SEA EMPRESS OIL
ON THE PEMBROKESHIRE COAST ON THE THIRD ANNIVERSARY
OF THE OIL SPILL : FEBRUARY 1999

Friends of the Earth Cymru

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A Report to
FRIENDS OF THE EARTH

From
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Introduction

Since the Sea Empress oil spill in February 1996, this consultant has submitted brief yearly reports of the ongoing status of oiling on the Pembrokeshire coast. This report describes a survey which provides detailed observations of oiling on representative stretches of Pembrokeshire's principal shoreline environments and examines selected intertidal areas for the presence of residual Sea Empress oil.

Three major coastal types were identified: Sheltered coasts of the Milford Haven Waterway, relatively sheltered coasts of the Carmarthen Bay and exposed rocky coasts. At selected survey sites upper, intermediate and lower shores, between the High Water Mark and the Low Water Mark, were examined during the low tide cycle. Examination consisted of visual observation of the surface, followed by shallow scraping and pit digging to a depth of 30cms. Total hydrocarbon concentrations were estimated according to the principles set out in the following table:

Appearance of Oil on Water	**Concentrations in ppm**
Barely visible	0.05
Silver sheen	0.1
First trace of colour	0.2
Bright bands of colour, iridescent	0.4
Colours tending to be dull	1.2
Colours fairly dark, rainbow tints	2.4
Brown or black	12.0
Brown / dark brown	120.0

From Oil Spill Response in the Marine Environment. J.W. Doerffer (Pergamon Press 1992 ISBN 0 08 041000 6)

SUMMARY

16 sites, representative of Pembrokeshire's three principal coastal types, were surveyed for residual Sea Empress oil during the low tide cycles in January/ February of 1999.

At 11 survey sites deposits of non-toxic, fully weathered oil were discovered, but at five sites partially weathered, active and potentially toxic oil was found.

Of particular concern was the relatively high concentrations of unweathered oil found in close proximity to important assemblages of wildlife in the Angle Bay and Pembroke River/Pwllcrochan Flats Sites of Special Scientific Interest in the Milford Haven Waterway, in Tenby Harbour and the Site of Special Scientific Interest at the Giltar Point end of Tenby South Sands.

Maximum concentrations of active, potentially toxic oil were estimated at 12 parts per million, which is well within the range known to cause chronic sublethal, and possibly cumulative lethal, toxic impacts, particularly over the long term. (Ref 1)

Since weathering and degradation of this oil appears to be taking a very long time at these sites, it seems likely that the problem will continue for the foreseeable future.

On many rocky, boulder/cobble shores and even on some sandy muddy shores there is still strong evidence of run away seaweed growth arising as a result of the high mortality of grazing species (e.g.. limpets) during the spill and subsequent poor recruitment of juveniles. A typical example may be seen at Manorbier, where excessive growth of green algae on the eastern end of the reef system has been followed by rampant growth of brown algae. Algal growth is now so dense that it is mitigating against recolonisation of grazers. Other examples may be seen at Freshwater West, Freshwater East and Giltar Point.

This survey has born out the predictions made by FOE in the report "Lost Treasure" which was published in 1996 in the aftermath of the Sea Empress spill.

Coastal type 1 : The Milford Haven Waterway

The Haven is a drowned ria system bounded on the east by the extensive estuaries of the two Cleddau rivers and opening to the sea at it's westward extent. The coastline of the Haven is approximately 110 kms long and deeply indented by a number of creeks and coves and bays. Tidal influence extends up to 7km inland of the confluence of the two rivers. Towards the seaward, or outer, sector of the Haven relatively high energy environments, exposed to prevailing winds and waves are found, but in general the majority of the Haven waterway is protected from prevailing winds and seas.

The important wildlife habitats are principally found on the extensive, shallow gradient, intertidal zone consisting, in the most part, of sand, sandy mud or mud. These habitats are very important for shellfish and wading birds. The Haven coastline holds a number of very important intertidal SSSIs.

Some of the Haven coastline is of relatively high amenity value but the majority of it is not easily accessible and the muddy nature of both the water column. The characteristics of the north coast of the Haven are dissimilar from those of the south coast, accordingly surveys were made of sections of both coasts.

