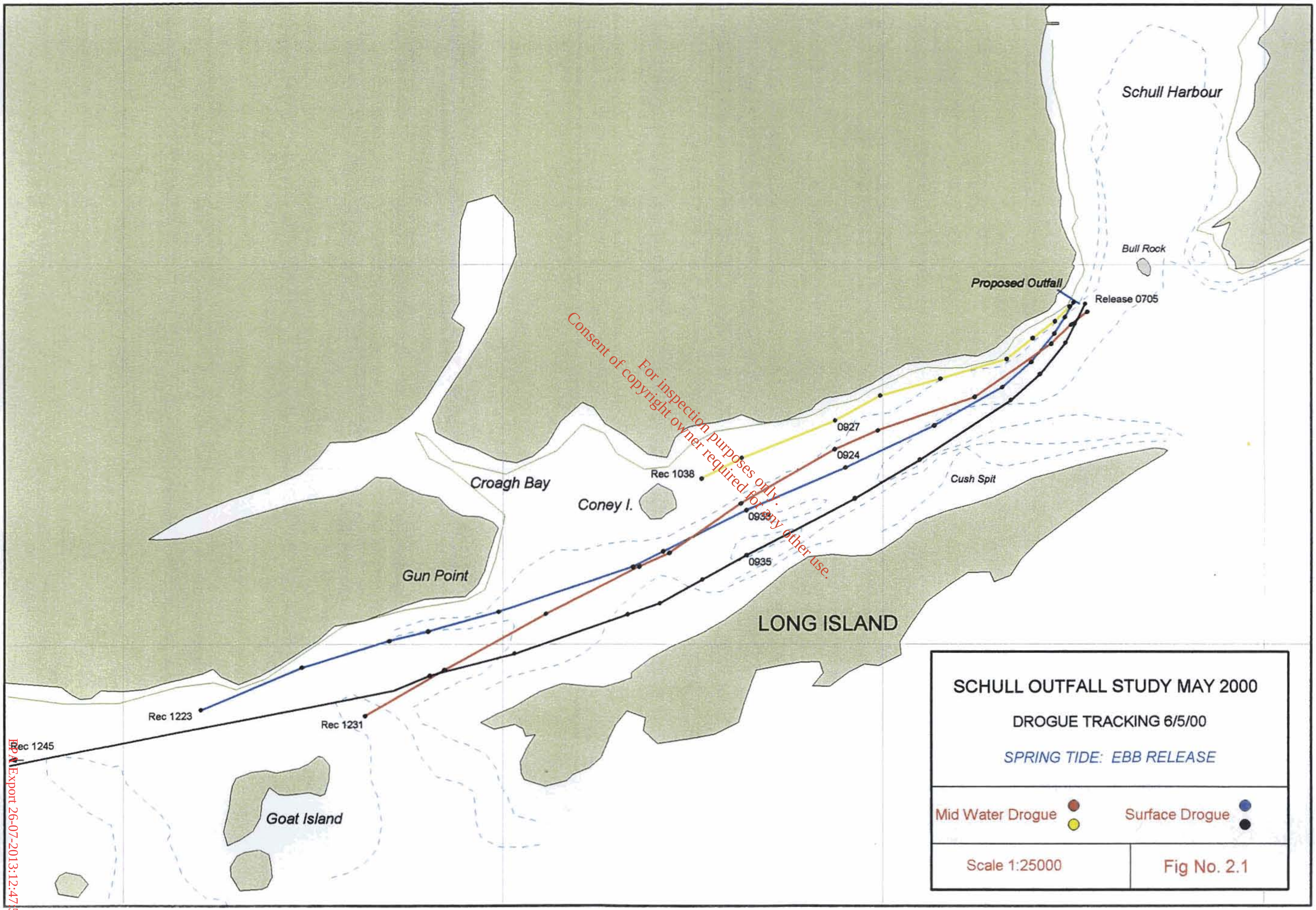
The observed current patterns at the location suggest that restricting the discharge to the ebb tide would be advantageous. This would ensure no contamination of Schull harbour and rapid dispersal of the plume in Long Island Sound.

The data indicates that the chosen location is probably the optimum one in that it ensures that discharges are carried away from the shoreline. No discharge point within the harbour is likely to prove favorable due to the slack flows. A possible site on Coosheen Point is unlikely to prove acceptable as currents continue to flow into Schull Harbour along the eastern shoreline for several hours after they have started to ebb along the western shore.

References:

1 Admiralty Hydrographic Department (1987)
Admiralty Chart (No. 2129) Long Island Bay to Castlehaven

2 Hunter, J.R., (1985)
A suite of programs for the simulation of marine outfalls, Centre for Marine Science & Technology, Curtin University, Australia.

