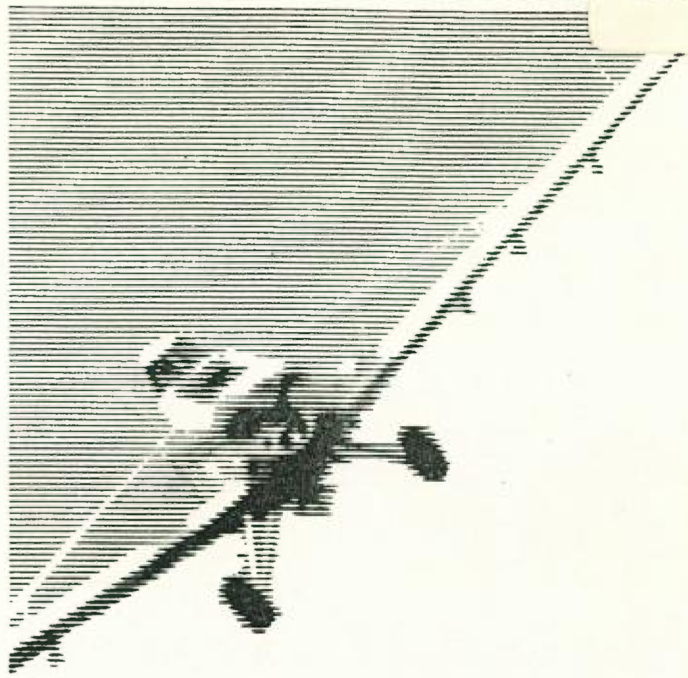

Aerial Application of Dispersants in Botany Bay

A Feasibility Report

AERIAL APPLICATION OF DISPERSANTS IN BOTANY BAY

A FEASIBILITY REPORT

State Pollution Control Commission

August 1982

CONTENTS

1. INTRODUCTION

Although bulk petroleum cargoes have been shipped in and out of Botany Bay since 1948, the first serious oil spill causing obvious damage to the bay's environment did not occur until November 1979. That incident, and two others since, have highlighted the bay's vulnerability and emphasised the need for a rapidly-effective oil spill combat response.

The containment and collection of oil spills of any appreciable size in Botany Bay - where severe constraints are imposed by the bay's winds, tides and turbulent waters - can be virtually impossible. Principal reliance has therefore been placed on the application of solvent-based dispersants applied from work boats.

Substantial advances have been made in the development of oil spill control and cleanup chemicals, particularly in the development of dispersants suitable for application from properly equipped aircraft. This report discusses the feasibility of applying self-mixing dispersant concentrates to oil spills in Botany Bay from small, commercially available helicopters, carrying underslung spray buckets, operating from a helipad located at Kurnell.

2. CONCLUSIONS

Botany Bay lies within the control zone of Sydney (Kingsford-Smith) Airport and contains a relatively large area of shallow water (where the application of dispersants is ecologically undesirable) and long sections of environmentally sensitive shorelines.

Even so, it is both feasible and practicable to mobilize small helicopters to chemically disperse oil spills, and have them operating effectively within two hours of the decision to mobilize.

The use of helicopters offers speed of response and the capability to treat large areas quickly, key factors in combatting oil spills in Botany Bay. This capability is simply not available from surface craft.

3. SELECTION OF AN APPROPRIATE DISPERSANT

Chemical dispersants for treating free-floating oil slicks are formulated with two principal components:

- A surface-active agent (surfactant)
- A solvent (carrier).

The chemical nature and the quantity of each component varies according to the characteristics desired in the formulated product (Poliakoff, 1969).

The main classes of dispersant formulations manufactured are solvent-based dispersants and dispersant concentrates. Each has a different mode of action.

- Solvent based dispersants are those in which the solvent is a refined petroleum hydrocarbon and in which the percentage of surfactant is low, usually less than 25 percent by volume. Dispersants in this class are designed to be used without dilution.

- Dispersant concentrates are those in which the solvent is a combination of alcohols and glycols (water soluble compounds) and which contain a relatively high percentage of surfactant. Dispersants in this class are designed to be used either with or without dilution.

Though dispersants are capable of treating a wide range of crude oils and petroleum products they nevertheless have certain limitations in application. The are not effective on viscous oils whose pour-points are close to ambient temperatures or on thick water-in-oil emulsions, and thus may be ineffective on spills of some heavy (thick) crude oils and fuel oils; on petroleum products that have thickened by weathering and on any oils that have formed "chocolate mousse" (oil in water emulsions).

Solvent base dispersants (such as BP-AB currently used in Botany Bay) require relatively high application rates, which present logistic problems, and thorough surface-mixing is necessary after their application to an oil film. Work-boats must be rigged with surface-mixing devices (such as breaker boards) and this can seriously prolong the "make ready" time of spraying vessels, limit their speed and create difficulties in manoeuvering in enclosed waters.

Dispersant concentrates, on the other hand, can be applied at far lower rates and do not require energetic mixing after application since the natural turbulence of the water surface is usually sufficient to provide satisfactory dispersion. The self-mixing characteristics of dispersant concentrates simplify surface spraying by eliminating the need for trailing breaker boards, facilitating manoeuverability and permitting faster spraying speeds.

But despite these advantages surface spraying of oil spills will always be a lengthy and difficult task. Where minimal response time is of paramount importance the time required to implement surface spraying seriously reduces the practicability of using dispersants at all (Martinelli, 1980, p. 2).

The limitations inherent in surface spraying can be overcome by aerial spraying. Dispersant concentrates are eminently suitable for aerial application and have been successfully used in this way on many occasions overseas (Lindblom, 1979; Nichols and White, 1979; Lindthom et. al., 1981).

4. CHOICE OF AIRCRAFT

4.1 Fixed wing aircraft

Light aircraft permanently fitted with spraying equipment (such as the Piper "Pawnee") are in common use in country areas of New South Wales for agricultural spraying. These aircraft are fitted with internal spray tanks with volumetric capacities similar to those installed in helicopters.

However, the use of fixed wing aircraft in Botany Bay is not practicable for several reasons:

- First, agricultural spray nozzles are designed for spraying pesticides at extremely low application rates, commonly less than ten percent of the rates recommended for dispersants. Proper nozzles would need to be fitted before the aircraft could be used for oil spill control. (Lindblom, 1978, p. 138; 1979 p. 455).

