Preliminary Operations Planning Manual for

THE RESTORATION OF OIL-CONTAMINATED BEACHES

U.S. DEPARTMENT OF THE INTERIOR ● FEDERAL WATER POLLUTION CONTROL ADMINISTRATION

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PRELIMINARY OPERATIONS PLANNING MANUAL FOR THE RESTORATION OF OIL-CONTAMINATED BEACHES

by

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Prepared for

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DEPARTMENT OF THE INTERIOR

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INTRODUCTION

Under a contract with the Federal Water Pollution Control Administration, URS Research Company has conducted Phase I of a research study to evaluate the use of selected earthmoving equipment in oil-contaminated-beach restoration operations and to determine the cost and effectiveness of such equipment in removing oil-contaminated sand and debris from the beach. To disseminate the findings of Phase I, this Operations Planning Manual has been prepared for use by FWPCA personnel involved in oil-spill cleanup operations. Full-scale testing of the beach restoration procedures described in this manual will be conducted during Phase II of the study, and a final report describing the results of the entire study will be issued on July 1, 1970, to supercede this document.

The objectives of the research study are to be accomplished in two phases, each consisting of several tasks as follows:

PHASE I

Task I

Review existing reports on recent oil pollution incidents and other available information to determine the magnitude of beach contamination and previous methods utilized in beach restoration operations.

Task II

Survey commercially available equipment and obtain information on pertinent performance characteristics; design candidate beach restoration procedures, and identify possible limitations of equipment.

Task III

Conduct preliminary evaluation tests to determine operating characteristics and performance of the equipment in removing a thin layer of sand under various beach conditions; determine the necessary modification and cost of modifications to improve the performance of the equipment.

Task IV

Prepare a test plan for the full-scale testing of the candidate beach restoration methods and develop performance criteria and specifications for the various classes of equipment to be evaluated.

PHASE II

Task I

Conduct full-scale field tests to evaluate the operating plans, methods, and equipment selected in Phase I. Evaluate effectiveness of modifications to equipment. Performance criteria to be measured for each procedure and equipment combination evaluated shall include:

(a) Efficiency with which each procedure/equipment collects (and/or spills) oil-contaminated material.

(b) The ratio of oil to inert material in the mixture collected.

(c) The cost per unit of oil collected and unit of beach area cleaned.

(d) Capability of the equipment to operate under a variety of beach conditions.

(e) Performance characteristics at various speeds, blade angles, and depths of cut.

BEACH RESTORATION PROCEDURES

The surface conditions and topography of a beach contaminated with oil and the manner in which the oil has been deposited onto the beach will dictate the choice of equipment to be utilized and the operating procedures to be followed.

The Phase I preliminary evaluation tests indicated that several restoration procedures seem to provide considerable savings in effort and cost over some methods previously used. These procedures are listed in Table 1.

The restoration procedures described herein are those recommended for the restoration of relatively flat, sandy beaches contaminated under one or both of the following situations:

a. Beach material uniformly contaminated with a layer of oil up to the high-tide mark and/or deposits of oil dispersed randomly over the beach surface. Oil-deposit penetration is limited to approximately 1 in.

b. Agglomerated pellets of oil-sand mixture or oil-soaked material, such as straw and beach debris, distributed randomly over the surface and/or mixed into the sand.

The procedures tested utilize the following equipment, singly or in combination:

- Motorized Graders
- Motorized Elevating Scrapers
- Front End Loaders
- Conveyor-Screening Systems

Based on the visual observations made during the Phase I preliminary evaluation tests described in ANNEX I, and the overall production rates calculated for each equipment type evaluated, the following conclusions are offered:

Table 1

RECOMMENDED RESTORATION PROCEDURES

RESTORATION PROCEDURE	METHOD OF OPERATION
A. Combination of motorized grader and motorized elevating scraper	Motorized graders cut and remove surface layer of beach material and form large windrows. Motorized scrapers pick up windrowed material and haul to disposal area for dumping or to unloading ramp-conveyor system for transfer to dump trucks. Screening system utilized to separate beach debris such as straw and kelp from sand when large amounts of debris are present.
B. Motorized elevating scraper	Motorized elevating scrapers, working singly, cut and pick up surface layer of beach material and haul to disposal area for dumping or to unloading ramp-conveyor system for transfer to dump trucks. Screening system utilized to separate beach debris such as straw and kelp, from sand when large amounts of debris present.
C. Combination of motorized grader and front end loader	Motorized graders cut and remove surface layer of beach material and form large windrows. Front end loaders pick up windrowed material and load material into following trucks. Trucks remove material to disposal area or to conveyor-screening system for separation of large amounts of debris from sand.
D. Front end loader	Front end loaders, working singly, cut and pick up surface layer of beach material and load material into following trucks. Trucks remove material to disposal area or to conveyor-screening system for separation of large amounts of debris from sand.

1. A motorized grader and motorized elevating scraper working in combination provide the most rapid means of beach restoration; and in addition, their use results in the removal of the smallest amount of uncontaminated beach material.

