AMSA
Australian Maritime Safety Authority

Marine Environment Protection Services

IDENTIFICATION OF OIL ON WATER

Aerial Observation and Identification Guide

Report all spills to 1800 641 792

Contents

A bulk vessel aground at Cape Cuvier, Western Australia.

Visible in this photograph is a water-in-oil emulsion (cream/brown) veined by fresh heavy fuel oil (black) flowing from the vessel.

Source: AMSA

Purpose

This package has been developed to assist persons involved in surveillance operations to more accurately report the presence of oil in the marine environment. The information also aims to assist observers in effectively differentiating oil from other phenomena which may be similar in appearance to oil.

Introduction

The importance of accurate reporting of an oil spill is paramount for the preparation of response operations.

Many phenomena viewed by an aerial observer may appear similar to oil. These include algal blooms, storm run-off from rivers, coral spawn, kelp and seagrass beds, urban run-off discharged from drainage systems and even fish swimming just under the sea surface.

This package is designed to help observers characterise the oil and describe what they see in standard terms. Observers should concentrate on the location of the spill, the colour and distribution of the oil and the on-scene weather. In addition to these key matters, observers may be requested to report other observations (eg. vessels observed within the area which could be potential pollution sources or the presence of wildlife).

The information the aerial observer provides will determine the initial response and effectiveness of operations from the organisation to whom they report.

Discharges from shipping in Australian waters

The International Convention for the Prevention of Pollution from Ships (known as MARPOL 73/78) regulates the discharge of all forms of ship-generated marine pollution. Over 90 per cent of world shipping tonnage is regulated by this Convention.

MARPOL specifies when, where and how a substance can or cannot be discharged into the sea. Current regulations cover oils, chemicals, garbage, and harmful substances in packaged forms (eg. containers). In the future regulations covering sewage, ballast water and air pollution will be implemented.

Generally oil discharges from shipping are only permitted at 15 parts per million (ppm).

Oil/oily mixtures at a concentration of 15 ppm cannot be detected by visual observation, only becoming visible to the naked eye at around 60 ppm. This means that an oil discharge detectable from the air by visual observation indicates an illegal discharge may have occurred and must be reported for further investigation by the relevant authority.

Disposal of plastics at sea is prohibited. The disposal of some other types of garbage are permitted under strict circumstances, however all sightings of garbage disposal should be photographed and reported.

VISIBILITY OF OIL ON WATER

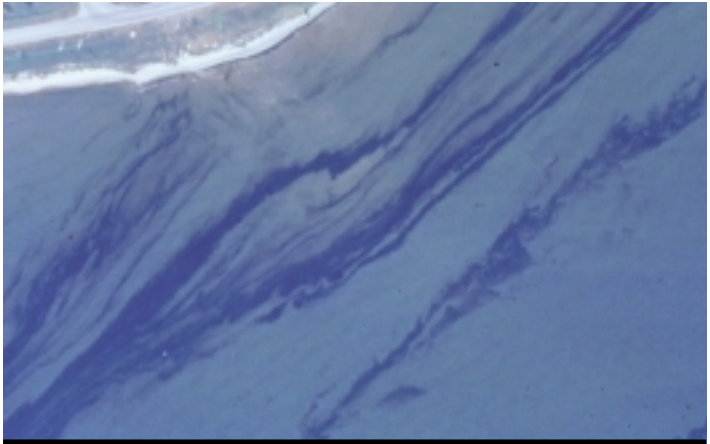
It is often difficult to assess if irregularities on the sea surface are actual oil spills or other phenomena with similar appearances. The following information should aid observers in assessing discolouration and disturbances on the sea surface.

Look closely at the range of photographs and compare these to actual observations.

Carefully read through the decision tree on page 19, and then make an assessment of the circumstances.

1: Boats towing a boom & skimmer through oil sheen and emulsion.