- Secondly, fixed wing aircraft need to operate from runways, the nearest being at Bankstown Airport. (Their use from Sydney Airport is unlikely due to traffic restrictions). Thus their sortie time, through Sydney's control zone, would be inordinately long.
- Thirdly, the nearest crop-spraying aircraft is based at Cessnock (Appendix 4) 130 kilometres from Bankstown, too far away to be quickly available for operations over Botany Bay.

For these reasons the rest of this report deals only with rotary wing aircraft (helicopters).

4.2 Helicopters

Helicopters can be equipped with fuselage-mounted spray tanks or with underslung spray buckets fitted with spray-booms and a spray-pump driven by a small petrol engine mounted on the bucket.

Spray buckets are the more versatile since they can be quickly attached to and removed from the aircraft eliminating the need for an aircraft to be "dedicated" to the spraying role. (Figures 1 and 2).

The most common commercially available helicopter in Sydney is the Bell "Jet Ranger" 206B. Heliflite Pty. Ltd. operating from Castle Hill and Scruse Air operating from Kingsford-Smith Airport each maintain a fleet of three. Each operator is prepared to make aircraft available in a period of not less than 30 minutes and not more than 1½ hours.

The "Jet Ranger" 206 G, flown solo with full fuel tanks, has an authorised hook-load of 500 kilograms. After allowing for the tare-weight of an empty bucket and its attachments the "Jet Ranger" 206 B could carry a dispersant pay-load of about 360 litres (79 imp gals) sufficient to treat 7.7 hectares (19 acres) of oil in 1.5 minutes spraying time at 60 knots ground speed, 50 litres/hectare (5 US gals/acre) before re-loading.

Allowing 10 minutes per sortie from a helipad adjacent to Botany Bay, the "Jet Ranger" has a capability of spraying 45 hectares (113 acres) per hour equivalent to the capability of three large work boats travelling continuously at seven knots spraying a 12 metre (40 feet) wide swath. (Lindblom 1979, Tables 1 and 3, page 455).

5. ADVANTAGES OF AERIAL SPRAYING

The most important objective in planning for control of oil spills in Botany Bay is prevention. The low incidence of large oil spills during the past thirty years is testimony to the success with which this objective has been recognised by both the oil industry and the port authority.

Nevertheless, accidental oil spills do, and will occur. Experience has highlighted the need for oil spill combat resources to provide back-up to the primary objective of prevention; to work within the particular constraints imposed by the bay's environment, and to be effective in all foreseeable circumstances.

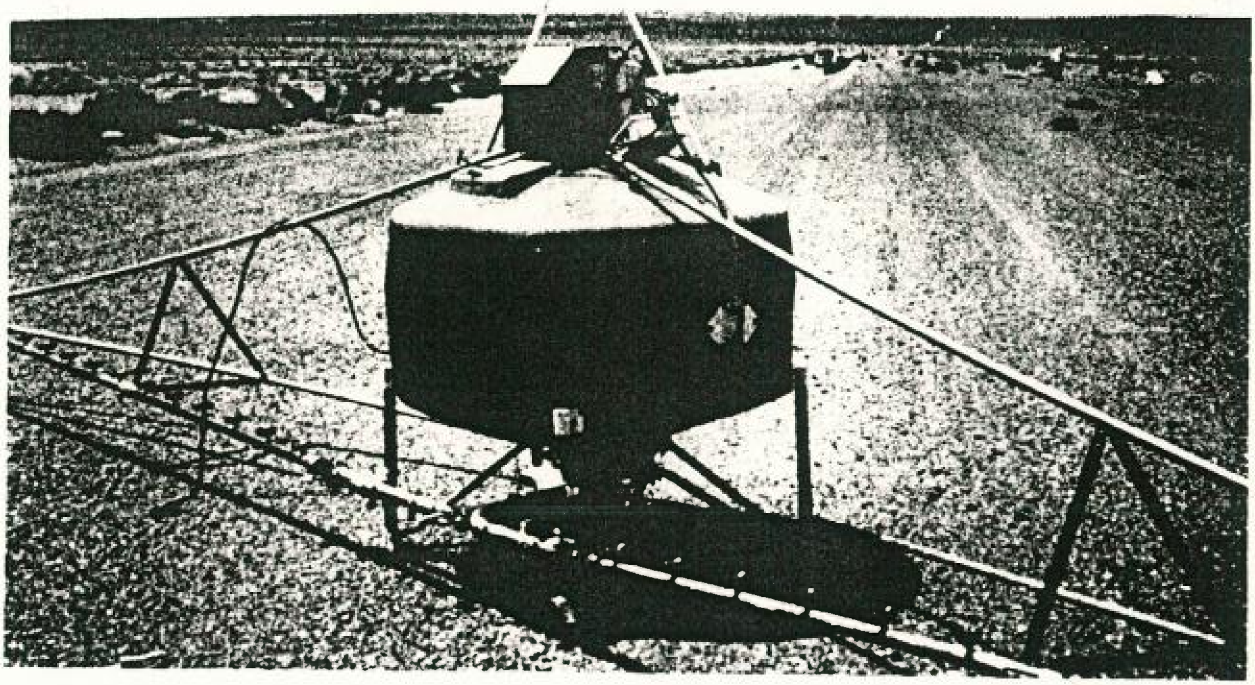

FIGURE 1

PHOTOGRAPH OF A HELICOPTER APPLICATION OF CHEMICAL DISPERSANTS USING THE "SLUNG BUCKET" SPRAY SYSTEM. PICTURE SHOWS A CLOSEUP OF THE "SLUNG BUCKET." (Exxon Corporation, 1980)

FIGURE 2

PHOTOGRAPH OF A HELICOPTER APPLICATION SYSTEM FOR CHEMICAL DISPERSANTS USING THE "SLUNG BUCKET" SPRAY SYSTEM.

(Exxon Corporation, 1980)

Experience has also demonstrated that combat resources based on containment and collection, and on dispersant application by surface craft have a limited capability and cannot be mobilized rapidly enough for effective deployment.

Even with expanded surface-capabilities and a streamlined organisational response, oil spill combat can be made many times more effective by the inclusion of an airborne response. In some circumstances such a response would be complete in itself - in others it would provide a rapidly mobilisable response effective during the period when surface facilities are being organised.

The advantages of an airborne response are speedy mobilisation, a rapid treatment rate, a high degree of control and a minimum need for support-personnel. Although aircraft are expensive in costs per unit of time, their advantages combine to make their use in dispersant spraying of oil spills in Botany Bay essential.

