10337 5310 2011

FINAL

CENTRE FOR ENVIRONMENT, FISHERIES AND AQUACULTURE SCIENCE,
FISHERIES LABORATORY, LOWESTOFT, SUFFOLK, ENGLAND

2000 RESEARCH VESSEL PROGRAMME

REPORT: RV *CIROLANA*: CRUISE 4a

STAFF:

Part 1 : H L Rees (SIC)
W Meadows
S Boyd
D Limpenny
M Schratzberger
C Brown
K Cooper
T Locke
C Wall
R Kilbride
K Langford

Part 2 : D Limpenny (SIC)
S Boyd
C Brown
T Locke
R Kilbride
K Cooper
C Wall
J Balaam
P Roberts

DURATION:

Part 1 : 22 May – 1 June
Part 2 : 1 June – 10 June

LOCALITY:

Celtic Sea/English Channel/North Sea

AIMS:

1. To survey dredged material disposal sites at the Tyne (Souter Point), Tees, South Falls, Inner Gabbard (outer Thames estuary), Nab Tower (Isle of Wight), and Swansea Bay for trace metal contaminants, TBT, PAHs and other organic contaminants and benthos (including meiofauna at the Tyne), using grab and acoustic methods.

2. To conduct a special intensive survey at the Roughs Tower disposal site following cessation of capital disposal, using AGDS, bathymetry, grab and underwater camera.

3. To sample a transect of stations from the mouths of the Tyne and Tees estuaries to nearby dredged material disposal sites, and from the Solent to the Nab Tower disposal site, for later analysis of TBT in sediments.

4. To sample representative offshore NMMP locations using grab, core and trawl for trace metal contaminants, PAHs and other organic contaminants (including nonylphenols, flame retardants and HCs) and the benthic fauna.

5. To sample surface waters at representative offshore and intermediate NMMP locations for nutrients and chlorophyll and for phytoplankton species.

6. To investigate areas of fine sediment in the E English Channel for possible location of an additional NMMP station.

7. To conduct surveys at aggregate extraction sites off the Isle of Wight and Lowestoft using grab, trawl and acoustic techniques.

8. To conduct pilot sampling at gravelly locations following cessation of aggregate dredging.

9. To conduct follow-up sea-bed sampling in connection with the mapping of gravelly habitats in the English Channel.

10. To conduct a survey of the benthos and sediments at the Thames sewage-sludge disposal site.

11. To sample horse-mussels from the Humber/Wash area for later analyses of contaminants in flesh.

12. To conduct further sampling at an experimentally dredged area off the Norfolk coast, using grab and side-scan sonar in order to establish the time required for recovery of the sea bed fauna.

13. To sample the sediments and benthos off the Tyne for time-series studies using grab, core and beam trawl, including extra sampling at the sewage-sludge disposal site and continuation of sampling within a temporal box.

14. To carry out sampling at a selection of stations previously worked as part of the ICES 1986 North Sea Benthos Survey.

NARRATIVE:

Figure 1 shows sites visited during the cruise.

RV *Cirolana* sailed from Lowestoft at 11.30, 22 May for sampling at NMMP 345 (Aims 4 and 5), working offshore ICES North Sea Benthos Survey (NSBS) stations (Aim 14) on the way. On completion, further offshore NSBS stations were sampled *en route* to the Tyne where, on 24 May, Day grab samples were collected to augment a time-series of contaminants data (Aim 13), and an acoustic survey of the Souter Point dredged material site was started (Aim 1). Stations were then worked in the vicinity of this disposal site for the macro- and meio-benthos, and for trace contaminants including TBT and PAHs (Aims 1 and 3), before sailing to NMMP 245 (Aims 4 and 5) *via* an annually sampled biological station south of the now-disused sewage-sludge disposal site (Aim 13).

On 25 May, the acoustic survey at the Souter Point disposal site was completed (Aim 1), along with sampling of time-series stations at and to the north of the sewage-sludge disposal site (Aim 13). *Cirolana* then sailed for the Tees, completing a grid of Day and Shipek grab stations for later contaminants analyses (Aim 3), before heading SE for further sampling of NSBS stations (Aim 14). On 26 May, a side-scan sonar and Hamon grab survey was carried out at an aggregate dredging area (408) east of the Humber (Aim 8). Subsequent sampling at NSBS stations was prevented by strengthening SW winds, and *Cirolana* made slow progress towards the Norfolk coast, anchoring to await moderation. While at anchor, a trial of a new digital camera was successfully carried out using the 'drop' camera frame.