Source: NOAA

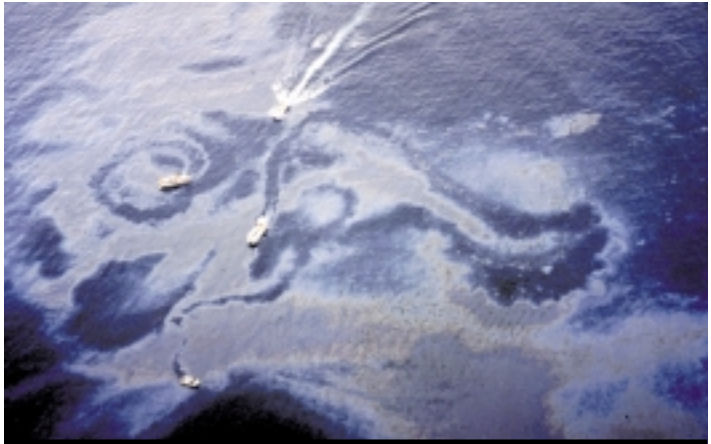


2: Black oil breaking into streamers.

Source: NOAA

3: A thin spread of oil shown as a rainbow sheen.

Source: NOAA



4: Mixture of heavy brown and lighter sheens from a spill being broken by propeller wash.

Source: AMSA

5: A sheen behind a bulk vessel under tow.

Source: AMSA

6: Heavy fuel spill which has an associated sheen.

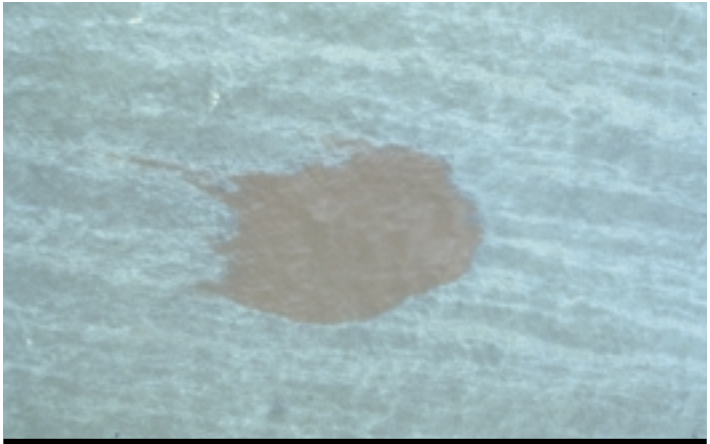
Source: WADOT

7: Weathered fuel oil washed onto a beach.

Source: AMSA

8: Crude oil entering mangrove intertidal areas.

Source: AMSA



9: An isolated circular patch of heavy crude oil commonly referred to as a ‘pancake’.

Source: NOAA

10: A ‘pancake’ of waste engine oil illegally discharged from a fishing vessel.

Source: Coastwatch

11: Vessel leaking heavy fuel oil.

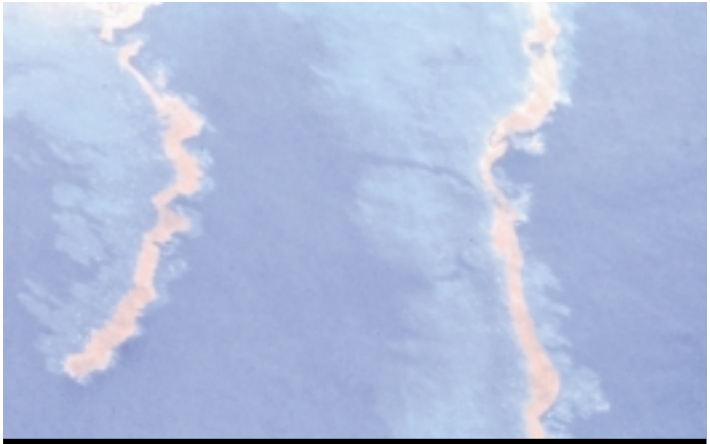
Source: AMSA

12: Vessel discharging an oily mixture.

Source: Coastwatch

13: Emulsified oil.

Source: AMSA



14: Two lines of orange/brown mousse with associated grey sheen.

Source: NOAA

15: Windrows of crude and sheen lining up in the same direction as the wind.

Source: AMSA

16: The orange-red colouration of coral spawn found in the tropical half of Australia's northern waters.

Source: GBRMPA

17: Red tide algal bloom off a Sydney Beach.

Source: Steve Higham (NSW EPA)

18: Vessel in shallow waters of a bay. The discolouration of the water is due to storm water run off being disturbed by propeller wash.

Source: AMSA

19: Fluvial discharge being released into marine waters. Staining with tannin from organic matter is the cause of colouration.

