MARITIME SAFETY AUTHORITY
OF NEW ZEALAND
Te Mana Ārai Hauata Moana o Aotearoa

OIL SPILL DISPERSANTS

GUIDELINES FOR USE IN NEW ZEALAND

CAWTHRON

Report No. 594

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MARITIME SAFETY AUTHORITY
OF NEW ZEALAND
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GUIDELINES FOR USE IN NEW ZEALAND

Prepared for

Maritime Safety Authority
of New Zealand

by

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Report reviewed by:	Approved for release by:
Paul Barter - Marine Scientist	Barry Robertson - Coastal and Estuarine Manager

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OVERVIEW OF GUIDELINES FOR OIL SPILL DISPERSANT USE

These guidelines are designed to facilitate and document rapid and justifiable decisions for dispersant use during a marine oil spill. The guide is designed as a single use document to be filled in during use. The On-Scene Commander should retain the completed guide as a record of the spill decision process and response actions.

As every spill will be different, the guidelines do not provide hard and fast rules for when dispersants should or should not be used. The decision-maker is expected to judge, based on the information available and the type of values requiring protection, whether a dispersant response will result in a *'net environmental benefit'*, either on its own, or in combination with other response options.

> *Net environmental benefit* is the best outcome likely after weighing up the advantages and disadvantages of all possible response outcomes, including taking no action. It accepts that some cleanup responses will cause damage that may be justifiable because of overriding benefits.

The guidelines are in two linked parts:

1) Dispersant Use Flowchart (page 2)

- Summarises the key aspects to be considered during the decision making process.

The decision-maker should use the flowchart to guide dispersant use decisions. The corresponding section of the dispersant use checklist should be consulted where further information is required.

2) Dispersant Use Checklist (pages 10-43)

- Provides detail on the key aspects to be considered during the decision making process (uses check boxes numerically linked to the flowchart).
- Provides templates for spill reporting, assistance requests, and monitoring.
- Provides written documentation of each stage of the decision process.
- Includes information following each box containing:
    - Text, checklists, or questions to assist in answering the key questions.
    - Discussion notes summarising knowledge or providing rationale for decisions.
    - Data summaries of key information.
    - Links to other sources of information.

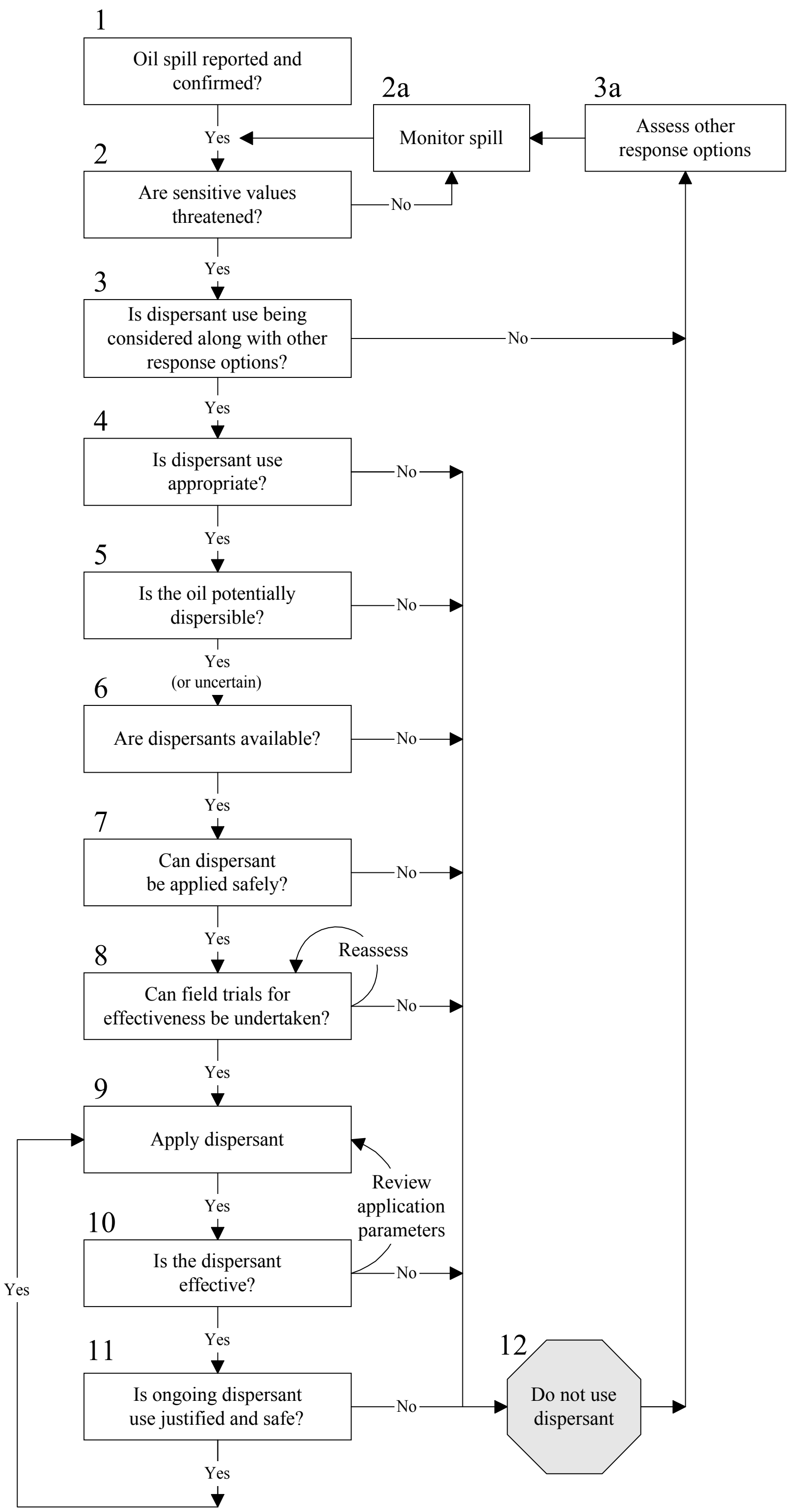
> **It is imperative that the decision process commences as soon as possible after notification of a spill, and that response decisions are implemented quickly. Rapid decision making is extremely important as dispersant is generally most effective when applied within 24 hours of a spill.**

NOTE OF CAUTION: These guidelines are intended for use by trained decision-makers who:

- Are familiar with these guidelines, and relevant Regional and National response plans.
- Know the range of oil spill response options available to protect sensitive values and habitats.
- Have a basic understanding of: dispersant chemistry and toxicity,
  application methods,
  monitoring requirements,
  the benefits and drawbacks of dispersant use.

If you do not have these skills, you should not use these guidelines

DISPERSANT USE FLOWCHART



Dispersant Decision Summary

Spill location: ....

Decisions approved by: ....

Box	Decision:	Time:	Date:	Initials:
1	Yes/No	....	....	....
2	Yes/No	....	....	....
3	Yes/No	....	....	....
4	Yes/No	....	....	....
5	Yes/No	....	....	....
6	Yes/No	....	....	....
7	Yes/No	....	....	....
8	Yes/No	....	....	....
9	Apply	....	....	....
10	Yes/No	....	....	....
11	Yes/No	....	....	....
12	Do not use	....	....	....

Comments:

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LIST OF DISCUSSION NOTES

Discussion notes, highlighted in shaded boxes, explain the salient points of key areas throughout the guidelines.

LIST OF INSTRUCTIONS AND FORMS

ABBREVIATIONS

ADIOS	Automated Data Inquiry for Oil Spills
AMSA	Australian Maritime Safety Authority
Avgas	Aviation gasoline
cSt	Centistoke
DOC	Department of Conservation
EEZ	Exclusive Economic Zone
ETA	Estimated Time of Arrival
ETD	Estimated Time of Departure
GPS	Global Positioning System
HFO	Heavy Fuel Oil
IFO	Intermediate Fuel Oil
IMO	International Maritime Organisation
ISB	*In situ* burning
ITOPF	International Tanker Owners Pollution Federation
MDO	Marine Duty Officer
MOF	Ministry of Fisheries
MOU	Memorandum of Understanding
MSA	Maritime Safety Authority of New Zealand
MSDS	Material Safety Data Sheet
NIWA	National Institute of Water & Atmospheric Research Ltd
NOAA	National Oceanic and Atmospheric Administration
NOSC	National On-Scene Commander
NOSSC	National Oil Spill Service Centre
NZ	New Zealand
OSC	On-Scene Commander
OSDO	Oil Spill Duty Officer
OSH	Occupational Safety and Health
PMS	Premium Motor Spirit
PPE	Personal Protective Equipment
ppt	parts per thousand (also $^{0}/_{00}$)
RMS	Regular Motor Spirit
ROSC	Regional On-Scene Commander
SITREP	Situation Report
SMART	Special Monitoring of Advanced Response Technologies
Tier 1	Site or spiller level plan or response
Tier 2	Regional level plan or response
Tier 3	National level plan or response
UHF	Ultra High Frequency
USCG	United States Coast Guard
VHF	Very High Frequency

avg	average
ft	feet
h	height
Ha	hectare
km	kilometre
kph	kilometres per hour
L	litre
m	metre
ml	millilitre (0.001 L)
mph	miles per hour
mm	millimetre
m^3	cubic metre
nm	nautical mile
%	percent
π	pi (= 3.14156…)
r	radius
>	greater than
<	less than

GLOSSARY

ADIOS
Automated Data Inquiry for Oil Spills. A computer database listing the characteristics of crude oils and refined products, and predicting expected characteristics and behaviour of oil spilled into the marine environment.

API gravity
A scale for measuring fluid specific gravities based on an inverse relationship with specific gravity.

Bioremediation
The processes where living organisms (bacteria and fungi) use oil as a food source, converting it into a non-hazardous form. Nutrients are often added to speed up the rate of digestion and the rate of reproduction of naturally occurring hydrocarbon-eating microbes. Hydrocarbon-eating organisms' can also be introduced to contaminated sites.

Black oil
A black or very dark brown layer of oil, sometimes with a latex texture. Generally spreads quickly to a thickness of about 1 millimetre (depending on quantity of oil spilt). Can look like kelp and other natural phenomenon

Brown oil
Water-in-oil emulsion. Thickness typically 0.1 to 1.0 mm, but will vary depending on wind & current conditions. Usually has a heavy or dull sheen. Brown oil can be easily confused with algal scum collecting in convergence lines, algae patches, or kelp.

Centistoke (cSt)
A unit of measurement used in defining the kinematic viscosity of a fluid.

Chemical dispersant
A chemical formulation containing surface active agents (surfactants) that lower the surface tension between oil and water, promoting the formation of oil droplets and reducing the tendency of oil to stick to other droplets or surfaces, thereby enhancing dispersion into the water column.

Clean-up
Actions taken to prevent further oil releases, protect areas from oil damage, mitigate oil effects (*e.g.* through deflection, containment, collection, chemical dispersion, or bioremediation), and clean-up oil contaminated areas and wildlife where monitoring shows a net environmental benefit in doing so.

Coastal waters
The Territorial Sea of New Zealand from high water mark to 12 nautical miles.

Continental waters
The Territorial Sea (high water mark to 12 nautical miles) and the Exclusive Economic Zone (12 to 200 nautical miles), and all water over the continental shelf of New Zealand beyond 200 nautical miles (refer to the Territorial Sea and Exclusive Economic Zone Act 1977 for further detail).

Contingency plan
An action plan prepared in anticipation of an oil spill for a site or region containing guidelines and operating instructions to facilitate efficient and effective clean-up operations, and to protect areas of biological, social and economic importance.

Convergence line
A line on the water surface where floating objects and oil collect, *e.g.* the interface between two bodies of water, areas with significant depth change, tidal changes, or other common phenomena. Convergence lines are common in the marine environment.

Dispersion
The breaking up of an oil slick into small droplets that are mixed into the water column by breaking waves and 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.

Entrainment
The loss of oil from containment when it is pulled under a boom by a strong current. Entrainment typically occurs from booms deployed perpendicular to currents greater than 1 knot (0.5 meter per second).

Exclusive Economic Zone (EEZ)
All marine waters between the outer edge of the New Zealand Territorial Sea (12 nautical miles) and the 200 nautical mile limit.

Flash point
(see volatility)

Hydrophilic
Water loving. A strong affinity for water.

Kinematic viscosity
A unit of measurement used to define an alternative viscosity measurement, *i.e.* the fluid dynamic viscosity divided by its density.

Marine Duty Officer (MDO)
Maritime Safety Authority staff providing a 24 hour alert for maritime incidents and accidents, including oil spills, search and rescue, and at sea collisions (also see Oil Spill Duty Officer).

Maritime Safety Authority (MSA)
Crown-owned body corporate established under the Maritime Transport Act 1994, responsible for cost effective and efficient marine pollution prevention and oil pollution response.

Mousse
An emulsified mixture of water in oil. Mousse typically has a thick consistency compared with fresh oil, and can incorporate up to 75 percent water into the oil, increasing apparent oil volume by up to four times. Colours can range from red, orange or tan to dark brown. Mousse can be easily confused with algal scum collecting in convergence lines, algae patches, or kelp. See also emulsification.

National marine oil spill contingency plan (NMOSCP)
The marine oil spill response plan produced by the Director of Maritime Safety for Tier 3 responses. Usually referred to as the National Plan.