6. LIMITATIONS ON AERIAL SPRAYING

6.1 Environmental constraints

The State Pollution Control Commission has published guidelines for oil-spill control which recognise that:

> "control of oil spills by the application of low-toxicity dispersants at controlled rates from systems demonstrated to be technically reliable for use in air or surface craft is an environmentally acceptable option".

Even so, the use of dispersants to treat stranded oil on shorelines (except on recreationally important beaches) and in shallow waters, less than about five metres deep, is discouraged.

The application of dispersants in Botany Bay is constrained, at least to some extent, by the proximity of environmentally sensitive shorelines and by the relatively large area of shallow water. Unless there are compelling reasons to the contrary therefore, spraying from <u>any</u> type of craft - air or surface - should be limited to the deep-water side of the five metre depth contour shown in Figure 3.

6.2 Operations in controlled air space

Sydney (Kingsford-Smith) Airport is located on the northern shore of Botany Bay. The main (north-south) runway intrudes about 2.5 kilometres into the bay, forming the north-western limit to Port Botany.

An extensive area of Sydney's airspace, centred on the airport and extending vertically from 0 - 2500 feet, is designated the Aerodrome Control Zone (CTR). Aircraft movements within CTR are prohibited unless prior authorization is received from Air Traffic Control. All the airspace above Botany Bay lies within the Aerodrome Control Zone.

Aircraft arriving from, and departing to, the south pass over the bay. Departing aircraft use a series of pre-designated outbound tracks, gaining altitude after leaving the runway. Arriving aircraft use a straight, south to north, approach descending to the runway threshold.

Despite the restrictions on aircraft movements within the bay's airspace, the Department of Aviation is prepared to assist in an emergency use of aircraft necessitated by oil spill control, subject to the limitations summarised below (Appendix 4) and illustrated in Figure 3.

- The effect that the spraying operations would have on Sydney Airport would vary depending on the runways in use at the airport and the location of the spill

- Spraying operations east of a line joining Kurnell wharf, the submarine terminal and the southern wall of the port revetment (Area 1), would, generally speaking, have little effect on airport operations

- Operations west of that line and along the southern shores of the bay (Area 2) would begin to have an adverse effect on airport operations and would require visual monitoring of helicopter flights by the tower controller

- Oil blown toward the western shore between Kyeemagh and Dolls Point (Area 3) would be moving under the influence of south-east to north-east winds. In that event the airport's east-west runway would be in use for arrivals and departures and access to the area of the oil spill would be readily available

- Similarly oil blown into the area north-west of the revetment (Area 4), substantially the present and future area of Port Botany, would be moving under the influence of south-easterly winds. Spraying flights would have access subject to increasing involvement by Air Traffic Control

- Access to oil spills lying in an arc south/south-east/south-west of the runway (Area 5) would be difficult to arrange but with the tower controller's co-operation and the possible closure of the main runway (weather permitting) it would be reasonable to permit spray-helicopters to operate, if this was considered essential.

6.3 Weather limitations

Obviously aircraft operating over oil spills must be able to maintain visual reference to the ground and water. This requires that they operate under Visual Flight Rules (VFR). Aircraft operating under VFR must operate only in Visual Meteorological Conditions (VMC).

The minimum conditions prescribed for helicopters operating in VMC are:

- Flight visibility must be not less than 5 kilometres

- Separation from cloud must be not less than 500 feet vertically and 600 metres horizontally.