The north coast of the Haven is slightly more exposed to prevailing wind and wave action than the south coast and is dominated by the action of the flood tide which exercises a degree of scouring and carries sediments (and associated pollutants) eastward and inland. (Ref 3)

Sandy Haven, Sandy Haven Pill and Sleeping Bay

(Outer Haven : North Coast). This shoreline opens to the south and south west with the eastern section of Sandy Haven Beach being more exposed to prevailing wind and wave action. The Pill is tidal and carries a small fresh water stream. Fine sands (with some mud) predominate in the Pill. On Sandy Haven Beach and Sleeping Bay, the intertidal zone consists of fine to coarse sands/ shingle with upper shore boulders and rocky outcrops. Sandy Haven is easily accessible from roads and paths and is of high amenity value.

Previous Oiling

This shoreline was repeatedly heavily oiled on an every tide basis for several weeks during the Sea Empress spill. The Marine Pollution Control Unit (MPCU) recorded that bulk oil was reported on the shore on 19th Feb. 1996. beach cleaning started on Feb. 27th and bulk oil was removed by trenching and suction. A maximum of 40 workers were deployed and work ceased on the 12th of March. Throughout the summer of '96 small teams conducted repeated short clean up visits and reported patches of "free oil" and "fresh oiling". It is reported that a boom was deployed early on during the spill and afforded some protection to the harbour and the pill. (Ref 2)

Survey Observations

The presence of subsurface oil was strongly demonstrated by large numbers of grey/black worm casts on the surface of the middle to lower sectors of the intertidal across the majority of the survey site.

In Sandy Pill a layer of fully weathered oil was buried beneath 1.5 to 10 cms of fine sand with mud. The weathered oil layers was in excess of 30 cms thick and well mixed with fine sand and sediment
and presented a grey/black colour. There was no sheening and no evidence of active hydrocarbons.
In Sleeping Bay the weathered oil was buried beneath 5 to 15 cms of fine to medium sand. The weathered oil layer was generally in excess of 30 cms thick and again mixed with sedimentary material. There was no sheening and no evidence of active hydrocarbons.

Sandy Haven Beach In the centre of the beach a layer of weathered oil was observed similar in depth and appearance to that found at the Pill and Sleeping Bay. In the more exposed eastern sector of the Haven Beach the weathered oil layer become progressively more patchy and less visible. There was no sheening and no evidence of active hydrocarbons.

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Gelliswick Bay

(Central Haven : North Coast) This is a small bay facing south and fairly well protected from prevailing wind and wave action. The intertidal zone consists of cobbles and pebbles with sandy mud patches in the west, mud and fine sand with pebbles in the centre and coarse sand/shingle in the east which is slightly more exposed to prevailing wind/wave.
The Bay is adjacent to the Herbrandston Jetties where the Sea Empress was moored for some time following salvage.

Previous Oiling

The MPCU recorded that by 23rd February the beach was heavily oiled. Up to 20 personnel skimmed oil into pits and recovered it with gully suckers. Cleaning was suspended on March 2nd. The beach was surveyed on 7th March and reported to be "fairly clean with the exception of an area of moderately oiled shingle and boulders on the eastern side of the bay" Subsequently the beach was tractor harrowed, which caused re-oiling. Through the summer of '96 further trenching, flushing, oil collection, dispersant use, steam cleaning and high pressure washing was carried out. However, fresh oil was still being reported in the September/October of '96. (Ref 2)

Survey Observations

Weathered oil was observed throughout the intermediate and lower sectors of the intertidal zone of the west and centre of the Bay. The weathered oil layer was generally buried 1 to several centimetres beneath the surface. The layers was of variable thickness and grey/black in colour and mixed with sedimentary material. There was no sheen and no evidence of active hydrocarbons.

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Llanstadwell Shore
(Inner Haven : North coast) A linear shoreline consisting of small boulders, cobbles, pebbles with patches of mud. Protected from prevailing wind and wave action. The shoreline is adjacent to the road and has some amenity value.