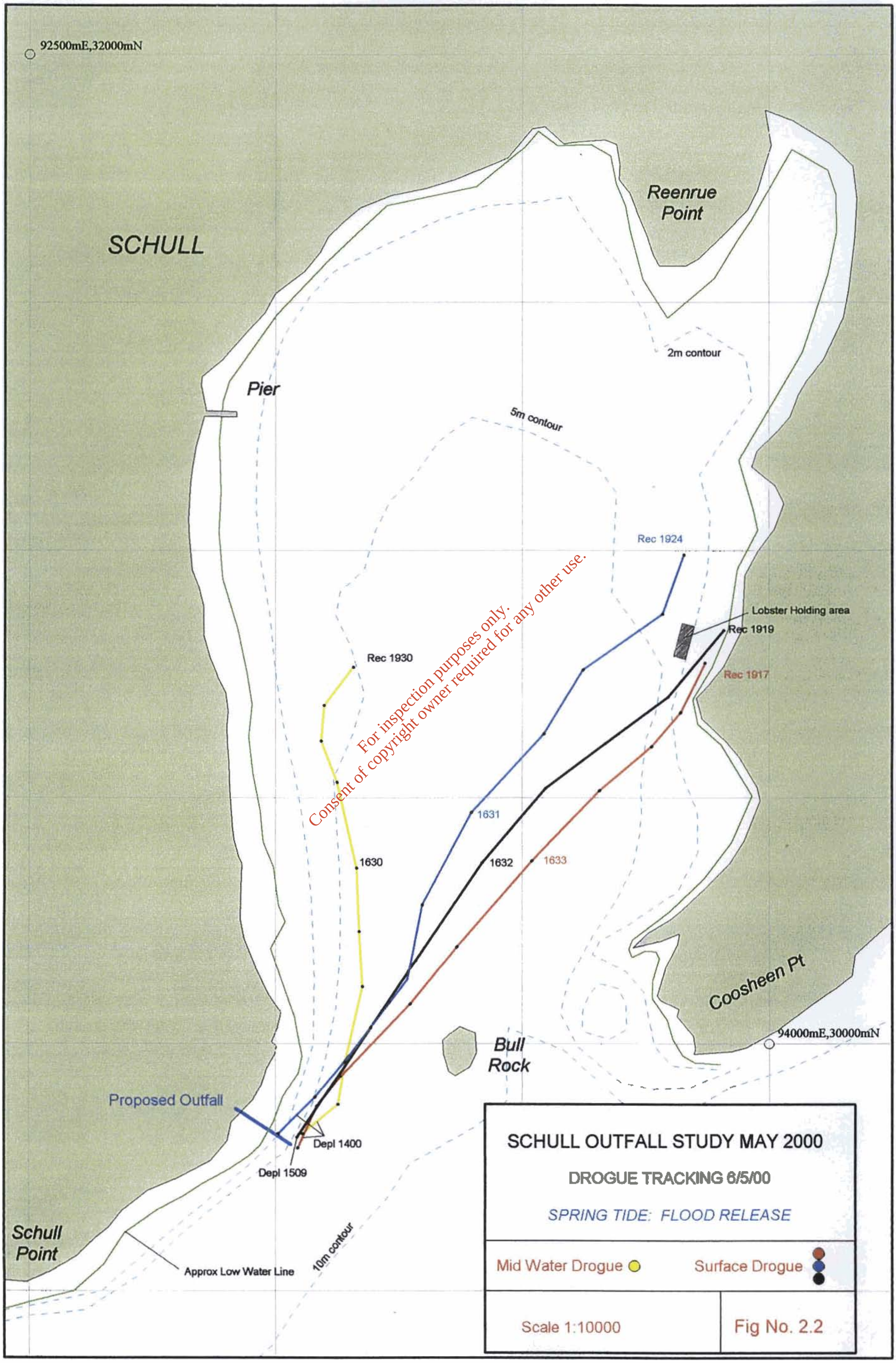


SCHULL OUTFALL STUDY MAY 2000

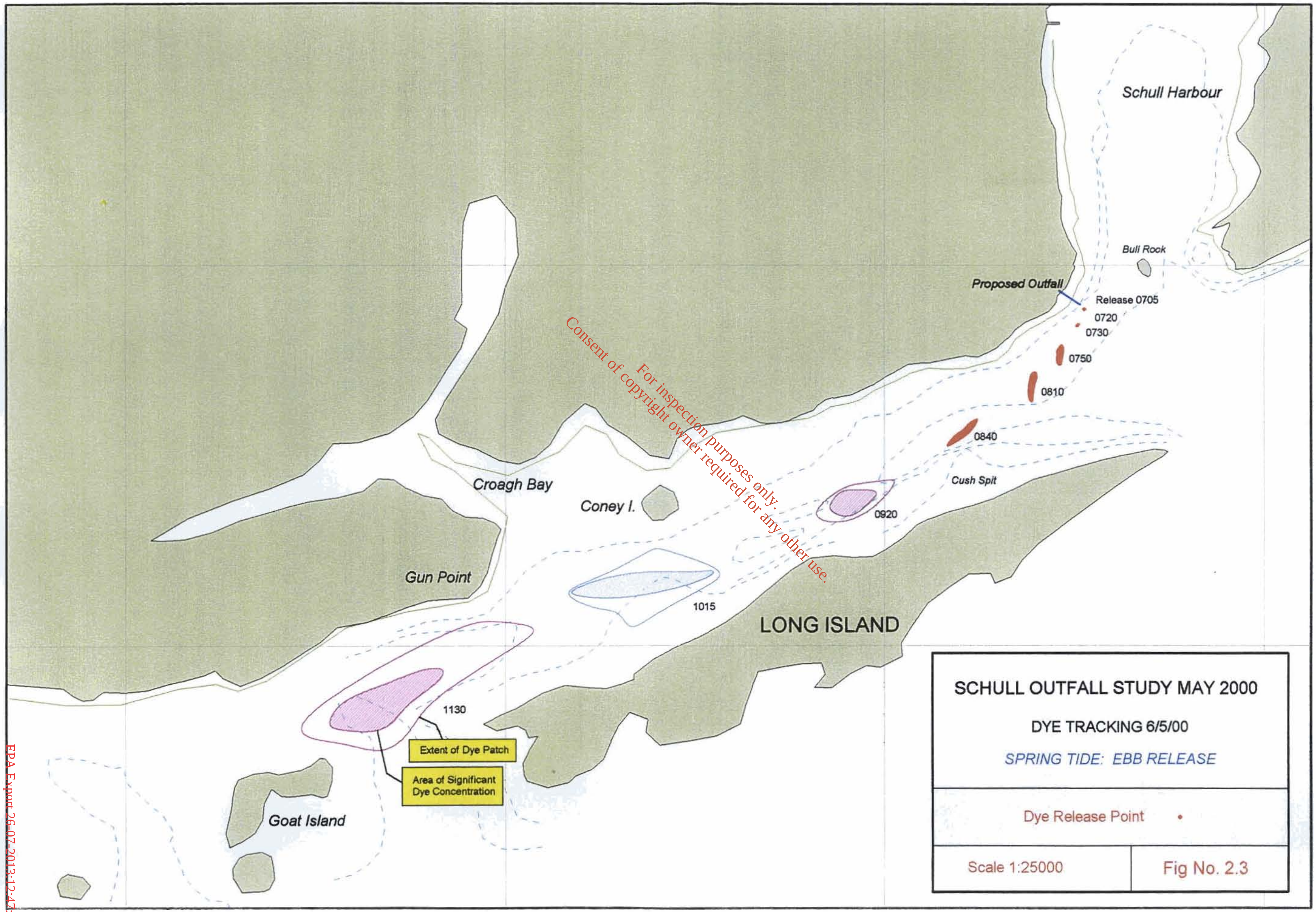
DROGUE TRACKING 6/5/00

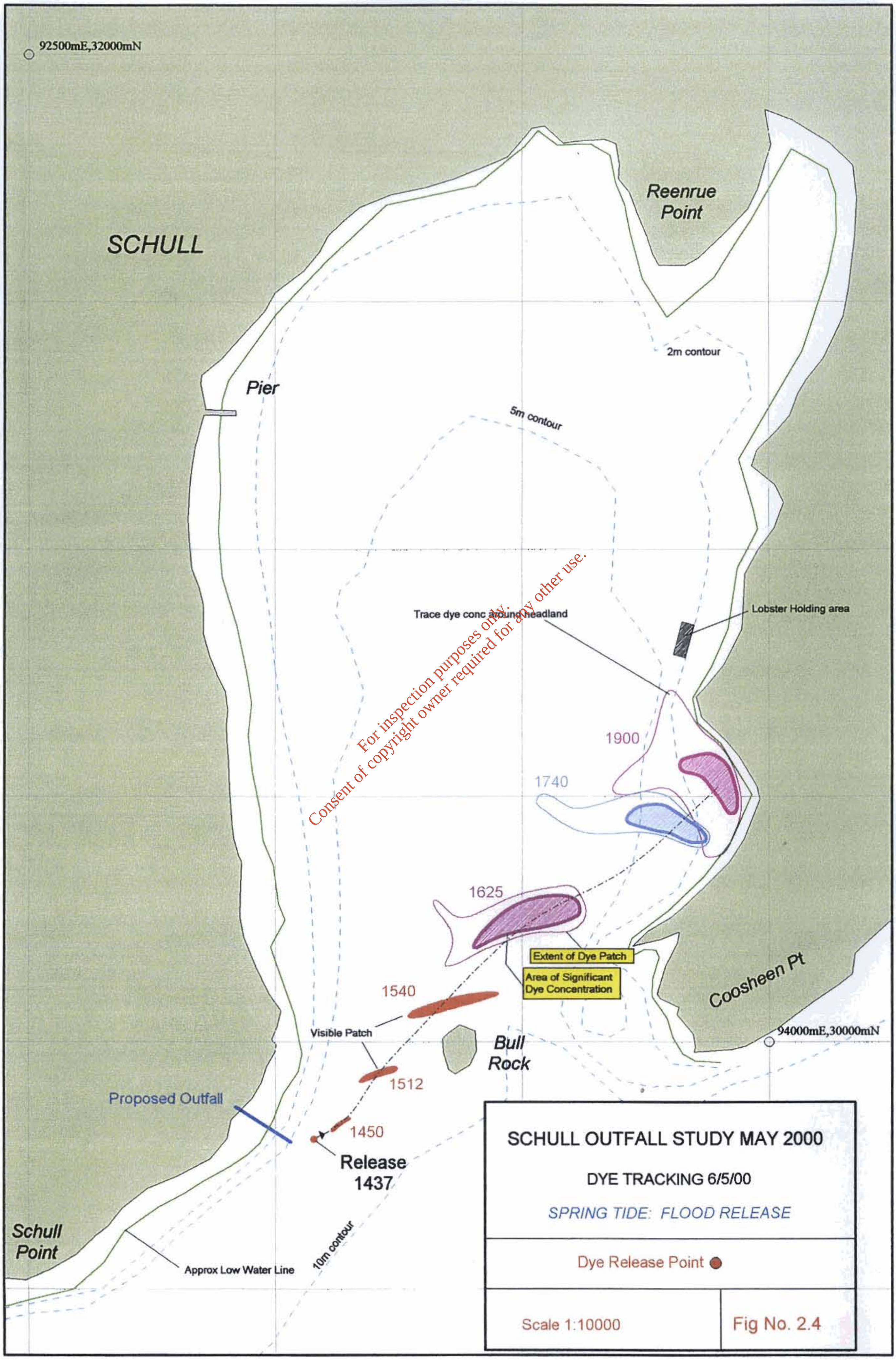
SPRING TIDE: EBB RELEASE

Mid Water Drogue	Surface Drogue
Scale 1:25000	Fig No. 2.1

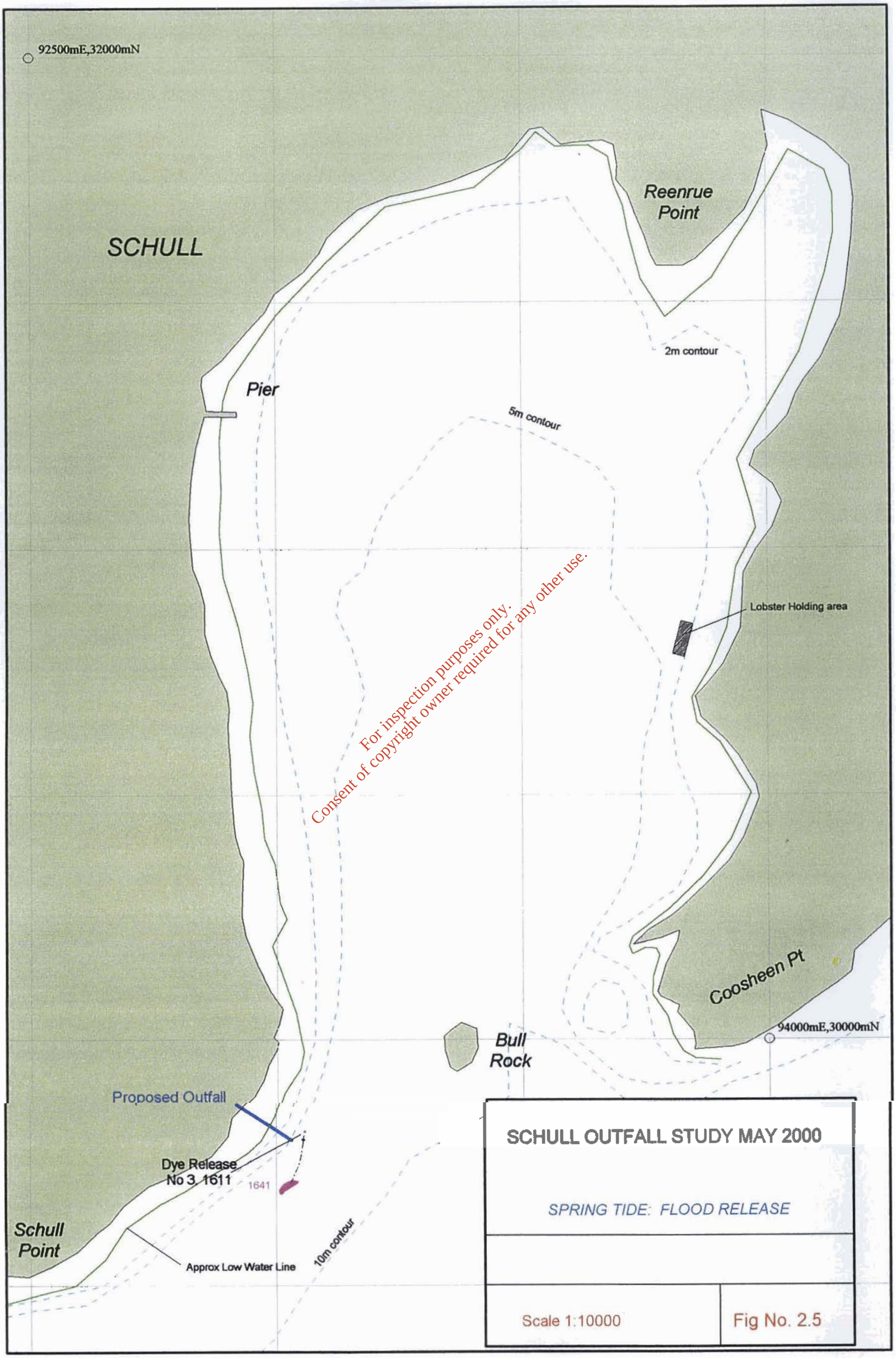


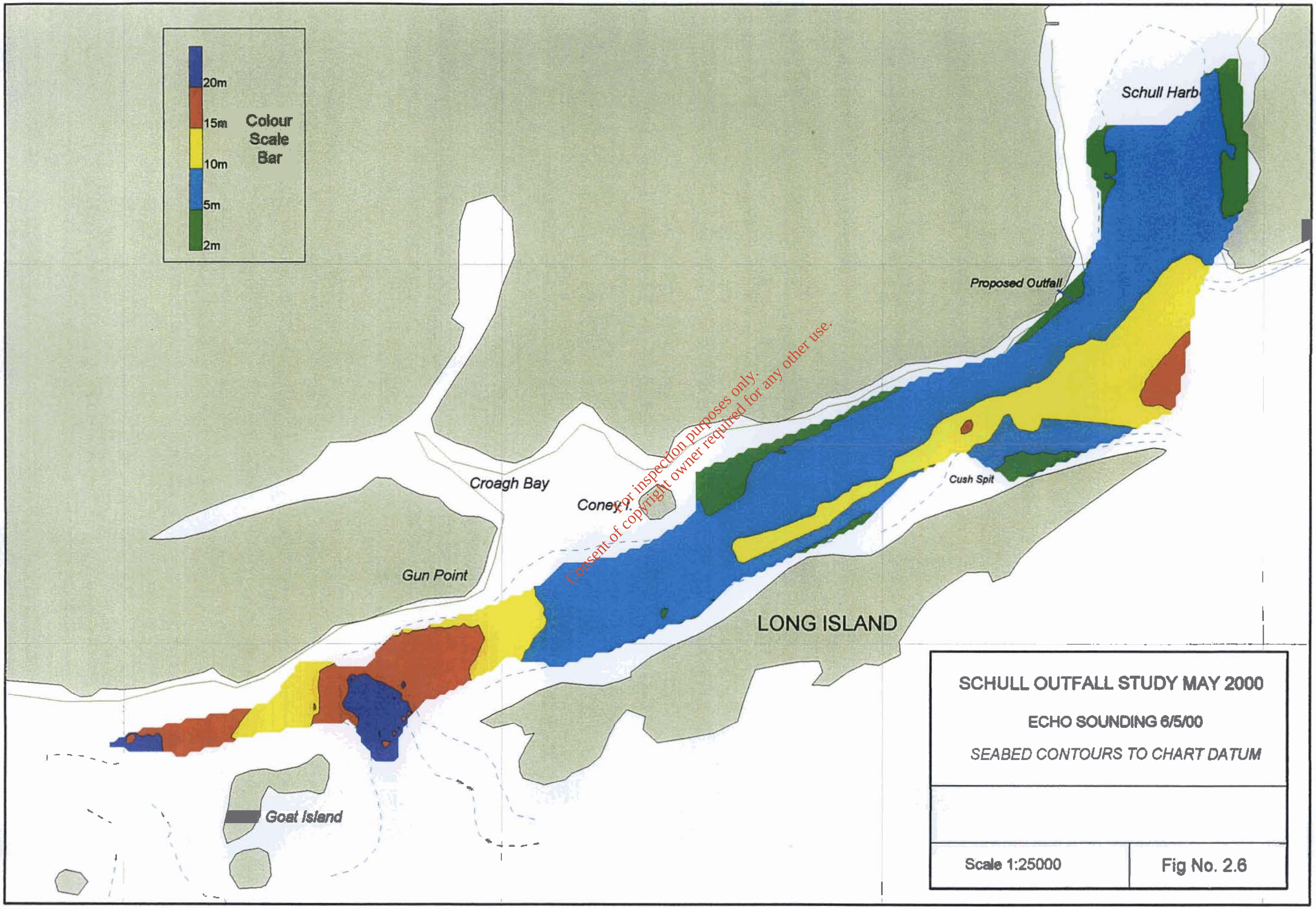
92500mE,32000mN
SCHULL
Reenrue Point
2m contour
Pier
5m contour
Rec 1924
Lobster Holding area
Rec 1919
Rec 1930
Rec 1917
1631
1630
1632
1633
Coosheen Pt
94000mE,30000mN
Bull Rock
Proposed Outfall
Depl 1400
Depl 1509
Schull Point
Approx Low Water Line
10m contour
SCHULL OUTFALL STUDY MAY 2000
DROGUE TRACKING 6/5/00
SPRING TIDE: FLOOD RELEASE
Mid Water Drogue
Surface Drogue
Scale 1:10000
Fig No. 2.2


Schull Harbour
Bull Rock
Proposed Outfall
Release 0705
0720
0730
0750
0810
0840
Cush Spit
0920
Croagh Bay
Coney I.
Gun Point
1015
LONG ISLAND
1130
Extent of Dye Patch
Area of Significant Dye Concentration
Goat Island
SCHULL OUTFALL STUDY MAY 2000
DYE TRACKING 6/5/00
SPRING TIDE: EBB RELEASE
Dye Release Point
Scale 1:25000
Fig No. 2.3



92500mE,32000mN
SCHULL
Reenrue Point
2m contour
Pier
5m contour
Trace dye conc around headland
Lobster Holding area
1900
1740
1625
Extent of Dye Patch
Area of Significant Dye Concentration
1540
Coosheen Pt
94000mE,30000mN
Visible Patch
Bull Rock
1512
Proposed Outfall
1450
Release 1437
Schull Point
Approx Low Water Line
10m contour
SCHULL OUTFALL STUDY MAY 2000
DYE TRACKING 6/5/00
SPRING TIDE: FLOOD RELEASE
Dye Release Point
Scale 1:10000
Fig No. 2.4


92500mE,32000mN
SCHULL
Reenrue
Point
2m contour
Pier
5m contour
Lobster Holding area
Coosheen Pt
94000mE,30000mN
Bull
Rock
Proposed Outfall
Dye Release
No 3 1611
1641
Schull
Point
Approx Low Water Line
10m contour
SCHULL OUTFALL STUDY MAY 2000
SPRING TIDE: FLOOD RELEASE
Scale 1:10000
Fig No. 2.5

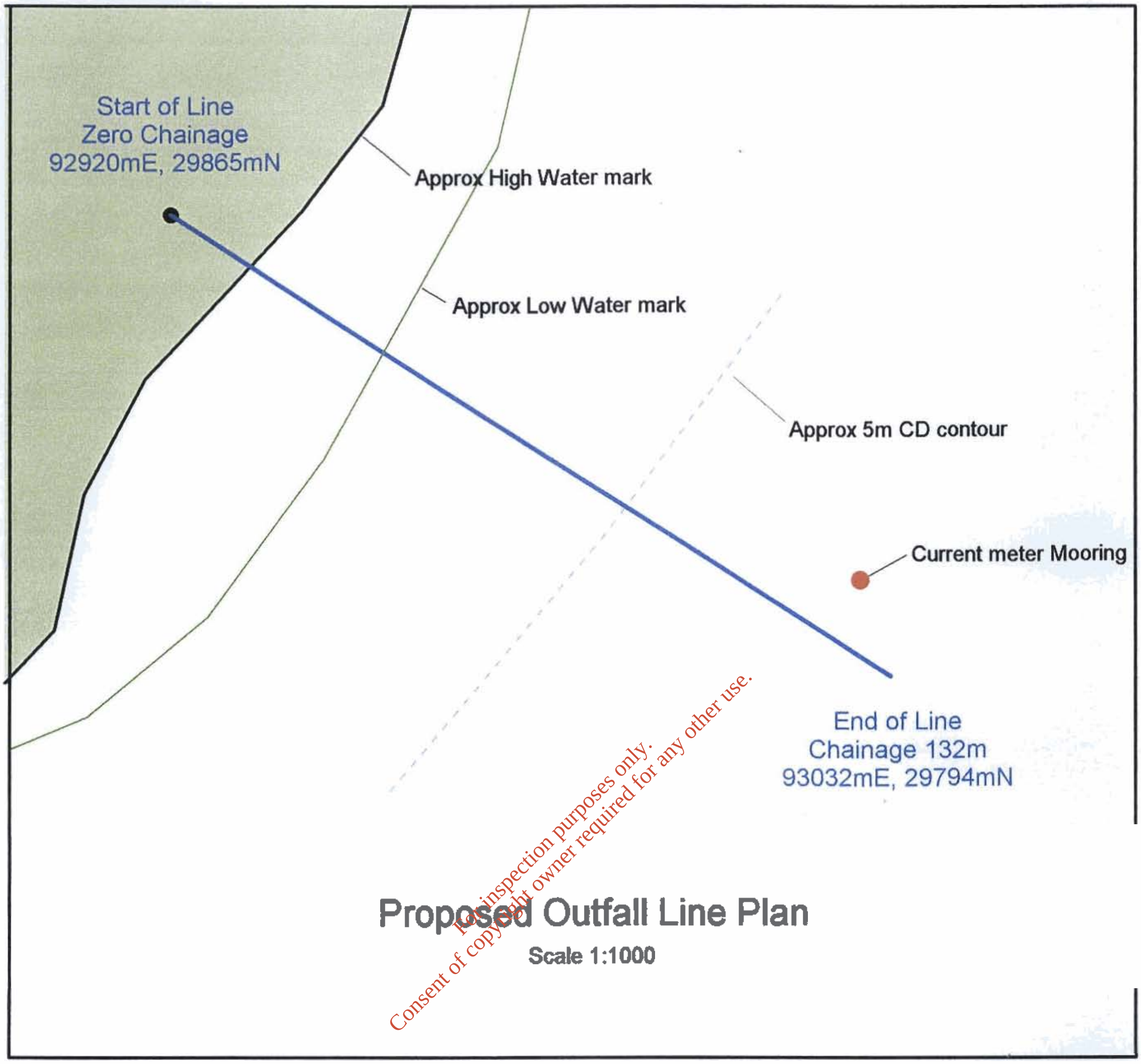


SCHULL OUTFALL STUDY MAY 2000

ECHO SOUNDING 6/5/00

SEABED CONTOURS TO CHART DATUM

Scale 1:25000	Fig No. 2.6


Start of Line
Zero Chainage
92920mE, 29865mN
Approx High Water mark
Approx Low Water mark
Approx 5m CD contour
Current meter Mooring
End of Line
Chainage 132m
93032mE, 29794mN
Proposed Outfall Line Plan
Scale 1:1000