Net environmental benefit
The best outcome likely after weighing up the advantages and disadvantages of all possible response outcomes, including taking no action. It accepts that some cleanup responses will cause damage that may be justifiable because of overriding benefits.

Oil spill
The actual or probable release, discharge, or escape of oil into waters of the New Zealand Territorial Sea or EEZ.

Oil spill response
The entire process by which a marine oil spill is managed, including spill verification, response planning, set-up, clean-up, and termination.

Oil
Petroleum in any form (except petrochemicals) including crude oil, fuel oil, sludge, oil wastes, and refined products.

Oleophilic
Oil loving. A strong affinity for oil.

On-Scene Commander (OSC)
The person responsible at a Tier 2 regional level (Regional On-Scene Commander - ROSC) or Tier 3 national level (National On-Scene Commander - NOSC) for the control and management of a marine oil spill response.

Oil Spill Duty Officer (OSDO)
Maritime Safety Authority staff providing a 24 hour alert for marine oil spills within the National Marine Oil Spill Contingency Plan.

Pancakes
Isolated patches of mostly circular oil (size range: few cms to 100's of meters in diameter). Sheen may or may not be present.

Persistent oil
Oils and petroleum products such as crude oils, fuel oils and lubrication oils that, when spilt, remain in a residual form in the environment for an appreciable period.

Pour point
The temperature below which oil will not flow.

Recoverable oil
Oil thick enough to be recovered by mechanical techniques and equipment. Generally only black or dark brown oil, mousse, and heavy (dull brown) sheens are considered thick enough to be recovered by skimmers.

Regional Councils
The Regional Councils and Unitary Authorities responsible for marine oil pollution response in the Territorial Sea.

Regional marine oil spill contingency plan (RMOSCP)
The marine oil spill response plan prepared by each Regional Council and approved by the Director of Maritime Safety for Tier 2 responses. Usually referred to as the Regional Plan.

Sheen
A very thin layer of oil (less than 0.003 millimeters 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 color from dull brown for the thickest sheens to rainbows, grays, silvers, and near-transparency in the case of the thinnest sheens. Natural sheens can result from biological processes.

Slick
Oil spilled on the water, which absorbs energy and dampens out surface waves, making the oil appear smoother (or slicker) than the surrounding water.

Specific gravity
The ratio of the mass of oil to the mass of freshwater for the same volume, and at the same temperature.

Streamers
A narrow line of oil, mousse, or sheen surrounded on both sides by clean water. Streamers result from the combined effects of wind, currents, and/or natural convergence zones. Heavier concentrations are often present in the centre, with progressively lighter sheen along the edges. Streamers are also often called "fingers", "ribbons" or "windrows".

Tar balls
Oil weathered into a pliable ball up to approximately 30 cm. Sheen may or may not be present.

Tar mats
Non-floating mats of oily debris (usually sediment and/or plant matter) found on beaches or just offshore in shallow water.

Territorial Sea
Coastal waters extending out to the 12 nautical mile limit.

Tier 1
Site level plan or first response to marine oil spills for which they are responsible. Includes most shore-side industry with oil transfer sites, offshore installations and all vessels required to have a shipboard plan.

Tier 2
Regional level plan or response for marine oil spills within the Territorial Sea (12 nautical miles) which exceed the Tier 1 response capability, or for which no responsible party can be identified.

Tier 3
National level plan or response for marine oil spills within the Territorial Sea (12 nautical miles) which are beyond the Tier 2 response capability, or which occur within the EEZ, but are outside Regional Council boundaries.

Viscosity
An oil's internal resistance to flow. Highly viscous oil will not flow easily.

Volatility
A property of a liquid that has a low boiling point and a high vapour pressure at ordinary pressures and temperatures.

Water-in-oil emulsion
(see mousse)

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.

Window of opportunity
The period of time available for undertaking a particular response. For example the application of dispersant before the oil emulsifies to a stage where dispersant becomes ineffective.

Windrows
Oil or sheen oriented in lines or streaks in the direction of the wind. Windrows typically form early during a spill when the wind speed is at least 10 knots (5.1 meters per second). Sheen is the form of spilled oil that most frequently windrows.

UNIT CONVERSIONS

Convert from	Into	Multiply by	Convert from	Into	Multiply by
AREA					
Hectares (100m x 100m)	Square metres	10,000	Square metres	Hectares	0.0001
Hectares	Square kilometres	0.0100	Square kilometres	Hectares	100
Hectares	Square statute miles	0.0039	Square statute miles	Hectares	258.9990
Hectares	Square nautical miles	0.00291	Square nautical miles	Hectares	3.3489
Hectares	Acres	2.4711	Acres	Hectares	0.4047
Square nautical miles	Square kilometres	3.4345	Square kilometres	Square nautical miles	0.2912
Square nautical miles	Square statute miles	1.3261	Square statute miles	Square nautical miles	0.7541
Square nautical miles	Acres	8.2753	Acres	Square nautical miles	0.0012
Square statute miles	Square kilometres	2.5900	Square kilometres	Square statute miles	0.3861
LENGTH/DISTANCE					
Mils	Microns	25.3807	Microns	Mils	0.0394
Inches	Centimetres	2.5400	Centimetres	Inches	0.3937
Feet	Metres	0.3048	Metres	Feet	3.2808
Yards	Metres	0.9144	Metres	Yards	1.0936
Fathoms	Metres	1.8288	Metres	Fathoms	0.5468
Statute miles	Kilometres	1.6093	Kilometres	Statute miles	0.6214
Nautical miles	Kilometres	1.8532	Kilometres	Nautical miles	0.5396
TEMPERATURE					
Centigrade	Fahrenheit	1.8 (°C) + 32	Fahrenheit	Centigrade	0.5556 [(°F) - 32]
VELOCITY					
Kilometres/hour	Metres/second	0.2778	Metres/second	Kilometres/hour	3.5997
Kilometres/hour	Nautical miles/hour	0.5400	Nautical miles/hour	Kilometres/hour	1.8518
Kilometres/hour	Statute miles/hour	0.6214	Statute miles/hour	Kilometres/hour	1.6093
Nautical miles/hour	Statute miles/hour	1.1508	Statute miles/hour	Nautical miles/hour	0.8690
Nautical miles/hour	Metres/second	0.5148	Metres/second	Nautical miles/hour	1.9426
Statute miles/hour	Metres/second	0.4470	Metres/second	Statute miles/hour	2.2369
VOLUME					
Litres	Cubic metres	0.001	Cubic metres	Litres	1000
Litres	Tonnes	0.001	Tonnes	Litres	1000
Litres	US gallons	0.2642	US Gallons	Litres	3.7854
Litres	Barrels (US oil)	0.0063	Barrels (US oil)	Litres	158.9873
Cubic metres	Tonnes	1	Tonnes	Cubic metres	1
Cubic metres	US gallons	264.1721	US gallons	Cubic metres	0.0038
Cubic metres	UK gallons	219.9688	UK gallons	Cubic metres	0.0045
Cubic metres	Barrels (US oil)	6.2898	Barrels (US oil)	Tonnes	0.1590
Barrels (US oil)	US gallons	42	US gallons	Barrels (US oil)	0.0238
Imperial gallons	US gallons	1.2010	US gallons	Imperial gallons	0.8327

VOLUME FLOW RATE		per second	per minute	per hour
Cubic metre per second	Cubic cm	1,000,000	60,000,000	3,600,000,000
	Litre	1,000	60,000	3,600,000
	Cubic metre	1	60	3,600
	Cubic inch	61,023.7441	3,661,424.6456	219,685,478.7
	Cubic foot	35.3147	2,118.8800	127,132.8002
	US gallon	264.1721	15,850.3231	951,019.3885
	UK gallon	219.9688	13,198.1280	791,887.6748

A windows conversion programme can be downloaded from: http://www.savard.com/masterconverter/download.asp

BOX 1 OIL SPILL REPORTED AND CONFIRMED?

			Date	Time
❑	Yes	Go to Box 2. Assess if sensitive values are threatened	....	....
❑	No	Complete reporting	....	....

Back to flowchart

1.1 Checklist of spill reporting requirements

Tick where relevant. Forms listed are described at the bottom of this page and follow this section.

- ❑ Oil spill reported
- ❑ Details recorded on Marine Oil Spill Assessment form
- ❑ Marine Oil Spill Assessment form forwarded to Regional On-Scene Commander (ROSC)
- ❑ Receipt confirmed by ROSC
- ❑ ROSC evaluates spill details
- ❑ ROSC notifies the Maritime Safety Authority (MSA) Marine Duty Officer (MDO) of any unverified significant oil spill using the Notification of a Marine Oil Spill form
- ❑ ROSC co-ordinates verification of spill report
- ❑ ROSC reports results of spill verification to MSA MDO

For any verified spill the ROSC must as soon as possible:

- ❑ Fax the MSA MDO a completed Marine Oil Spill Assessment form
- ❑ Request any MSA assistance required using the Regional Council Request for MSA Assistance form

Forms following this section:

MARINE OIL SPILL ASSESSMENT

- A template is provided to ensure that the spill information necessary to mount an appropriate response is collected
- Information includes spill location, weather conditions, predicted spill movement, spill size, and oil type
- The forms can be updated and used as a situation report (SITREP) throughout a spill response

NOTIFICATION OF A MARINE OIL SPILL

- A template is provided for Regional Councils to report details of all oil spills to the MSA
- For any potentially significant spill, the MSA Marine Duty Officer should be notified without delay of the spill, and whether MSA equipment or specialist advice may be needed
- For minor spills, the MSA should be notified within 3 days of the spill so data on spill size and frequency can be recorded in the national spill database

REGIONAL COUNCIL REQUEST FOR MSA ASSISTANCE

- A template is provided to request MSA assistance with equipment and/or specialist advice
- For any potentially significant spill, the MSA Marine Duty Officer should be immediately notified of the type and quantity of MSA equipment or specialist advice that may be needed
- Requests for assistance should be made as early as possible to allow personnel to be notified and prepared for possible mobilisation

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MARINE OIL SPILL ASSESSMENT (PAGE 1 OF 2)

FILL IN THIS FORM WITH A BLACK PEN. RETAIN BOUND ORIGINAL AND FAX A PHOTOCOPY TO THE MSA.

Incident Name: .... Report Number: ....

This report made by: .... Organisation: .... Date: .... Time: ....

Phone: .... Fax: .... Mobile: .... Pager: ....

Spill reported by: .... Organisation: .... Date: .... Time: ....

Phone: .... Fax: .... Mobile: .... Pager: ....

Address: .... Availability (next few hours): ....

Spill observed from:
❑ Vessel — Name: .... Flag State: ....
❑ Aircraft — Identification: .... Altitude: .... ft/m
❑ Land — Location: ....

SOURCE OF SPILL: .... Time spill started: ....

❑ Instantaneous spill: .... litres/tonnes ❑ Continuous spill: .... litres/tonnes per hour

TYPE OF OIL SPILT ....

Product name ....

Product origin ....

❑ Crude oil

❑ Refined product

Specific gravity .... at .... °C/°F

API gravity .... at .... °C/°F

Kinematic viscosity .... cSt at .... °C/°F

Pour point .... °C/°F

Volatility (flash point) .... °C/°F

SHAPE OF SLICK ❑ Oval ❑ Circle ❑ Square ❑ Rectangle ❑ Streamers ❑ Other ....

EXTENT OF SPILL

1. Overall length of spill = ... km

2. Overall width of spill = ... km

3. *Calculate* **TOTAL SPILL AREA =** .... **km²**
=spill length (1) X spill width (2)

4. *Estimate* proportion of total spill area *(3)* covered by oil: .... • .... maximum=1, (100%)

5. **ESTIMATED SLICK AREA =** .... **km²**
= total spill area (3) X proportion covered by oil (4)

ESTIMATED SPILL VOLUME – As a general rule of thumb use: 1 tonne (1000 L) of oil per Ha, 0.1 mm average thickness

Use the following table to:

i. Record the proportion of the slick area (5) made up by the oil appearances listed below (=A).
ii. Multiply (A) by the slick area (5), (=B).
iii. Multiply (B) by (C) to estimate oil volume (=D).
iv. Add (D) to estimate total oil volume.

Oil appearance	i. Proportion of slick area		ii. Slick area (km²)		iii. Approximate oil volume (m³/km²)	iv. Estimated oil volume (m³)
Silvery sheen Approx. 0.0001 mm thick (0.1 microns)	(A) ..... •	X slick area (5) =	(B)	X	(C) 0.1 (1 Litre/Hectare)	= (D) ....
Rainbow sheen Approx. 0.0003 mm thick (0.3 microns)	(A) ..... •	X slick area (5) =	(B)	X	(C) 0.3 (3 Litres/Hectare)	= (D) ....
Fresh dark/black oil Approx. 0.1 mm thick (100 microns)	(A) ..... •	X slick area (5) =	(B)	X	(C) 100 (1,000 Litres/Hectare)	= (D) ....
Brown/orange mousse Approx. 1.0 mm thick (1000 microns)	(A) ..... •	X slick area (5) =	(B)	X	(C) 1000 (10,000 Litres/Hectare)	= (D) ....
TOTAL	*Maximum=1*		.... km² Estimated slick area (5)			.... m³ Estimated total oil volume

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MARINE OIL SPILL ASSESSMENT (PAGE 2 OF 2)

FILL IN THIS FORM WITH A BLACK PEN. RETAIN BOUND ORIGINAL AND FAX A PHOTOCOPY TO THE MSA.

Incident Name:...Report Number:.............................