Previous Oiling
The MPCU reports that this shoreline was contaminated with both crude and Sea Empress fuel oil. Cleaning was carried out from 24th Feb. until mid March and then sporadically through until the end of April. (Ref 2)

Survey Observations
There was evidence of weathered oil in the upper, intermediate and lower sectors of the intertidal. The weathered oil was patchy and found at variable depths and layers of varying thickness. Oil staining was observed on the underside of large cobbles. There was no sheening and no evidence of active hydrocarbons.

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The south coast of the Haven is generally extremely well protected from the action of the prevailing wind and waves. It is strongly influenced by the ebb tide which carries sedimentary material and pollutants westward along the shorelines. This coast is characterised by an wide, shallow gradient, intertidal zone in which extensive areas of fine sediment mud flats have developed areas, there are also two large, shallow embayments (Angle Bay and the Pembroke River). Previous surveys have shown that the fine sediment deposits on the south coast and in the embayments are depositional sinks, or end points of deposition, where pollutants including hydrocarbons deposit and reach their greatest in-Haven concentrations. (Ref 3)

Martin's Haven
(Central Haven : South Coast). This site is a small tidal creek to the east of the Texaco refinery and jetties. At the upper beach there a small saltmarsh, below which the upper shore consists of shingle and gravel.. To the west the upper shore consists of shell sand and gravel and rocky outcrops and to the east the upper shore consists of gravel and pebbles and rocky outcrops. From approximately the middle of the intertidal down to the Low Water Mark there are extensive fine sediment mudflats. Martin's Haven has been of high biological value and accordingly was incorporated into the Pembroke River/Pwllcrochan Flats Site of Special Scientific Interest (SSSI). Martin's Haven is accessible from the Pembrokeshire coast path and is of slight amenity value.

Previous Oiling
In the 1960s the saltmarsh was much larger and was categorised as "an unspoilt transition from the marine to the terrestrial habitat". However following 30 years oil port and refinery activity, during which Martin's Haven has been repeatedly oiled, the saltmarsh was described in 1994/95 as "little more than an eroding, compacted clay platform and isolated mud mounds". (Refs. 3 & 4)

The MPCU recorded that during the Sea Empress spill Martin's Haven was contaminated by both crude and bunker fuel oil, with the bunker fuel predominating. A limited clean up was carried out between 8th and 11th of May. No work was done on the rock surfaces or on the saltmarsh which was extensively oiled : both being left to recover naturally. (Ref 2)

Survey Observations

In the muddy sediments between saltmarsh plant stands light rainbow sheening was observed at places on the surface. Below brown surface sediments 1 to 3 cms thick a discrete layer of grey black oil, partially weathered oil (mixed with fine sediment material) was observed. This layer was generally in excess of 30 cms thick. Light rainbow sheen was observed on the surface of interstitial (pore) water in pits dug into the oily layer. Active hydrocarbons were present.
Using the principles laid out in the table above it was estimated that the total hydrocarbon concentration (THC) was between 0.2 and 0.4 ppm.

In upper shore shingle and gravel areas only patchy thin layers of weathered oil were observed and there was no sheening and no evidence of active hydrocarbons.

In fine mud and sandy mud sediments from the mid shore down to Low Water a thick layer of weathered oil mixed with sedimentary material was found beneath 2 to 5cms of brown/grey brown surface sediment. The weathered oil layer was generally in excess of 30 cms thick. No sheening was observed and there was no evidence of active hydrocarbons.

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Pwllcrochan Flats

(Central Haven : South Coast) This is a linear shoreline, approximately 1 km long, extending from the Texaco jetties in the west to Martin's Haven in the east. There is a steep upper shore consisting of rock outcrops interspersed with shell sand and gravel. The mid shore to low water mark is principally composed of extensive fine sediment mud flats and a large shells gravel and shingle spit towards the eastern end.. The mud flats were biologically rich and this shoreline was an important part of the Pembroke River/Pwllcrochan Flats SSSI. There is poor access from the coast path and the area has a low amenity value.

Previous Oiling

Although not reported so, it appears inevitable that this area must have received historical impacts similar to those noted for Martin's Haven. The MPCU report that during the Sea Empress spill this shore received a great deal of heavy fuel oil (bunker) as well as both fresh and emulsified crude oil. Although the MPCU report that the area was regularly monitored through the summer, their report does not record any cleaning activity prior to Dec. 96. (Ref 2)

Survey Observations

On the upper shore only patchy deposits of weathered oil were found. These deposits were

at variable depths and of variable thickness. No sheening was observed and no active hydrocarbons were present.