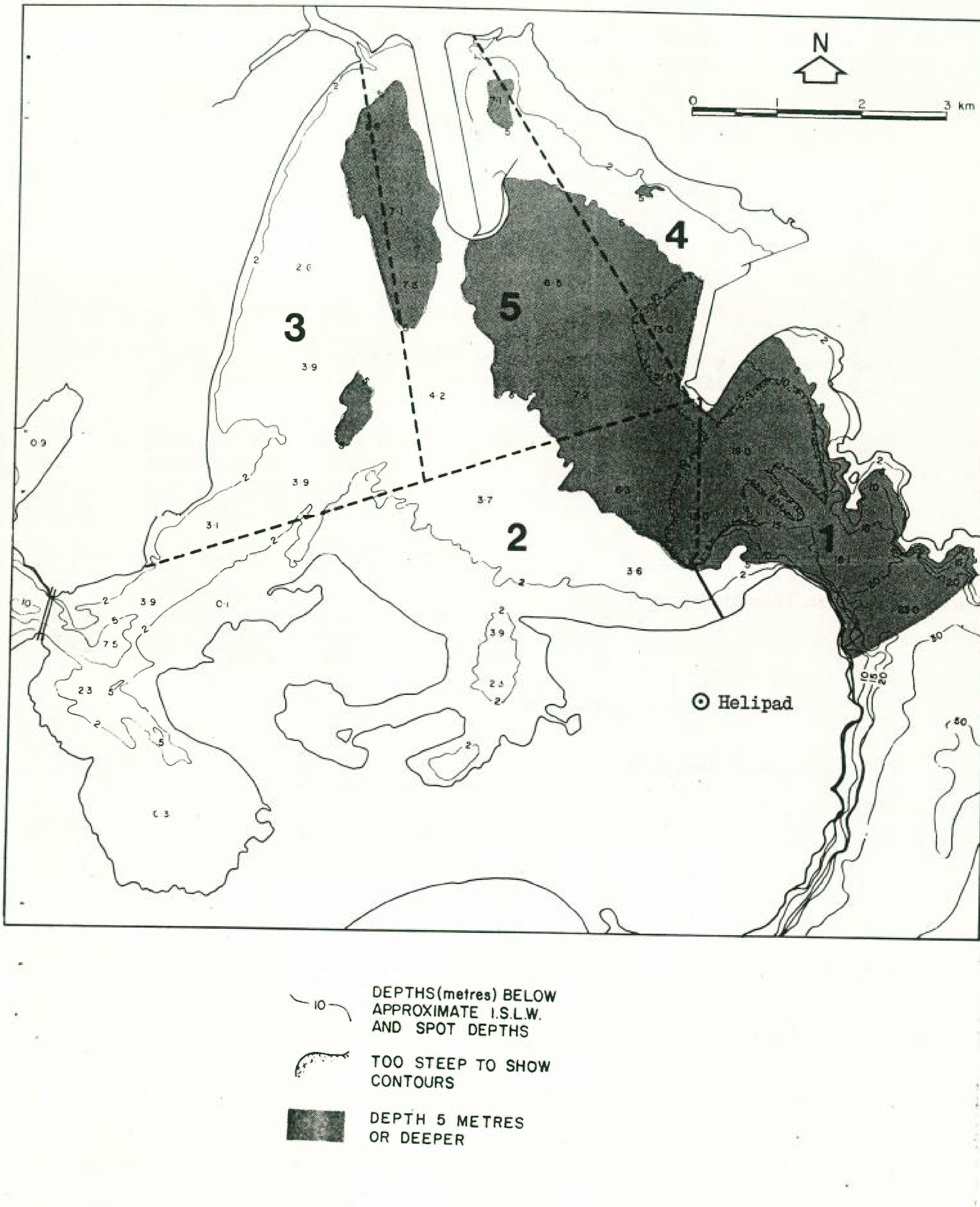

Figure 3 Botany Bay Bathymetry and ATC Zones

Within his area of responsibility, the tower controller may require an increase or permit a decrease in these criteria within controlled air space.

Clearly therefore helicopters could not operate when weather conditions include:

- Low cloud (particularly low scud and drizzle)
- Fog or ground mist
- Heavy rain
- Darkness

Strong surface winds especially those associated with gusting and low-level turbulence would also militate against the use of helicopters, causing difficulty in manoeuvering accurately and in controlling spray-drift.

However, it is likely that rough seas associated with strong wind conditions would preclude the use of work boats as well - certainly they would not be able to operate effectively under conditions of poor visibility and in darkness.

7. LOGISTICS OF AERIAL SPRAYING

The use of helicopters in Botany Bay requires consideration of several matters important in planning their deployment including:

- The location of the helipad
- Storage of equipment and expendables
- Communications
- Dispersant application rates
- Spraying flight paths
- Pilot and ground-crew training

7.1 Location of helipad

Australian Oil Refining Pty. Ltd. (AOR) maintains a helipad within its refinery premises at Kurnell (Fig. 3). The company is prepared to make this helipad available for helicopters engaged in oil spill control operations. It is authorized for use in emergencies but is not an Authorized Helipad as defined in Air Navigation Orders.

The distance from the helipad to various parts of Botany Bay is:

Location	Distance km	Distance nautical miles	Time interval (mins) for return flight (at 60 knots)
Submarine terminal	2.4	1.3	2.6
Single-buoy mooring	3.25	1.75	3.5
Yarra Bay (groin)	4.0	2.15	4.3
Brotherson Dock	5.0	2.7	5.4
South end of runway	6.0	3.2	6.4

Thus the radius of action for most areas in which helicopters would operate is within 1.5 to 3 minutes flight time, at a speed of 60 knots.

7.2 Storage of equipment and expendables

AOR is prepared to provide storage (and servicing where necessary) for those items of equipment requiring on-site, undercover storage at the helipad. The items should include two spray-buckets, drums of dispersant and a transfer pump, jet fuel, petrol and oil.

The spray-buckets should be kept filled and ready for use. Each has a small, self-contained petrol engine (for powering the spray pump) which needs to be started, run and serviced at regular intervals. Extra fuel and oil for the petrol engine should be readily available.

A stock of dispersant, sufficient for two hours of spraying, should be stored on-site in 200 litre (44 gallon) steel drums. Each spray-bucket would carry about 360 litres (79 imperial gallons) of dispersant, equivalent to 1.8 drums. Allowing 10-15 minutes turnaround time for spraying sorties (i.e. 4-5 sorties per hour) a two-hour stock (8-10 sorties) would amount to 18 drums.

Fuel for the helicopters (Jet A1) of at least 2 x 200 litre drums and a refuelling pump should be maintained on-site.

7.3 Communications

Good communications are vital to the success of dispersant spraying. The minimum of radio communications needed are air-to-air and air-to-ground (control). If work boats are involved as well, radio communications should include ship-to-shore (control) and ship-to-ship.

To ensure that an operation is conducted both safely and effectively, it is desirable that it be controlled and co-ordinated from an additional observer aircraft, which should have a high endurance and good communications both with the spray aircraft and ground control. The observer aircraft can be used in a number of roles especially to identify the heaviest concentrations of oil, or those slicks posing the greatest threat, and to direct the spray aircraft accordingly. It can be used to guide the spray aircraft on to the target and to judge the accuracy of the application and the effectiveness of the treatment (International Tanker Owners, 1982).

7.4 Dispersant application rates

(This section has been taken from International Tanker Owners, 1982).

Depending on the type of oil spilled and the prevailing weather conditions, the ratio of dispersant concentrate to oil may vary from 1:5 to 1:30. To calculate the application rate (in litres per hectare) the average thickness of the floating oil must be assessed (Appendix - Table 1). Generally, most free floating oils will spread to an average thickness of 0.1 mm (10^{-4} metres) within a few hours. At this thickness the volume of oil in one hectare (10^{-4}square metres) is:

$$10^{-4}\text{m} \times 10^{4}\ \text{m}^2 = 1\text{m}^3 \text{ or } 1000 \text{ litres}$$

For a dose rate of 1:20 the appropriate application rate would then be 50 litres/hectare (5 US gal/acre).

With an effective swath width of 15 m, an aircraft flying at 90 knots (45 m/s) can apply dispersant at 50 litres/hectare (0.005 $1/\text{m}^2$) if discharged at a rate calculated as follows:

application rate x	swath x	speed	=	discharge rate
0.005	15	45	=	3.37 litre/sec

or 202 litre/min (44.4 imp gal/min)

Whilst application rates of the order of 50 litres/hectare have been found to be appropriate in many situations, adjustment is required to compensate for variations in thickness of the floating oil. Thick patches may call for an increase of the application rate or for multiple application in order to achieve the required dosage. The application rate can be controlled in flight by varying aircraft speed and dispersant pumping rate.

In calculating application rates an allowance must be made for losses of dispersant during its passage through the air to the sea surface. It is essential to reduce to a minimum those losses due to wind drift and air turbulence. Large droplets assist in this respect but in addition the aircraft should be flown as low as safety considerations allow. Typically altitudes of 30 to 50 feet are used depending on the aircraft's characteristics and the prevailing conditions.