   (a) The optimum moldboard (blade) angle for the motorgrader, in which minimum spillage occurred while windrowing sand, was found to be 50 deg from the perpendicular to the direction of travel. At smaller angles the sand builds up on the moldboard and spills around the leading edge. At larger angles, the operator loses the fine control of the blade and has difficulty keeping a constant depth of cut.

   (b) Straw spread on beach areas is easily windrowed by the motorized grader and removed by the motorized elevating scraper. Removing straw directly with a motorized elevating scraper posed no problem.

   (c) Kelp, seaweed and similar debris does not interfere with the operation of either the motorized grader or motorized elevating scraper.

   (d) On beaches of very coarse sand, both the rubber-tired motorized grader and motorized elevating scraper may become immobilized while conducting beach restoration operations. For such beaches, flotation tires or rubber-belted half tracks on the motorized grader and tracked prime movers to assist the motorized elevating scraper in loading or cutting operations would be required.

   (e) When a motorized elevating scraper is picking up a windrow or making a thin cut, a certain amount of spillage occurs around each edge of the scraper bowl. Although the spillage could not be considered excessive for normal earthmoving operations, it would be undesirable when conducting beach restoration operations.

2. A front end loader mounted on a crawler tractor is the most inefficient apparatus. In addition more spillage occurs with its use than with any other equipment. These results can be extrapolated (we believe) to apply also to bulldozers.

3. A non-elevating motorized scraper will not operate efficiently on beach areas unless a tracked prime mover is used either as the principal source of power or as a pusher to assist in loading. A thin cut is difficult to maintain, and excess spillage occurs when loading.

4. Beach restoration operations on backshore areas become very difficult due to the looseness of the sand. Procedures for minimizing the oil-contamination of backshore areas should be instituted at the first indication of a possible shoreline pollution event. Under normal tide conditions, a berm or dike at the high-tide mark can prevent oil from contaminating backshore areas.

5. Conveyor-screening systems can be effectively utilized to: (a) load oil-contaminated material into trucks for transport to disposal areas, and (b) separate oil-contaminated debris (i.e., straw, kelp, seaweed) from oil-contaminated sand.

6. There has been little to no effort towards the systematic collection of data needed to accurately determine the cost and effectiveness of previous beach restoration operations. (See Annex II for Proposed Data Requirements).

In the following sections, descriptions of each type of equipment are given, including (a) principle of operation, (b) applicability, and (c) operational procedures. Included in each section are tables of equipment specifications and operating costs obtained from equipment manufacturers. The tables do not include all models and makes in each equipment category; however, the listed models constitute the majority of such equipment presently utilized in construction activities.

MOTORIZED GRADERS

Principle of Operation

Motorized graders (Fig. 1) are designed to move quantities of material short lateral distances by the process of side casting. They are not generally used to haul material in the direction of travel. When the blade is set at an angle, the material that is cut and pushed ahead of it tends to be deflected to one side with a rolling and sliding action. The curve of the moldboard (blade) is designed to promote the rolling and sliding action of the material as it moves across the blade.

The size of the windrow created by the material as it comes off the blade is dependent upon the depth of cut, angle of the blade and the condition of the material being moved. Under certain soil conditions, a motorized grader is capable of making successive passes, i.e., picking up a windrow and simultaneously cutting and moving the cut material along with the previous windrow. After the windrows are formed, they must be removed from the area by some other means.

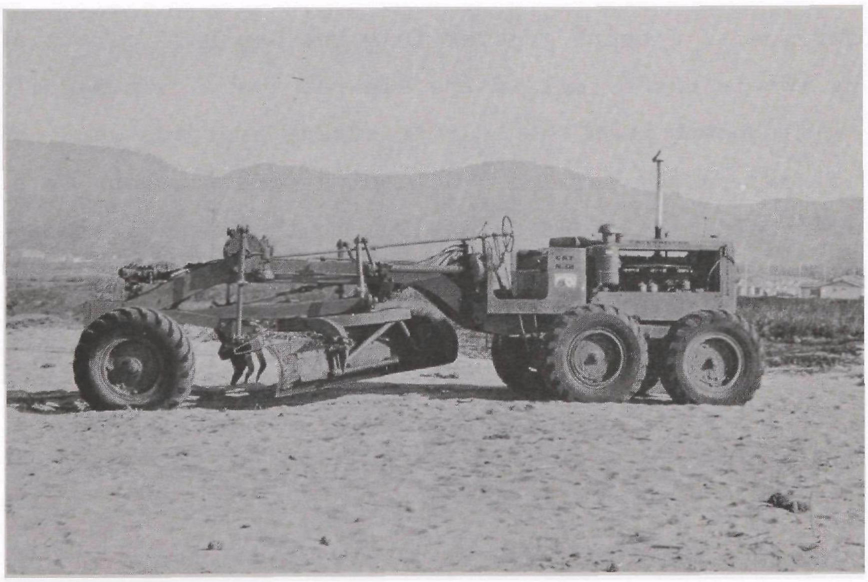


Fig. 1. Motorized Grader

Applicability

Motorized graders are most efficient when operating on relatively flat areas of cohesive soil, firm but not hard, and on relatively long narrow areas. A uniform cut is difficult to maintain under conditions where rocks are present in the surface layer. For the removal of oil-contaminated sand, the motorized grader would be most efficiently used on the firmly packed beach area lying between the high and low tidal zones.