In the mid to lower shore mud flats a layer of weathered oil was found similar in every way to that observed in the mid to lower shore at Martin's Haven. No sheening was observed and their was no evidence of active hydrocarbons.

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Angle Bay

(West central Haven : south coast) Angle Bay is a large embayment on the Haven's south coast, it is well protected from prevailing wave and wind action. Angle Bay has a shoreline over 3kms long.

The entire intertidal area of the Bay is biologically rich and represent an important feeding and roosting area for wintering and migrant wildfowl and waders. The intertidal area also supports a number of important beds of the nationally rare eelgrass Zostera. For these reasons the Angle Bay intertidal has been declared a Site of Special Scientific Interest. The shoreline of the Bay is, in places, accessible from the road and/or bounded by the Pembrokeshire coast path. Sections of the shoreline are of high amenity value. Historically a considerable amount of shellfish gathering and bait digging took place within the bay.

Previous Oiling

The MPCU have recorded that the whole of the Angle Bay was oiled early during the Sea Empress spill, receiving large quantities of crude and emulsified crude as well as bunker fuel. There were multiple strandings of oil on the upper shore above the mud flats. Cleaning began on 16th February with up to 20 people and continued at this level until March 20th. Bulk oil was removed by trenching and suction,, rock surfaces were cleaned with high pressure washing.. The clean up was scaled down late March and through April, but was resumed again in mid May. It was reported that ma great deal of oil had penetrated into the muddy sediments and mobile fuel oil was present below a surface covering of stones. It is plain from the MPCU's record that considerable quantities of oil remained after cleaning was suspended early autumn 1996. (Ref 2)

Kilpaison

is situated at the eastern end of the Bay close to Rhoscrowther village. On the upper shore there is a relatively narrow shingle/pebbly beach. From mid shore very extensive muddy sand/ mud flats run out to the low water mark. In the midshore to the left of the beach there are a series of low parallel sandstone reefs with sand and muddy sand lying between the outcrops.

Survey Observations

In the sand/gravel of the upper shore a layer of partially weathered oil was observed lying beneath 2 to 5 cms beneath the surface material. The layer was of varying thickness and appeared to overly a compact layer of clay and stones. Light to medium rainbow sheening was observed on the surface of pore water pools in pits and scrapes made into this layer. Active hydrocarbons were present and using the Table (above) it was estimated that the

THCs present were between 0.2 and 0.4 ppm

In sand and muddy sand deposits between the parallel outcrops of the red sandstone reef system in the left hand mid shore a similar layer of partially weathered oil was observed at variable depths beneath the surface. This layer to was of variable thickness and appeared to overly red sandstone rock. Silver to light rainbow sheening was observed on the surface of pore water in scrapes and pits dug into this material. Active hydrocarbons were present and it was estimated that the THCs present were in the range of 0.1 ppm to 0.2 ppm.

In the extensive fine sediment deposits of the mid and lower shores down to the low water mark a discrete layer of largely weathered oil mixed with sedimentary material was observed. This layer was buried beneath 2 to 5cms of fine surface sediment. The thickness of the layer was hard to define because pits in excess of 20 cms deep tended to collapse due to the inrush of pore water. Barely visible sheening to silver sheening was observed in this pore water. Active hydrocarbons were present and it was estimated that the THCs present were in the range of 0.05ppm to 0.1 ppm.

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Bangeston
lies to the west of the central section of the Angle Bay shoreline. There is a narrow shingle/pebble beach in the upper shore and from the mid shore down to low water mark there are extensive mud flats. Conditions here were very similar to those described for Kilpaison

In the mud flats a discrete layer of mainly weathered oil was observed at depths of between 5 and 15 cms below the surface mud. This layer was generally in excess of 30 cms thick and faint sheening to silver sheening was observed. Active hydrocarbons were present at THCs estimated to be between 0.05ppm to 0.1ppm.