This report made by: .... Organisation: .... Date:................. Time:................

LOCATION OF SPILL ....

Latitude: .... South
Longitude: .... East/West
Time position fixed: .... Hours

OR Range and bearing <u>from</u> geographical feature:
Bearing:.. degrees true/magnetic
Distance: ....nm/km
Feature: ....

POSITION OF SOURCE ....

Latitude: .... South
Longitude: .... East/West
Time position fixed: .... Hours

OR Range and bearing <u>from</u> geographical feature:
Bearing:.. degrees true/magnetic
Distance: ....nm/km
Feature: ....

If spill source a vessel: Speed: .... knots Approximate course:..................... degrees true/magnetic

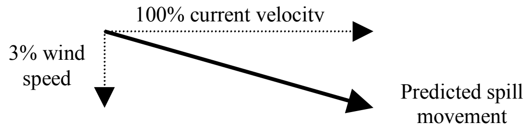
WEATHER CONDITIONS AT SPILL SITE ❑ Sunny ❑ Overcast ❑ Cloudy ❑ Rain ❑ Fog

Sea state: .... Wind speed: ....knots/km Air temperature:.................... °C
Wave height: .... m Wind direction: ....degrees true/magnetic Sea temperature: .... °C
Water depth:......................... m Visibility: .... nm/km Salinity: .... ppt

Weather and sea conditions expected over the next 24 hours: ....
....

PREDICTED SPILL MOVEMENT

Plot spill movement on appropriate nautical chart.
Predict slick direction and speed using
100% current velocity and 3% wind speed.



Note: Wind blows FROM the specified direction; currents flow TOWARDS the specified direction

Current velocity: .... knots/km
Current direction: ....degrees true/magnetic
Predicted slick speed:........................... knots/km

Tides: next low at..................hours, height.............. m
next high at ....hours, height.............. m
Predicted slick direction:............... degrees true/magnetic

Estimated distance to shore/sensitive area: ....nm/km
Estimated time for spill to reach shore/sensitive area: ....

Description of coastal areas and resources likely to be affected: ....
....
....
....

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NOTIFICATION OF A MARINE OIL SPILL

FILL IN THIS FORM WITH A BLACK PEN. RETAIN BOUND ORIGINAL AND FAX A PHOTOCOPY TO THE MSA.

Fax to: Marine Duty Officer (MDO)
Maritime Safety Authority of New Zealand (MSA)

URGENT **Fax: 04.473.1300** **Number of pages**
Phone: 04.472.7367 Pager: 086.816.159

NON-URGENT **Fax: 04.494.8901** ....

This report made by:.. Organisation: .... Date:................. Time:................

Phone: .... Fax: .... Mobile: .... Pager: ....

On-Scene Commander:....................................... Organisation: ....

Phone: .... Fax: .... Mobile: .... Pager: ....

ESTIMATED TIER OF RESPONSE:

❑ **Tier 1 – Local**	❑ **Tier 2 – Regional**	❑ **Tier 3 – National**
• Spiller identified • Spiller willing and able to respond adequately	• Beyond Tier 1 response capacity • Within 12 nautical miles • Council can respond adequately	• Beyond Tier 2 response capacity, or • Between 12 and 200 nautical miles • Response costs >$250,000

SITUATION REPORT:

Date of spill:... Time of spill: ....

Spill location: ....

Spill source and cause: ....

....

Vessel name: .... Flag state: .... MSA number:...............................

Estimated quantity of oil spilt: .... Type of oil spilt: ....

Response action taken: ....

....

....

IS MSA ASSISTANCE NEEDED? ❑ No ❑ Yes (Detailed request form to follow)

Does spill still require verification? .... YES/NO
Could a Tier 1 or Tier 2 response escalate to Tier 3? .... YES/NO
Are clean-up costs likely to exceed $5000? .... YES/NO
Is media interest likely?.. YES/NO
Is assistance from the MSA required?.. YES/NO
Is prosecution action likely?.. YES/NO

If 'NO' to all of the above, mark 'non-urgent' & fax this page to the MSA 04.473.1245 within 3 days.

If 'YES' to any of the above, notify the MDO immediately by phone, and fax the MDO this page.
Then complete and fax the **Marine Oil Spill Assessment form**. Do not delay notification. Include all available information, indicate information still to be obtained, and fax information updates when available.

MARITIME SAFETY AUTHORITY OF NEW ZEALAND
Te Mana Ārai Hauata Moana o Aotearoa

CAWTHRON

REGIONAL COUNCIL REQUEST FOR MSA ASSISTANCE

FILL IN THIS FORM WITH A BLACK PEN. RETAIN BOUND ORIGINAL AND FAX A PHOTOCOPY TO THE MSA.

Fax to: Marine Duty Officer (MDO)
Maritime Safety Authority of New Zealand (MSA)

URGENT **Fax: 04.473.1300**
Phone: 04.472.7367 Pager: 086.816.159

NON-URGENT **Fax: 04.494.8901**

Number of pages ....

This report made by:.. Organisation: .... Date:.................. Time:.................

Phone: .... Fax: .... Mobile: .... Pager: ....

On-Scene Commander:....................................... Organisation: ....

Phone: .... Fax: .... Mobile: .... Pager: ....

THE FOLLOWING ASSISTANCE IS REQUESTED FROM THE MSA

Advice on:

- ❑ Oil characteristics
- ❑ Response options
- ❑ Dispersants
- ❑ Spill movement
- ❑ Oil recovery
- ❑ Waste disposal
- ❑ Cost recovery
- ❑ Prosecution
- ❑ Media relations
- ❑ Other (specify):................
....
....

Staff and equipment:

- ❑ Spill managers
- ❑ Equipment operators (Number required: ....)
- ❑ Equipment (list below)
- ❑ Other (specify):..
....
....
....

EQUIPMENT REQUESTED: (Continue on separate page if necessary)

Type	Quantity	Priority	Type	Quantity	Priority
....	....	....	....	....	....
....	....	....	....	....	....
....	....	....	....	....	....
....	....	....	....	....	....
....	....	....	....	....	....
....	....	....	....	....	....
....	....	....	....	....	....

Delivery contact: ....

Delivery address:..

Phone: .... Fax: .... Mobile: .... Pager: ....

BOX 2 ARE SENSITIVE VALUES & HABITATS THREATENED BY THE SPILL?

			Date	Time
❑	Yes	Go to Box 3. Notify relevant wildlife/scientific advisers (refer to Tier 2 Plan)	....	....
❑	No	Go to Box 2A below. Continue monitoring spill	....	....

Back to flowchart

2.1 Assess the threat to sensitive values

i) Plot spill position on appropriate nautical chart.

ii) Estimate likely spill movement and speed using spill report data from the Marine Oil Spill Assessment form (Appended to section describing Box 1).

iii) Use any of the following relevant sources to identify if sensitive values are present in the spill location:

Information sources:

- ❑ Tier 2 Regional Plan
- ❑ Coastal Atlas
- ❑ Department of Conservation
- ❑ Ministry of Fisheries
- ❑ Regional/Local Council
- ❑ Fishing/Aquaculture Industry
- ❑ Charter boat operators
- ❑ Tourism agencies
- ❑ Port authorities
- ❑ Recreation groups – diving, boating, fishing
- ❑ Govt Institutes *e.g.* NIWA
- ❑ Maori/iwi
- ❑ Environmental groups
- ❑ University
- ❑ Other ....

2.2 Indicate the type of sensitive values threatened by the spill (NOTE: this is not an exclusive listing)

Environmentally important resources:

- ❑ Mangroves
- ❑ Salt marshes
- ❑ Seagrass beds
- ❑ Mudflats/sandflats
- ❑ Fish spawning/nurseries
- ❑ Sea birds
- ❑ Sea mammals
- ❑ Other..
- ❑ No environmental values threatened

Economically important resources:

- ❑ Marinas/ports/harbours
- ❑ Fishing/shellfish areas
- ❑ Fishing activity
- ❑ Aquaculture
- ❑ Water intakes
- ❑ Tourist beaches
- ❑ Recreation areas
- ❑ Other...
- ❑ No economic values threatened

2.3 Estimate if any threat to sensitive values is significant

Base this estimate on the values identified, the location and likely movement of the spill, and if known, the spill size and oil type. Significant threats can include ecological damage, high cleanup costs, slow natural recovery, effects to large areas, long-term economic impacts.

BOX 2A IS THE SPILL BEING MONITORED?

			Date	Time
❑	Yes	Return to Box 2. Continue to assess if sensitive values are threatened	....	....
❑	No	Return to Box 2. Start monitoring spill	....	....

Back to flowchart

Spill monitoring procedures are described in Tier 2 Regional and Tier 3 National contingency plans, and in Section 10 of this document. Record details on the Marine Oil Spill Assessment form (Appended to section describing Box 1). Important details to monitor include:

- Location of spill
- Position of source
- Weather conditions
- Spill movement
- Spill size
- Spill volume
- Areas likely to be affected
- Estimated time for oil to reach shore

BOX 3 IS DISPERSANT USE BEING CONSIDERED?

			Date	Time
❑	Yes	Go to Box 4. Notify relevant dispersant advisers (refer Tier 2 and 3 Plans)	....	....
❑	No	Go to Box 3A below. Assess other response options	....	....

Back to flowchart

Discussion Note 3.1 KEY BENEFITS OF DISPERSANT USE

- Dispersant use minimises the effects of an oil spill principally by dispersing oil before it reaches shorelines or sensitive areas (*e.g.* mangroves, estuaries).
- Removing oil from the surface of the water reduces the potential for impacts to birds and marine mammals, and limits the action of wind on spill movement.
- Dispersants can prevent oil from sticking to solid surfaces, and enhance natural degradation.
- Dispersants can effectively treat large spills more quickly and cheaply than most other response methods.
- Dispersants can be effective in rough water and strong currents where mechanical responses are limited.
- Effective dispersant responses can greatly reduce the quantity of oil requiring recovery and disposal.
- Dispersant use is often the only feasible response to spills that exceed mechanical response capabilities.
- Dispersant use does not generally limit other options, except oleophilic mechanical responses.
- Dispersed oil that cannot be mechanically recovered generally poses few significant environmental problems.

3.1 Consideration of dispersant use

Dispersant use should be considered if:

❑ Oil is likely to significantly impact birds, marine mammals, or other flora and fauna at the water surface
❑ Oil is likely to significantly impact shorelines, structures and facilities (*e.g.* marinas, wharves)
❑ Oil is likely to significantly impact economically important resources (*e.g.* shellfish beds, tourist beaches)
❑ Natural dispersion is limited
❑ Other response techniques are unlikely to be adequate, effective, or economical
❑ Sea/weather conditions preclude the use of other response techniques
❑ The oil could emulsify and form mousse or tar balls
❑ Other:...

BOX 3A ARE OTHER RESPONSE OPTIONS BEING ASSESSED?

			Date	Time
❑	Yes	See below. Determine and implement most appropriate response	....	....
❑	No	Go to Box 2A. Monitor the spill as a minimum response option	....	....

Back to flowchart

Consider all response options to identify which option, or combination of options, is most appropriate. The following options are described in Annex 8 of the National Plan:

- No action other than monitoring
- Containment and recovery of oil at sea
- Clean-up of oil from shorelines
- Dispersant
- Bioremediation
- *In situ* burning

BOX 4 IS DISPERSANT USE APPROPRIATE?

			Date	Time
❏	Yes	Go to Box 5. Determine if the oil is dispersible	....	....
❏	No	Go to Box 3A. Assess other response options	....	....

If dispersant use is considered appropriate, mobilise staff to commence operational planning for a dispersant response.

Back to flowchart

Discussion Note 4.1 ASSESSING THE APPROPRIATENESS OF DISPERSANT USE

- The most important question to answer is: **Will dispersant use significantly reduce the impact of the spilt oil?**
- Rapid decisions on use are essential as dispersant must be applied quickly to be effective.
- Decision-makers must consider the various environmental, social, economic, political, and cultural factors unique to each spill.
- Tradeoffs will be necessary, as no response is likely to satisfy all parties and protect all resources. Remember that the ecological impacts of oil are generally longer lasting and more persistent than most other impacts.
- Ecological effects will be due primarily to the spilt oil. Dispersant applied at recommended rates is unlikely to cause significant adverse effects, even in multiple applications.
- Oil dispersed into greater than 10m of water will quickly dilute to levels where acute toxic effects are unlikely.
- Few acute toxic effects have been reported for crude oil dispersed into less than 10m of well-flushed water.
- Small spills of light fuels seldom require dispersant use.

4.1 Is there a net environmental benefit in dispersant use?

❏ Yes ❏ No ❏ Neutral

Consider:

- The type and value of habitat potentially affected
- The sensitivity of affected resources to oil, and to different oil response strategies
- Natural recovery rates of affected species and habitats
- Likely oil persistence and degradation rates with and without dispersant use
- Potential oil toxicity on surface water species compared to water column and/or seafloor species

4.2 Are there benefits in dispersant use for any of the following values?

Social	❏ Yes	❏ No	❏ Neutral
Economic	❏ Yes	❏ No	❏ Neutral
Political	❏ Yes	❏ No	❏ Neutral
Cultural	❏ Yes	❏ No	❏ Neutral

Consider:

- Recreational and/or commercial use of potentially affected areas
- Relative social and economic costs of different response options
- Public and cultural expectations and concerns

Discussion Note 4.2 AREAS WHERE DISPERSANT USE IS <u>GENERALLY</u> NOT APPROPRIATE

- In shallow, nearshore areas, with limited circulation and flushing.
- Near aquaculture facilities, shellfish beds and fish spawning grounds.
- Around seawater intakes.