On the evening of 27 May, a rock dredge was successfully deployed off Cromer for horse-mussels (Aim 11), followed by Day grabs at a NSBS station (Aim 14) *en route* to the Inner Dowsing area where, on 28 May, Day grab samples for later contaminants analyses were collected at NMMP 376 (Aims 4 and 5), and for the benthos at a NSBS station (Aim 14), followed by rock-dredge sampling for horse-mussels off the Humber mouth (Aim 11). A further NSBS station was sampled before strengthening northerly winds prevented further work. *Cirolana* then sailed with the wind to a NSBS station off Lowestoft, which was successfully sampled on the evening of 28 May, as the wind and swell eased. A further NSBS station was sampled *en route* to NMMP 475 (Aims 4 and 5) which was completed on the morning of 29 May.

A transect of Hamon grab stations was then worked through the Roughs Tower disposal site (Aim 2), followed by a further transect through the now disused Barrow Deep sewage-sludge disposal site (Aim 10). Sampling was then carried out at NMMP 466 and at two further NSBS stations (Aims 4, 5 and 14), before completing a side-scan sonar survey at the Roughs Tower disposal site and associated 'ground-truth' sampling on 30 May (Aim 2). The underwater camera frame was also deployed at and to the east of the site. On completion of this work, *Cirolana* sailed to the South Falls for a 'baseline' survey of the benthos and sediments in the vicinity of an offshore dredged material disposal site which, in the near future, may be the recipient of a large amount of material arising from port developments in the Thames area (Aim 1). A series of Shipek grab samples for later contaminants analyses were then collected at the Inner Gabbard Dredged material disposal site (Aim 1) on the morning of 31 May, prior to sailing to Lowestoft, where H Rees, M Schratzberger and K Langford left the ship (along with the Senior Fishing Mate), and J Balaam and P Roberts joined.

On completion of the crew changeover, Cirolana commenced sampling at a grid of Hamon grab stations in the Cross Sand area, and at reference sites to the east, north and south (Aim 7). Sampling at the grid continued overnight until 08:00 hrs on 1.6.00. Two tows using the 2m Beam trawl were then completed successfully at the Cross Sand aggregate extraction site. Two deployments of the 3m Beam trawl at the extraction site resulted in the loss of one trawl and significant damage to the other. A number of fish were collected for stomach content analysis. Hamon grabbing at the Cross Sand grid was recommenced and continued throughout the day until bad weather forced a halt to the operation late in the evening. The Cross Sand grid was resumed the following morning and was completed by 12:00hrs.

Cirolana then sailed to aggregate extraction area 305/3 off Southwold, where a survey using the Hamon grab, sidescan sonar and RoxAnn was completed by early evening (Aim 8). Cirolana continued south to aggregate extraction area 222 to begin a Hamon grab survey at 20:00hrs, which was completed by 22:00hrs (Aim 8) A sidescan/RoxAnn survey of the site was commenced at first light. On completion of the acoustic survey the drop camera frame was deployed at three positions within and close to the extraction area. Further Hamon grabbing at the site completed the survey, and Cirolana steamed for an NSB site off Deal where Hamon and Shipek grabs were collected for benthos and contaminant analysis (Aim 14). That evening the Reineck corer was deployed successfully at site to the east of Dungeness that had previously been identified as a potential new NMMP site (Aim 6). During the evening, the Imagenex sub-bottom profiler was run at a shallow muddy site to the east of Dungeness (Additional Aim).

The following morning 8 camera dips using video and the digital stills system were carried out between Dungeness and Hastings (Aim 9). This piece of work provided valuable ground truth data for a sidescan survey carried out in the area towards the end of 1999. The Imagenex sub-bottom profiler was also run during each of the camera deployments to provide the system with a range of substrate types and water depths. Another camera dip was carried out at a position within an aggregate extraction site at the Owers Bank, where previous grab sampling during an earlier cruise had identified the presence of exposed clay, possibly as a result of dredging activity (Additional Aim).