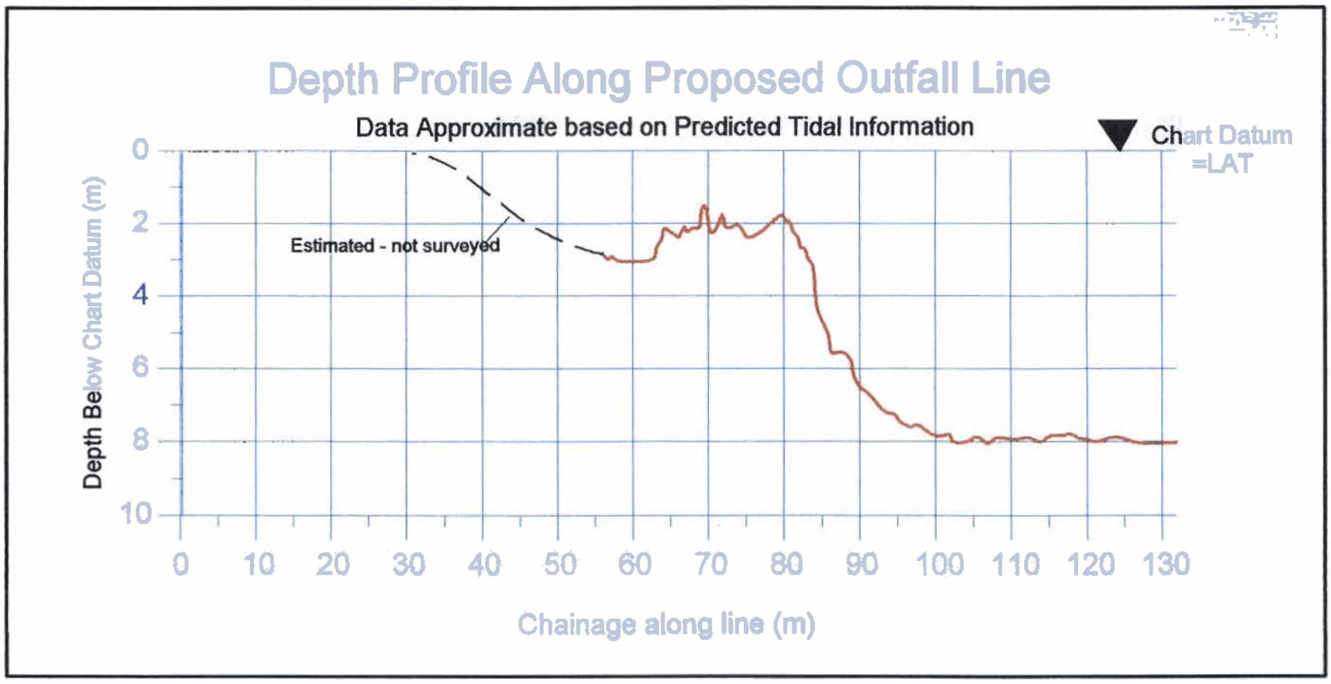
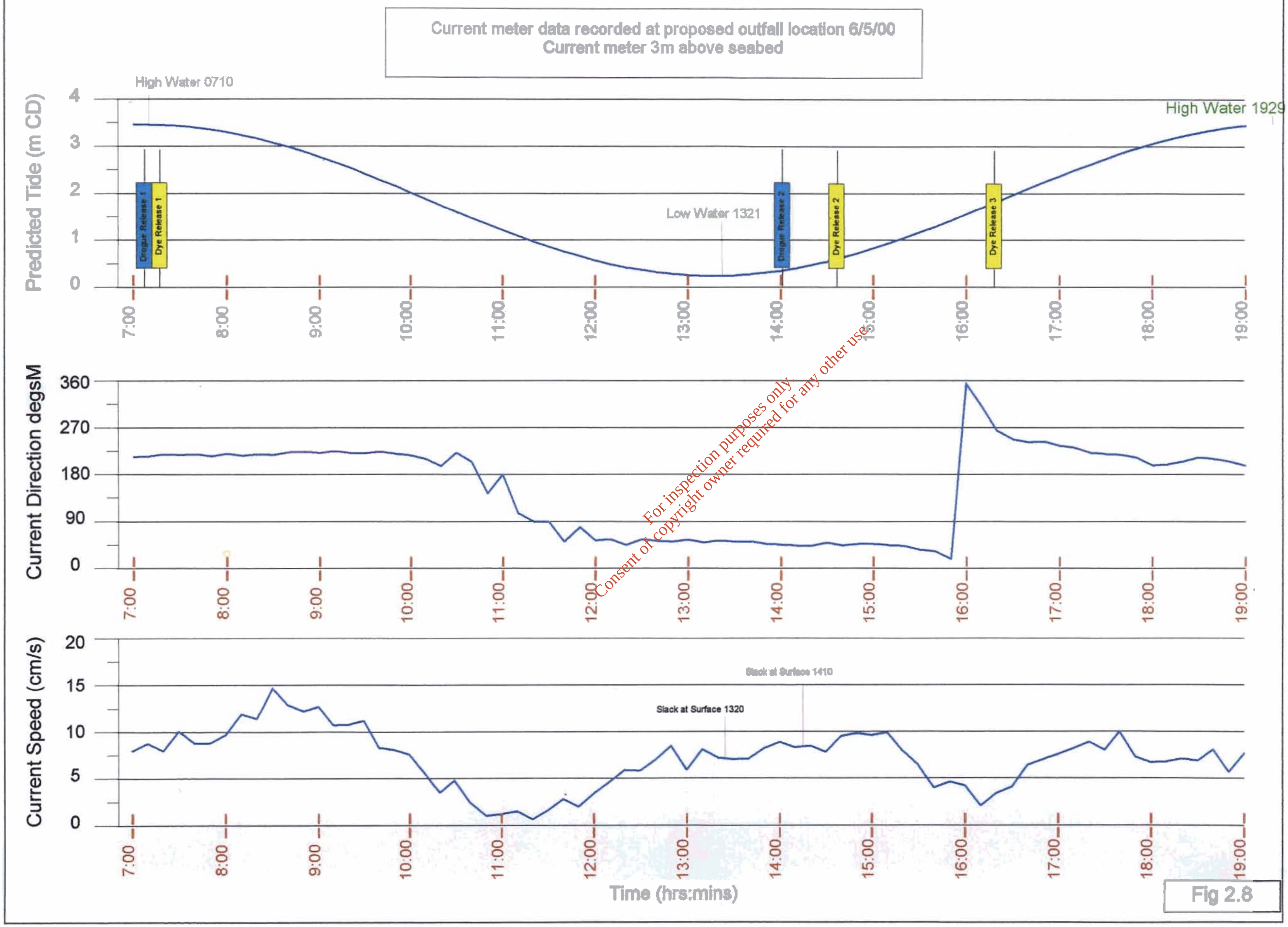
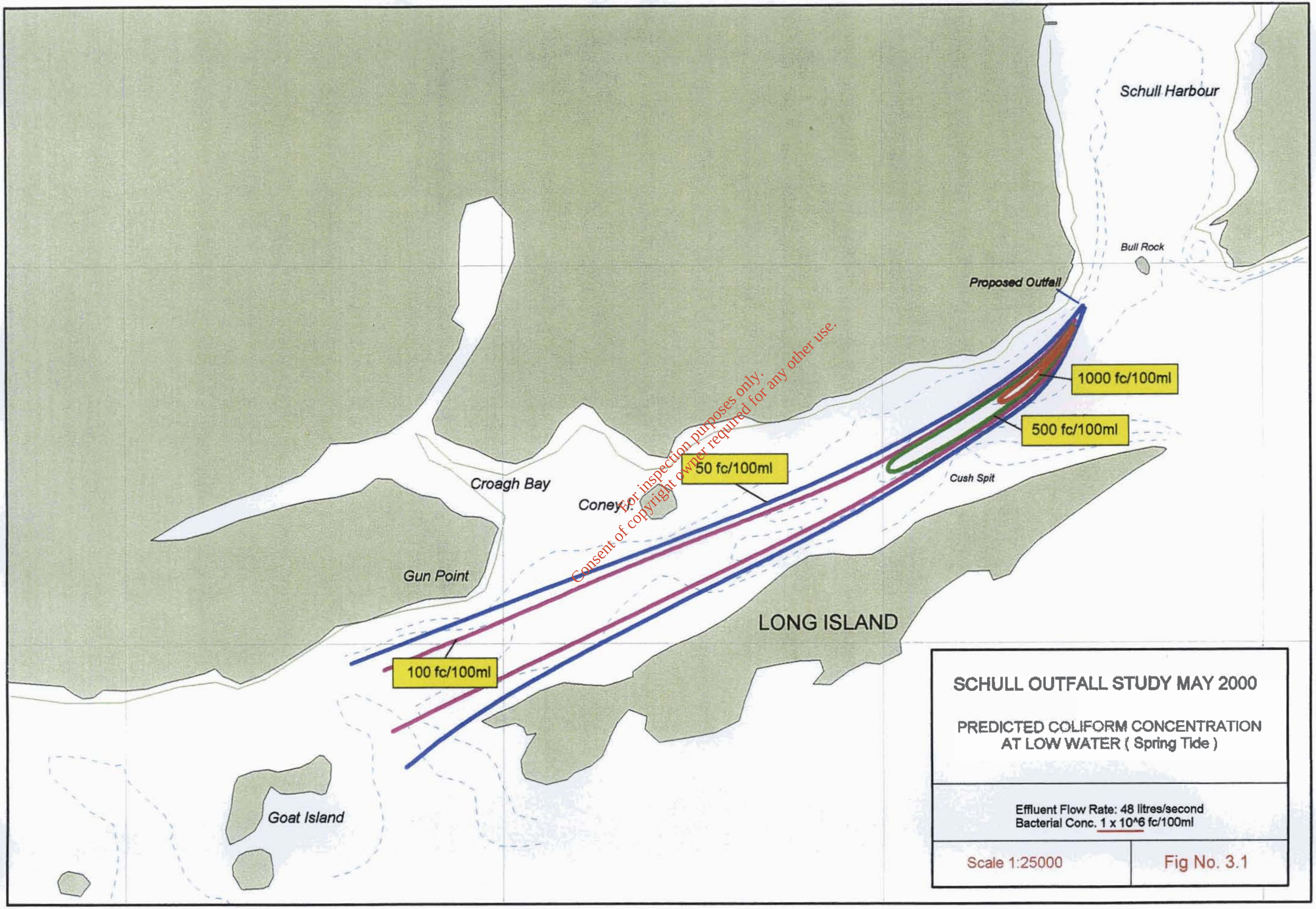

Depth Profile Along Proposed Outfall Line
Data Approximate based on Predicted Tidal Information
Chart Datum =LAT
Estimated - not surveyed
Depth Below Chart Datum (m)
0
2
4
6
8
10
0 10 20 30 40 50 60 70 80 90 100 110 120 130
Chainage along line (m)