A major problem encountered with a motorgrader is its inability to maintain traction when operating on a beach of low-bearing-strength sand. Flotation tires on all wheels will overcome this problem on most beaches. A set of flotation tires and rims to fit most models and makes of motorgraders would cost approximately $2400.

An alternative to flotation tires is the addition of rubber-belted half-tracks, which would fit over the drive wheels on each side of the grader. These half tracks are a standard shelf item and have been utilized extensively on agricultural machinery. A set of rubber-belted half-tracks can be installed for approximately $1000.

The front wheels of a motorgrader will, in some instances, depress the beach surface to a depth greater than the depth of cut being taken, thus leaving two tracks of oil in the cleared area. The magnitude of this "spillage" will depend upon the bearing strength of the sand, depth of cut, and amount of oil on the surface. Moldboard modifications to eliminate this spillage would consist of extensions to the cutting edge positioned as shown in Fig. 2.

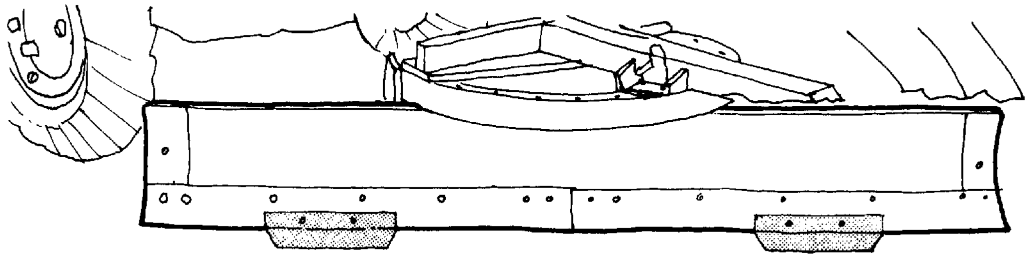
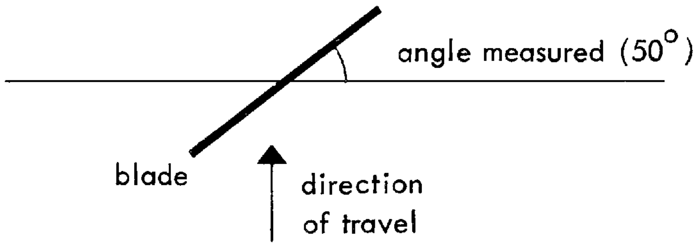


Fig. 2. Moldboard Modifications

Operational Procedures

Operational procedures for motorized graders conducting beach restoration operations follow:

(1) Set moldboard (blade) at a 50-deg angle perpendicular to the direction of travel.



(2) Set depth of cut at depth of oil penetration (1/2 to 1 in.).

(3) Operate grader in second gear (3 to 4 mph).

(4) Commence grading 1st pass on oil-contaminated material furthest inshore, casting windrow parallel to surfline. Continue grading to end of contaminated area or approximately 200 to 300 yards in distance.

(5) Return grader to starting point by backtracking on cleaned area.

(6) Reposition grader for 2nd pass so as to pick up 1st-pass windrow and cast 2nd-pass windrow parallel to surfline (see Fig. 3).

(7) Return grader to starting point by backtracking on cleaned area.

(8) Reposition grader for 3rd pass so as to cast a windrow from surfline side onto 1st- and 2nd-pass windrow as shown in Fig. 4. A three-pass windrow is the optimum for pickup by a motorized elevating scraper (see Fig. 5). Limit height of windrow to ground clearance of tractor.

Note: Optimum rate of operation for smooth firm beaches is 1/2 to 1/3 hr/acre.

Specifications of motorized graders are given in Table 2. Equipment manufacturer designations are given in Table 3.