Discussion Note 4.3 NOTIFICATION OF DISPERSANT USE

- Notification is discretionary and should not delay any dispersant response.
- Dispersant use is pre-approved in all New Zealand marine waters, except marine reserves.
- Areas where dispersant use is not recommended are listed in Tier 2 plans.
- The OSC should notify relevant interest groups of any significant dispersant operation (suggested list follows).

4.3 Interest groups notified of a significant dispersant operation

Group notified	Person notified	Date	Time
❑ Department of Conservation	....	....	....
❑ Ministry of Fisheries	....	....	....
❑ Environmental groups	....	....	....
❑ Maori/iwi	....	....	....
❑ Aquaculture industry	....	....	....
❑ Fishing industry	....	....	....
❑ Port authorities	....	....	....
❑ Charter boat operators	....	....	....
❑ Tourism agencies	....	....	....
❑ Recreation groups	....	....	....
❑ Media	....	....	....
❑ Other (specify)	....	....	....

Interest groups should be provided with information on dispersants during spill pre-planning exercises so that they understand why dispersant use is considered a primary response option in New Zealand, and how it may contribute to an oil spill response. Written agreement should be sought from each interest group indicating that the impacts of dispersant use are understood, and that dispersant operations are considered generally acceptable where there is a net environmental benefit resulting from their use.

BOX 5 IS THE OIL POTENTIALLY DISPERSIBLE?

			Date	Time
❑	Yes	Go to Box 6. Determine if appropriate dispersants are available	....	....
❑	No	Go to Box 12. Do not use dispersant	....	....

Where oil type or characteristics are unknown, consider the oil potentially dispersible and go to Box 6.

Back to flowchart

Discussion Note 5.1 OIL DISPERSIBILITY

- The most important criterion for dispersant use is whether the oil is dispersible.
- The best indication of oil dispersibility is from specific oil weathering and dispersion data from field trials.
- Potential dispersibility can be *estimated* from physical properties of oils, under different oil weathering and spill scenarios (*e.g.* ADIOS).
- Dispersant use should not be rejected exclusively on the basis of predictive models.
- Unless certain that the oil is non-dispersible, testing dispersant on the actual spill is recommended (see Discussion Note 5.2 for explanation).

In general terms, if:

- Oil is able to spread on the water, it is likely to be dispersible.
- Viscosity is <2000 cSt, dispersion is probable.
- Viscosity >2000 cSt, dispersion is possible.
- Viscosity >5000 cSt, dispersion is possible with concentrate dispersant *e.g.* Corexit 9500.
- Sea temperature >10°C below oil pour point, dispersion is unlikely.

5.1 Obtain details on spilt oil characteristics
Characteristics of the spilt oil should be recorded on the Marine Oil Spill Assessment form.

5.2 Assess potential dispersion
Determine from the most relevant of:

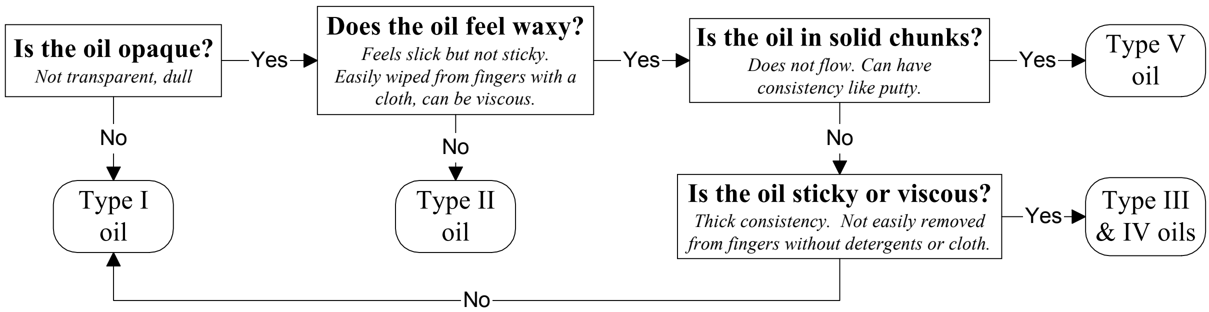
Table 5.1	Oil type classification flowchart
Table 5.2	Description of general oil characteristics based on oil type
Table 5.3	Prediction of general dispersibility based on oil characteristics
Table 5.4	Relationship between temperature and viscosity for selected oils
Table 5.5	ADIOS computer database (ADIOS predicts oil dispersion based on physical and chemical properties of spilt oil under specified spill conditions)
Table 5.6	Properties & predicted dispersibility of refined products likely to be encountered in NZ
Table 5.7a-b	Properties & predicted dispersibility of crude oils likely to be encountered in NZ

Discussion Note 5.2 LIMITATIONS OF PREDICTING DISPERSION

- Using generic values of viscosity and/or pour point to predict dispersion (*e.g.* ADIOS, Tables 5.2, Tables 5.6, 5.7) can underestimate the potential for oil to be dispersed.
- Most models are based on limited oil weathering, emulsification or dispersion data, therefore estimated windows of opportunity may be inaccurate.

It is recommended that dispersant effectiveness be tested directly on the spill if there is any doubt about the potential for oil to be dispersed

Table 5.1 OIL CLASSIFICATION FLOWCHART



Record oil type..Go to Table 5.2

Table 5.2 GENERAL CHARACTERISTICS OF DIFFERENT OIL TYPES

Type	Description	Characteristics	
I	**Light distillates** Specific Gravity: <0.80 API Gravity: >45 Viscosity: 0.5-2.0 cSt @ 15°C	• Non-persistent* • Very volatile and highly flammable • High evaporation rates • Rapid spreading rates	• Highly toxic to biota • Little, if any, emulsification • High penetration of substrate
	e.g. Maui & Kapuni distillate, Gasoline blendstocks, Motor spirit (RMS/PMS), Avgas, Jet A1, Kerosene		
	DISPERSION GENERALLY UNDESIRABLE DUE TO HIGH EVAPORATION RATE AND TOXICITY OF OIL		
II	**Light crudes** Specific Gravity: 0.80-0.85 API Gravity: 35-45 Viscosity: 4 cSt to solid @ 15°C (avg. 8 cSt)	• Non-persistent* • Moderate to high volatility • Low to moderate viscosity • Below pour points - behave like Group IV oil	• Moderate to high toxicity • Can form stable emulsions • Mod. to high penetration of substrates
	e.g. Automotive Gas Oil, Marine Gas Oil, Navy Gas Oil, Light crudes		
	DISPERSION GENERALLY POSSIBLE IF WATER TEMPERATURE ABOVE OIL POUR POINT		
III	**Medium – heavy crudes, fuel oils** Specific Gravity: 0.80-0.95 API Gravity: 17.5-35 Viscosity: 8 cSt to solid @ 15°C (avg. 275 cSt)	• Persistent** • Moderate volatility • Moderate viscosity • Below pour points - behave like Group IV oil	• Variable acute toxicity • Can form stable emulsions • Low to mod. penetration of substrates
	e.g. Light Fuel Oil, Medium – heavy crudes		
	DISPERSION GENERALLY POSSIBLE IF TREATED PROMPTLY & WATER TEMPERATURE ABOVE OIL POUR POINT		
IV	**Heavy crudes and residues** Specific Gravity: 0.95-1.00 API Gravity: 10.0-17.5 Viscosity: 1500 cSt to solid @ 15°C	• Persistent** • Low to moderate volatility • Moderate to high viscosity	• Variable acute toxicity • Can form stable emulsions • Low to mod. penetration of substrates
	e.g. Heavy Fuel Oil, Residues, Fletcher Blend, Maui F sands <pour point, Lube oils, Lube oil blendstocks		
	DISPERSION GENERALLY DIFFICULT, & NOT FEASIBLE IF WATER TEMPERATURE >10°C BELOW OIL POUR POINT		
V	**Non-spreading oils** Specific Gravity: >1.00 API Gravity: <10.0 Viscosity: solid (unless heated)	• Persistent** • Very low volatility • Little, if any, evaporation • Very high viscosity	• Very low acute toxicity • Can form stable emulsions • Little, if any, penetration of substrate
	e.g. Heavy Bunker Fuel Oil, Bitumen, Very heavy fuel oil		
	DISPERSION GENERALLY NOT FEASIBLE		

* **Non-persistent:** A petroleum based oil that, at the time of shipment, consists of hydrocarbon fractions of which at least 50% by volume distill at a temperature of 340°C (645 °F); and of which at least 95% by volume distill at a temperature of 370°C (700 °F).
** **Persistent:** A petroleum based oil that does not meet the distillation criteria for a non-persistent oil.

Table 5.3	GENERAL DISPERSIBILITY OF OIL

Pour point	Probably difficult or impossible to disperse	Medium weight material Fairly persistent Probably difficult to disperse if water temperature below pour point of oil	Light weight material Relatively non-persistent Probably difficult to disperse if water temperature below pour point of oil	No need to disperse Very light-weight material Oil will dissipate rapidly
5°C (41°F)		Medium weight material Fairly persistent Easily dispersed if treated promptly	Light weight material Relatively non-persistent Easily dispersed	

API gravity	17	34.5	45
Specific gravity	0.953	0.852	0.802

IMPORTANT NOTE: Dispersion estimates from this table will be conservative. If there is any doubt about oil dispersibility, dispersant should be tested directly on the spill for effectiveness.

Table 5.4	RELATIONSHIP BETWEEN TEMPERATURE AND VISCOSITY FOR SELECTED OILS

To determine the approximate viscosity of unweathered oil at a specific temperature, plot a line parallel with those shown below using viscosity at a known temperature:

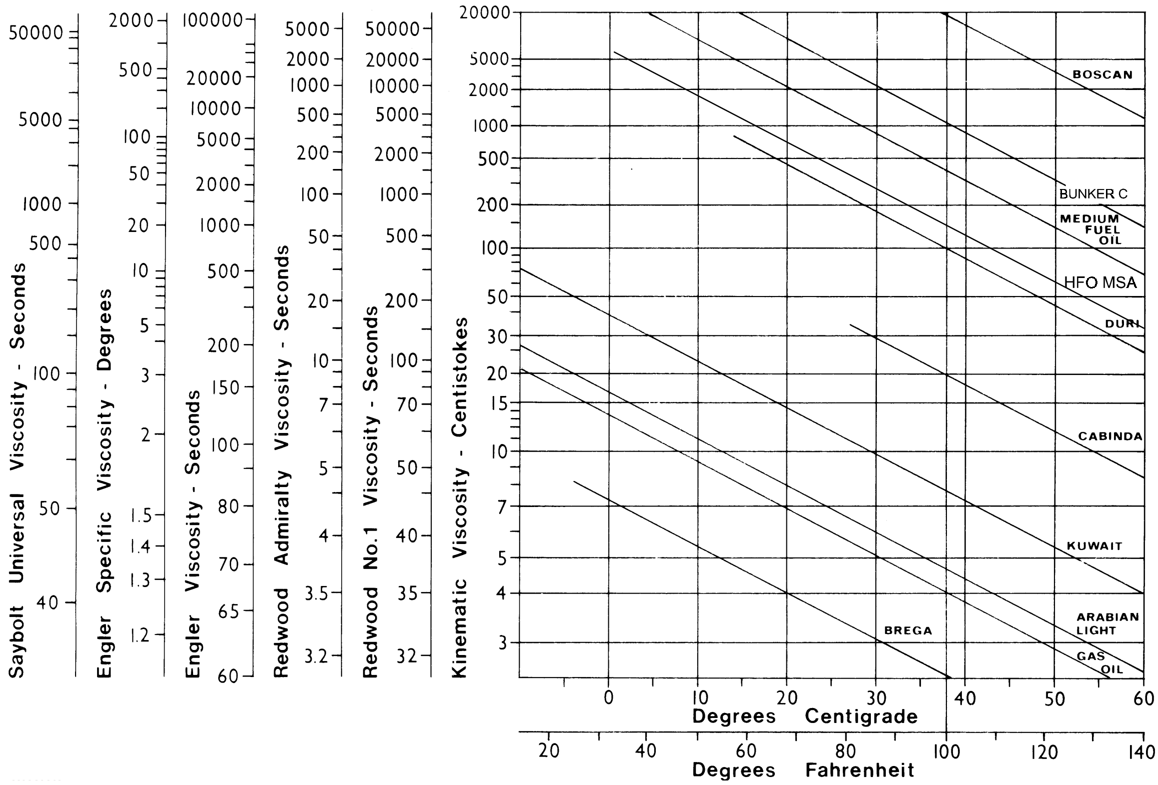


Table 5.5 ADIOS (AUTOMATED DATA INQUIRY FOR OIL SPILLS) COMPUTER DATABASE

ADIOS requires the following information to estimate the dispersibility of specific oils:
Use source information from page 1 of the Marine Oil Spill Assessment form.
Copies of ADIOS are held by the MSA & Regional Councils.
Copies are available from the NOAA website: http://response.restoration.noaa.gov/software/adios/adios.html

					Approximate water temp & salinity			
Oil/product name:	....	Wind speed:	.... m/s*		Aug	Feb		
Amount spilled:	.... m^3/tonnes	Wave height:	..............m	Northland	18 °C	25 °C	35.5 ppt
Type of release:	❑ Instantaneous	Water temp:	.............°C	Cook Strait	12 °C	18 °C	35 ppt
	❑ Continuous	Water salinity:	............ppt	Southland	4 °C	10 °C	34 ppt

*1 m/s=1.837 knots1 knot=0.544 m/s 1 m/s=3.6 km/h 1 km/h=0.278 m/s

IMPORTANT LIMITATIONS ON THE USE OF ADIOS

ADIOS predicts dispersibility based on estimates of oil properties (including emulsification) under different conditions. As emulsification data are scarce, **predicted rates of dispersion may be different to actual rates of dispersion.**
ADIOS is intended for use with floating oils only, and does not account for currents, beaching, or containment of oil.
ADIOS is unreliable for very large or very small spills. It is also unreliable when using very high or very low wind speeds in modelling the spill.