Cirolana continued west to commence a widespread Hamon grabbing survey at and around the concentration of aggregate extraction sites to the east of the Isle of Wight (Aim 7). The survey was completed by 20:00hrs on 5.6.00. The following morning a transect of six sites between the inner Solent and the Nab Tower disposal site were sampled for TBT/PAH and metals analysis using the Shipek grab (Aim 3). During the afternoon, sidescan lines across two areas of intensive dredging situated to the east of the Isle of Wight were carried out, followed by video and stills camera dips at selected sites along the sidescan lines. Five stations at the Nab Tower dredged material disposal site were sampled for benthos and comtaminants(TBT/PAH/metals) using the Hamon grab and Shipek grab respectively (Aim 1).

Cirolana steamed westwards through the English Channel arriving in Lyme Bay at 06:00hrs on 7.6.00 where NMMP site 536 was successfully sampled for in- and epifauna and contaminants using the Day grab, multicorer and 2m Beam trawl (Aim 4). Cirolana then steamed to the Celtic Deep to NMMP 605 where a heavy southerly swell

prevented successful sampling(Aim 4). The ship then headed inshore to Swansea Bay where six sites at the dredged material were samples were collected for TBT, PAH and metals analysis (Aim1). A bulk sediment sample was also collected from the disposal site to provide suitable material for an investigation into the effects on chemical contaminants of long term frozen storage of sediments (Additional Aim). Surface water samples were collected for nutrient, chlorophyll and plankton analysis at each NMMP site visited (Aim 5). The continuous logginng CTD annd Chelsea cell fluorimeter were recording data throughout the cruise, with calibration samples being collected daily.

Cirolana docked in Swansea at 11:00 on 9.6.00.

RESULTS:

Part 1

Aims 2, 10 and 13 were successfully completed, along with the North Sea component of Aims 1, 3, 4 and 5. Additionally, 24 (of a planned 28) ICES North Sea Benthos Survey stations were also successfully sampled under Aim 14, and initial progress was made under Aim 8. It is anticipated that Aims 11 and 12, which were, respectively, curtailed and abandoned due to weather constraints, will be addressed during *Cirolana* 4b/2000, along with additional sampling at NSBS stations.

A bathymetric survey of the Souter Point (inner) dredged material disposal site (Aim 1) identified a mound of material some 5-6 metres above the natural sea bed (Figure 2) near to the inshore boundary, which can be attributed largely to the now-discontinued practice of colliery waste and fly ash disposal. Benthic sampling in the early 1990s revealed the surface presence of such material, whereas sampling during the present cruise revealed that fine sediments prevailed superficially, and hence were comparable with those outside the disposal site, although with intrusions of coarse material which can probably be ascribed to the ongoing disposal of maintenance dredging. The effect of such activity on the benthic fauna must await laboratory processing of samples.

Examination of the contents of a 2 m beam trawl deployed within the now-disused sewage-sludge disposal site off the Tyne (Aim 13) confirmed that sewage-derived artefacts have now largely dispersed from the area, although tomato pips (a useful longer-term physical indicator of sewage-derived discharges) were still much in evidence in grab samples from the same location.

Side-scan sonar images of the sea bed at an aggregate dredging area off the Humber (Aim 8) showed that, within the surveyed zone, dredge tracks were still evident some 2 years after cessation of the activity. The benthic fauna and sediments corresponding with different degrees of dredging intensity were successfully collected, and the sampling effort will contribute to the eventual selection of a suite of locations suitable for evaluating the rehabilitation of dredged areas at different times after effective cessation.

Observations on the content of Hamon grab samples collected across the Roughs Tower disposal site (Aim 2), where the disposal of several million tonnes of dredged material was completed in April 2000, showed the presence of a mixture of both

consolidated and unconsolidated clay and gravel, consistent with the approach of 'sprinkling' of the latter (rather than an earlier intention to provide a uniform 'capping' layer). Conditions were too turbid to provide underwater camera images at the site itself, but a nearby location to the east revealed a gravelly substratum typical of parts of the outer Thames estuary, thus providing no visible evidence of an overburden of material arising from dispersion in this direction.