Fig. 3. Motorized Grader Casting Second-Pass Windrow

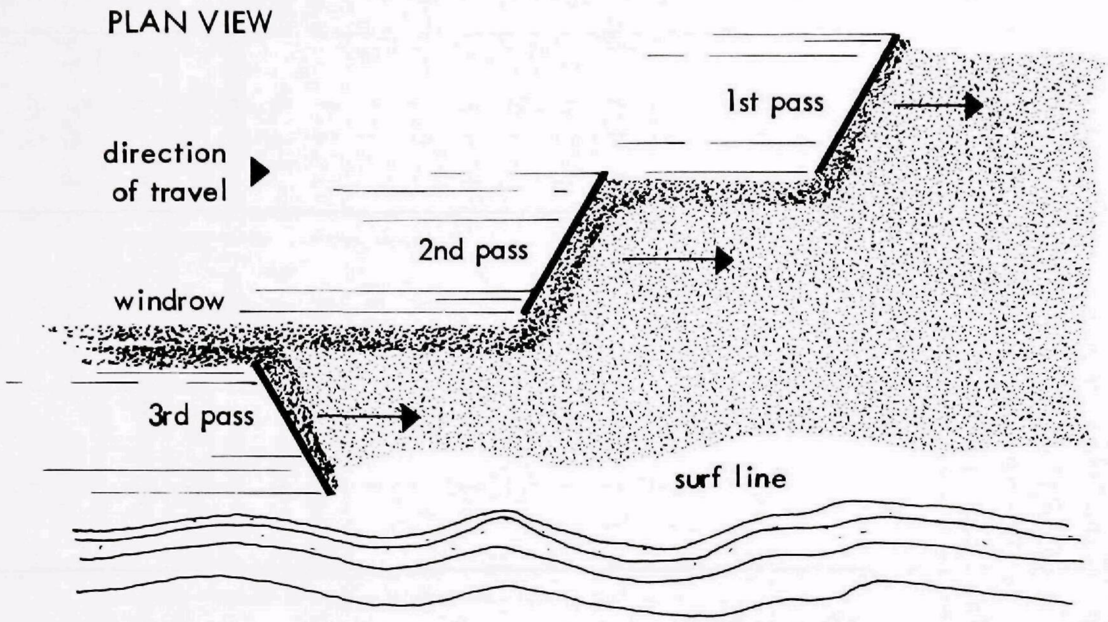


Fig. 4. Motorized Grader Operational Sequence

Fig. 5. Three-Pass Windrow Formed by Motorgrader

Table 2

EQUIPMENT SPECIFICATIONS: MOTORIZED GRADERS

TYPE: Wheeled, self-propelled to operating site

Make & Model	Net Engine HP Rating	Weight including attachments (tons)	Blade Size	Rating - chain speed (ft/min)	Labor Requirements (man-hrs per hour of equipment operation)		Fuel, Oil & Lube Reqmts. (per hour of equipment operation)		
					Equipment Operator	Maint. & Repair	Diesel Fuel (gal)	Lube (lb)	Oil (gal)
CAT - 16	225	24	14'x31"	Not Applicable	1	.28	10.0	.4	.22
WABCO 888	230	20	14'x32"		1	.28	10.1	.4	.22
WABCO 777	160	14.5	12'x28"		1	.25	7.0	.3	.16
Galion T 600	175	14.5	13'x26"		1	.25	7.5	.3	.18
AW Super 500	179	15	13'x28"		1	.25	7.5	.3	.18
WABCO 330 H	100	11	12'x25"		1	.2	4.5	.25	.10
AW Super 200	106	11	12'x24"		1	.2	5.0	.25	.10
CAT 12F	115	13	12'x24"		1	.2	5.0	.30	.11
Galion 104H	125	12	12'x24"		1	.2	5.5	.30	.12
Galion 118	135	12.5	12'x24"		1	.22	6.0	.30	.13
AW Pacer 400	143	13.5	13'x26"		1	.25	6.5	.30	.14
WABCO 440 H	147	12	12'x25"		1	.25	7.0	.30	.14
CAT - 14E	150	15	13'x27"		1	.25	7.1	.30	.15
AC-M-100B	127	13	12'x24"		1	.2	5.5	.30	.12
AW Super 100	106	10	12'x24"		1	.2	5.0	.25	.10
AW Super 300	143	12.5	13'x26"		1	.25	6.5	.30	.14
CAT 112F	100	10.5	12'x24"		1	.2	4.5	.25	.10
CD D-560	100	12.5	12'x25"		1	.2	4.5	.25	.10
CD D-562	125	13	12'x25"		1	.2	5.5	.30	.12

(continued)

Table 2 Continued

EQUIPMENT SPECIFICATIONS: MOTORIZED GRADERS

TYPE: Wheeled, self-propelled to operating site

Make & Model	Net Engine HP Rating	Weight including attachments (tons)	Blade Size	Rating - chain speed (ft/min)	Labor Requirements (man-hrs per hour of equipment operation): Equipment Operator	Labor Requirements: Maint. & Repair	Fuel, Oil & Lube Reqmts. (per hour of equipment operation): Diesel Fuel (gal)	Fuel, Oil & Lube Reqmts.: Lube (lb)	Fuel, Oil & Lube Reqmts.: Oil (gal)
CD D-640	135	14	12'x25"		1	.22	6.0	.30	.13
CD D-650	160	14	12'x25"		1	.25	7.0	.30	.16
Galion 104 B	106	11.5	12'x24"		1	.20	4.5	.25	.10
" 160 B	160	13.5	12'x27"		1	.25	7.0	.30	.16
" 160 L	190	14.5	12'x27"		1	.27	8.3	.35	.18
Huber D-1100	107	11.5	12'x24"		1	.20	5.0	.25	.10
" D-1300	130	12.5	12'x26"		1	.24	5.8	.27	.13
" D-1500	150	13.5	12'x26"		1	.25	7.1	.30	.15
" D-1700	165	14.5	12'x28"		1	.25	7.3	.32	.16
" D-1900	195	16	12'x28"		1	.28	8.6	.35	.18
Pettibone-402	125	11.5	12'x24"		1	.20	5.5	.30	.12
" -502	145	13.5	12'x24"		1	.25	6.7	.30	.14
Wabco - 440	115	12	12'x25"		1	.20	5.6	.30	.11
" 660-B	150	14	12'x28"		1	.25	7.1	.30	.15
" 666	132	13	12'x25"		1	.24	5.9	.27	.13