Table 5.6 GENERAL DISPERSIBILITY OF REFINED PRODUCTS

Refined product name	Specific Gravity @ 15.5 °C	API Gravity @ 15.5 °C	Pour Point °C	Viscosity cSt @ 20°C	Dispersibility at Specified Sea Temperature Ranges (°C) 7-13	13-18	18-24	>24
Asphalt (Bitumen) - no solvent	0.99-1.2	NA	+40 to+80	Solid	No?	No?	No?	No?
Automotive Gasoil	0.84	36.3	-15	7.5	Yes	Yes	Yes	Yes
Aviation Gasoline	0.716	66.2	-60	1.0	Yes	Yes	Yes	Yes
Bunker Fuel C (No 6 fuel oil)	0.984	12.3	+15	Solid	No?	No?	No?	Yes?
Bunker Fuel C	1.000	10.0	+2	Solid	No?	No?	Yes?	Yes?
Bunker Fuel C (BHP Hawaii)	0.993	11.0	+10	>3000	No?	No?	No?	Yes?
Bunker Fuel No 6 (BP)	0.991	11.3	-1	>800	No?	No?	No?	Yes?
Bunker Fuel No 6 (Phillips)	1.022	7.0	+26	>650	No?	No?	No?	Yes?
Bunker Fuel Caltex/Ampol (K-940)	0.991	11.3	+15	>2000	No?	No?	No?	Yes?
Bunker Fuel Shell (FO-467)	0.980	12.9	+15	>300	No?	Yes?	Yes?	Yes?
Diesel (automotive Winter blend)	0.855	34.0	-20	7.0	Yes	Yes	Yes	Yes
Diesel (automotive Summer blend)	0.865	32.0	-12	13.0	Yes	Yes	Yes	Yes
Diesel (Marine Diesel/Gasoil)	0.854	34.2	-11	13	Yes	Yes	Yes	Yes
Gasoline	0.739	60.0	-18	3.0	Yes	Yes	Yes	Yes
Gasoline (Leaded)	0.750	57.2	-29	1.0	Yes	Yes	Yes	Yes
Heating Oil (fuel oil #2)	0.876	30.0	-12	7.0	Yes	Yes	Yes	Yes
Heating Oil (fuel oil #5)	0.925	21.5	-9	190	No	No	Yes?	Yes
Heavy Fuel Oil	0.94	17.5	(-6–15)	1343	No?	No?	No?	Yes?
IF-30 Bunker	0.936	19.7	-6	180	No?	No?	Yes?	Yes
IFO-180 Bunker (BHP)	0.983	12.5	(4-15)	>1000	No?	No?	Yes?	Yes?
IFO-280 Bunker (BHP)	0.986	12.0	(4-15)	>1700	No?	No?	No?	Yes?
IFO-380 Bunker (BHP)	0.990	11.5	(4-15)	>2400	No?	No?	No?	Yes?
Jet Fuel (fuel oil #1 A-1)	0.806	44.0	NA	1.0	Yes	Yes	Yes	Yes
Jet Fuel (JP-1)	0.800	45.4	-40	1.2	Yes	Yes	Yes	Yes
Kerosene (dual purpose, fuel oil #1)	0.800	45.4	-25	1.5	Yes	Yes	Yes	Yes
Light Fuel Oil	0.91	23.9	(-9<-24)	166	Yes	Yes	Yes	Yes
Lube Oil 10W30	0.882	29.0	-40	200	No?	Yes?	Yes?	Yes
Naphtha (White Spirit)	0.794	46.8	NA	1.0	Yes	Yes	Yes	Yes
Naphtha (EXXON)	0.758	55.0	-17	3.0	Yes	Yes	Yes	Yes
No 2 Fuel Oil	0.871	31.0	-30	6.5	Yes	Yes	Yes	Yes
Mineral Spirits (Petroleum Spirit)	0.794	46.8	NA	1.0	Yes	Yes	Yes	Yes
Paraffin/Waxes	-	-	-	Solid	No?	No?	No?	No?
Residual Oils #6	0.986	12.0	+15	>45,000	No?	No?	No?	No?
Solvents	-	-	-	1-5	No?	No?	No?	No?
Transformer Oil (Electrical Oil)	0.883	28.8	-30	18	Yes?	Yes	Yes	Yes

Shaded cells indicate products used in NZ
? indicates where data on the potential for dispersion are not unanimous or uncertain

Oil Chemistry Data Sources ITOPF, USCG, IMO, AMSA, & Oil Companies
Dispersibility is based upon the chemical composition of the fresh product and not from any specific testing
Confirmation of dispersibility requires laboratory and/or field testing under various conditions

Table 5.7a GENERAL DISPERSIBILITY OF CRUDE OIL

Crude oil name	Specific Gravity @ 15.5 °C	API Gravity @ 15.5 °C	Pour Point °C	Viscosity cSt @ 20°C	Dispersibility at Specified Sea Temperature Ranges (°C) 7-13	13-18	18-24	>24
A960 Residue (Saudi Arabia)	0.959	17.3	+12		Yes?	Yes?	Yes	Yes
Alaskan (North Slope)	0.896	26.4	-18	160	Yes	Yes	Yes	Yes
Algerian Blend (Algeria)	0.799	45.5	-29	18	Yes	Yes	Yes	Yes
Anoa (Indonesia)	0.799	45.5	16	3.03	Yes	Yes	Yes	Yes
Arun Condensate (Indonesia)	0.761	54.4	-30	1.0	Yes	Yes	Yes	Yes
Arabian Extra Light (Saudi Arabia)	0.831	38.76	-20.3	4.5	Yes	Yes	Yes	Yes
Arabian Light (Saudi Arabia)	0.861	32.9	-36	10.7	Yes	Yes	Yes	Yes
Arabian Medium (Saudi Arabia)	0.872	30.8	-15	25	Yes	Yes	Yes	Yes
Arabian Heavy (Saudi Arabia)	0.887	28.3	-36	65.1	Yes	Yes	Yes	Yes
Bach Ho (Vietnam)	0.855	34.0	+33	Solid	No	No	No?	No?
Bachequero (Venezuela)	0.973	14.0	-17	>3000	No?	No?	No?	Yes?
Barrow Island (Aust NW Shelf)	0.841	36.7	-60	3.0	Yes	Yes	Yes	Yes
Basrah Light (Iraq)	0.857	33.7	-15	9	Yes	Yes	Yes	Yes
Basrah Heavy (Iraq)	0.909	24.2	-30	54.4	Yes	Yes	Yes	Yes
Bekapai (Indonesia)	0.825	41.0	-12	3.15	Yes	Yes	Yes	Yes
Belinda (Indonesia)	0.801	43.0	+16	2.55	No	Yes?	Yes	Yes
Boscan (Venezuela)	0.994	10.9	+21	Solid	No?	No?	No?	No?
Brae (North Sea - UK)	0.857	33.6	-6	8	Yes	Yes	Yes	Yes
Brass River (Nigeria)	0.801	45.2	+9	2.55	Yes	Yes	Yes	Yes
Brent Crude (UK)	0.835	37.9	-9	6.1	Yes	Yes	Yes	Yes
Challis (Timor Sea)	0.827	39.6	-15	3.0	Yes	Yes	Yes	Yes
Champion (Brunei?)	0.902	25.37	-51	12.0	Yes	Yes	Yes	Yes
Cinta (Indonesia)	0.865	32.0	+39	99.1	No?	No?	No?	No?
Cooper Basin (Aust)	0.800	45.4	+12	7	No?	Yes	Yes	Yes
Dia Hung (Vietnam)	0.840	36.9	+27		No?	No?	No?	Yes?
Dubai (Dubai)	0.860	32.8	-29	20	Yes	Yes	Yes	Yes
Enhanced Maui (NZ)	0.770	52.22	< -24	0.7	Yes	Yes	Yes	Yes
Ekofisk (North Sea - Norway)	0.825	40.1	-6	9	Yes	Yes	Yes	Yes
Forties (North Sea - UK)	0.838	37.4	-5	8	Yes	Yes	Yes	Yes
Gippsland Crude/Bass Strait (Aust)	0.800	45.4	+15	3.1	No?	No?	Yes	Yes
Griffin (Nth West Aust)	0.758	55.0	-48	1.2	Yes	Yes	Yes	Yes
Halibut (Gippsland)	0.817	41.7	+10	9	Yes?	Yes?	Yes	Yes
Handil (Indonesia)	0.858	33.4	+27	5.42	No	No	No	No
Harriet	0.837	37.5	+6		Yes	Yes	Yes	Yes
Iranian Light (Iran)	0.859	33.2	-15	20	Yes	Yes	Yes	Yes
Iranian Heavy (Iran)	0.979	13.0	-6	30	Yes	Yes	Yes	Yes
Jabiru (Timor Sea Aust)	0.814	42.3	+15	3.7	Yes?	Yes?	Yes	Yes
Kaimiro Crude (NZ)	0.846							
Kapuni (NZ)	0.734	61.3	+12	1.18	Yes	Yes	Yes	Yes

Shaded cells indicate products used in NZ.
? indicates where data on the potential for dispersion are not unanimous or uncertain

Oil Chemistry Data Sources ITOPF, USCG, IMO, AMSA, & Oil Companies
Dispersibility is based upon the chemical composition of the fresh product and not from any specific testing
Confirmation of dispersibility requires laboratory and/or field testing under various conditions

Table 5.7b	GENERAL DISPERSIBILITY OF CRUDE OIL continued…

Crude oil name	Specific Gravity @ 15.5 °C	API Gravity @ 15.5 °C	Pour Point °C	Viscosity cSt @ 20°C	Dispersibility at Specified Sea Temperature Ranges (°C) 7-13	13-18	18-24	>24
Khafji (Saudi Arabia)	0.891	27.3	-22	48.5	Yes	Yes	Yes	Yes
Kutubu (PNG)	0.806	44.0	+3	2.1	Yes	Yes	Yes	Yes
Kuwait (Kuwait)	0.873	30.6	-12	25.0	Yes	Yes	Yes	Yes
Lakes Entrance (Aust)	0.959	16.0	-15	250	No?	Yes?	Yes?	Yes?
Labuan (Malaysia)	0.87	31.14	+15	4.29	Yes?	Yes?	Yes	Yes
Maui Condensate (NZ)	0.74	60.2			Yes?	Yes?	Yes?	Yes?
Maui F Sand (NZ)	0.81	43.19	+18	3.15	No?	No?	Yes	Yes
Maui-B (NZ)	0.74	59.9	-45	0.73	Yes	Yes	Yes	Yes
McKee Crude (NZ)	0.813				No?	No?	Yes?	Yes?
McKee Fletcher Blend (NZ)	0.827	39.6	+9	6.41	No?	No?	Yes?	Yes?
Minas (Indonesia)	0.853	34.3	+36	29.9	No	No	No	No
Miri Light (Malaysia)	0.875	30.6	-12	7.78	Yes	Yes	Yes	Yes
Murban (Abu Dhabi)	0.825	39.9	-9	4.3	Yes	Yes	Yes	Yes
Ngatoro-1 Crude (NZ)	0.848							
Ngatoro-2 Crude (NZ)	0.887							
Nigerian Light (Nigeria)	0.846	35.8	+15	7	No?	Yes?	Yes	Yes
Nigerian Medium (Nigeria)	0.905	24.8	-30	45	Yes	Yes	Yes	Yes
Nth West Shelf Condensate (Aust)	0.740	59.7	-48	0.79	Yes	Yes	Yes	Yes
Oman (Oman)	0.856	33.8	-30	21.2	Yes	Yes	Yes	Yes
Pilon (Venezuela)	0.970	13.5	-12	>5000	No?	No?	No?	No?
Santa Cruz (Argentina)	0.788	48.18	-21	2.47	Yes	Yes	Yes	Yes
Saladin (Aust)	0.787	48.2	-30	1.7	Yes	Yes	Yes	Yes
Stratfjord (UK)	0.836	37.8	-5	6	Yes	Yes	Yes	Yes
Suka (Timor Sea)	0.813	42.5	+9	3.0	No	Yes?	Yes	Yes
Syngas (NZ)	0.73	61.0			Yes?	Yes?	Yes?	Yes?
Taching (China)	0.860	33.0	+35		No	No	No?	No?
Talisman	0.820	41	+9		Yes?	Yes	Yes	Yes
Tapis (Malaysia)	0.798	45.7	+6	2.7	Yes	Yes	Yes	Yes
Thevenard (Australia)	0.826	39.77	-24	3.83	Yes	Yes	Yes	Yes
Trinidad (Trinidad)	0.876	30.0	+7	15	Yes?	Yes	Yes	Yes
Umm Shaif (Abu Dhabi)	0.841	36.85	-18	6.1	Yes	Yes	Yes	Yes
Undang (Borneo)	0.827	39.6	+37	90	No?	No?	No?	No?
Varanus	0.797	46.04	+9	4.0	Yes	Yes	Yes	Yes
Venezuela Mix (Venezuela)	0.919	22.5	-32	150	Yes	Yes	Yes	Yes
Waihapa Crude (NZ)	0.752				Yes?	Yes?	Yes?	Yes?
Wandoo	0.940	19.3	-30	182	Yes?	Yes	Yes	Yes
West Texas Intermediate (USA)	0.830	39.0	-21	4.9	Yes	Yes	Yes	Yes
Widuri (Indonesia)	0.864	32.1	+42	Solid	No	No	No	No
Zaire (Zaire)	0.867	31.7	+26		No	No	No?	No?