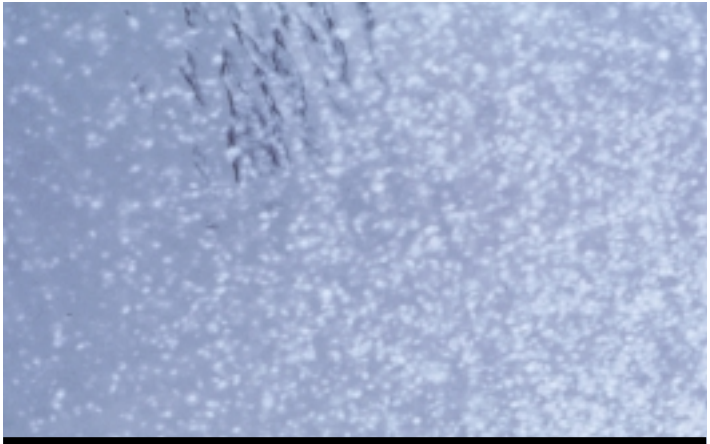
Source: AMSA

20: Water depth differences indicated by a channel. The channel also has an algal bloom in its centre.

Source: NOAA

21: Jellyfish in clusters such as these may be misinterpreted as an oil slick.

Source: NOAA



22: The dotting of transparent blue jellyfish.

Source: NOAA

23: Seagrasses close to shore with an appearance similar to oil.

Source: ITOPF

24: The dark patchy nature of kelp beds is often deceiving.

Source: NOAA

25: Seagrass beds close to shore. Note the absence of surface deadening.

Source: ITOPF

26: Sewage (urine) discharge from a livestock carrier.

Source: Coastwatch

27: The discolouration left behind this vessel is from the deck washings of coal dust.

Source: Coastwatch

28: Vessel discharging drill mud taken from an exploration rig.

Source: Coastwatch

Decision tree for aerial observation of sea-surface irregularities

Surface or Subsurface Feature

Is the mass on the water surface? (distinguished by wind-chop, waves, etc.)

NO → **What colour and shape is the mass?**

- Black or brown masses in shallow water - *Kelp beds or seagrasses*
- Moving through water, area changing shape - *School of fish*
- Pink/blue transparent spots - *Jellyfish*
- Murky clouds of discoloured water trailing back to a coastal source - *Suspended sediment*

YES ↓

Does the mass appear to move quickly over the water surface?

NO → **Deadening**

Does the surface appear smoother or 'slicker' than the surrounding water?

NO → Rusty, brown colour with grey, green or purple streaks (occurs more commonly in the warmer months) - *Algal bloom*

YES ↓

Grey/black shadow on water surface, usually moving

- *Cloud shadow*

YES ↓

Colour/Texture

Dark, frothy, transparent, rainbows, contain tarballs?, etc. (see definitions)

- Frothy brown to orange, may contain tar-balls - *Weathered oil ('mousse' emulsion)*
- Spreads to sheens & evaporates quickly, variety of colours from transparent to blue and rainbows - *Fresh spill of a light oil*
- Black to dark brown 'patches' - *Fresh spill of a heavy fuel oil*

Reporting a suspected oil spill

Estimation Of Slick Area

Record the separate areas of sheen, heavy oil and emulsion, as these have corresponding differences in the thicknesses which alter the volume estimations by clean-up responders.

- Enter the estimated lengths and widths of the slicks in the following table to achieve estimations of slick area.
- Add these together to complete the total area for the slick.

Slick Types	length of slick (m)	width of slick (m)	estimated slick area (m2)	Proportion of total area (%)	Comments
Sheen					
Heavy oil					
Emulsion					
Total				**100%**	

Preferred Angles of Aerial Photographic Evidence

NOTE: Ensure the inclusion of colour photographs and record any radio communication with vessels suspected of involvement with the spill.

Photographs should be taken at a recorded altitude, with the sun over your shoulder (not into the sun) and positioned above the slick.

The following photographs represent the preferred angles and vessel positions that are required to prosecute a vessel for illegal discharges of oil.

It is important to capture the slick emanating from the vessel in question, in this way the possibility of false prosecution is eliminated.

Plate 1.0: Long distance view of slick emanating from vessel's stern.