Table 3

EQUIPMENT MANUFACTURER DESIGNATORS

NAME OF MANUFACTURER	DESIGNATION
Caterpillar Tractor Company	CAT
Allis Chalmers Mfg. Company	HD or AC
Eimco Corporation	Eimco
International Harvester Company	TD or IH
Euclid Div., General Motors	EUC
Michigan: Clark Equipment Company	Michigan
Hough: International Harvester Company	Hough
R.G. Le Tourneau Inc.	LET
Pettibone Mulliken Corp.	Pettibone
Trojan Div. — Eaton Yale & Towne Inc.	Trojan
Scoopmobile Inc.	Scoopmobile
WABCO, Construction Equipment Div.	WABCO
Austin Western: Baldwin-Lima-Hamilton Corp.	AW
Galion Iron Works & Mfg. Company	Galion
Hancock Div., Clark Equip. Company	Hancock
John Deere & Company	JD
Soilmover Mfg. Company	Soilmover
Huber Machinery Division	Huber
Cleveland-Drimco-Allith Corporation	CD
General Motors-Earthmoving Division	GM
MRS Manufacturing Co.	MRS

Note: Mention of commercial products does not imply endorsement by the Federal Water Pollution Control Administration or URS Research Company.

MOTORIZED ELEVATING SCRAPERS

Principle of Operation

Motorized elevating scrapers (Fig. 6) are utilized to pick up and haul material short distances, then dump and spread. They are equipped with self-loading elevators that pick up the cut material and dump it back into the hopper. In some materials, such as sand, they pick up material more easily than a standard non-elevating scraper that relies on the resistive force of the undercut material to fill the hopper.

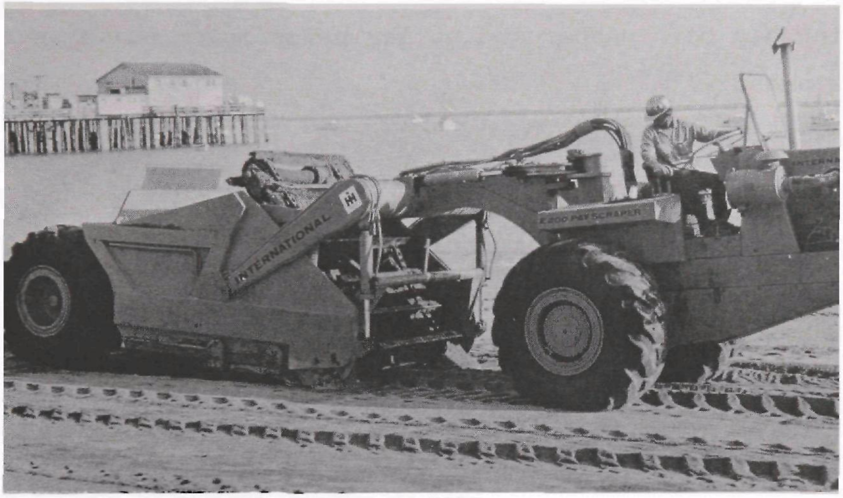


Fig. 6. Motorized Elevating Scraper

Applicability

Motorized elevating scrapers are most effective in clearing large areas that are relatively flat; however they can operate on sloped beaches. The motorized elevating scraper is the most efficient type of equipment for picking up windrows left by a motorized grader. The maximum size of the windrow should be restricted to the height of the ground clearance of the tractor, which ranges from 12 to 24 in. for most tractors.

On beaches exhibiting low bearing strength, the motorized elevating scraper, in its present configuration, will become immobilized in the sand. Two possible methods that will overcome the immobilization problem are:

(1) Use of a non-self-propelled elevating scraper (see Table 5), pulled by a tracked bulldozer or front end loader. The use of a crawler tractor increases traction greatly and would permit scraper operation on beaches of low bearing strength.

(2) Use of a pusher unit (i.e., a tracked or wheeled bulldozer) as an additional prime mover to push the elevating scraper unit, or use of a tandem-drive elevating scraper, such as the WABCO BT 33F, which has both pusher and puller prime mover units as standard equipment.

Operational Procedures

Operational procedures for motorized elevating scrapers working singly or in combination with a motorized grader are listed below. Since a motorized grader is capable of producing windrows continuously, several motorized elevating scrapers can be utilized simultaneously to pick up windrows.

- Operating in combination with motorized graders

  (1) Position elevating scraper so as to straddle the windrow formed after three passes by the motorized grader (see Fig. 7). Lower cutting edge of bowl to cut to depth of oil penetration (1/2 in.).

  (2) Operate the scraper in 1st gear (low range) and pick up windrow, keeping elevator flights moving after bowl has filled up.

  (3) Proceed to unloading area (keeping elevator flights moving). Rates of operation depend upon distance to unloading area.

- Operating singly

  (1) Commence operations on oil-contaminated material farthest inshore. Operate parallel to surfline.

(2) Set depth of cut to depth of oil penetration (1 to 2 in.) or just to skim surface if only oil-contaminated debris to be removed. Figures 8 and 9 show the results of picking up beach debris and Figs. 10 and 11 show the results of removing straw from a test area.

(3) Operate scraper in 1st gear (low range).