The Roughs Tower disposal site was surveyed using a digital chirps sidescan sonar system, a bathymetric sounder and two Acoustic Ground Type Discrimination (AGDS) systems QTC and RoxAnn. The bathymetric and AGDS data will be post processed at the Lowestoft laboratory. The acoustic image of the disposed material became apparent early in the survey and was clearly discernible from the naturally occurring substrates surrounding the site. Initial processing of the sidescan data allowed the spatial extent of the capital material within the site to be mapped (Fig 3). It appears that the disposal operation has placed all of the material within the boundaries of the site. The clay walls designed to retain the bulk of the material appear to be intact. Subsequent post-processing of the data produced from the range of acoustic techniques applied at the site will further aid interpretation of the current condition of the substrates at the site.

Part 2.

Aims 1 and 2 were completed during the second half of the cruise with the collection of samples from Nab Tower the Solent and Swansea Bay. Aims 4 and 5 were further addressed following sampling at NMMP 536. NMMP 605 in the Celtic Deep could not be sampled due to bad weather conditions. It is hoped that this Aim can be completed during Cir 4B/00. A Reineck core collected from a site to the east of Dungeness (Aim 6) revealed an oxic layer of soft mud overlying firmer, comparatively anoxic mud with layers of dead bivalve shells. It is possible that this could prove to be a useful site for future monitoring purposes. Aim 7 was completed with an extensive survey of the aggregate extraction activity immediately to the east of the Isle of Wight. Two further sites, one off Southwold and another off Harwich, were surveyed as part of Aim 8. Aim 9 was completed with the collection of ground truth video and stills images between Dungeness and Hastings. One North Sea Benthos Site was sampled off Deal complementing work carried out during Part 1.

The Imagenex sub-bottom profiler was trialled as an additional Aim at a number of locations over a variety of substrate types and water depths. The system did not appear to clearly define sub-bottom structure at any of the sites visited although it is possible that it was able to identify a bed of *Crepidula* shell over a sandy substrate off the Isle of Wight. A typical image is shown in Fig 4.

Two further sites were surveyed as part of Aim 8. Area 305 off Southwold and Area 222 off Harwich, are sites which have been recently relinquished by the aggregate dredging industry, and were sampled using the mini Hamon grab video and stills camera (Area 222 only), and sidescan sonar. Replicate Hamon grabs were collected from two sites within each extraction area that had received respectively high and moderate levels of dredging intensity in the past. The sidescan surveys provided sufficient information to allow reference sites to be chosen outside of the influence of

dredging, over substrates deemed representative of pre-dredging conditions. Sidescan sonar imagery provided probable evidence of historical dredging activity at both of the sites surveyed, and also provided confirmation of the appropriate positioning of grab samples in relation to the area of impact. Underwater TV images at Area 222 revealed a distinct difference in the nature of the substrates in the area of most intensive dredging. This may be due to dredging effects, or could be natural differences associated with a bathymetric feature within the site. All information generated from this Aim will be further studied and used to select suitable sites for continued research.

A grid of 85 stations in the vicinity of the Cross Sands aggregate extraction block of licences was successfully sampled using a 0.1 m^2 Hamon grab for macrofauna and sediments. This survey is intended to contribute to a time-series of information for assessing the persistence of any effects associated with changes in dredging intensity against a background of natural environmental variation in macrofauna.

Surveys were also undertaken to examine the nature of biological effects arising from commercial aggregate extraction at sites east of the Isle Of Wight, with a view to assessing the potential for cumulative environmental impacts. Samples of sediments and the associated macrofauna were collected from locations which had been intensively dredged and along transects extending to a distance of 5km. These samples will be analysed in the laboratory to assess the spatial extent of the effects of aggregate extraction. Side-scan sonar images also indicated the presence of localised pits which are likely to be a result of anchor dredging in the area.

Trials using an underwater digital stills camera were carried out extremely successfully at a number of sites throughout the cruise. The system allows for up to 200 timed or user controlled digital images to be collected in a single deployment. The quality of the still image was excellent, and images that appeared to be fairly poor when viewed online could be significantly enhanced using the system software. An additional advantage of this system is that still images may be viewed immediately after collection.