In the upper shore beach a thin layer of only partially weathered oil was observed beneath a surface covering of shingle and pebbles. Scrapes and shallow pits revealed that this oil was not well mixed with sedimentary material and that it overlies a clayey/stoney layer. Strong rainbow sheening, with brown microdroplets of oil, was observed on the surface of pore water pools in the pits and scrapes. Oil staining was observed on the underside of pebbles and manual contact with the pore water left oily stains on the skin. Active hydrocarbons were present at THCs estimated to range between 1.2 ppm and 12ppm.

(I have been observing this site since Dec. 1996. The nature and volume of the oil here does not seem to have appreciably changed since that time. It seems inevitable that the lifespan of this oil is going to be extremely prolonged.).

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Coastal Type 2 : Carmarthen Bay

The sheltered coasts of the large embayment of Carmarthen Bay represent the entire eastern coastline of Pembrokeshire. Although exposed to occasional winter storms from the Southeast, these environments are relatively sheltered from the prevailing westerly and south westerly winds and seas and are therefore markedly less active and dynamic than the exposed rocky south and west coasts. Because of their very shallow gradient these intertidal sands extend seaward for up to 2kms at spring tides.

The Carmarthen bay coast contains a number of SSSIs. The important wildlife habitats are principally found on the very extensive intertidal zone, consisting of sand with a varying degree of mud. Although there is a lack of baseline data about the numbers and diversity of both the intertidal and the benthic species along this coast there is a general consensus that both the intertidal and the subtidal zones have historically supported high populations and a good diversity of species. Species inhabiting such environments are often more sensitive to certain environmental conditions and impacts than rocky coast species. There is a general consensus among local fishermen and boatmen that this shoreline is influenced by a tidal gyre which creates a dominant southward flow parallel to the shore (running from Amroth in the north towards Giltar head in the south). This coastline contains Pembrokeshire's most important amenity coasts and the immediate hinterland has the county's highest resident and seasonal tourist population.

Previous Oiling

Following the Sea Empress spill most of this coast was heavily oiled on an every tide basis for some time. Both crude oil and emulsified crude oil definitely came ashore and there is some possibility that a small amount of bunker fuel also oiled Carmarthen Bay shorelines. Because of their high amenity value and the importance of the regional tourist trade Carmarthen Bay shorelines were intensively cleaned following the oiling. The MPCU report shows that activity on this coast was intense. Much heavy machinery was used on certain shorelines, personnel concentration was high, cleaning was prolonged and the full range of cleaning strategies were used including the heavy shoreline use of dispersants. (Ref 2)

Survey Observations

Amroth/ Wiseman's Bridge/Saundersfoot/Monkstone.

This whole shoreline was surveyed during a single, low tide cycle, walkover. In the upper shore sandy beaches with rock outcrops are frequent. Patchy weathered oil in layers of variable thickness were observed across much of the upper shore of this shoreline. In mid shore and lower shore muddy sand and sandy sediments down to the low water mark, the presence of sub surface weathered oil was demonstrated by grey black worm casts. Digging revealed a layer of weathered oil mixed with sediment buried beneath 3 to 20cms of surface material. In mid and lower shore sediments this layer was generally in excess of 20cms thick. There was no sheening and no evidence of active hydrocarbons.

Tenby Harbour.

Tenby Harbour, like all harbours has been designed to enclose and protect a specific area from the more severe action of the sea. It might be expected that oil in the harbour would not be dispersed or weathered as rapidly as on more open stretches of coastline.

Incompletely weathered oil was observed across the entire intertidal zone of Tenby Harbour. The oil was at varying depths according to the pattern of sand distribution, but generally between 5 and 10 cms deep. The oil layer was generally in excess of 20 cms thick. The partially weathered oil was mixed with sand.

In the upper section of the Tenby Harbour intertidal the oil was more weathered than lower down. Scrapes and pits dug into the oil layer in this zone showed that slight silver to faint rainbow sheening gathered on the surface of pore water pools. This showed the presence of active hydrocarbons, with THCs of between 0.05ppm and 0.4ppm.

In the mid to lower zone of the Tenby harbour intertidal, partially weathered oil was observed. Scrapes and pits dug into the oil showed a discrete layer of very dark oil mixed with sediment. Strong rainbow sheen with microdroplets of oil appeared on the surface of pore water pools. It was estimated that active hydrocarbons were present, with THCs of up to 12 ppm.