(4) Length of pass dependent upon size of scraper bowl. Keep elevator flights running after bowl is filled.

(5) Proceed to unloading area (keeping elevator flights moving).

Note: Rate of operation for one elevating scraper is 3/4 to 1 hr/acre when removing windrows and 1 hr/acre when operating singly. Rates are based on a haul distance of 200 ft (see Fig. 17, Annex I). Table 4 lists the specifications of the motorized elevating scraper. Table 5 presents a similar listing for the crawler tractor-drawn elevating scrapers.

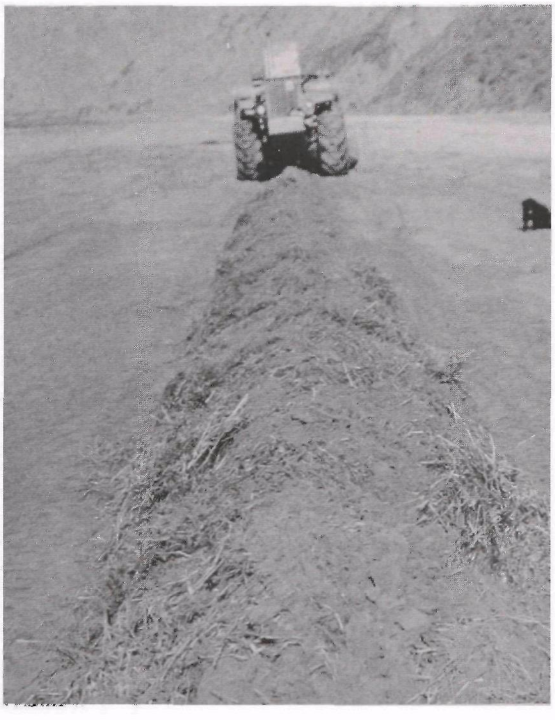


Fig. 7 Motorized Elevating Scraper in Position to Remove Windrow.