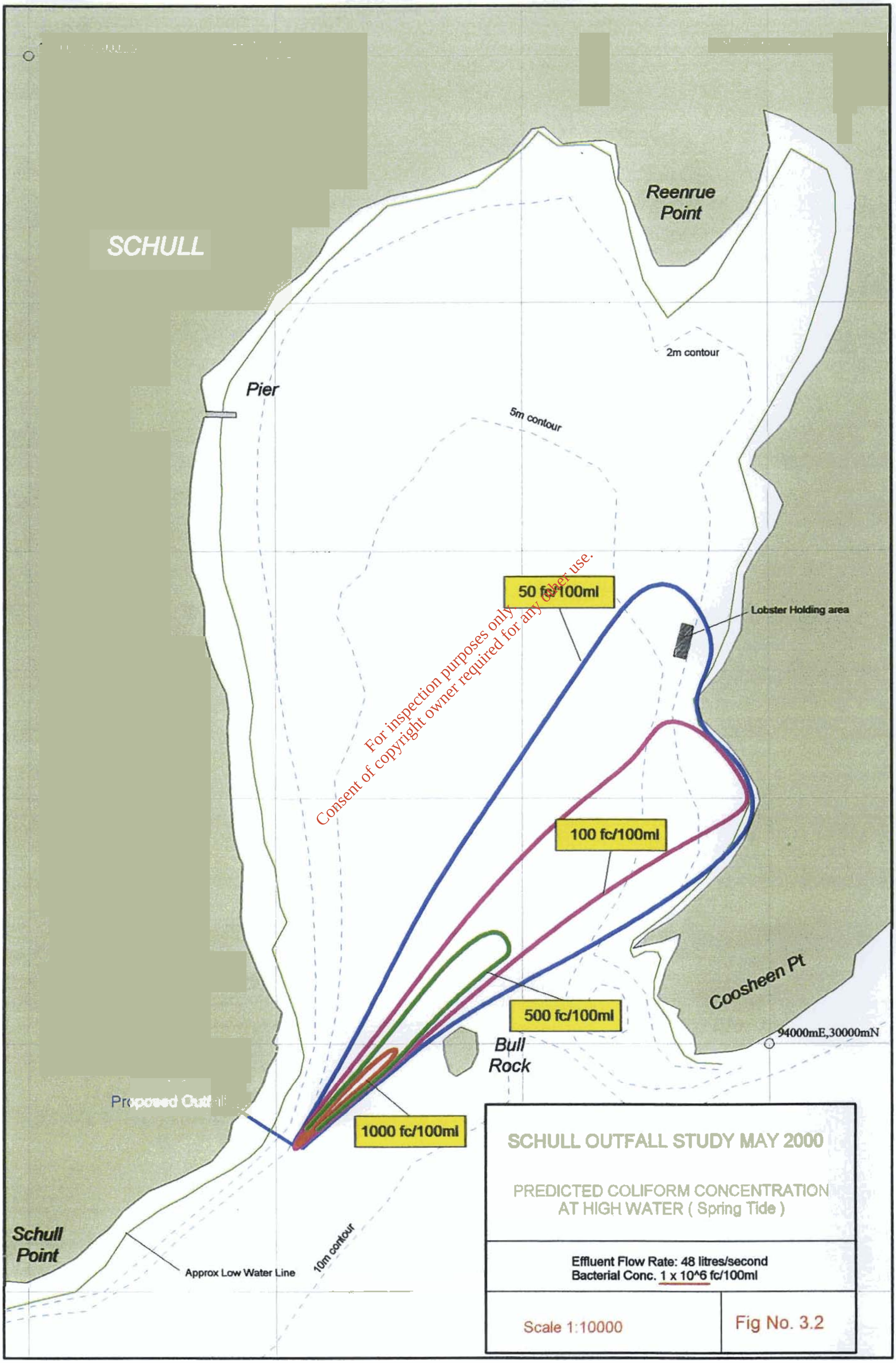
FIG 2.7



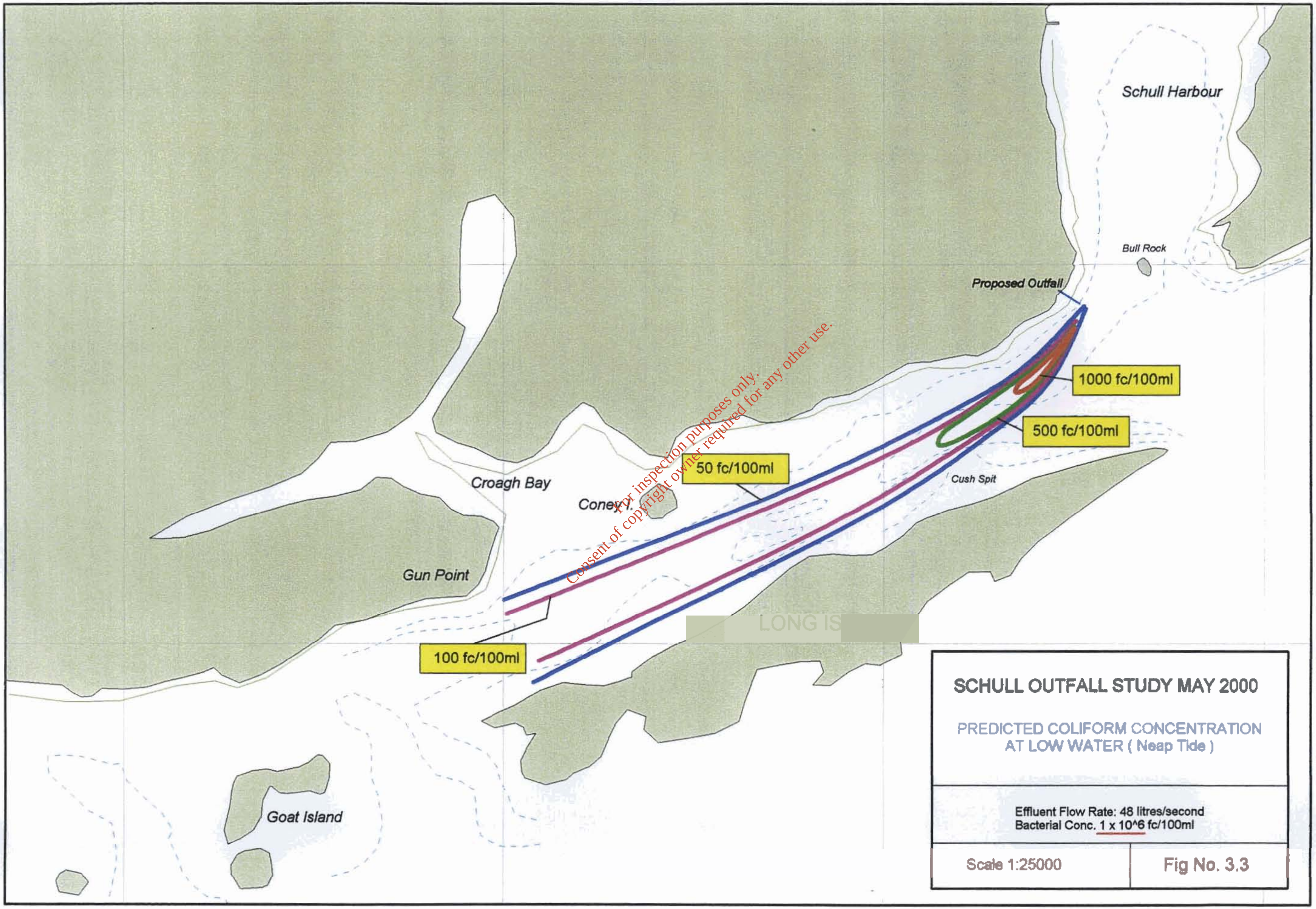
Current meter data recorded at proposed outfall location 6/5/00
Current meter 3m above seabed
High Water 0710
High Water 1929
Low Water 1321
Drogue Release 1
Dye Release 1
Drogue Release 2
Dye Release 2
Dye Release 3
Predicted Tide (m CD)
Current Direction degsM
Current Speed (cm/s)
Slack at Surface 1410
Slack at Surface 1320
Time (hrs:mins)

Fig 2.8

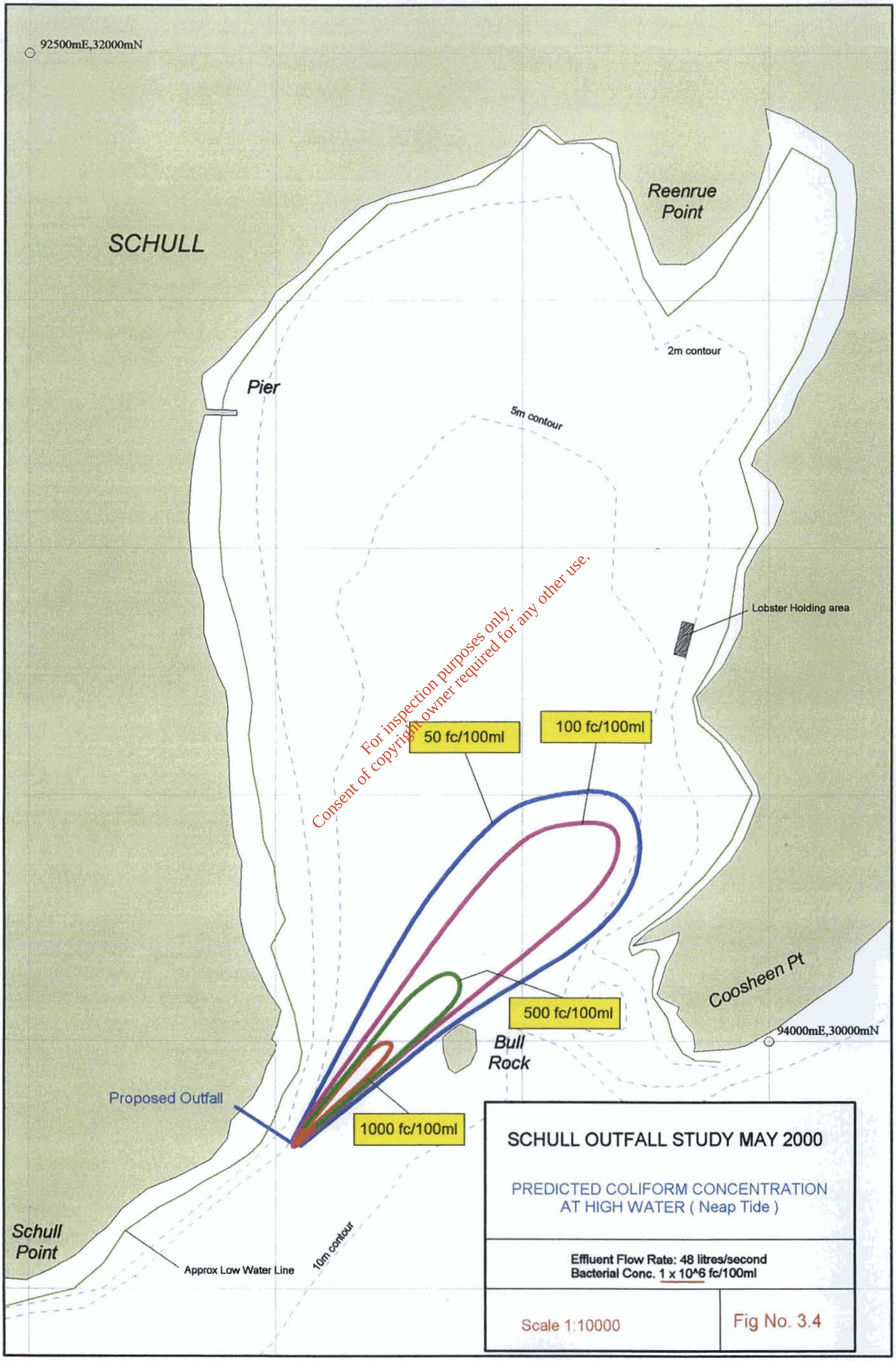

Schull Harbour
Bull Rock
Proposed Outfall
1000 fc/100ml
500 fc/100ml
50 fc/100ml
Cush Spit
Croagh Bay
Coney I.
Gun Point
LONG ISLAND
100 fc/100ml
Goat Island
SCHULL OUTFALL STUDY MAY 2000
PREDICTED COLIFORM CONCENTRATION
AT LOW WATER (Spring Tide)
Effluent Flow Rate: 48 litres/second
Bacterial Conc. 1 x 10^6 fc/100ml
Scale 1:25000
Fig No. 3.1

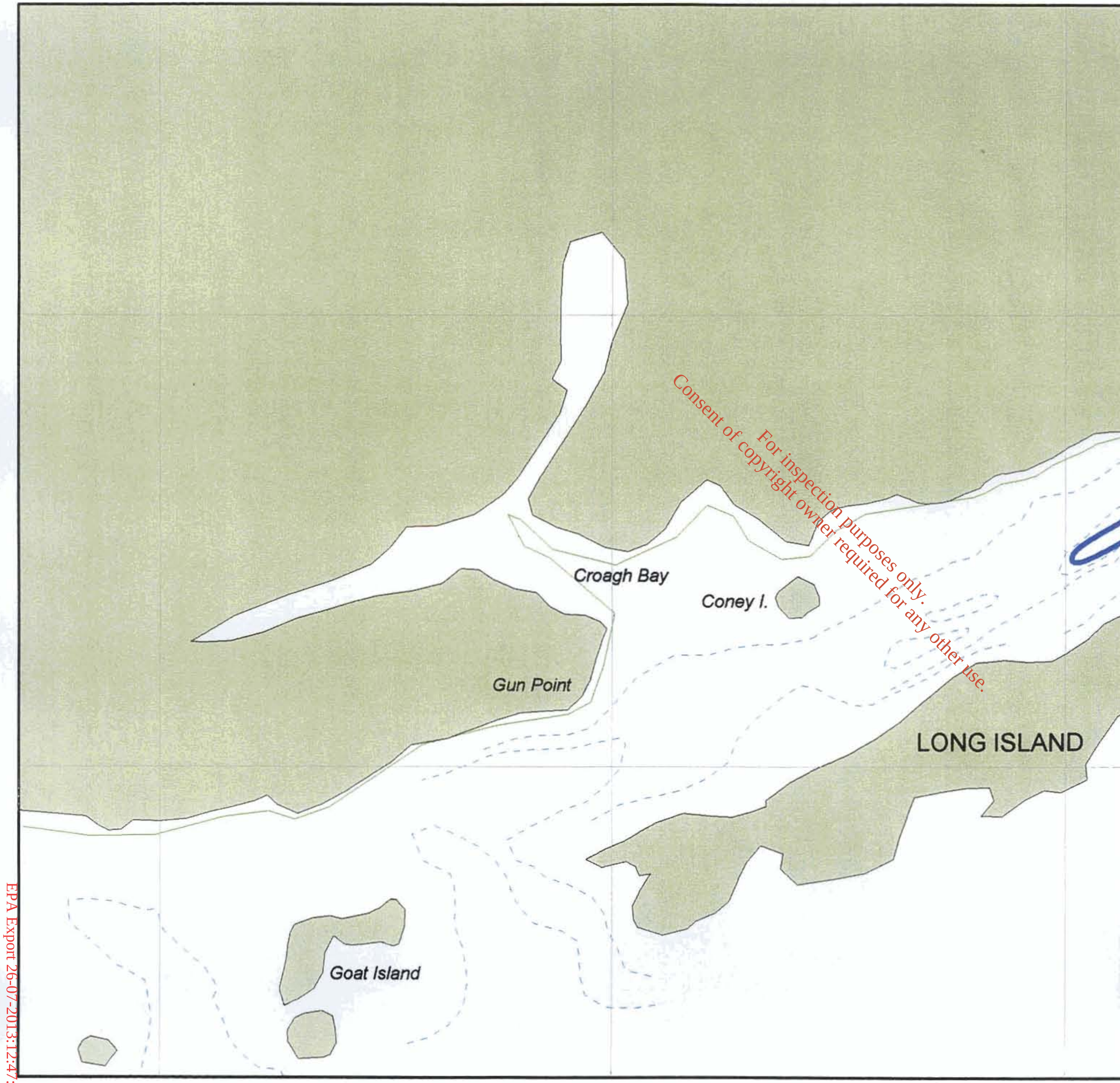


SCHULL
Reenrue Point
Pier
2m contour
5m contour
50 fc/100ml
Lobster Holding area
100 fc/100ml
500 fc/100ml
Coosheen Pt
94000mE,30000mN
Bull Rock
1000 fc/100ml
Schull Point
Approx Low Water Line
10m contour
SCHULL OUTFALL STUDY MAY 2000
PREDICTED COLIFORM CONCENTRATION AT HIGH WATER (Spring Tide)
Effluent Flow Rate: 48 litres/second
Bacterial Conc. 1 x 10^6 fc/100ml
Scale 1:10000
Fig No. 3.2