Source: Coastwatch

Plate 2.0: Approaching shot of vessel stern, clearly showing oil escaping from vessel.

Source: Coastwatch

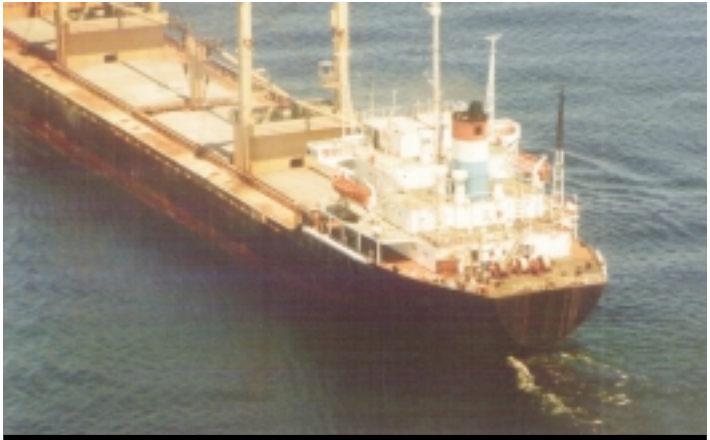


Plate 3.0: Close up shot of the stern used to identify the vessel (other photographs which clearly identify the vessel's name are also acceptable).

Source: Coastwatch

Plate 4.0: Long distance shot from ahead of the vessel, confirming the size and origin of the oil slick.

Source: Coastwatch

General information to be reported

- Date / Time (24hr time format)
- Sea state (Wind speed/ direction; wave height)
- Reporting/observation platform (helicopter, fixed-wing aircraft)
- Location of spill’s suspected source and position of source vessel (if known)
- Did you take colour photographs? (Give important frame numbers)
- Names/positions of all other vessels observed in the area
- Did you make radio contact with vessels in the area and record this conversation?

Observations of oil spill

- Spill location(s) (latitude / longitude)
- Description of oil in terms of texture colour and appearance (eg. windrows, streamers, pancakes, single mass or patches; rainbow, dull or silver sheen, black, or brown in colour, or mousse)
- Has the oil come ashore? Is it near to the shore?

Where to report observations

Report marine pollution incidents from ships to the Australian Maritime Safety Authority's Search and Rescue (AusSAR) Centre:

Phone: 02 62306811 (24 Hrs)

Free call: 1800 641792

Fax: 02 62306868

Telex: 62349

How oil reacts when it enters the marine environment

When oil enters the marine environment it will quickly start to spread to a thin layer, often over a large area.

Oil initially spreads out and forms a continuous or cohesive patch on the water surface. This layer or patch of oil absorbs energy and deadens out surface waves, making the area appear smoother or ‘slick’ compared with the surrounding water.

As the oil layer becomes thinner, it becomes more susceptible to being broken up by wave, wind, and current movement into smaller patches and narrow bands, or windrows, oriented in the direction of the wind or current. Light oils, such as diesel and gasoline, may evaporate and disappear completely. Heavy oils, such as bunker fuels and crude oil, eventually spread out to form smaller, discrete patches or streaks, ultimately becoming tarballs.

The colour, distribution, and consistency of the oil indicate the type of oil spilled, how long the oil has been on the water, and how readily it can be dispersed, contained and/or recovered.

Factors influencing the spread of oil

- **Wind, wave and current action:** Oil will generally move at the rate of 3% of the wind speed and at the same speed as water currents. As can be seen in figure 1, as a slick moves across the water surface it leaves behind a sheen of thinner oil and begins to form 'windrows'.
- **Persistence of the oil:** Persistence is important in terms of spreading rate, impact to the shoreline and subsequent clean-up. The persistence of an oil is determined by its ***pour point*** (the lowest temperature at which oil will flow), ***viscosity*** (the property of a liquid which determines its rate of flow),and ***density*** (the mass per unit volume). Non-persistent oils are those which generally evaporate relatively quickly from the sea surface, whilst persistent oils are those which generally require a clean-up response.
- **Temperature:** The water temperature of a spill area alters the properties of an oil, hence changing its spreading characteristics. With increased temperature, the persistence of oils decreases.