7.5 Pilot and ground-crew training

Aerial spraying from underslung buckets at low altitude requires a degree of precision which can only be obtained with flight experience. Initially between five to ten hours training would be required for a pilot followed by refresher training of two to three hours per year. Training flights should be carried out under full 'operational' conditions so as to ensure maximum participation by controllers, support groups and ground crew.

A small ground-crew is required to change buckets on the helicopter while it is hovering; to refill the empty bucket with dispersant, and to refuel the helicopter at intervals. This small group should be under the control of a loadmaster. A trained loadmaster can be made available by Scruse Air on a daily rate.

7.6 Spraying flight-paths

The dispersant pay-load carried in an underslung bucket is comparatively small and conceivably could be discharged in a few minutes if sprayed continuously in one pass. Even at slow speeds however (50-60 knots ground-speed) the helicopter would travel up to three nautical miles before emptying the bucket.

In practice it is more usual to spray to a pattern generally over the leading edge (the more threatening part) of a slick, in a series of short spray paths. Turning and repositioning is required when the end of each spray path is reached.

Three basic spray patterns are possible:

- Into wind only
- Both into wind and downwind
- Cross wind.

Into wind only: This is the preferred method because it affords uniform application rates and provides good control over the spray path. Several tests have shown that the effective swath width obtained, when spraying up-wind at an altitude of 30 to 50 feet, is about 2.5 times the length of the spray boom (Lindblom, 1979).

Ground speed remains constant (in a constant wind) and hence application rate, which is a function of ground speed, remains constant. The dispersant spray falls rearward onto the aircraft's track. Figure 4 illustrates this technique which is frequently necessitated by the tendency of floating oil to become aligned in the direction of the wind as narrow bands (or windrows) interspersed with zones of thin sheen or clear water.

Into wind and downwind: Unless the wind speed is low, substantial differences in ground speed occur when the aircraft changes direction through 180°. Consider an aircraft flying at 60 knots airspeed in a wind of 20 knots:

Groundspeed when into wind = 60 - 20 = 40 knots

Groundspeed when downwind = 60 + 20 = 80 knots

Thus, unless the pumping rate is altered for each pass (which makes high demands on a single-pilot operation) or the airspeed is reduced by twice the windspeed, the application rate on the downwind pass will be only half that on the upwind pass.

Cross wind: When an aircraft is flying cross wind its heading is at an angle to its track by an amount which is proportional to the wind speed and direction. The wind correction angle is at a maximum when flying at 90^{o} to the wind direction.

Unless the wind speed is low cross wind application leads to inaccuracies in application rates and makes for large inaccuracies both in positioning the spray on the surface and in maintaining the aircraft's heading in parallel passes. Figure 5 illustrates a cross wind spraying pattern.

When spraying the edge of a slick along a windward shore, it may be impossible to avoid using a cross wind spray path. In those circumstances the pilot should be directed to allow a substantial margin of safety on his lee side to avoid spray drift on to the shoreline. Undiluted dispersant could cause high mortality to organisms in shallow-water areas and to shoreline vegetation.

8. RECOMMENDATIONS

The State Pollution Control Commission during its extensive Environmental Control Study of Botany Bay, identified oil spills as posing the most ominous threat to the bay's environment. The time is ripe for the port authority to capitalise on the technological advances made in the manufacture of chemical dispersion agents and on the ready availability of suitable aircraft and ancillary equipment.

The Maritime Services Board of New South Wales should not continue to place sole reliance on surface application of dispersants but, as a matter of urgency, implement a contingency plan employing an aerial response at least to supplement existing resources if not to be the principal combat response.

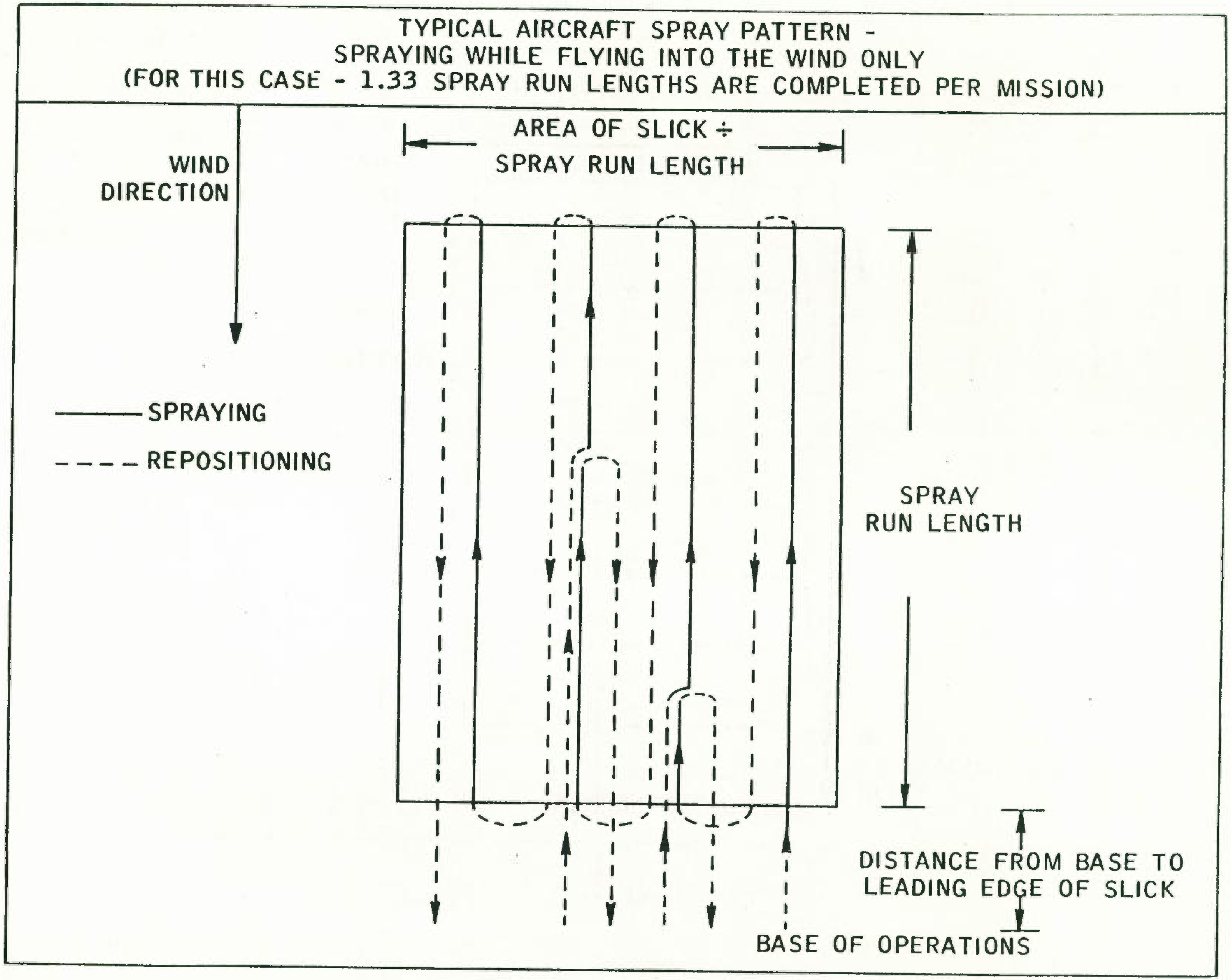

Figure 4 (Steelman, 1979)