Schull Harbour
Bull Rock
Proposed Outfall
1000 fc/100ml
500 fc/100ml
50 fc/100ml
Cush Spit
Croagh Bay
Coney I.
Gun Point
100 fc/100ml
Goat Island
SCHULL OUTFALL STUDY MAY 2000
PREDICTED COLIFORM CONCENTRATION AT LOW WATER (Neap Tide)
Effluent Flow Rate: 48 litres/second
Bacterial Conc. 1 x 10^6 fc/100ml
Scale 1:25000
Fig No. 3.3


92500mE,32000mN
SCHULL
Reenrue Point
Pier
2m contour
5m contour
Lobster Holding area
50 fc/100ml
100 fc/100ml
500 fc/100ml
1000 fc/100ml
Coosheen Pt
94000mE,30000mN
Bull Rock
Proposed Outfall
Schull Point
Approx Low Water Line
10m contour
SCHULL OUTFALL STUDY MAY 2000
PREDICTED COLIFORM CONCENTRATION AT HIGH WATER (Neap Tide)
Effluent Flow Rate: 48 litres/second
Bacterial Conc. 1 x 10^6 fc/100ml
Scale 1:10000
Fig No. 3.4



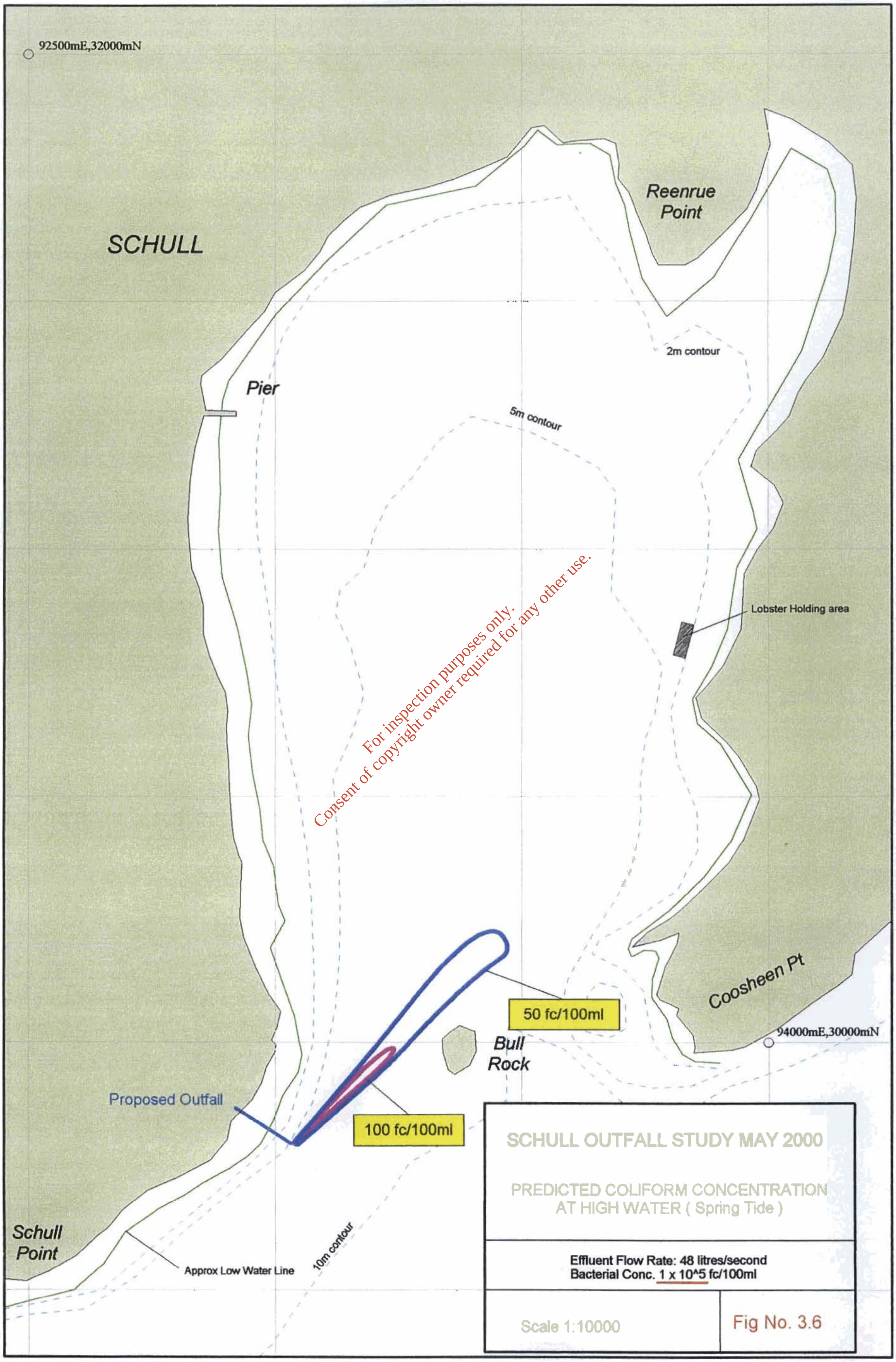
SCHULL OUTFALL STUDY MAY 2000

PREDICTED COLIFORM CONCENTRATION AT LOW WATER (Spring Tide)

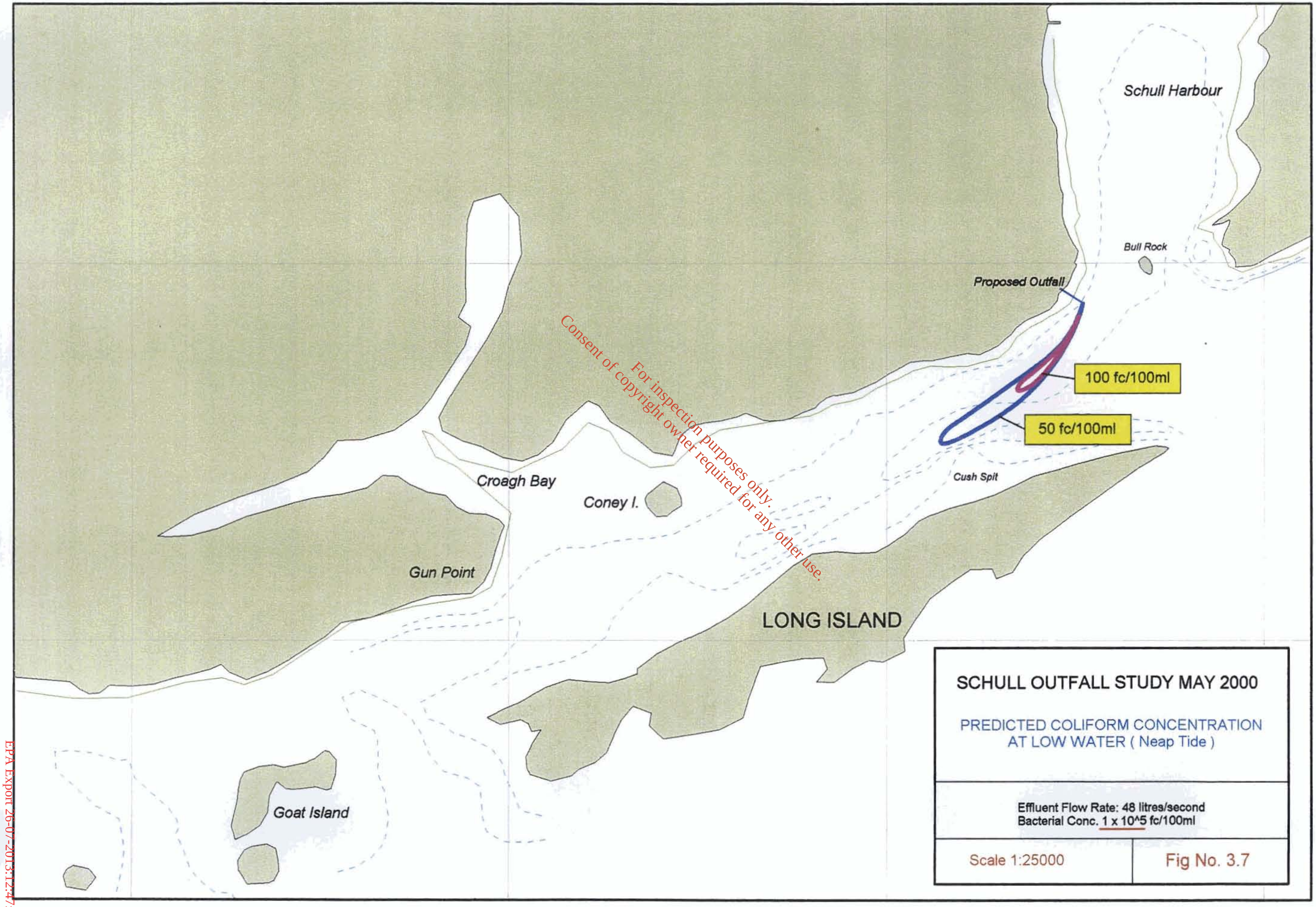
Effluent Flow Rate: 48 litres/second
Bacterial Conc. 1 x 10^5 fc/100ml

Scale 1:25000

Fig No. 3.5



92500mE,32000mN
SCHULL
Reenrue Point
2m contour
Pier
5m contour
Lobster Holding area
Coosheen Pt
50 fc/100ml
94000mE,30000mN
Bull Rock
Proposed Outfall
100 fc/100ml
Schull Point
Approx Low Water Line
10m contour
SCHULL OUTFALL STUDY MAY 2000
PREDICTED COLIFORM CONCENTRATION AT HIGH WATER (Spring Tide)
Effluent Flow Rate: 48 litres/second
Bacterial Conc. 1 x 10^5 fc/100ml
Scale 1:10000
Fig No. 3.6



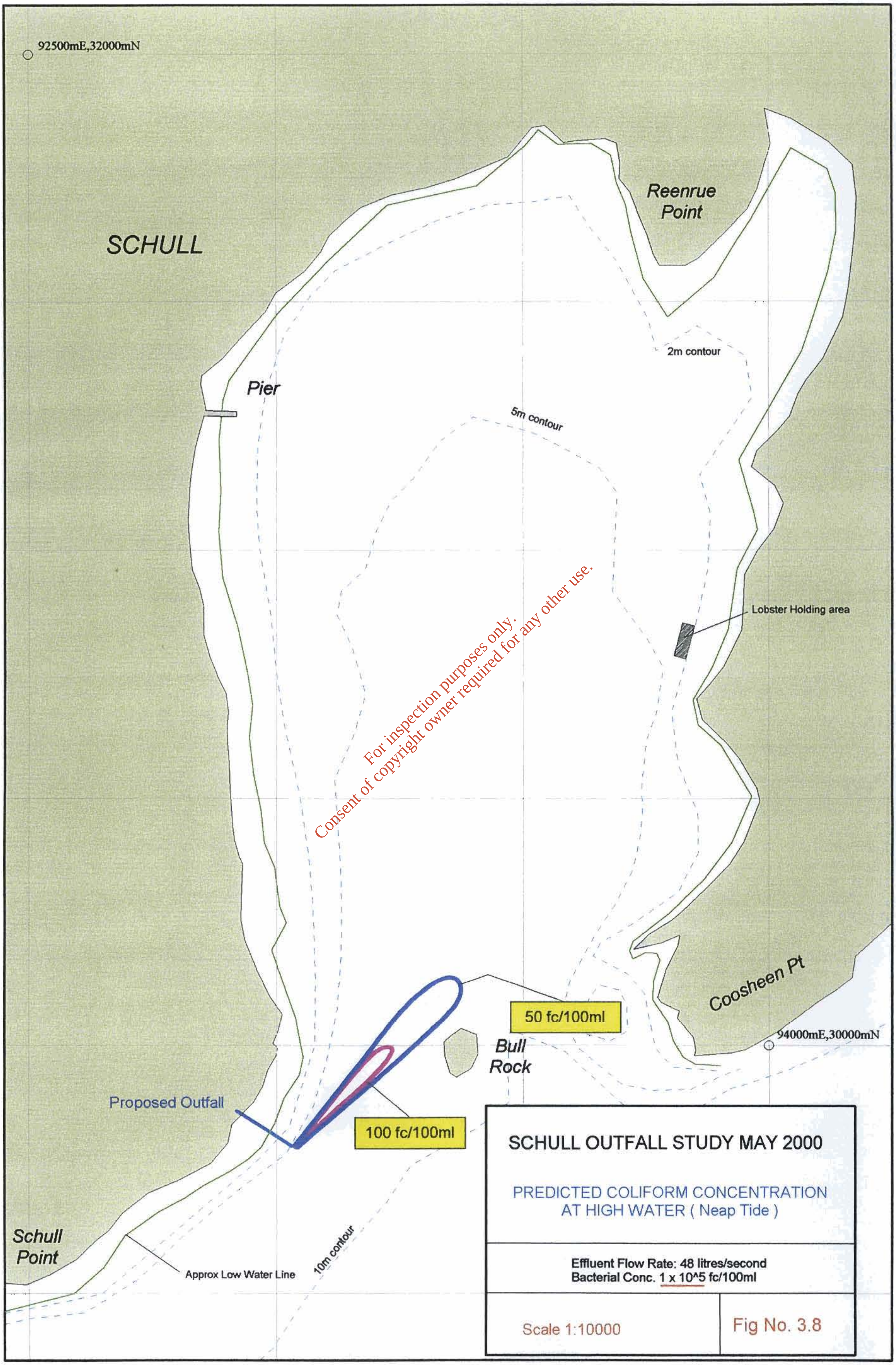
SCHULL OUTFALL STUDY MAY 2000

PREDICTED COLIFORM CONCENTRATION AT LOW WATER (Neap Tide)

Effluent Flow Rate: 48 litres/second
Bacterial Conc. 1 x 10^5 fc/100ml

Scale 1:25000

Fig No. 3.7



92500mE,32000mN
SCHULL
Reenrue Point
2m contour
Pier
5m contour
Lobster Holding area
Coosheen Pt
50 fc/100ml
94000mE,30000mN
Bull Rock
Proposed Outfall
100 fc/100ml
Schull Point
Approx Low Water Line
10m contour
SCHULL OUTFALL STUDY MAY 2000
PREDICTED COLIFORM CONCENTRATION AT HIGH WATER (Neap Tide)
Effluent Flow Rate: 48 litres/second
Bacterial Conc. 1 x 10^5 fc/100ml
Scale 1:10000
Fig No. 3.8

Document Reference 822/1/01

REPORT
ON
MARINE OUTFALL STUDIES
AT
SCHULL HARBOUR
COUNTY CORK

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Ballincollig.
Cork.