H Rees

D Limpenny

SEEN IN DRAFT: R McCurry (Master)

A Lincoln (Senior Fishing Mate)

DISTRIBUTION:

Basic list +
M Waldock
R Law
C Allchin
W Meadows
D Limpenny

S Morris
S Boyd
C Brown
T Locke
M Schratzberger
R Kilbride
K Cooper
C Wall
J Balaam
L A Murray
C Vivian
R Waldock
S Malcolm
S M Rowlatt
A Franklin
J Thain
P Leonard (CSG)
G Boyes (RMED)
A J Murray (Crown Estates Commission)

Figure 1

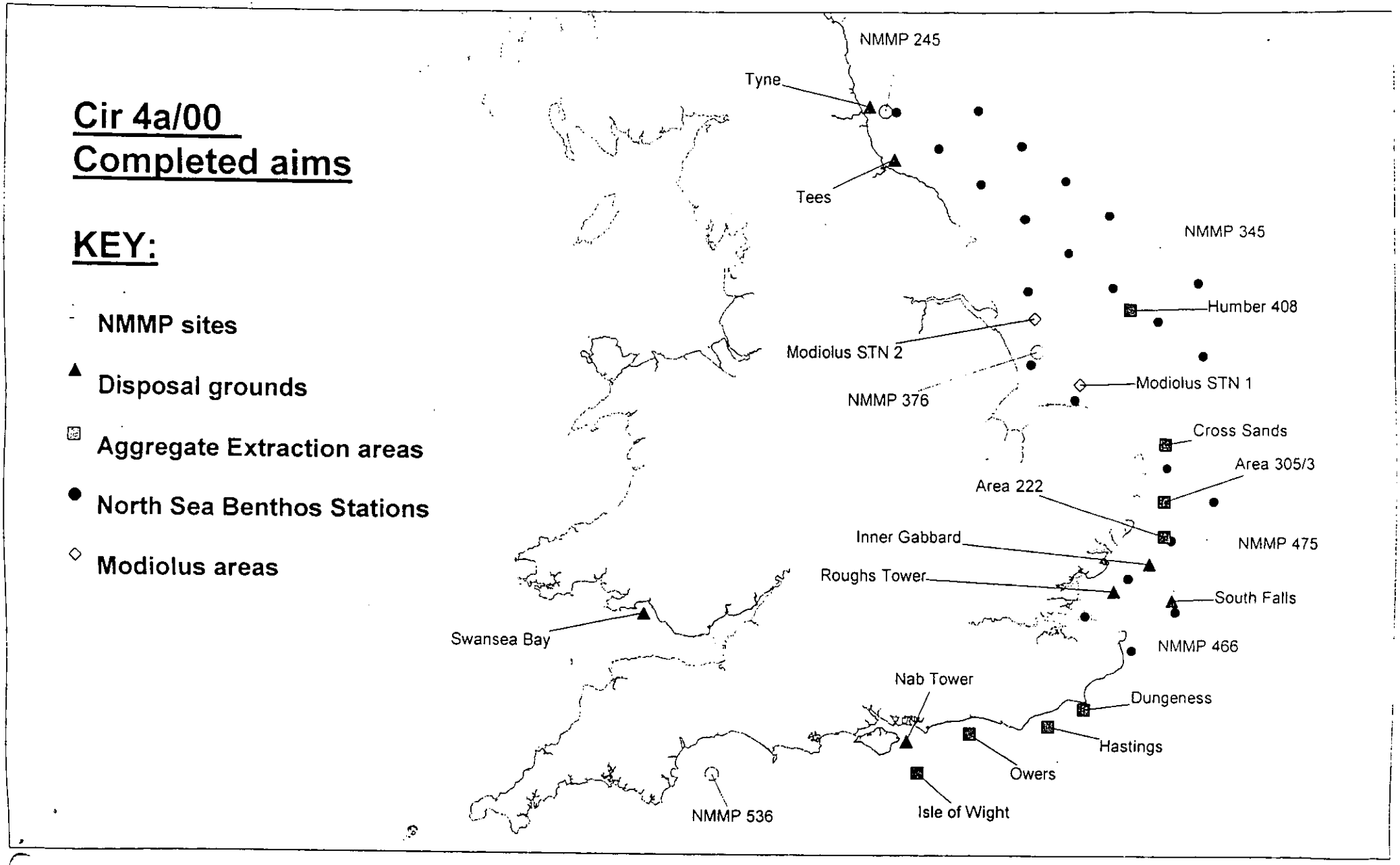
Cir 4a/00
Completed aims
KEY:
NMMP sites
Disposal grounds
Aggregate Extraction areas
North Sea Benthos Stations
Modiolus areas
NMMP 245
Tyne
Tees
NMMP 345
Humber 408
Modiolus STN 2
Modiolus STN 1
NMMP 376
Cross Sands
Area 305/3
Area 222
NMMP 475
Inner Gabbard
Roughs Tower
South Falls
Swansea Bay
NMMP 466
Nab Tower
Dungeness
Hastings
Owers
Isle of Wight
NMMP 536