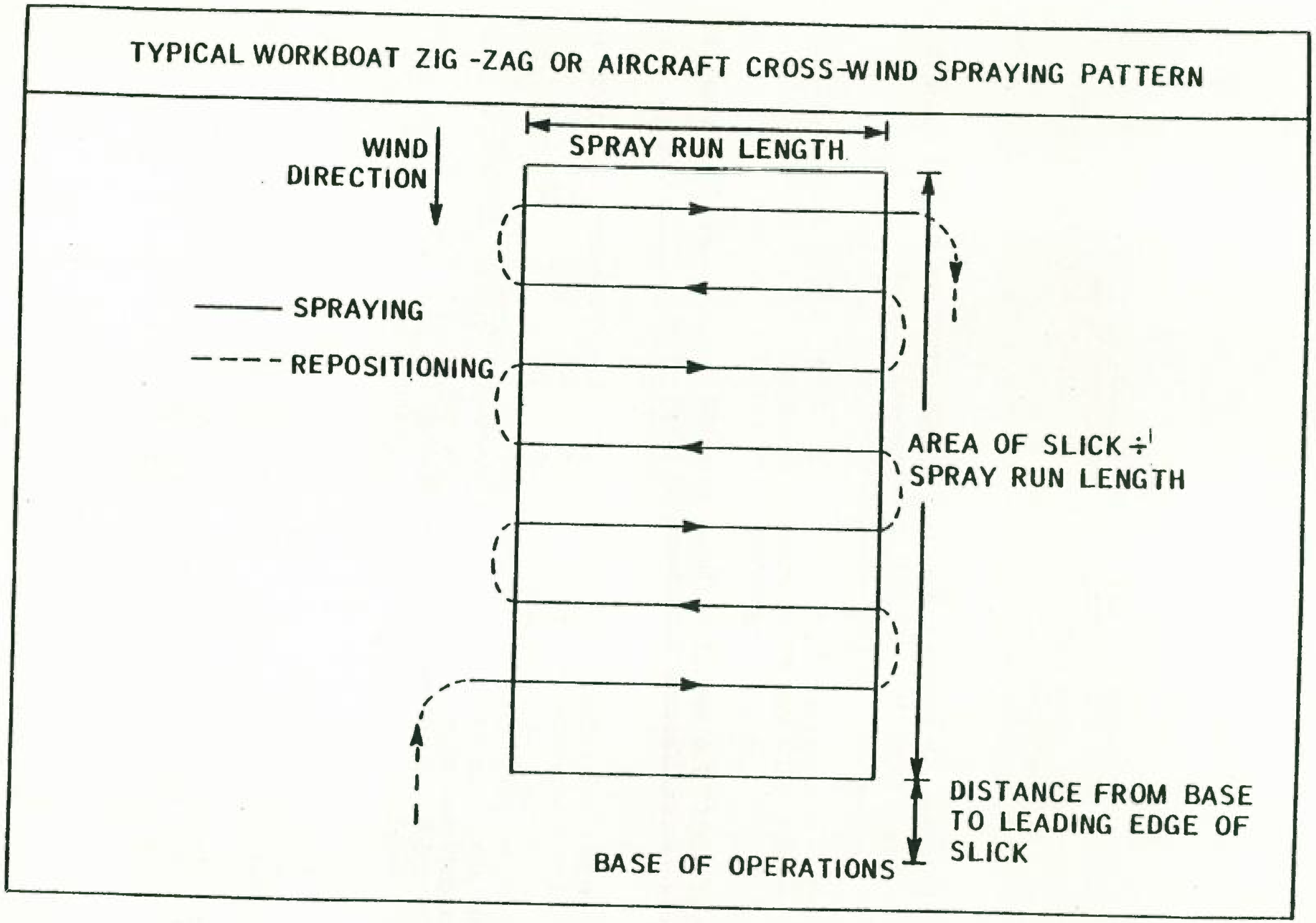

Figure 5 (Steelman, 1979)