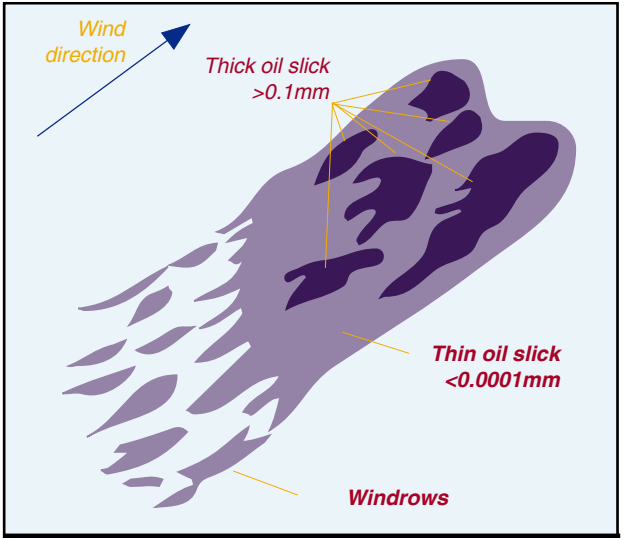


Figure 1

Glossary of common oil spill observation terms

Algal Bloom: Algal blooms can occur throughout the year, but are most common in the warmer months. They take place when optimum growth conditions exist (warm waters, excess nutrients), and appear as accumulations of a coloured mass on or below the surface of the water. Colours range widely from reds to greens and browns.

Convergence line: A line on the water surface where floating objects and oil collect. A convergence can be the interface between two different bodies of water, or it can be caused by a significant depth change, tidal changes, or other common phenomena. Convergences are common in the marine environment.

Coral Spawn: From late October to early December, corals reproduce simultaneously by releasing egg and sperm bundles, which float to the surface, often forming large slicks. This 'natural' slick gives the appearance of a white to pink, thick, dirty and irregular scum. It can persist on the water surface for around two days and may sometimes be misinterpreted as an oil slick.

Dispersion: The breaking up of an oil slick into small droplets that are mixed into the water column by wave action, chemical dispersant or other sea surface turbulence.

Emulsification: The formation of a water-in-oil mixture. Different oils exhibit different tendencies to emulsify, and emulsification is more likely to occur under high energy conditions (strong winds and waves). An emulsified mixture of water in oil is commonly called "mousse"; its presence indicates a spill that has been on the water for some time. See also mousse.

Mousse: An emulsified mixture of water in oil. Mousse can range in colour from dark brown to nearly red or tan, and typically has a thickened or pudding-like consistency compared with fresh oil. Incorporation of up to 75 percent water into the oil will cause the apparent volume of a given quantity of oil to increase by up to four times. See also emulsification.

Oil Spills: Depending on the characteristics of the slick and the environment in which it is positioned, oil may appear as many different forms of slick, ranging in colour, texture, volume and persistence. Oil spilled on water absorbs energy and deadens out surface waves, makes the oil appear smoother or slicker than the surrounding water.

Pancakes: Isolated, roughly circular patches of oil ranging in size from a few feet across to hundreds of yards (or metres) in diameter. Sheen may or may not also be present.

Recoverable oil: Oil in a thick enough layer on the water to be recovered by conventional techniques and equipment. Only black or dark brown oil, mousse, and heavy sheens (which are dull brown in colour) are generally considered to be thick enough to be effectively recovered by skimmers.

Sheen: A very thin layer of oil (less than 0.0001 inches or 0.003 millimetres in thickness) floating on the water surface. Sheen is the most commonly-observed form of oil during the later stages of a spill. Depending on thickness, sheens range in colour from dull brown for the thickest sheens to rainbows, greys, silvers, and near-transparency in the case of the thinnest sheens.

Tarballs: Weathered oil that has formed pliable balls or patches that float on the water. Tarballs can range in diameter from a few millimetres (much less than an inch) to 0.3 metres (1 ft.). Depending on how weathered, or hardened, the outer layer of the tarball is, sheen may or may not be present.

Weathering: A combination of physical and environmental processes, such as evaporation, dissolution, dispersion, and emulsification, which act on spilled oil to change its physical properties and composition.

Windrows: Streaks of oil that line up in the direction of the wind. Windrows typically form early during a spill when the wind speed is at least 10 knots (5.1 metres per second).

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