The MPCU report notes that Tenby Harbour had a great deal of oil entrained in the sediments: "there is thought that to be at least 50 cms of oil containing sediment in the harbour." The MPCU stated that the harbour would "only be thoroughly cleaned if the harbour is dredged". (Ref 2) Such work was never undertaken.

(Some sources have attempted to claim that this oiling is caused by waste engine oil jettisoned by Tenby boatmen. No evidence has been offered to support this claim and no scientific analysis of the oil has been conducted. Saundersfoot Harbour, with a similar boating population has not experienced comparable problems. It is noteworthy that Saundersfoot Harbour was boomed to prevent the ingress of oil, while Tenby harbour was not)

Giltar Point Beach (an SSSI located at the southern end of Tenby South Sands)

While the great majority of Tenby South Sands has no discernible traces of weathered oil, the area in the vicinity of Giltar Point contains both fully and partially weathered oil from the mid shore down to the low water mark, approximately 500 metres north of the Penally Range drainage, outfall patchy traces of fully weathered, non active oil are discernible at depths of 20 to 30 cms below the surface sand.

Between approximately 100 metres and 50 metres north of the outfall, partially weathered oil was observed at depths of between 20 and 30 cms. Faint silver sheen was observed on the surface of pits dug into this layer which extended to depths beyond 30 cms. Active hydrocarbons were present, and concentrations were estimated at 0.1ppm.

Closer to the outfall the presence of oil becomes more visible. From the mid shore down to the low water mark in the vicinity of the outfall, a layer of only slightly weathered oil was observed at depths between 2 and 5 cms below the surface sand. Pits dug into this layer showed that it was up to 20 cms thick. In the mid shore zone the layer overlies a tight packed layer of stones, lower down the shore the layer is thicker but still overlying tight packed stones.

Strong rainbow sheen with microdroplets of oil was observed on the surface of pore water pools in pits dug into the layer. Active hydrocarbons were present and concentrations were estimated at up to 12 ppm.

This oiling extends along the side of the rocky, cobbly area which lies against the cliffs of Giltar Point headland. In all the area covered by this oiling is approximately several hundred square metres. It is likely that a similar degree of oiling underlies the cobbly area which has in the past supported extensive communities of mixed shellfish. Major ecological changes are underway over much of this habitat, with runaway seaweed growth and very reduced numbers of herbivorous shellfish, particularly in the mid shore sector.

The MPCU report (Ref 2) noted that Giltar Point "appears to act as a natural sump with oil continually re-appearing in the area." This dovetails neatly with the observation that there is a tidal gyre of this coast which generates a predominantly southward flow along the coast. Such a flow might assist the transport of any oil, escaping from Tenby Harbour for example, southward towards Giltar.

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Coastal Type 3 : Rocky Shores .

These shores are located principally on the south and west coasts of Pembrokeshire. These environments are generally fully (or near fully) exposed to prevailing westerly and south westerly winds and seas and characterised by highly active and dynamic conditions which are recognised as significant factors in the generally relatively rapid natural cleansing and degradation of oil pollution. The important wildlife habitats are principally rock face, boulder and rock pool with many small rocky coves and a number of larger sandy beaches which also have a high amenity value. Species inhabiting such environments are generally robust and resilient. The majority of the rocky coastline shelves steeply into the sea and, except on the larger sandy beaches, the intertidal zone is relatively narrow. On the west coast these habitats have been relatively well studied by various Field Studies Council Research Centres (and others) and there is a generally good baseline data about species numbers, diversity and distribution.

Three sites on the south coast were surveyed. Each was heavily oiled following the Sea Empress spill. Observations at Broadhaven (Bosherston), Freshwater East and Manorbier Bay found only very faint traces of completely weathered oil in sheltered areas, near rocks and cliffs, in the intertidal zone.

Skrinkle Haven (near Manorbier) was also heavily oiled during the spill. The MPCU reported that there was bulk oil buried around the low tide region at this beach (Ref 2). Skrinkle Haven was to have been included in this survey but the coast path access has collapsed and the beach is not accessible from the path. However I did visit this beach, by boat, during the summer of 98 and can confirm that there are still traces of oil buried in the extreme low tide (springs) section of the intertidal.

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