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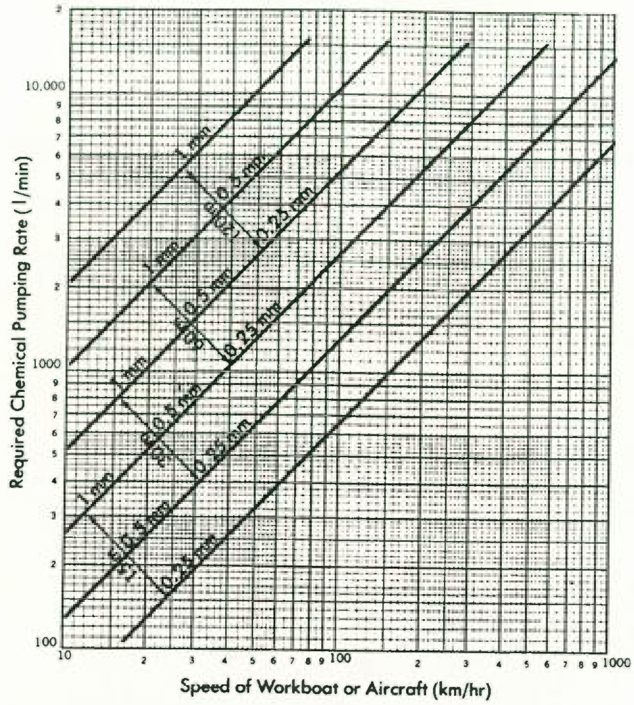
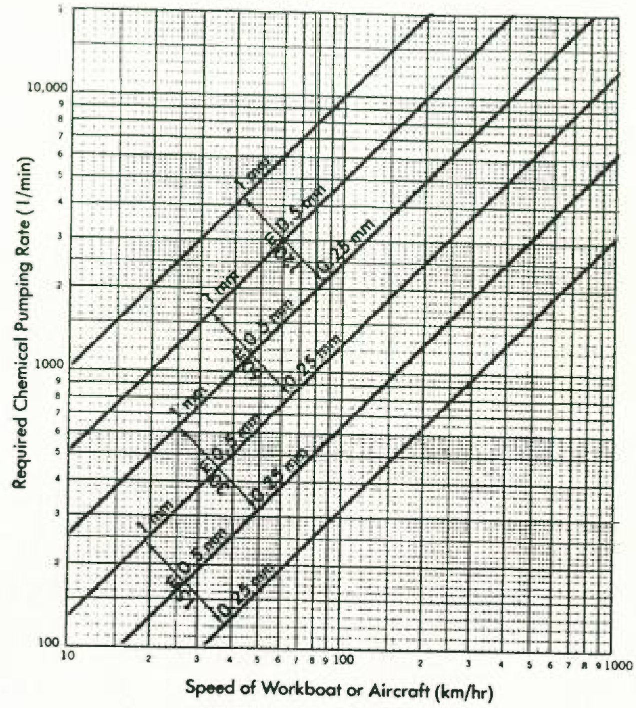
Relationship Between Boat or Aircraft Speed and Undiluted Chemical Pump Rate for Dispersant/Oil Treating Ratio of 1:10 to 1:50

Swath Widths in Meters. Slick Thickness in Millimeters.

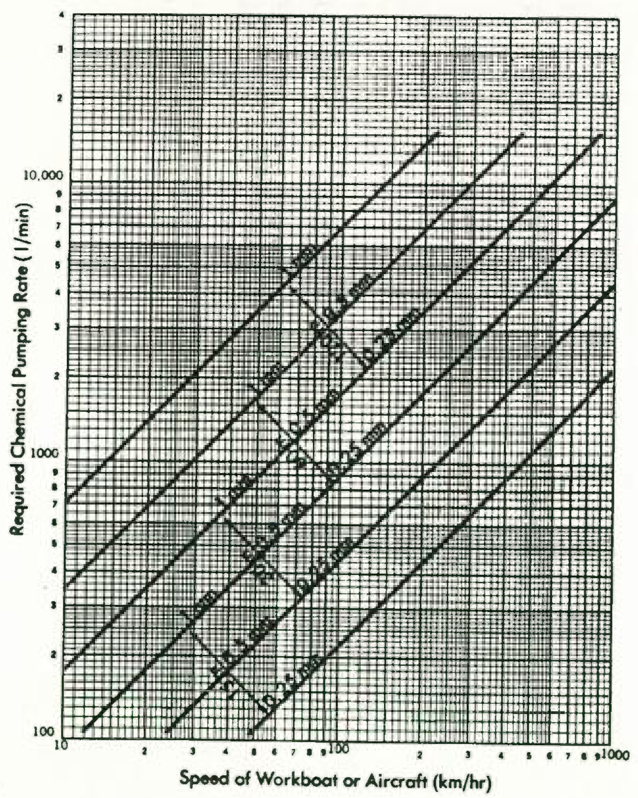
1:10 Ratio



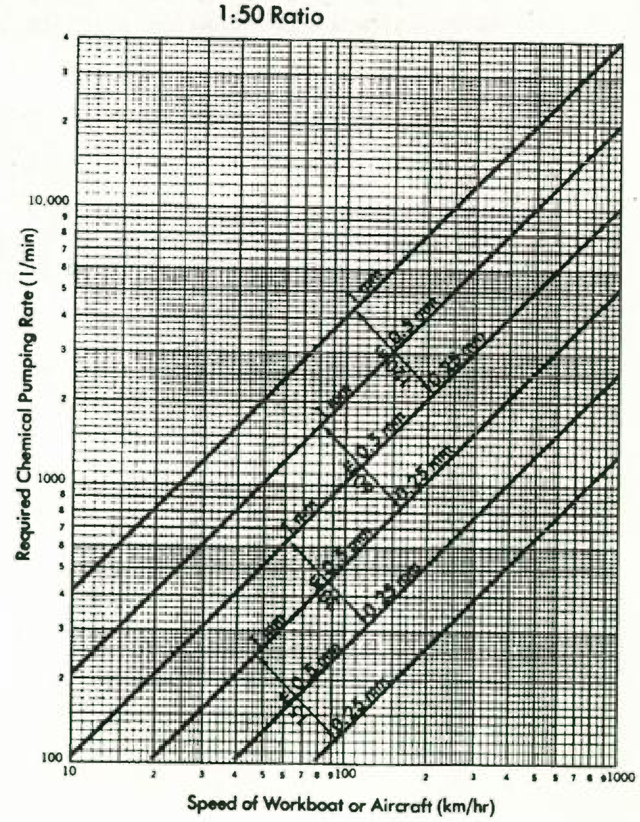
1:20 Ratio



1:30 Ratio



1:50 Ratio



To convert to other units:

1. Convert mph or knots to km/hr (km/hr = 1.6 x mph or km/hr = 1.85 x knots).
2. Enter chart on X axis at proper km/hr.
3. Read liters per minute on Y axis corresponding to intersection with slick thickness line.
4. Convert liters per minute to USG/min (USG/min = l/min ÷ 3.785).