Fig. 8. Beach Debris Prior to Removal by Motorized Elevating Scraper

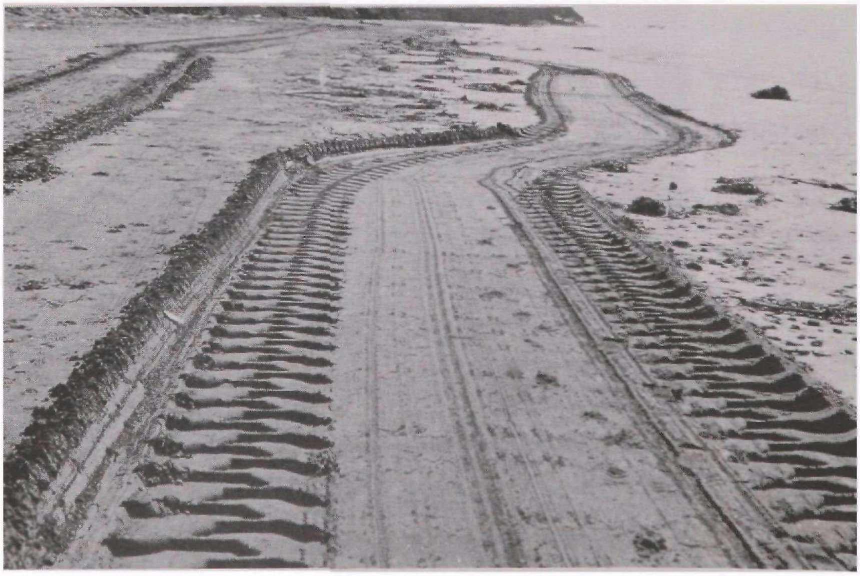


Fig. 9. Beach After Removal of Debris by Motorized Elevating Scraper

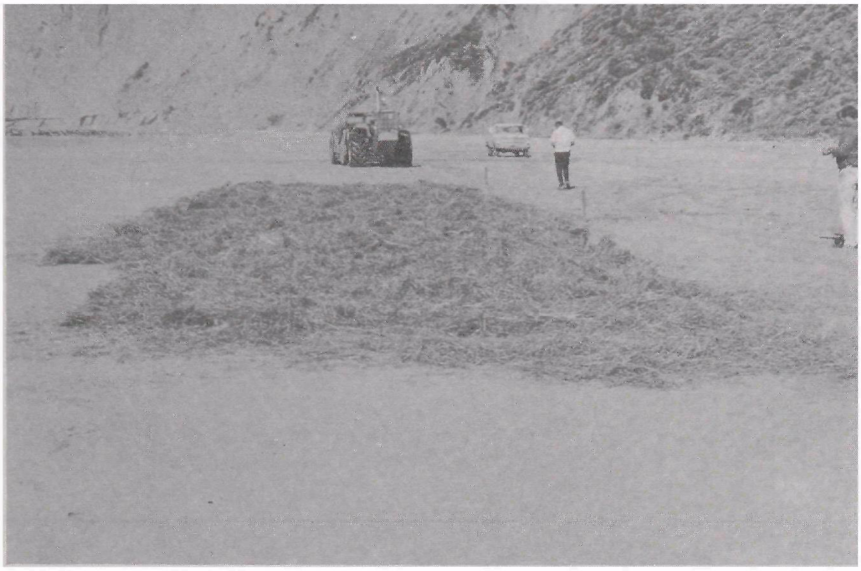


Fig. 10. Test Area Before Removal of Straw

Fig. 11. Test Area After Straw Removal by Motorized Elevating Scraper

Table 4

EQUIPMENT SPECIFICATIONS: MOTORIZED ELEVATING SCRAPERS

TYPE: See below

Make & Model	Net Engine HP Rating	Weight including attachments (tons)	Capcaity (cu yds)	Rating - chain speed (ft/min)	Labor Requirements (man-hrs per hour of equipment operation): Equipment Operator	Labor Requirements: Maint. & Repair	Maintenance Requirements (per hour of equipment operation): Diesel Fuel (gal)	Maintenance Requirements: Lube (lb)	Maintenance Requirements: Oil (gal)
SELF-PROPELLED to Operating Site									
IH - E 200	135	13	9	166	1	.35	4.8	.5	.15
IH - E 211	157	14	11	155 / 206	1	.35	7.0	.45	.16
CAT - 613	150	14	11	225	1	.35	7.0	.45	.16
GM S-7	148	16	12		1	.35	7.0	.45	.16
Hancock - HF 6	64	10	6		1	.3	2	.43	.05
" 282 G	115	13.5	9		1	.34	4	.47	.13
" 292 B	160	16.5	11		1	.36	7	.50	.18
Michigan 110-12	178	19	12		1	.37	8.5	.52	.21
MRS - 1 - 905	186	18	12		1	.37	8.5	.52	.21
Wabco - D - 111A	160	18	11		1	.36	7	.50	.18
TRANSPORTATION REQUIRED to Operating Site									
JD - 860	228	21	15	200	1	.40	10.0	.55	.16
IH - E 270	260	25	21		1	.45	9.0	.60	.30
CAT J-621	300	31	21	202 / 172	1	.45	13.5	.60	.30
IH - E 295	420	44	32		1	.50	15.0	.7	.33
CAT - 633	400	43	32		1	.50	15.0	.7	.33

(continued)

Table 4 Continued

EQUIPMENT SPECIFICATIONS: MOTORIZED ELEVATING SCRAPERS

TYPE: See below

Make & Model (continued)	Net Engine HP Rating	Weight including attachments (tons)	Capacity (cu yds)	Rating - chain speed (ft/min)	Labor Requirements (man-hrs per hour of equipment operation)		Maintenance Requirements (per hour of equipment operation)		
					Equipment Operator	Maint. & Repair	Diesel Fuel (gal)	Lube (lb)	Oil (gal)
TRANSPORTATION REQUIRED to Operating Site									
AC 260 E	320	30	24		1	.45	13.7	.65	.32
GM 35E	495	49.5	35		1	.55	16.2	.75	.36
Michigan - 110 - 14	238	21	14		1	.4	10.8	.56	.27
" 210 - H	335	28	23		1	.46	14.0	.65	.33
" 310 - H	475	47	31		1	.53	16.1	.74	.36
MRS I- 95 S	250	28.5	17.5		1	.41	11	.57	.27
" I - 100 S	290	32	20.5		1	.43	12.6	.60	.30
" I - 105 S	337	36.5	23		1	.46	14.0	.65	.33
" I - 110 S	389	39	25		1	.49	15.1	.68	.34
WABCO - C 222-F	318	29	21		1	.45	13.7	.65	.32
" B 333-F	475	47	32		1	.53	13.1	.74	.36
* " BT 333-F	475 475	57	34		1	.8	32.2	1.48	.72

*Has dual engines.

Table 5

EQUIPMENT SPECIFICATIONS: TRACTOR-DRAWN ELEVATING SCRAPER

TYPE: Wheeled, transportation required to operating site

Make & Model	Net Engine HP Rating	Weight including attachments (tons)	Capcaity (cu yds)	Rating - chain speed (ft/min)	Labor Requirements (man-hrs per hour of equipment operation)		Fuel, Oil & Lube Reqmts. (per hour of equipment operation)		
					Equipment Operator	Maint. & Repair	Diesel Fuel (gal)	Lube (lb)	Oil (gal)
Hancock 4R2	40	2.5	4	Not Applicable	1				
Soilmover - 50 E	40-55	3	5		1				
Hancock 8R4	70	6	8		1				
Soilmover - 90 E	55-75	5-1/2	8-1/2		1				
Hancock 11 E	90	11	11		1				
Hancock 14 E	120	12-1/2	14		1				
Hancock 18 E	170	19-1/2	18		1				
Soilmover - 130 E	70	4	13		1				
Johnson - 40-B	50	3	4		1				
Johnson - 80-C	70	5	8		1				
Johnson - 110-B	70	6	11		1				
Johnson - 410-B	100	7	11		1				

FRONT END LOADERS

Principle of Operation

Front end loaders (Fig. 12) are designed for digging, loading, and limited transport of material. The front loader (bucket) may be carried by any type of tractor, crawler tractor, or four-wheel-drive or two-wheel-drive rubber-tired tractors. Crawler tractors and four-wheel-drive tractors are used for heavy service and two-wheel-drive models for lighter work.