Shaded cells indicate products used in NZ
? indicates where data on the potential for dispersion are not unanimous or uncertain

Oil Chemistry Data Sources ITOPF, USCG, IMO, AMSA, & Oil Companies
Dispersibility is based upon the chemical composition of the fresh product and not from any specific testing
Confirmation of dispersibility requires laboratory and/or field testing under various conditions

BOX 6 ARE DISPERSANTS AVAILABLE?

			Date	Time
❑	Yes	Use the tables below to determine if dispersants are available, then go to Box 7 to determine if dispersant can be applied safely	....	....
❑	No	Go to Box 12. Do not use dispersant	....	....

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6.1 Identify suitable dispersants available in NZ
Determine from the most relevant of:

Table 6.1	Suitability of dispersant for use on different oil types
Table 6.2	Summary of dispersant types
Table 6.3	Dispersants approved and held by the MSA
Table 6.4	Location and quantity of MSA dispersant stocks
Table 6.5	Effectiveness test results of MSA dispersant stocks

- A test application may be required to determine dispersant effectiveness
- It may be necessary to test several different dispersants to find an effective product
- Dispersant must be available within the timeframe that dispersants are likely to be effective
- Additional dispersant stocks or products may need to be brought into the country

Table 6.1 SUITABILITY OF DISPERSANT FOR USE ON DIFFERENT OIL TYPES

	Oil Type	Dispersant Type			Limits on use
		Type 1: Conventional	Type 2: Water-Based	Type 3: Concentrate	
I	Light distillate fuels		✓	✓	Dispersion generally undesirable except in cases of fire hazard due to high evaporation rate and toxicity of oil
II	Light crudes	✓	✓	✓	Dispersion generally possible if water temperature above oil pour point
III	Medium – heavy crudes, fuel oils			✓	Dispersion generally possible if treated promptly and if water temperature above oil pour point
IV	Heavy/waxy crudes and residues	✓		✓	Dispersion may be possible, but not feasible if water temperature >10ºC below oil pour point
V	Non-spreading oils Very heavy fuel oils, bunker oils	Dispersion generally not feasible			

Table 6.2 SUMMARY OF DISPERSANT TYPES

Name	Generation	Type	Application mode	Solvent type	Toxicity
Conventional dispersants	2nd	1	Undiluted from vessel 1:1-1:3	Non-aromatic hydrocarbon 10-25% surfactant	Low
Concentrate dispersants	3rd	2	Diluted from vessel as 10% solution in seawater 1:1-1:3 diluted dispersant:oil	Oxygenates or polar organic & non-aromatic hydrocarbons 25-60% surfactant	Very low
Concentrate dispersants	3rd	3	Undiluted from aircraft &/or vessel 1:20-1:50		

High toxicity 1st generation dispersants (detergents, degreasers) are no longer used.

Table 6.3 DISPERSANTS APPROVED FOR USE IN NZ, AND TOTAL STOCKS HELD BY THE MSA

Approvals as at June 2000

Type 1 Dispersant	Stock	Type 2 Dispersant	Stock	Type 2/3 Dispersant	Stock
~~BP1100X~~	-	~~BP 1100WD~~	-	~~Atpet 787~~	-
BP A-B	-	Castrol Solvex OSD 9 Conc	-	Corexit 9527	32,800L
~~Castrol Atlas OSD~~	-	Gamlen OSD LT*	70,400L	Shell VDC/Slickgone LTSW	101,400L
~~Drew Ameroid OSD/LT~~	-	~~Corexit 9600~~	-	Simple Green*	20,000L
Gamlen OSR LT	-	~~Quell Oil C1~~	-	**Type 3 Dispersant**	
Shell Dispersant ND	-	Shell Dispersant Conc	-	BP Enersperse 1037	-
~~Shell SD LT~~[X]	-	~~Surflow OW1~~	-	~~Shell Dispersant HEC~~	-
Tergo (Rochem) OSR WSA	-	Tergo (Rochem) OSR LT	-	Tergo (Rochem) R40*	29,700L

* Considered appropriate for freshwater use
Struck-out products are no longer manufactured, and continued approval for use in NZ is currently being reviewed

The use of beach cleaners and other chemicals requires assessment and approval by the MSA

Only approved dispersants are to be considered for use in NZ

Table 6.4 LOCATION AND QUANTITY OF MSA DISPERSANT STOCKS

Inventory as at June 2000

	Gamlen OSD LT	Shell Disp VDC	Corexit 9527	Tergo R40	Simple Green	Slickgone LTSW
NOSSC Te Atatu	10,400	17,000	14,000	25,900	15,820	70,000
Northland	4,000	800	9,600	3,200	4,180	-
Auckland	4,000	800	-	-	-	-
Waikato	4,000	800	-	-	-	-
Bay of Plenty	4,000	800	-	600	-	-
Taranaki	4,000	800	-	-	-	-
Gisborne	4,000	800	-	-	-	-
Hawkes Bay	4,000	800	-	-	-	-
Wanganui	-	1,600	-	-	-	-
Wellington	4,000	800	7,200	-	-	-
Marlborough	4,000	800	-	-	-	-
Tasman/Nelson	4,000	800	-	-	-	-
West Coast	4,000	800	-	-	-	-
Lyttleton	2,800	800	1,200	-	-	-
Timaru	1,200	800	-	-	-	-
Otago	4,000	800	-	-	-	-
Southland	4,000	800	-	-	-	-
Chathams	4,000	800	800	-	-	-

These stocks are available for immediate distribution to other regions in the event of a significant oil spill.
Refer to Tier 2 Regional Plans to obtain non-MSA held dispersant.
Refer to Annex 19 of the National Plan to obtain international dispersant.

Table 6.5 EFFECTIVENESS TEST RESULTS OF MSA DISPERSANT STOCKS*

	Unweathered IFO-180 Seawater (34ppt)			Unweathered IFO-180 Freshwater
1:25 dispersant:oil ratio	**5°C**	**10°C**	**15°C**	**10°C**
Corexit 9527		most effective		ineffective
Shell VDC (Slickgone LTSW)	↑			ineffective
Gamlen OSD LT	↑			effective
Tergo (Rochem) R40	↑			effective
Simple Green	least effective			ineffective

** These preliminary effectiveness testing results on unweathered oil are for general guidance only and relate to specific stocks of dispersant held by the MSA. Further effectiveness testing is scheduled by the MSA for late 2000.*

Discussion Note 6.1 DISPERSANT EFFECTIVENESS TEST KITS

- Dispersant test kits can be used to determine the relative effectiveness of different dispersants.
- Dispersant test kits do not provide a reliable measure of dispersion rates or likely application success.
- The MSA and each Regional Council hold test kits and detailed instructions for their use.

SAMPLING INSTRUCTIONS FOR DISPERSANT EFFECTIVENESS TEST ING

1. Collect samples as soon as possible after the spill.
2. Collect oil samples from representative parts of the slick, particularly areas appearing visually distinct.
3. Collect oil samples in clean containers (preferably glass, but any clean container will do)
   Avoid potential sources of hydrocarbon contamination (*e.g.* vessel exhausts).
   Avoid potential cross contamination between samples (*e.g.* use disposable gloves for each sample).
4. Ensure sufficient oil is collected for the testing planned (ideally 5 mls of oil per test). If an oil and seawater mixture is collected, excess water may need to be removed with a syringe to obtain sufficient oil.
5. Label sample containers with:
   Sample number, location, time, date, approximate time since oil spilt, sampler/s name.
6. Record relevant sample collection details including slick appearance, presence of emulsions, type of oil, *etc*.
7. Follow the instructions in the test kit to determine the relative effectiveness of test kit dispersants.
8. Rank and record the effectiveness of the test kit dispersants.

Note that chain of custody records and full sample security procedures are not required for effectiveness samples

BOX 7 CAN DISPERSANT BE APPLIED SAFELY?

			Date	Time
❑	Yes	Go to Box 8. Assess if field trials are possible	....	....
❑	No	Go to Box 12. Do not use dispersant	....	....

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Discussion Note 7.1 GENERAL SAFETY ISSUES

- The OSC is responsible for ensuring Health and Safety requirements are adequately addressed during a response.
- Individuals should not engage in activities that they are not appropriately trained to perform.
- Individuals are expected to adhere to safety procedures appropriate to the conditions they are working under.
- Vessel/aircraft operators are expected to define appropriate operational limits & safety and maintenance requirements for their craft.
- Aircraft should be regularly washed with fresh water to remove any dispersant and salt water, particularly from the tail rotor assembly of helicopters, or exposed rubber components of aircraft controls.
- Material Safety Data Sheets (MSDS) for MSA stocked dispersants are contained in Annex 9 of the National Plan.

7.1 Determine if dispersant can be applied safely

❑ There is no significant risk to response personnel (*e.g.* ignition risk, operational hazards *etc*).
❑ Response personnel are appropriately trained and briefed
❑ Appropriate personal protective equipment is available
❑ Application aircraft and vessels will remain within standard operating limits

HUMAN SAFETY OVERRIDES ALL OTHER CONSIDERATIONS DURING A RESPONSE

7.2 Responsibilities for the safe application of dispersant

Each person involved in a response is required to take personal responsibility for his or her safety. The OSC will appoint a Health and Safety Co-ordinator if required.

Key safety aspects to consider:

- Physical hazards (*e.g.* waves, tides, unstable or slippery surfaces)
- Heavy machinery and equipment
- Chemical Hazards (*e.g.* oil and dispersant exposure)
- Atmospheric hazards (*e.g.* fumes, ignition risks)
- Confined spaces
- Personal Protective Equipment (PPE)
- Noise
- Fatigue
- Heat/cold stress
- Wildlife (bites/stings)
- Cleanup facilities
- Medical treatment

BOX 8 CAN FIELD TRIALS FOR EFFECTIVENESS BE UNDERTAKEN?

			Date	Time
❑	Yes	Go to Box 9. Start field trial and dispersant monitoring programme	....	....
❑	No	Go to Box 12. Do not use dispersant	....	....

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Discussion Note 8.1 FIELD TESTING DISPERSANT

- Field tests are the best way to determine whether spilt oil can be successfully dispersed.
- Monitoring is required to determine the effectiveness of different dispersants and application ratios.
- Field tests should not delay a dispersant response if the application has a reasonable likelihood of being successful, and there is a narrow window of opportunity, and/or weather conditions are forecast to deteriorate rapidly.
- If field trails are not possible, dispersant applications will also not be possible.

8.1 Identify the preferred application method/s

Detailed guidance for selecting application methods is beyond the scope of this document. The On-Scene Commander is expected to guide the application method selection process considering aspects such as availability, speed, capacity, duration, effectiveness, cost, and safety. Regional Tier 2 plans provide details on available options. Table 8.1 provides a very general summary of the capacity and characteristics of application methods likely to be considered.

8.2 Assess if field trials can be undertaken

- ❑ Confirm that trained staff and application platforms are available within a suitable time frame.
- ❑ Confirm appropriate dispersant is available.
- ❑ Ensure effectiveness monitoring can be undertaken.
- ❑ Ensure conditions at the spill site are within operational limits of the available application method/s.

Dispersant applications are generally not effective when wind speeds exceed 25-30 knots as dispersant efficiency is reduced when blown off target, and when applied to breaking seas.

8.3 Reassessment of whether field trials can be undertaken

Regularly review decisions about whether field applications are possible until a dispersant response is no longer considered feasible.

8.4 Select dose rate

As a general guide, **a dispersant:oil ratio of 1:20 is recommended**. However, dispersion will be affected by many factors including oil type, weathering, slick thickness, application method, and prevailing conditions. The On-Scene Commander should set specific dispersant dose rates based on any relevant information available for the spilt oil *e.g.* laboratory results or past experience. Most importantly, the results of effectiveness monitoring of a field trail should be used to revise the dose rate.

8.5 Mobilise monitoring of field trials

Field trials must be monitored to determine how effectively oil is dispersed with the selected dispersant, application ratio, and method. Details of monitoring methods are described in Section 10.