Ph. 021-4870200

December 2001

Document Ref 822/01

Report
on
Marine Outfall Studies
at
Schull Harbour
Co. Cork

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Ballincollig,
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Co. Cork.

December 2001

1. Introduction

M.C. O' Sullivan & Co. commissioned Irish Hydrodata Limited to investigate the bacterial impact on the marine environment of proposed treated wastewater discharges to Schull Harbour, Co. Cork.

At present an outfall discharges into the northern end of Schull Harbour close to the shoreline. The possibility of extending this outfall and providing additional treatment are being investigated. This study complements an earlier investigation which examined the impact of a proposed outfall at Schull Point.

A number of field measurements were made in the inner harbour to assist with the study. These included drogue and dye tracking and current metering.

This data was analysed and then incorporated into computer models to simulate the impacts of the proposed discharges for a range of conditions. The results indicate likely levels of bacterial contamination of the surrounding waters.

2. Field Measurements

Field measurements were made simultaneously at various times during August, October and November 2001. Calm or light wind conditions were the primary objective for field measurements to ensure worst case situations as regards mixing were achieved.

Current Meter Data

A recording current meter (Interocean S4) was deployed at the locations shown in Figure 2.1. This recorded current speed and direction data at 10 minute intervals over a period of several days.

Results are shown in Figures 2.2. Measured current speeds are very low. The directions show little or no tidal variation suggesting local gyre-type motions at the northern end of the harbour

Drogue Data

A drogue tracking exercise was conducted on three dates in November 2001. The drogues, cruciform shaped canvas sails set to track the water mass at 0.0-1.0m and 2.0-3.0m, were released in the vicinity of the proposed outfall. As they moved with the water mass they were followed by the survey boat and the position recorded at regular intervals. The drogue data in the form of trajectory plots are presented in Figures 2.3a to 2.5a. Tides corresponded to mean spring conditions and the winds were calm to light for the duration of the tracks.

On the 14th November drogues were released from three locations at low water. Winds were westerly, Force 1-2 (0-3m/s). The drogues travelled in an easterly direction (Figure 2.3a) with speeds of 0.03-0.06m/s. This pattern was maintained throughout the flood. At high water drogues were recovered and re-released. Winds had calmed at this time. The drogues travelled in a south-easterly direction with speeds up to 0.06m/s. They were recovered after a short track when darkness fell.

On the 15th November drogues were released from three locations soon after high water. Winds were calm throughout the day. The drogues initially travelled in a south-south westerly direction (Figure 2.4a) with speeds of 0.02-0.04m/s. Later the tracks became more circular with drogues moving in a westerly direction. At low water drogues were recovered and re-released. On the flooding tide the surface drogues moved in a north westerly direction towards the head of the harbour while the deeper drogues followed a more northerly path.

On the 16h November drogues were released from two locations soon after high water. Winds were north north-easterly, Force 1-2 (0-3m/s). The drogues travelled in a south-south easterly direction (Figure 2.5a) with speeds of 0.03-0.06m/s for the duration of the ebb.

Dye Track Data

Releases of Rhodamine WT tracer dye were made simultaneously with the drogue tracking surveys on two dates. Small quantities of dye were released on a number of occasions during each day. These were tracked visually and later as the concentrations reduced tracking continued with a continuous flow-through fluorometer fitted to the survey vessel.

Dye releases on 14th November showed patches following the trajectories adopted by the drogues indicating that the surface waters in the harbour were being driven primarily by the wind.

Dye releases on 15th November showed little or no movement of the dye patches for the ebb tide. On the flood the patch moved in a northerly direction with a speed of approx. 0.02m/s.

3. Modelling of Effluent Discharges

The onsite measurements described previously together with general oceanographic data were used to develop numerical models of the likely fate of effluent discharging from the outfall. Only bacterial contamination is considered as its impact is by far the most significant in view of concentrations in the treated effluent source.

Effluent Characteristics

Domestic effluent from the town will be subjected to comprehensive treatment before being discharged to the sea via the proposed outfall. Design flow rates and bacterial concentrations are as follows:

Flow Rate:	18 to 48 litres /second;
Faecal Coliforms at outfall:	1×10^5 to 1×10^6 fc /100ml;
Bacterial Decay Time:	12 hours.

Worst case conditions are likely to occur when flow rates are at their highest. Therefore a flow rate of 48 litres/second was employed in the simulations. The bacterial concentration will depend on the efficiency of the treatment process and may be lower than the range indicated. With disinfection it is possible to reduce levels below 1×10^4 fc /100ml. For comparative purposes model results are presented with all three values.

Effluent Simulations

The location of the outfall is yet to be determined. For this study two representative discharge locations were examined. These are shown in Figure 3.1. The location to the north-west is referred to as the *Nearshore Outfall* and the location further east, the *Mid-Bay Outfall.*

Simulations of the plume were made with a gaussian patch model (ref.2). This model assumes that the expanding contaminant plume may be described by a three dimensional Gaussian concentration distribution in which the effects of horizontal boundaries (the sea surface, sea bottom) are accounted for by using the method of images. The model facilitates incorporation of field data into the simulation and therefore produces excursion and dispersion results which closely resemble recorded values.

Measured current speed, drogue and dye data were used as the primary input. Directions were modified to account for observed trajectories over the survey area.

Model simulations were made of discharges for spring and neap tide conditions. An output grid of 50m x 50m centred on the discharge point was used (the computational grid coveres the full extent of tidal excursion). A bacterial decay time of 12 hours was employed and output generated for every hour of the tidal cycle.

For spring tides the excursion is as recorded during the field work while for the neap simulations the excursion is reduced by approx 30 % in line with the change in tidal ranges. It is assumed that the plume trajectories remain the same for spring and neap tides.

Model Results

The results for calm weather High and Low Water times, corresponding to maximum flood and ebb excursions are presented in graphical format in Appendices A-D.

The results show that a high outfall source level (1 x 10^6 fc /100ml) leads to bacterial contamination over a wide area while if outfall source levels are reduced to 1 x 10^4 fc /100ml then the contamination zone is minimal.

Light wind conditions result in the movement of surface waters in the direction of the wind vector as observed on 14/11/2001. Simulated effluent dispersion under these conditions are presented in Appendix E. A concentrated plume extends to the eastern shoreline. Predictions for an easterly wind are presented in Appendix F. This is based on a surface current speed of 1% of wind speed (F3). A concentrated plume is predicted to extend to the pier area.

4. Discussion

This document presents the findings of marine outfall studies in Schull Harbour.

Field measurements at the location, including drogue, dye and current meter data, has shown weak and poorly defined current flow patterns at the site. Surface water movements are strongly influenced by the prevailing winds, even when speeds are relatively low. During calm conditions data suggests short tidal excursions and circular type motions in the north-western part of the harbour.

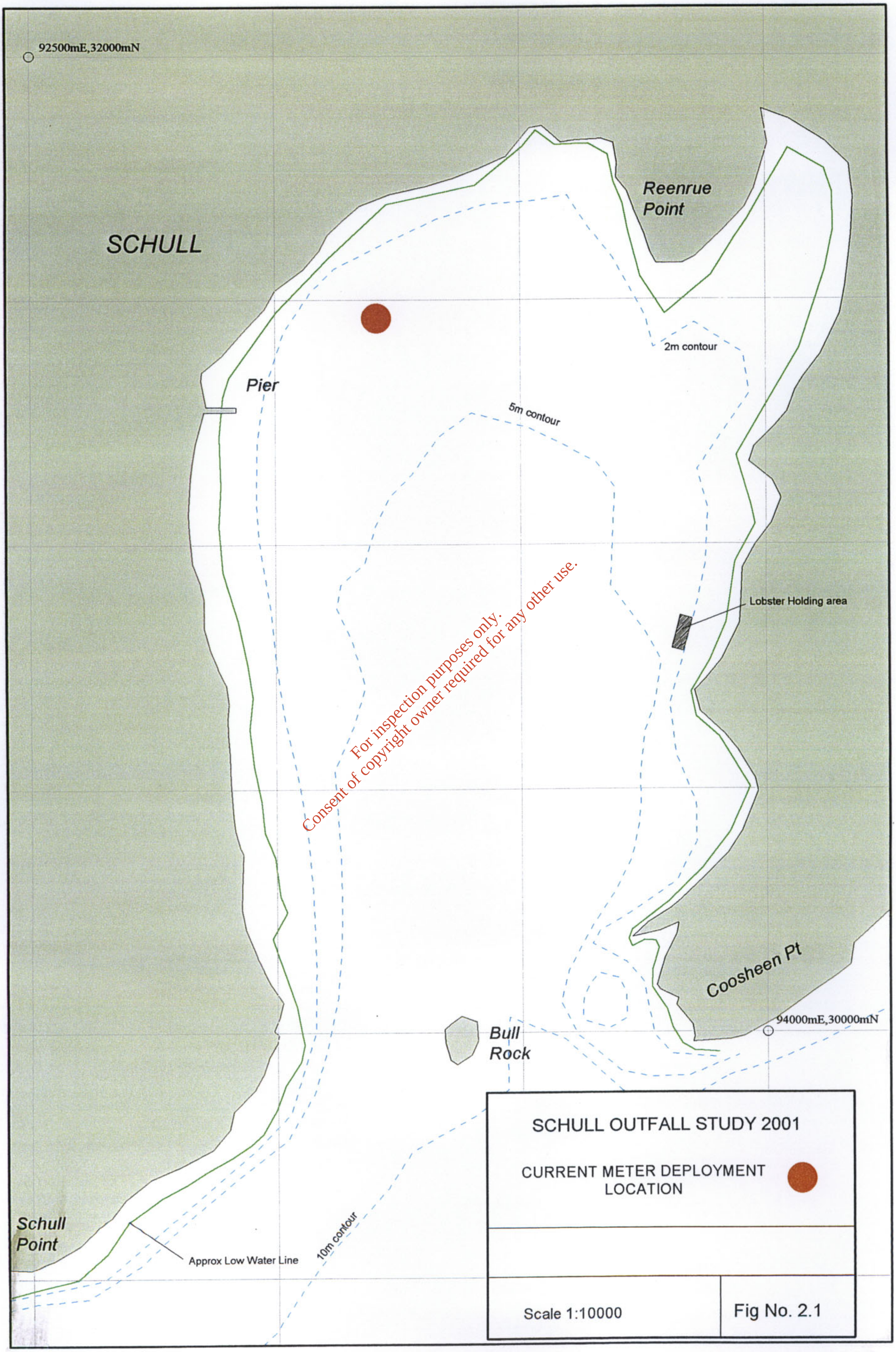
Model simulations were used to predicted bacterial levels during calm weather conditions. At high outfall source levels (1×10^6 fc/100ml) bacterial concentrations over a greater part of the inner bay will exceed 100fc/100ml. Reducing the source level to 1×10^4 fc/100ml will produce a significant improvement.

During windy conditions the effluent plume will travel with the wind vector. All areas within the bay will therefore occasionally experience elevated bacterial concentrations. For high source levels (1×10^6 fc/100ml) all points within a radius of 1100m of the discharge location can expect bacterial levels to exceed 100fc/100ml. For a source level of 1×10^5 fc/100ml this radius reduces to 300m approx. and to less than 50m for a source level of 1×10^4 fc/100ml.

References:

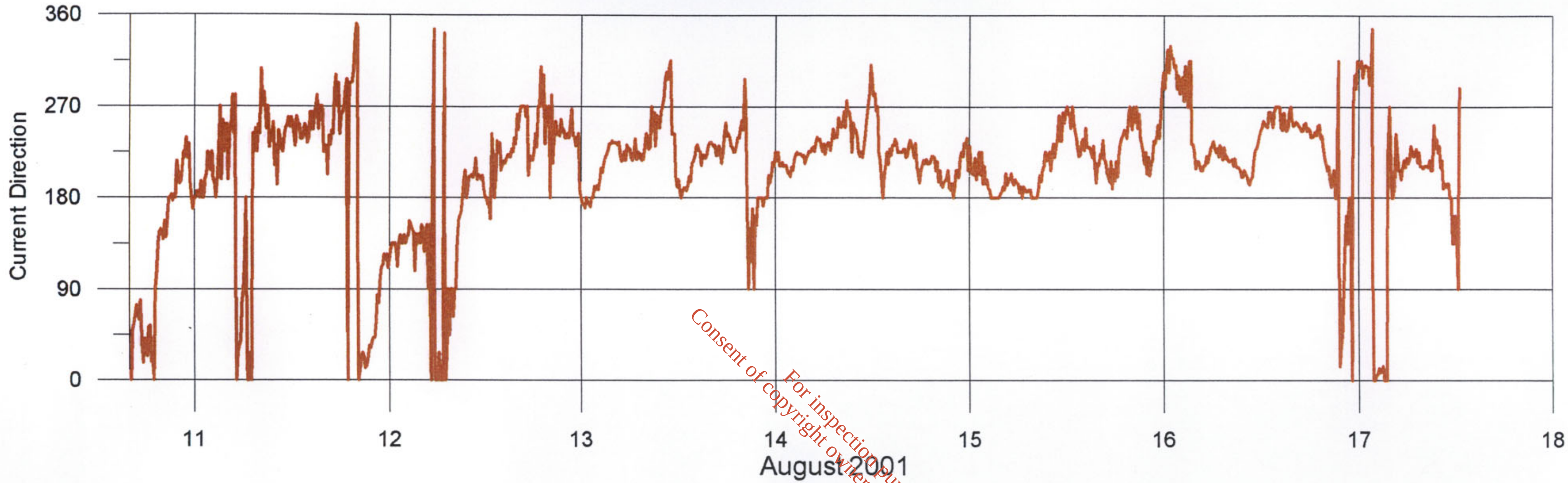
1 Admiralty Hydrographic Department (1987)
Admiralty Chart (No. 2129) Long Island Bay to Castlehaven