APPENDIX 2 (Exxon, 1980)

Table 1

Correlation of Oil Volume Per Unit Area with Slick Thickness

USG/acre	USG/hectare	bbl/mi²	bbl/km²	bbl/acre	ml/ft²	ml/m²	ft³/acre	l/hectare	Thickness of Stabilized Film (mm)
4.2	10.37	64	25	0.10	0.36	3.87	0.56	38.7	3.94×10^{-3}
5	12.35	76	29	0.12	0.43	4.63	0.67	46.3	4.69×10^{-3}
8.4	20.76	128	49	0.20	0.73	7.85	1.12	78.5	7.88×10^{-3}
10	24.71	152	59	0.24	0.87	9.36	1.33	93.6	9.30×10^{-3}
12.6	31.13	192	74	0.30	1.09	11.73	1.68	117.3	1.18×10^{-2}
21	51.89	320	123	0.50	1.82	19.58	2.80	195.8	1.97×10^{-2}
42	103.78	640	247	1.00	3.65	39.27	5.60	392.7	3.94×10^{-2}
50	123.55	762	294	1.19	4.33	46.58	6.67	465.8	4.66×10^{-2}
53.6	132.44	817	315	1.28	4.65	50.03	7.16	500.3	5×10^{-2} (50μ)
84	207.56	1280	494	2.00	7.30	78.54	11.20	785.4	7.88×10^{-2}
100	247.10	1524	588	2.38	8.67	93.27	13.33	932.7	9.33×10^{-2}
150	370.65	2286	882	3.57	13.01	139.97	20.00	1399.7	0.14
168	415.13	2560	988	4.00	14.60	157.07	22.40	1570.7	0.16
214.6	530.28	3270	1262	5.11	18.58	199.89	28.61	1998.9	0.20
250	617.75	3810	1471	5.95	21.65	232.92	33.33	2329.2	0.23
268	662.23	4088	1578	6.38	23.23	249.92	35.76	2499.2	0.25
420	1037.82	6400	2470	10.00	36.50	392.68	56.00	3926.8	0.39
525	1297.27	8000	3088	12.50	45.62	490.80	70.00	4908.0	0.49
535.8	1323.96	8165	3155	12.76	46.45	499.73	71.44	4997.3	0.50
839	2073.17	12800	4941	20.00	72.91	784.39	111.87	7843.9	0.79
1071.6	2647.92	16329	6303	25.51	93.12	1001.82	142.88	10018.2	1.00
1607	3971.88	24494	9454	38.26	139.68	1502.73	214.32	15027.3	1.50

*Usual thickness range for slicks treated with dispersants.

μ = microns (micrometers)

APPENDIX 3
(Exxon, 1980)

Table 2

Volume of Oil Per Acre (bbl)
Which Can Be Treated at Various Doses of
Dispersant Per Acre (USG)

Dispersant to Oil Ratio	Dispersant Per Acre (USG) 5	7	10	20	50
1:1	0.12	0.17	0.24	0.48	1.20
1:2	0.24	0.33	0.47	0.94	2.35
1:4	0.47	0.65	0.94	1.80	4.70
1:10	1.20	1.70	2.40	4.70	12.00
1:20	2.40	3.30	4.70	9.40	23.50
1:30	3.50	5.00	7.20	14.30	36.00
1:50	5.90	8.40	11.90	23.80	59.50
1:100	11.90	16.60	23.80	47.70	119.00

Table 3

Pump Rate Required (USG/min)

For Chemical Doses of 5, 7 and 10 USG
Per Acre Over Swath Widths of 100-400 Feet from
Aircraft Traveling at 30-200 mph (26-174 knots)

		100-ft Swath Width			200-ft Swath Width			300-ft Swath Width			400-ft Swath Width		
mph	knots	5 gpa	7 gpa	10 gpa	5 gpa	7 gpa	10 gpa	5 gpa	7 gpa	10 gpa	5 gpa	7 gpa	10 gpa
30	26	30	42	60	60	85	120	91	127	182	120	169	242
50	43	51	71	101	101	141	202	152	212	303	202	282	403
100	87	101	141	202	202	284	404	303	424	606	404	568	811
120	104	121	169	242	242	339	484	361	506	723	484	677	968
150	130	152	212	303	303	424	606	455	636	909	606	840	1200
175	152	176	247	353	353	494	706	526	737	1053	706	1000	1429
200	174	201	282	405	405	568	810	600	840	1200	810	1135	1622

gpa = gallons per acre

APPENDIX 4

DEPARTMENT OF Transport Australia

New South Wales Region

Sydney Plaza
59 Goulburn Street
Sydney N.S.W.
P.O. Box J93
Brickfield Hill, 2000
Telephone 2 0929
Telex 26178

In reply quote: 80/1725

State Pollution Control Commission
157-167 Liverpool St
SYDNEY 2000

Your Ref 705107

1? AUG 1981

Attention: Mr James Oliff

Dear Sir

Aerial Spraying of Oil Spills in Botany Bay

Thank you for your correspondence soliciting our advice on the above subject.

Regarding the practicability of aerial spraying, the following information may be of some assistance.

Esso Australia Ltd, in Victoria, have used a device called a "Huss Bucket". This consists of a bucket containing about 100 gals of dispersant, spraying booms, a rudder to keep it flying straight and a remote controlled pump. The unit is carried beneath the helicopter, by means of a sling, with a control cable extending to the cockpit.

The advantages of this unit are as follows:-

1) Any of the State Government owned Bell Jetranges (Police,DMR) could easily be adapted to uplift the device.
2) At least 4 helicopters are available at Sydney Airport to be called upon as necessary.
3) The nearest "dedicated" spraying helicopter in NSW, is based at Canberra, at least two hours flying time away.
4) Local helicopter operators advise that it would take at least one full working day to convert a normal chopper to spraying operations.
5) The nearest fixed wing crop dusting-spraying aircraft is at Cessnock which would need to land at Sydney to replenish dispersant whereas the chopper could operate from, say Caltex Refinery at Kurnell. This would reduce significantly the time between sorties.

Mr Alan Adams of Esso Australia, available on telephone 051 49 7200, has considerable experience with the equipment.

In regard to your second enquiry, this office and the Air Traffic Controllers at Sydney Airport could be relied upon to provide every assistance in spraying operations.

The effect that the spraying operation would have on Sydney Airport would vary depending on the runways in use at the airport, and the exact location of the spill.

.../2

Generally speaking, a spraying operation east of a line joining the Kurnell Wharf, the submarine terminal and the southern wall of the revetment would have little effect on the airport area. Progressing westward from this line begins to have an adverse effect on operations at Sydney. Area 2 would begin to create problems and would require the tower controller to visually monitor the helicopter operations.

For an oil spill to reach Area 3 would require, in most cases, a north easterly wind and that being the case, the aircraft would be using runway 07, ie the east-west runway and access to this area 3 would be readily available.

Area 4, contaminated by a south easterly wind would also be available with increasing controller involvement. Access to area 5 would be very difficult but with the tower controllers co-operation and the possible closure of runway 16 into Botany Bay, weather permitting, it is reasonable to expect to be able to spray, if considered essential.

If further information or assistance is required you could telephone me on 218-7308.

Yours faithfully

(K. Gale)
for Director