Table 8.1 KEY PARAMETERS OF DIFFERENT DISPERSANT APPLICATION METHODS

Platform	Capacity (tonnes)	App. rate (L/Ha)	Spray width (m)	Manoeuvr -ability	Range	Tonnes oil treated per hour
Helicopter	0.5-3	80-200	15-20	excellent	medium	-
Single engine aircraft	0.5-1.5	50-100	15-20	good	medium	40
Multi engine aircraft	5-20	50-100	20-40	poor	long	400
Boat	0.5-6.5	100-350	5-20	good	long	5-10 (Type 2) 75 (Type 3)
Back pack	<0.020	-	0.5-1	excellent	short	0.3-3
Fixed hose & eductor	-	-	5-10	v. limited	v. short	1

Platform	Area best suited to:	Advantages	Disadvantages
Helicopters	harbour/coastal	Treat areas with poor access Useful in multiple roles High treatment rate Seldom require modification Operate at low speeds (<150 kph) Don't require runway	More expensive than planes Limited capacity
Single engine aircraft	harbour/coastal	Relatively cheap Readily available High treatment rate Operate at low speeds (<200 kph) Only need a rudimentary airstrip	Limited capacity May require nozzle adaptation
Multi engine aircraft	coastal/offshore	Most efficient option for large spills Large capacity High treatment rate	Limited availability Require long runway Require extensive operational support Expensive Operate at high speeds (200-400 kph)
Boats	harbour/coastal/ offshore	Relatively cheap Equipment fits a range of vessels Large capacity	Limited swath width Limited operational distance and speed Require aircraft guidance to thickest oil
Back packs	foreshore/ harbour	Light, portable, cheap Can be used in inaccessible areas (*e.g.* under wharves)	Small payload Low application rate
Hose & eductor	wharf/foreshore	Generally available Provide good mixing energy Few personnel required to use	Difficult to calibrate and/or control dose rate and droplet size Usually freshwater (most dispersants are formulated for seawater use) Tendency to overdose

BOX 9 APPLY DISPERSANT

		Date	Time
❑ Yes	Go to Box 10. Monitor dispersant effectiveness	....	....

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Discussion Note 9.1 GENERAL APPLICATION INFORMATION

- The On-Scene Commander has final responsibility for operational aspects of dispersant applications.
- Dispersant must only be applied by experienced spray applicators.
- Dispersant must be applied in accordance with manufacturers instructions, unless approved otherwise by the OSC.
- The person applying dispersant is responsible for the calibration and operation of the spraying system, and the safety and maintenance of the application platform.
- Droplet size is the key variable influencing dispersant effectiveness. Undersized droplets (*e.g.* fog or mist) will be lost through drift and evaporation. Oversized droplets will punch through the oil and be lost in the water column.
- Dispersants pre-diluted in water are less effective than undiluted dispersant.
- Only undiluted concentrate dispersant is applied from aircraft.
- Dispersant should, where possible, be applied into the wind and parallel with the slick.
- Dispersant should be applied in a methodical and continuous manner to ensure the entire target area is treated.
- Dispersants are generally more effective, and smaller quantities are needed, on fresh oil compared to weathered oil.
- Spraying effort should concentrate on the thickest sections of oil that threaten sensitive areas.
- Thick portions of the slick may require several applications.
- Oil sheen should not be sprayed with dispersant.

9.1 Dispersant application

❑ Calculate the volume of oil to be dispersed from the Marine Oil Spill Assessment form
❑ Determine the dispersant application ratio (usually 1:20)
❑ Calculate the volume of dispersant required

Record details on the Dispersant Application Summary form

❑ Mobilise application team
❑ Mobilise monitoring team

A general guide is provided below for each of the main application methods. The guides are intended simply to highlight key issues. The On-Scene Commander is expected to co-ordinate and oversee operational aspects of dispersant applications. Dispersant applicators and equipment are listed in Tier 2 and Tier 3 contingency plans.

Discussion Note 9.2 AERIAL APPLICATION

- Aircraft application should always include pump driven spray units.
- Dispersant droplet size should be between 400 and 1000 microns.
- Commercial aircraft spraying nozzles generally range between 350 to 700 microns.
- The MSA can supply 1000 micron spray nozzles for use on viscous oils.
- Nozzles should achieve an application rate of between 20 and 100 litres per hectare.
- Spray nozzles should be installed to discharge directly aft.
- Underslung buckets on helicopters should be mounted so the pilot can see the ends of the spray booms in flight.
- The altitude of the aircraft should be as low as possible.
- Recommended aircraft speed and altitude are shown in Table 9.1.

Table 9.1 RECOMMENDED AIRCRAFT SPEED AND ALTITUDE FOR MSA DISPERSANT STOCKS

Dispersant	Viscosity cSt @ 10^0C	Viscosity cSt @ 20^0C	Recommended ground speed and altitude for spraying
Slickgone LTSW (Shell VDC)	59	32	Speed < 100 mph, Altitude 30-50 ft
Corexit 9527	85	47	At 10^0C, Speed > 100 mph, Altitude 50-100 ft At 20^0C Speed < 100 mph, altitude 30-50 ft
Tergo R40	113	62	Speed > 100 mph, Altitude 50-100 ft

Dispersant viscosity > 60 cSt is suitable for aerial application at speeds greater than 100 mph, at 50-150 ft. altitudes.
Dispersant viscosity at 30 to 60 cSt is suitable for aerial application at speeds less than 100 mph, at 30-50 ft. altitudes.

Discussion Note 9.3 BOAT APPLICATION

- Spray booms should be mounted as far forward as possible to prevent oil being moved aside by the bow wave before being sprayed. This then utilises the mixing energy of the bow wave to break up the oil.
- Spraying systems should be set so that the spray pattern is flat, striking the water in a line perpendicular to the direction of the boat's travel.
- The fan shaped sprays from adjacent nozzles should be set as low as possible, overlapping just above the oil/water surface, with the inboard spray striking the hull just above the water line.

Undiluted dispersants

- Air blast sprayers and modified spray pumps can be used to apply undiluted concentrated dispersants and conventional dispersants.
- Treatment rate is usually constant and determined by nozzle size, and spray pressure.
- Calibration and use of an appropriate droplet size is critical to effective applications.

Pre-diluted dispersants

- Concentrated dispersants can be applied after pre-dilution in seawater, but will be less effective.
- The dispersant : water ratio should be equal to, or greater than, 10%.
- Applications through ship's fire fighting equipment are controlled by opening or closing the dispersant supply. Vessel speed is used to control the treatment rate.
- Dual pump systems for dispersant and seawater supplying spray booms allow the dilution rate to be adjusted.
- MSA Warren Spring spray equipment has a fluid pumping rate set at approximately 90 litres/minute. A 10% ratio of dispersant to seawater will be achieved with the proportioning valve open ¾ to 1 turn.
- Boat speed is the main determinant of dispersant dose rate (reduce boat speed to increase the dose rate).
- Boat speed should be in the order of 5 knots for fresh spills of liquid crude or fuel oil, which assumes that the oil has spread to 0.1 mm thick.
- With reduced boat speeds, the required application rate per hectare can be maintained by reducing pump speed.

Discussion Note 9.4 SMALL SCALE APPLICATIONS

- Dispersant may also be applied to small spills using backpack sprayers, or from land-based hose and eductor systems.
- Efficient dispersant applications require calibrated equipment and appropriate droplet sizes.
- Controlling droplet size and dose rate for hose and eductor applications can be difficult, and care must be taken to ensure water pressure does not push the dispersant through the slick.
- Many hose and eductor systems use freshwater. Many dispersants are unsuitable for pre-dilution in freshwater.
- Effectiveness monitoring is required to maximise efficiency and prevent overdosing.

DISPERSANT APPLICATION SUMMARY

TO BE COMPLETED BY DISPERSANT APPLICATORS FOR AIRCRAFT AND VESSELS

Incident Name:..Report Number:............................

This report made by: .... Organisation: .... Date:................. Time:................

Application Parameters

General location of application: ....

Size of target area:... Ha

Volume of oil targeted: ....Tonnes

Volume of dispersant required:..........................Tonnes

Dispersant selected:..

Dispersant:oil ratio:..

Dispersant volume/Ha=........... L at a ratio of 1: ....

Weathering period since spill:...........................Hours

Application Platform

Aircraft/Boat/Other:..

Type:..

Capacity:...

Swath width:..

Application speed:...

Pump rate:...

Dilution factor:..

Result of effectiveness test

Field test:..

Lab test:..

Test kit: ....

Application capacity

Distance to slick:..

Base to spill return time:..

Applications per hour:..

Coverage per hour:..

Diagram of application: (include scale, north arrow, location of oil, flight path, application location)

Application details	**Pass Number**			
(complete for each pass)	1	2	3	4
Application start time:	……………	……………	……………	……………
Application finish time:	……………	……………	……………	……………
Total dispersant applied:	……………	……………	……………	……………

BOX 10	IS THE DISPERSANT EFFECTIVE?	Date	Time
❑ Yes	Go to Box 11. Assess if ongoing use justified	....	....
❑ No	Go to 10.2. Review dispersant use	....	....

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Discussion Note 10.1 MONITORING DISPERSANT EFFECTIVENESS

- Dispersant applications must be monitored to confirm whether or not dispersant use is effective, and to determine the fate and transport of treated oil.
- Dispersant applications should not be delayed simply because monitoring is not in place.
- Visual observation is the minimum level of monitoring.
- There will be very few instances where dispersant application is possible but visual monitoring is not possible.
- *In situ* monitoring of oil dispersed in the water column should support visual monitoring wherever possible.
- Decisions to terminate operations due to poor effectiveness should ideally be based on *in situ* monitoring results.
- A visible coffee coloured cloud in the water column indicates the dispersant is working.
- A milky white plume in the water column can indicate excessive dispersant application.
- A difference in the appearance of treated and untreated slicks indicates dispersion is likely.
- Absence of a visible cloud in the water column makes it difficult to determine whether the dispersant is working.
- Successful dispersion can occur with no visible indication of dispersion.
- Boat wakes may physically part oil, falsely indicating successful dispersion.

10.1 Assessing dispersant effectiveness

❑ Mobilise monitoring team (This should be done as early as possible in the response)
❑ Review dispersant monitoring results after each dispersant application
❑ Determine if dispersant application is effective
❑ Determine if chemical dispersion is significantly greater than natural dispersion
❑ Assess whether changing application parameters could make the application more effective

A guide to Monitoring Dispersant Effectiveness follows this section

10.2 When dispersant not effective

If monitoring shows dispersion does not appear effective, review all aspects of the application and monitoring for possible reasons why. Aspects to consider include:

- Dispersant formulations (try different types)
- Application ratios (increase or decrease oil:dispersant ratios)
- Application methods
- Monitoring methods
- Monitoring interpretation
- Oil weathering
- Weather conditions

If dispersion is not effective, and reviewed application and monitoring parameters do not alter effectiveness, dispersant operations should be terminated. Go to Box 12.

MONITORING DISPERSANT EFFECTIVENESS

Information in this section is based on the SMART (Special Monitoring of Advanced Response Technologies) Guidelines – a joint project of the US Coast Guard, National Oceanic and Atmospheric Administration (NOAA), United States Environmental Protection Agency (USEPA), and Centers for Disease Control and Prevention. Additional information is from the NOAA HAZMAT Report 96-7.

- It is essential to monitor the effectiveness of dispersant applications on oil dispersion.
- It is desirable to monitor the fate of oil, and to assess the impact of dispersed oil on the environment.
- Monitoring intensity should reflect spill size and prevailing conditions, as well as the potential effects of the spill, and logistical and physical constraints. Monitoring intensity should increase with spill size as follows:

Spill size	Visual monitoring	Water column monitoring and sample collection	
		1 m depth	multiple depths
Small	✓		
Medium	✓	✓	
Large	✓	✓	✓

Visual observation of dispersant effectiveness is the minimum acceptable level of monitoring. Termination of dispersant operations should, wherever possible, be based on real-time *in situ* water column monitoring results from at least one depth. Monitoring at multiple depths (either with real-time data or samples collected for later analysis) will provide the best information on dispersant effectiveness and the fate of the dispersed oil.

MOBILIZING MONITORING RESOURCES

Dispersant application has a narrow window of opportunity. It is imperative that monitoring teams and technical advisors are notified of possible dispersant use, and are mobilised as soon as possible. Due to the detailed requirements of monitoring, dedicated monitoring staff should be appointed, and should not be expected to perform other operational functions.

VISUAL OBSERVATION

Visual observation from aircraft is the most reliable technique for detecting and mapping oil distribution. General objectives for aerial observations include mapping the distribution and appearance of the oil, verifying modelled forecasts of oil movement, providing responders with an overview of the incident, and directing cleanup operations. Aircraft selection will be determined by many factors including aircraft availability, mission objectives, required flight frequency, passenger numbers, equipment deployment needs, landing and refueling requirements.

Trained observers can provide a qualitative assessment of dispersant effectiveness, ensuring reporting consistency through the use of visual guides such as the MSA *IDENTIFICATION OF OIL ON WATER Aerial Observation and Identification Guide*. Observations should be photographed and/or videotaped for comparison and documentation. Oil close to the coastline is best viewed from a helicopter, ideally with a door or window removed allowing the observer to look straight down on the oil. For oil further offshore, multi-engined aircraft provide a longer range, higher speeds, and a wider margin of safety. As a minimum, the aircraft should have space for two observers (excluding the pilot), visibility from both sides, pilot-observer communications, and sufficient navigational aids to follow the proposed flight path.

Prior to take-off, the observer should be aware of aircraft safety procedures, be familiar with the general spill area, have appropriate maps or nautical charts to record spill details, and know the environmental conditions likely to be encountered (*e.g.* on-scene winds, visibility, sea state, surface currents, *etc*). Mission objectives must be clearly understood by both the pilot and observers so all the mission aims are met.