Figure 2. Bathymetry of the Souter Point Dredged Material Disposal Site

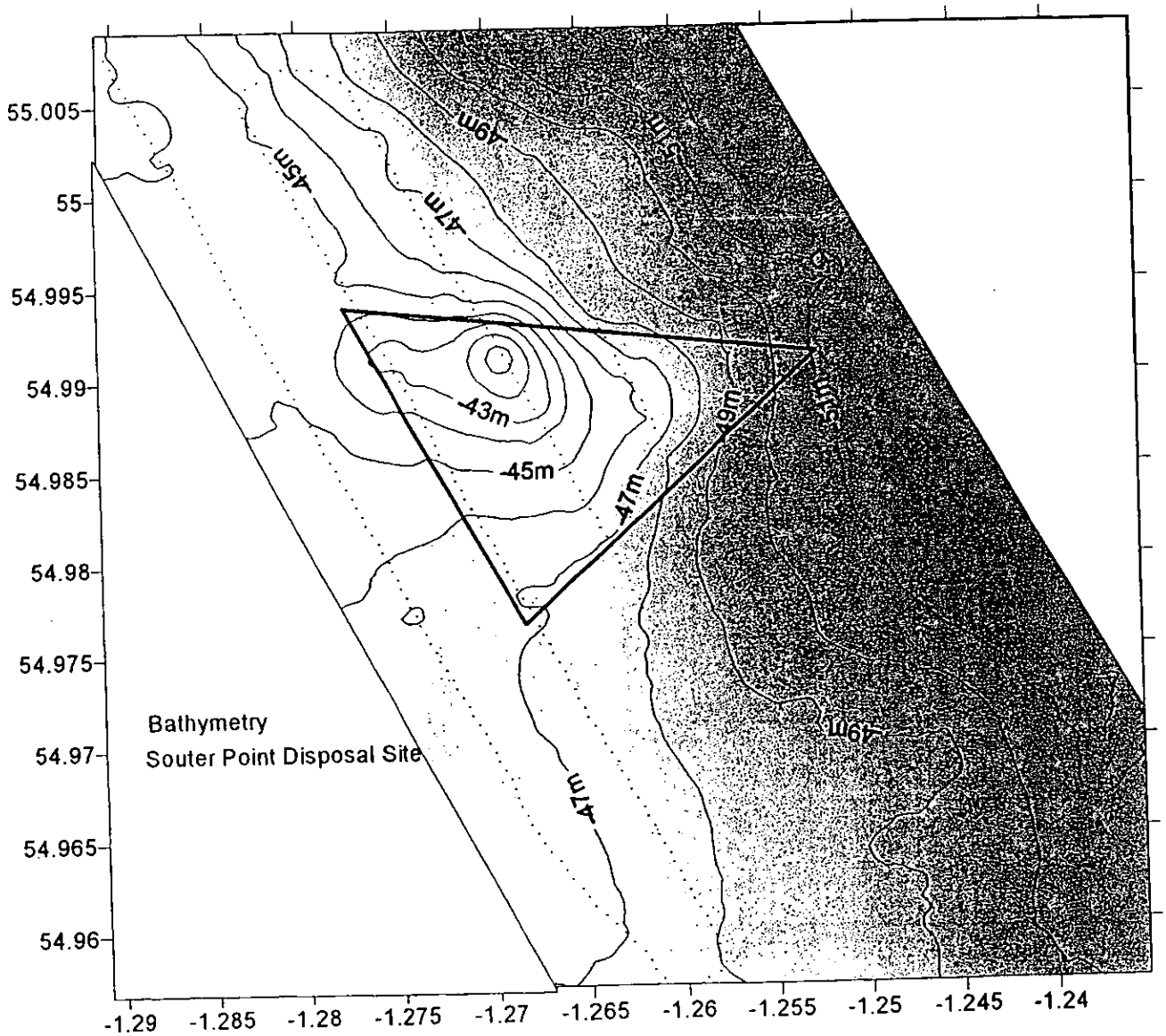

Figure 3. Sidescan image showing the extent of the capital disposal operation at the Roughs Tower disposal site