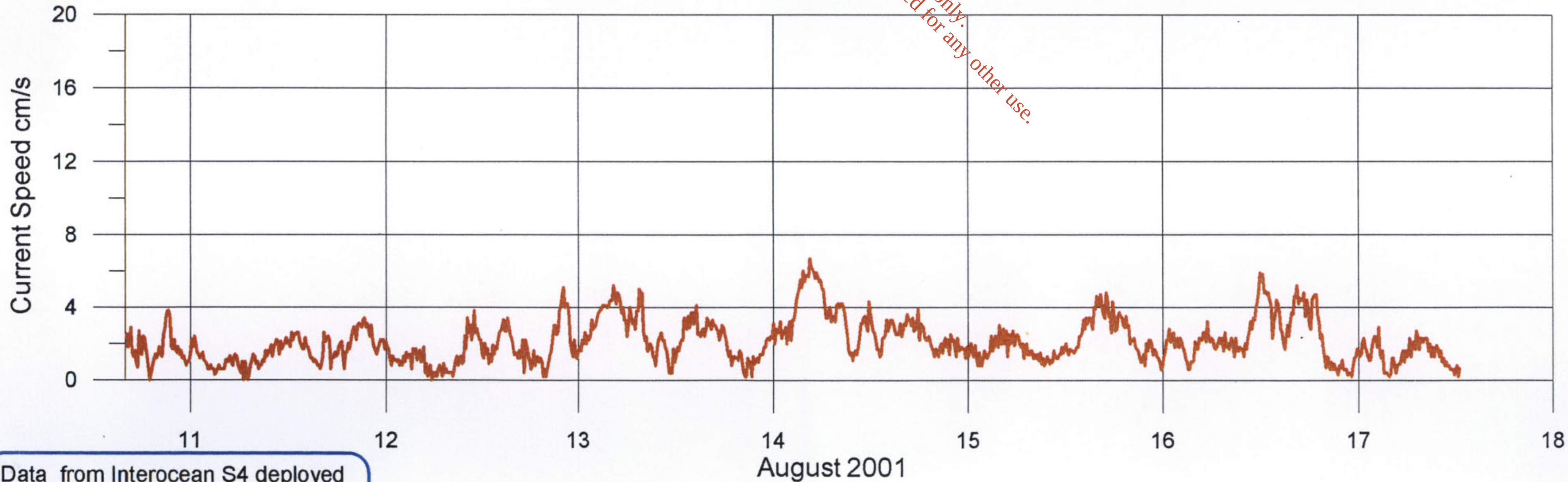
2 Hunter, J.R., (1985)
A suite of programs for the simulation of marine outfalls, Centre for Marine Science & Technology, Curtin University, Australia.


92500mE,32000mN
SCHULL
Reenrue Point
Pier
2m contour
5m contour
Lobster Holding area
Coosheen Pt
94000mE,30000mN
Bull Rock
Schull Point
Approx Low Water Line
10m contour
SCHULL OUTFALL STUDY 2001
CURRENT METER DEPLOYMENT LOCATION
Scale 1:10000
Fig No. 2.1