Weather information, particularly visibility, surface wind speed and direction, and sea state are all important for predicting oil movement, and interpreting visual observations. Poor viewing conditions (*e.g.* fog, rain, or overwashing in rough seas) can prevent observers from seeing the entire spill. Strong winds could indicate emulsification rates may be more rapid than anticipated.

Advanced sensing instruments (*e.g.* infrared thermal imaging, side-looking airborne radar, laser fluorescence, microwave radiometer, infrared-ultraviolet line scanner, and LANDSAT satellite systems) can provide a high degree of sensitivity in determining dispersant effectiveness where they are available for use. However, problems associated with each of these systems preclude their exclusive use during oil spills. Visual observations cannot always confirm that the oil is dispersed, and physical sampling of water beneath the slick may also be required.

WATER COLUMN FLUOROMETRY AND WATER SAMPLES

Visual monitoring will not always provide a reliable indication of dispersant effectiveness. Dispersant effectiveness can be confirmed in real-time by monitoring hydrocarbons in the water column using fluorometry. For medium and large spills, *in situ* monitoring is the preferred method of determining whether there is a significant difference between natural and chemically enhanced dispersion, and for deciding when dispersant operations should cease. It also provides the best means for determining the volume of chemically dispersed oil.

Samples should ideally be collected at multiple depths from:

- Water free of oil contamination (Reference sites)
- Water beneath the oil spill before dispersant application (Pre-treatment)
- Water beneath the oil spill after dispersant application (Post-treatment)

The time of sampling, instrument readings, relevant observations at selected time intervals, and the exact position of each reading (preferably using Global Positioning System - GPS) must be recorded. Documentation of fluorometer calibration and verified instrument response should also be available.

The sampling regime will depend on the availability of monitoring resources, the spill size, and the logistical constraints of the response. At a minimum, sufficient samples are needed to characterise pre- and post-treatment differences relative to reference sites.

As fluorometry measures natural fluorescence and not just oil, water samples should also be collected to allow fluorometry results to be related to measured oil concentrations. Fluorometry measures should be made using a continuous flow fluorometer (*e.g.* Turner Designs™ or equivalent). Water samples should be collected at the outlet port of the flow-through water duct, past the fluorometer cell. Water samples should be kept in a cool dark place prior to laboratory analysis.

FATE OF DISPERSED OIL

Monitoring the track of the dispersed oil plume at several depths allows the dilution rate of the dispersed oil to be assessed, and determination of the rate that hydrocarbon levels in the water column return to background levels. Trajectory models should be used where available to assist in tracking the plume. Dye markers can also be used.

Oil fate monitoring requires:

- Simultaneous monitoring from a single vessel using independent set-ups from at least two depths (*e.g.* 1 and 5 m).
- Collection of water samples to validate the fluorometer readings.
- Wherever possible, measurement of water quality parameters (*e.g.* temperature, conductivity, dissolved oxygen, pH, turbidity) to help explain the behavior of the dispersed oil.

USING AND INTERPRETING MONITORING RESULTS

Fluorometry readings will vary widely, reflecting the patchiness and inconsistency of the dispersed oil plume. Real-time data are essential if monitoring results are being used to guide dispersant operations and to determine when a response is no longer effective. An increase in the fluorometer signal trend beneath chemically dispersed oil of five times or greater that of readings beneath untreated oil and reference sites (no oil) is a good indication of dispersion occurring. It is important that actual oil concentrations are also measured so that the rate of natural dispersion can be compared to the rate of chemically enhanced dispersion, to determine the actual effect of dispersant use.

GENERAL OBSERVATION GUIDELINES

- Where ever possible, use observers trained and experienced in identifying and quantifying oil floating on the sea
- Use standard reporting terms (see below) and common guidelines to maintain consistency between observers (*e.g.* MSA *IDENTIFICATION OF OIL ON WATER Aerial Observation and Identification Guide*)

STANDARD TERMS TO DESCRIBE OIL FLOATING ON THE WATER (adapted from NOAA)

1	**Light sheen**	A light, almost transparent layer of oil. Sometime confused with windrows and natural sheen resulting from biological processes.
2	**Silver sheen**	A slightly thicker layer of oil that appears grey, silvery or shimmers.
3	**Rainbow sheen**	Sheen that reflects colors.
4	**Brown oil** (heavy or dull sheen)	Water-in-oil emulsion. Thickness typically 0.1 to 1.0 mm. Can vary depending on wind & current conditions.
5	**Mousse**	Water-in-oil emulsion. Colours can range from orange or tan to dark brown.
6	**Black oil**	Sometimes with a latex texture. Can look like kelp and other natural phenomenon.
7	**Windrows** (fingers (stringers, streamers)	Oil or sheen oriented in lines or streaks. Brown oil and mousse can be easily confused with algal scum collecting in convergence lines, algae patches, or kelp.
8	**Tar balls**	Oil weathered into a pliable ball up to c.30 cm. Sheen may or may not be present.
9	**Tar mats**	Non-floating mats of oily debris (usually sediment and/or plant matter) found on beaches or just offshore in shallow water.
10	**Pancakes**	Isolated patches of mostly circular oil (size range: few cms to 100's of meters in diameter). Sheen may or may not be present.

Oil on the water

- Oil is best viewed with the sun behind the observer, flying at a 30-degree angle to the slick
- Mid-morning or mid-afternoon viewing is generally best, avoiding midday glare off the water surface, and the limited contrast encountered in the early morning or early evening
- Overall spill dimensions are generally best viewed from an altitude of 1,000 to 2,000 feet
- Estimating oil coverage and color is best from an altitude of 200 to 300 feet or less
- Oil surface slicks and plumes can appear different for many reasons including oil or product characteristics, sun angles, viewing angles, type of observation platform, weather, light conditions, sea state, dispersion rate, *etc*
- Waves, kelp beds, natural organics, pollen, plankton blooms, cloud shadows, ice, jellyfish, and algae can all look like oil under certain conditions
- Low-contrast conditions (*e.g.* overcast, twilight, haze) make observations difficult

Dispersant applications

- May have variable effectiveness where different oil concentrations (spill thicknesses) result in variable oil/dispersant ratios being applied
- May cause herding, temporarily “pushing” the oil together and making the slick appear to shrink, or to disappear from the sea surface for a short time
- May change the color of an emulsified slick by reducing water content and viscosity
- May change the shape of the slick, due to the de-emulsification action of the dispersant
- May modify the spreading rates of oils (treated slicks can cover larger areas than control slicks)

Dispersed oil plumes

- May not form immediately after dispersant application
- Can take several hours to form (*e.g.* if the oil is emulsified, low mixing energy)
- May not form or be visible at all
- May be masked by surface oil and sheen
- Can be hidden by poor water clarity
- May be mistaken for other things such as suspended solids
- Are often highly irregular in shape and concentration
- Can range in appearance from brown to white (cloudy)

Dispersant effectiveness

- A visible cloud in the water column indicates the dispersant is working
- Differences in the appearance of treated and untreated slicks indicates dispersion is likely
- The absence of a visible cloud in the water column, makes it difficult to determine if the dispersant is effective
- Boat wakes may physically part oil, falsely indicating successful dispersion

DISPERSANT OBSERVATION CHECKLIST

FOR DISPERSANT OBSERVERS ON AIRCRAFT AND VESSELS TO COMPLETE BEFORE DEPARTURE

Incident Name:..Report Number:............................

This report made by: .... Organisation: .... Date:................. Time:................

Observers name/s: ....Organisation/s: ....

Observation platform: helicopter / aircraft / boat / other (specify): ....

Application platform: helicopter / aircraft / boat / other (specify): ....

COMMUNICATIONS	**VHF**	**UHF**	**Other**
Air to air	....	....	....
Air to vessel	....	....	....
Air to ground	....	....	....
Ground to vessel	....	....	....
Vessel to vessel	....	....	....

	Aircraft/personnel names	**Call sign**	**ETD to spill**	**ETA at spill**
Sprayer 1:	....	....	....	....
Sprayer 2:	....	....	....	....
Spotter:	....	....	....	....
Observer:	....	....	....	....
Command Centre:	....	....		

Name of dispersant:... Dispersant : oil ratio:...

Dilution prior to application (if any): .... Rate of application: .... litres/Ha

Dispersant application altitude:....................................feet Observation altitude:...feet

WEATHER CONDITIONS ❑ Sunny ❑ Overcast ❑ Cloudy ❑ Rain ❑ Fog

Sea state:	Wind speed: .... knots	Air temperature:.................. °C
Wave height: .... m	Wind direction: ....degrees true/magnetic	Sea temperature: .... °C
Water depth:......................... m	Current speed: .... knots	Salinity: .... ppt
Visibility: .... nm/km	Current direction:..............degrees true/magnetic	Tide: ....flood / ebb / slack

DISPERSANT OBSERVATION EQUIPMENT AND SAFETY CHECKLIST

Observation

- ❑ Basemaps/charts
- ❑ Clipboard/notebook/reporting forms/checklists
- ❑ Pens/pencils
- ❑ GPS + spare batteries
- ❑ Job aids for visual observation
- ❑ Camera + spare film
- ❑ Video camera + spare batteries
- ❑ Binoculars

Personal Safety Equipment

- ❑ Lifejacket (and exposure suit if required)
- ❑ Survival equipment (*e.g.* flares, locator beacon)

Safety Brief

- ❑ Safety brief with pilot/skipper
- ❑ Purpose of mission
- ❑ Operational constraints
- ❑ Area orientation/observation plan
- ❑ Trip duration
- ❑ Landing/mooring sites
- ❑ Radio frequencies and reporting schedule
- ❑ Safety features (*e.g.* emergency locator beacon, fire extinguishers, first aid kit, radios, *etc.*)
- ❑ Emergency exit procedures
- ❑ Gear deployment (*e.g.* current drogue, dye)

MARITIME SAFETY AUTHORITY OF NEW ZEALAND
Te Mana Ārai Hauata Moana o Aotearoa

CAWTHRON

DISPERSANT OBSERVATION REPORTING FORM

FOR RECORDING DISPERSANT OBSERVATIONS FROM AIRCRAFT AND VESSELS

Incident Name:...Report Number:.............................

This report made by: .... Organisation: .... Date:................. Time:.................

Start time of application:........................... Hours Viewing difficulties (if any): ....

Finish time of application: .... Hours ....

VISUAL APPEARANCE OF SLICK (use standard definitions and visual guides of oil on water)

Before application:	**Immediately after** application:	**20 minutes after** application:
. . . .	. . . .	. . . .
. . . .	. . . .	. . . .
. . . .	. . . .	. . . .
. . . .	. . . .	. . . .
. . . .	. . . .	. . . .
. . . .	. . . .	. . . .
Film No:	Film No:	Film No: . . . .
Photo No:	Photo No:	Photo No: . . . .

Dispersion cloud observed:................................. YES/NO Time taken for cloud to form:............................... minutes

Did oil reappear (recoalesce)?:............................ YES/NO Time taken to reappear: .... minutes

% of slick treated: .... % overspray:.................... Estimated efficiency of application: ....%

Describe any variation in effectiveness across slick:

. . . .

. . . .

. . . .

Describe differences between treated/untreated areas:

. . . .

. . . .

. . . .

Describe any biota present and any effects observed:

. . . .

. . . .

. . . .

General comments/problems encountered:

. . . .

. . . .

. . . .

Recommendations for future applications:...

. . . .

. . . .

Start position:	**Finish position:**
Latitude: .... South	Latitude:..South
Longitude: .... East/West	Longitude:... East/West
Distance from shore: .... nm/km	Distance from shore:...nm/km

FLUOROMETRY REPORTING FORM

FOR IN SITU WATER COLUMN MONITORING FROM VESSELS

To be developed

BOX 11 IS ONGOING DISPERSANT USE JUSTIFIED AND SAFE?

			Date	Time
❑	Yes	Go to Box 9. Apply dispersant	....	....
❑	No	Go to Box 12. Do not apply dispersant	....	....

Back to flowchart

There will be a point when the use of dispersant is no longer effective.

11.1 Justification of ongoing dispersant use

All of the following must apply to justify ongoing dispersant use:

- ❑ Sensitive values are significantly threatened (refer to Box 2)
- ❑ The option of no response other than monitoring is inappropriate (refer to Box 3A)
- ❑ There is a significant 'net environmental benefit' from continued dispersion, including dispersant use being more cost effective and having less adverse impact than other responses (refer to Box 3 and Box 4)
- ❑ The dispersant is effective (refer to Box 6 and Box 10)
- ❑ Chemically enhanced dispersion is significantly greater than natural dispersion (refer to Box 10)
- ❑ Dispersant can be applied safely (refer to Box 7)

BOX 12 DO NOT USE DISPERSANT		
	Date	Time
If dispersant use considered inappropriate, consider other response options. Go to Box 3a	....	....
Regularly review decisions limited by weather conditions or dispersant, equipment or personnel availability.		

Back to flowchart

12.1 When dispersant should not be used

Dispersant should not be used if any of the following apply:

- ❑ The option of no response other than monitoring is appropriate (refer to Box 3A)
- ❑ There is no significant 'net environmental benefit' from using dispersants (refer to Box 3 and Box 4)
- ❑ The oil is not dispersible (refer to Box 5)
- ❑ The dispersant is ineffective (refer to Box 6 and Box 10)
- ❑ Appropriate dispersants are not available (refer to Box 6)
- ❑ Dispersants cannot be applied safely (refer to Box 7)
- ❑ Chemically enhanced dispersion is not significantly greater than natural dispersion (refer to Box 10)