Figure 4. Imagenex Digital Sub-bottom Profiler Image

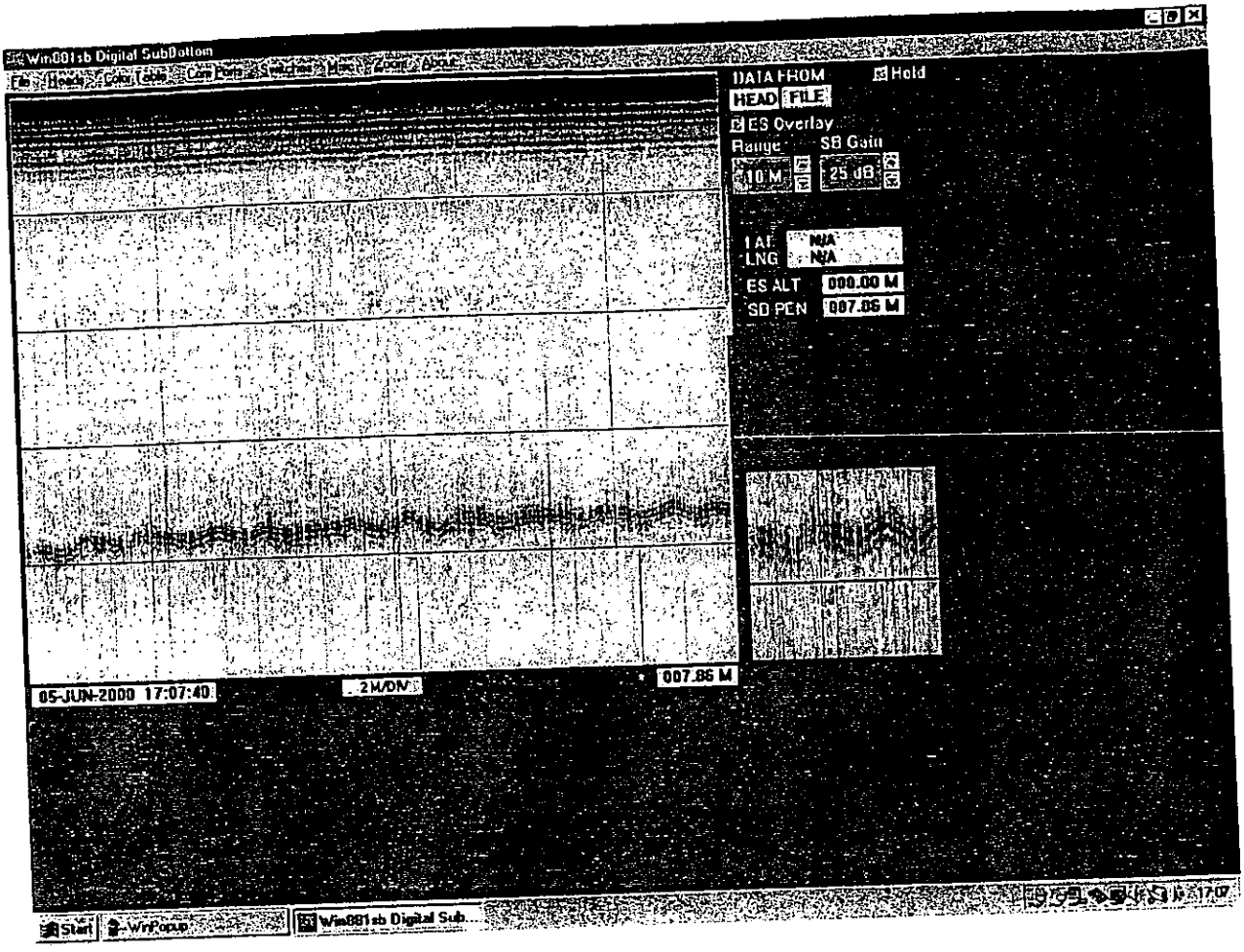

Figure 5. Sidescan sonar image of anchor dredge pits at an aggregate extraction site east of the Isle of Wight