SCHULL OUTFALL STUDY 2001

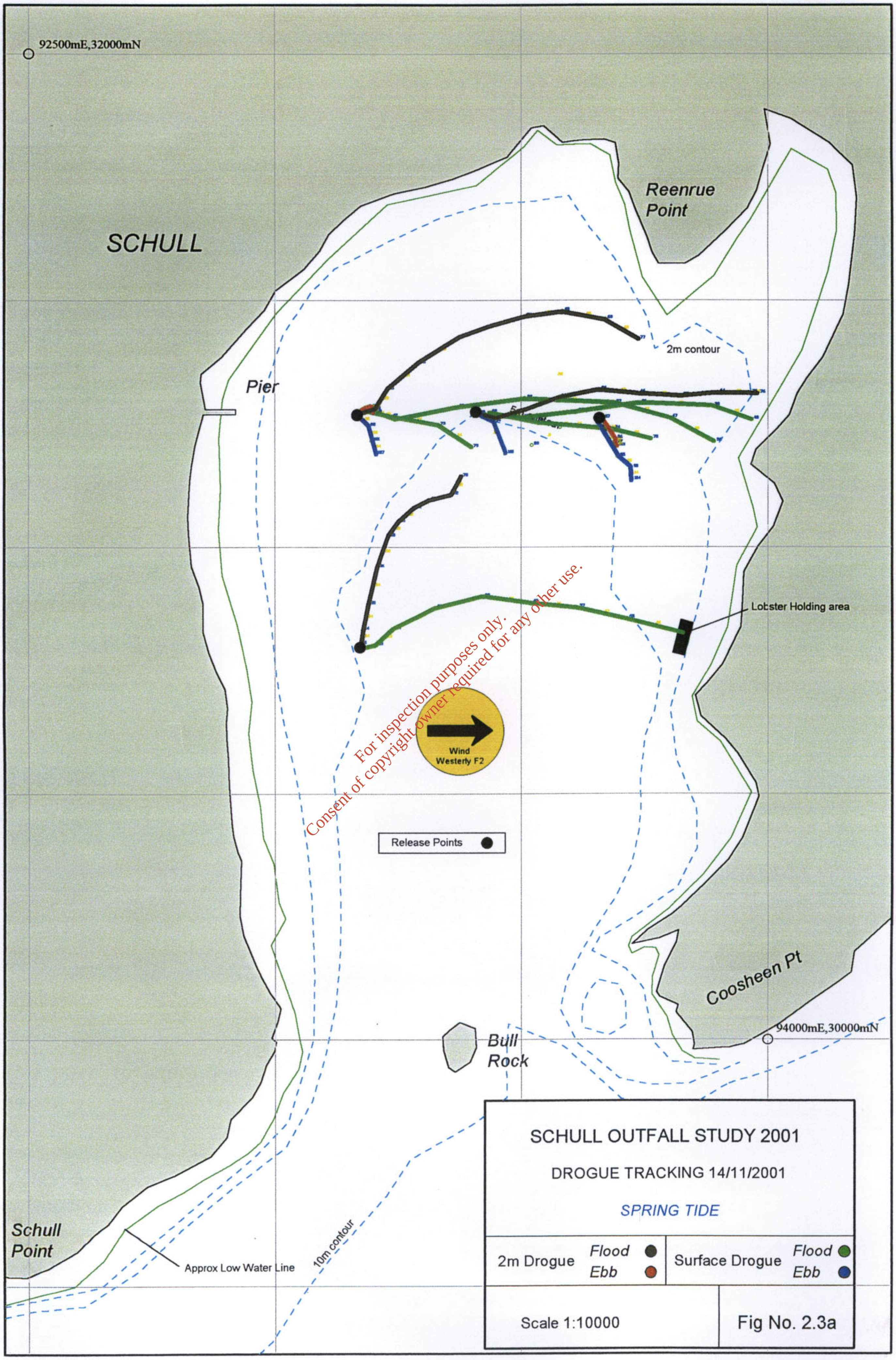
Current Measurements - Location 1





Data from Interocean S4 deployed
at 2m asb in 4m water at Low Tide

Figure 2.2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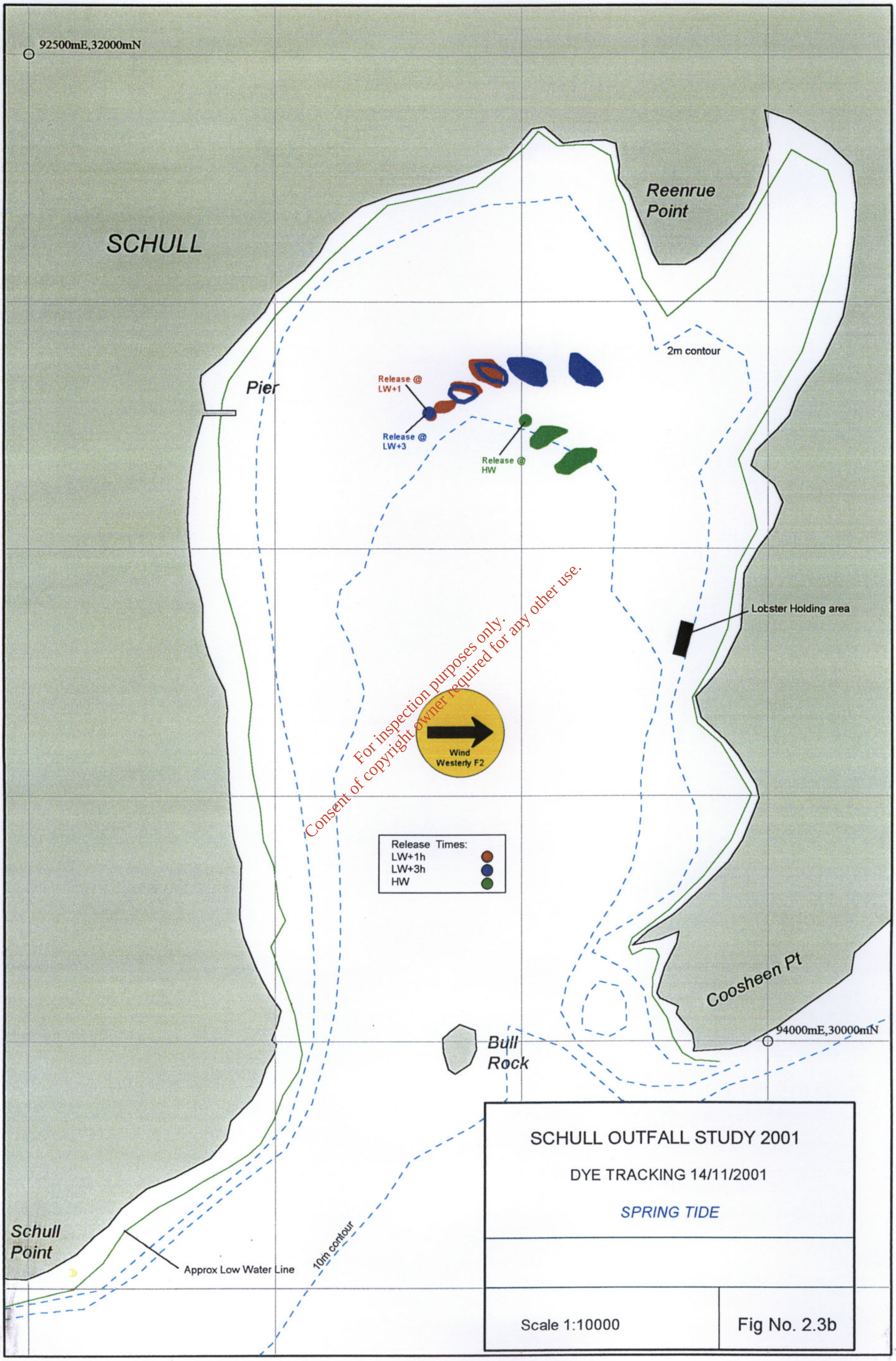
SCHULL
Reenrue
Point
2m contour
Pier
Lobster Holding area
Wind
Westerly F2
Release Points
Bull
Rock
Coosheen Pt
94000mE,30000mN
Schull
Point
Approx Low Water Line
10m contour
SCHULL OUTFALL STUDY 2001
DROGUE TRACKING 14/11/2001
SPRING TIDE
2m Drogue
Flood
Ebb
Surface Drogue
Flood
Ebb
Scale 1:10000
Fig No. 2.3a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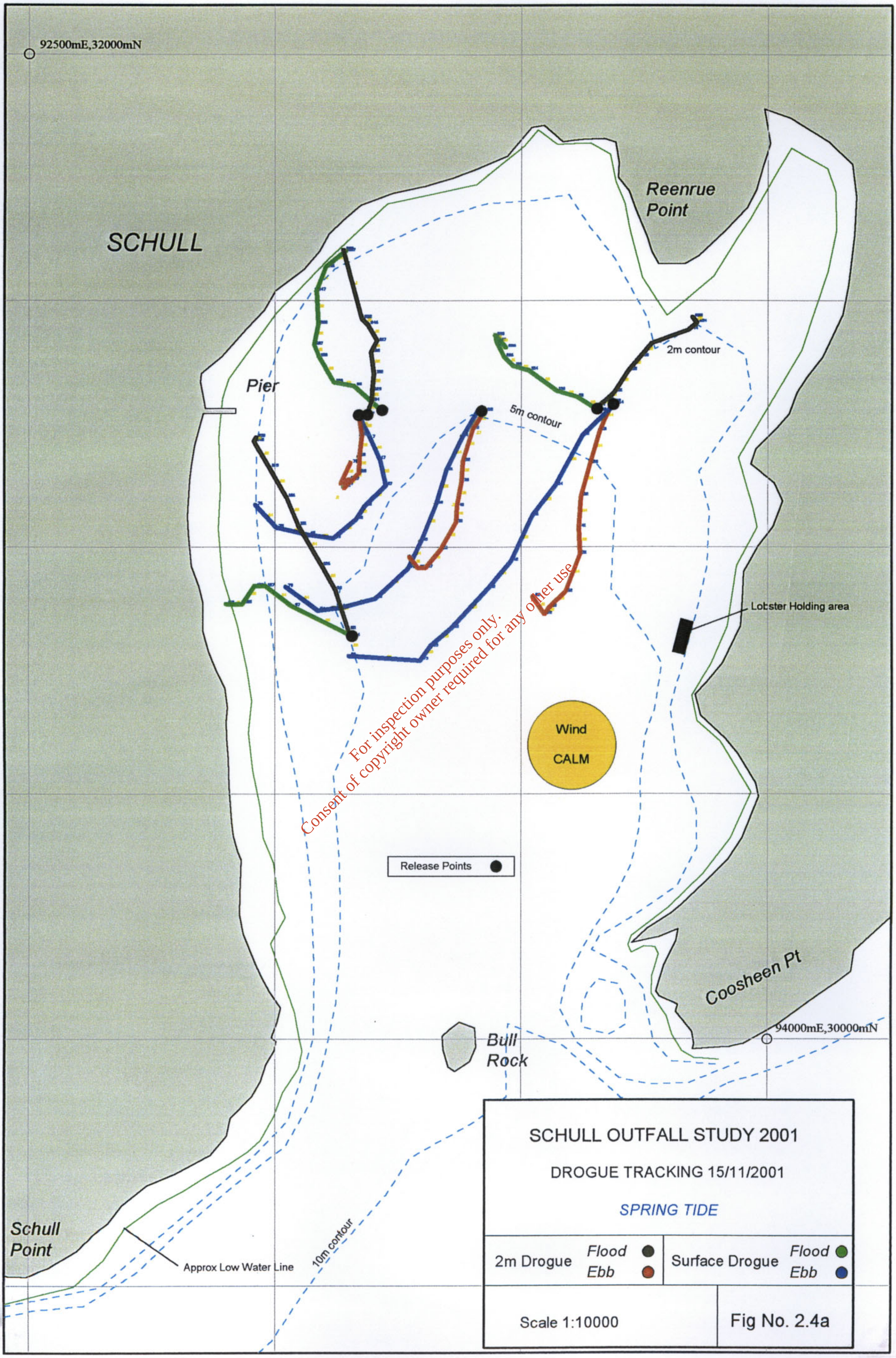
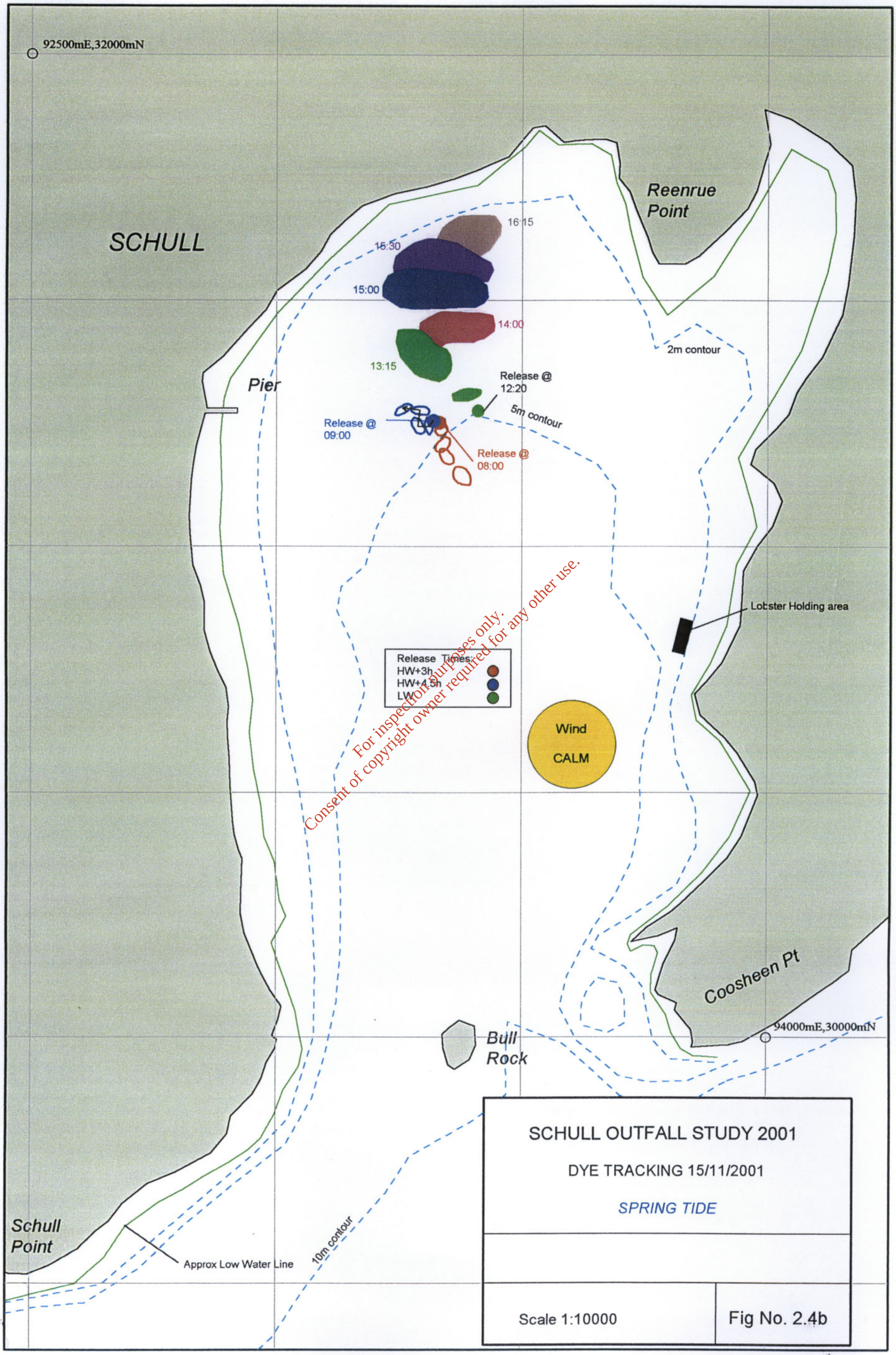
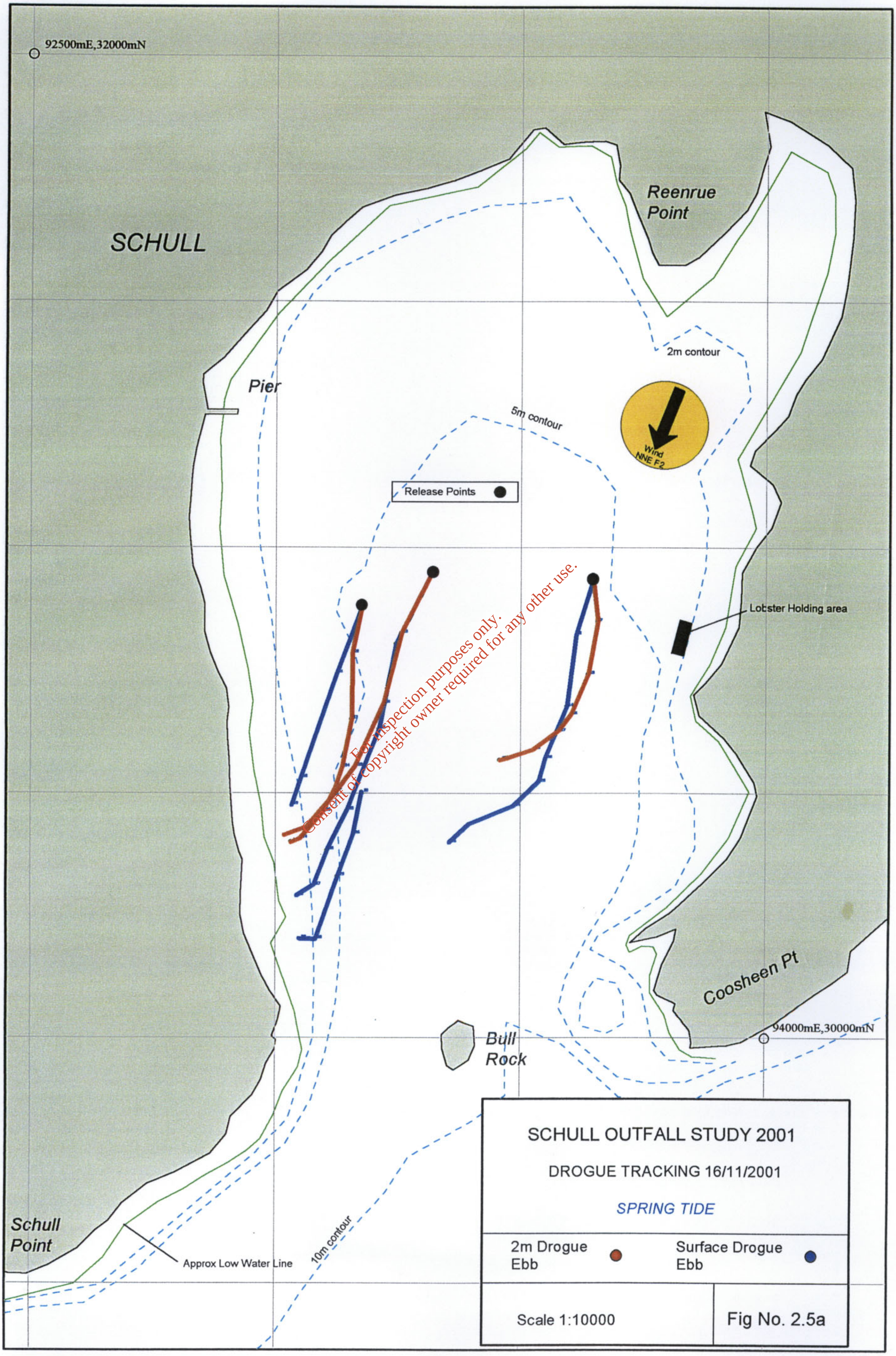
SCHULL
Reenrue Point
2m contour
Pier
Release @ LW+1
Release @ LW+3
Release @ HW
Lobster Holding area
Wind Westerly F2
Release Times:
LW+1h
LW+3h
HW
Coosheen Pt
94000mE,30000mN
Bull Rock
Schull Point
Approx Low Water Line
10m contour
SCHULL OUTFALL STUDY 2001
DYE TRACKING 14/11/2001
SPRING TIDE
Scale 1:10000
Fig No. 2.3b



92500mE,32000mN
SCHULL
Reenrue Point
Pier
2m contour
5m contour
Lobster Holding area
Wind
CALM
Release Points
Coosheen Pt
94000mE,30000mN
Bull Rock
Schull Point
Approx Low Water Line
10m contour
SCHULL OUTFALL STUDY 2001
DROGUE TRACKING 15/11/2001
SPRING TIDE
2m Drogue Flood Ebb
Surface Drogue Flood Ebb
Scale 1:10000
Fig No. 2.4a



92500mE,32000mN
SCHULL
Reenrue Point
16:15
16:30
15:00
14:00
13:15
2m contour
Pier
Release @ 12:20
5m contour
Release @ 09:00
Release @ 08:00
Lobster Holding area
Release Times:
HW+3h
HW+4.5h
LW
Wind
CALM
Coosheen Pt
94000mE,30000mN
Bull Rock
Schull Point
Approx Low Water Line
10m contour
SCHULL OUTFALL STUDY 2001
DYE TRACKING 15/11/2001
SPRING TIDE
Scale 1:10000
Fig No. 2.4b



SCHULL OUTFALL STUDY 2001

DROGUE TRACKING 16/11/2001

SPRING TIDE

2m Drogue Ebb	Surface Drogue Ebb

Scale 1:10000	Fig No. 2.5a

SCHULL OUTFALL STUDY 2001

Outfall Locations

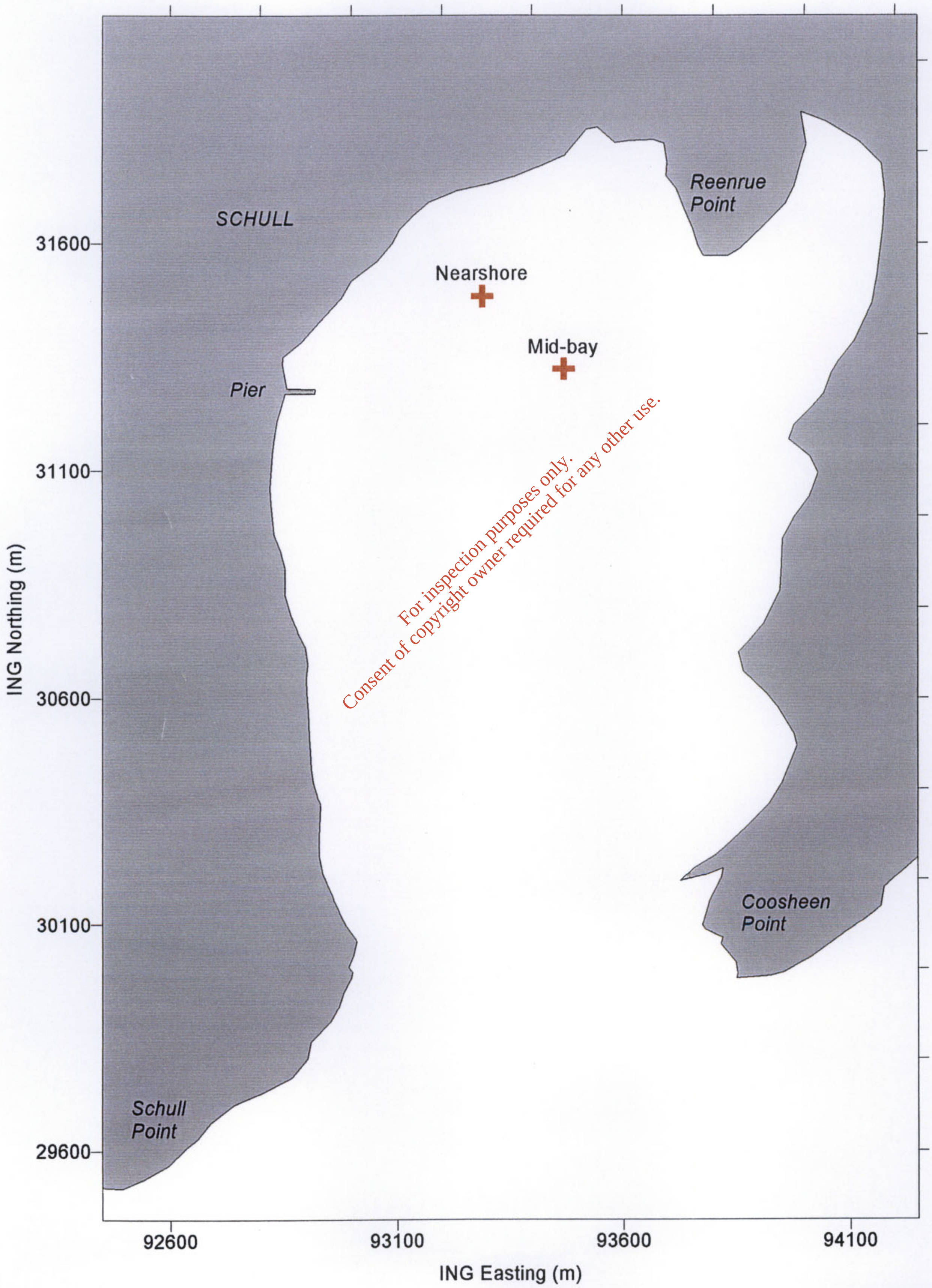


Figure 3.1