Buckets are made in different sizes and weights for various types of materials and work conditions. Bucket capacity will depend upon the size and type of tractor on which it is mounted. Buckets for crawler tractors range from 3/4 to 4 cu yd. Wheeled tractors have both smaller and larger buckets.

The bucket is loaded by the forward travel of the tractor. Most loading is done with the bucket flat or tilted at a slight downward angle. The flat position is best for loading a quantity of loose material. The amount picked up in the bucket will vary with the consistency of the material, the slope of the area worked on, and the skill of the operator.

Applicability

From the results obtained during the preliminary evaluation tests conducted in Phase I, and analysis of previous beach restoration operations, it is recommended that front end loaders be utilized only for loading material from windrows formed by motorized graders or from stockpiles into trucks. Their operations on oil-contaminated beach areas should be kept to a minimum, especially when utilizing crawler-tractor mounted front end loaders, which have been found to grind the oil several feet into the sand.

Front end loaders equipped with slot buckets could be utilized in removing large quantities of oil-contaminated debris, such as delp, driftwood, etc. Slot buckets would allow loose sand to fall away through the slots.

Operational Procedures

Operational procedures for front end loaders working singly or in combination with a motorized grader are listed below. Several front end loaders will be required to remove windrows formed by a single motorized grader.

(1) Utilize 4-in-1 type bucket if available (see Fig. 13).

(2) Operate tractor in 1st gear while loading.

(3) To minimize spillage, while scraping, only fill bucket 1/3-1/2 full.

(4) Minimize traffic over oil-contaminated area when using tracked loader.

Note: Rate of operation for one front end loader removing windrows over an average haul distance of 100 ft is 2-1/2 to 3 hr/acre.

Table 6 presents specifications of rubber-tired and self-propelled front end loaders. Table 7 presents specifications of the crawler front end loader.

Fig. 12. Front End Loader Mounted on Crawler Tractor

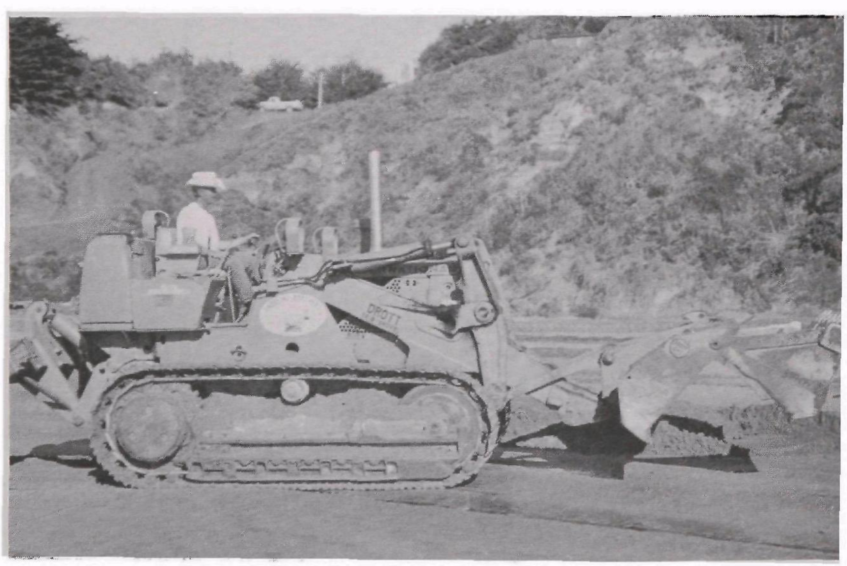


Fig. 13. 4-in-1 Bucket in Clamshell Position

Table 6

EQUIPMENT SPECIFICATIONS: FRONT END LOADER

TYPE: Wheeled, self-propelled to operating site

Make & Model	Net Engine HP Rating	Weight including attachments (tons)	Capacity (cu yds)	Rating - chain speed (ft/min)	Labor Requirements (man-hrs per hour of equipment operation)		Fuel, Oil & Lube Reqmts. (per hour of equipment operation)		
					Equipment Operator	Maint. & Repair	Diesel Fuel (gal)	Lube (lb)	Oil (gal)
CAT - 944	105	11	2	Not Applicable	1	.22	5.0	.3	.11
Michigan 75-111	108	8.5	2		1	.22	5.0	.3	.11
Pettibone 125A	108	8.3	1-3/4		1	.22	5.0	.3	.11
Trojan 164A	115	9	2		1	.22	5.1	.3	.11
EUC 72-21	115	9.5	2		1	.22	5.1	.3	.11
CAT - 950	125	11.5	2-1/4		1	.25	5.5	.3	.12
Michigan 85-111	140	10	2-3/4		1	.27	6.5	.4	.14
Hough H-65C	141	11.5	2-1/4		1	.27	6.5	.4	.14
EUC 72-31	145	12	2-1/2		1	.27	6.5	.4	.14
CAT - 966	150	16	3		1	.30	6.5	.5	.15
EUC 72-41	163	14.5	3		1	.35	7.5	.6	.16
Pettibone PM-440	175	16	3-1/2		1	.36	7.5	.6	.17
Pettibone PM-350	185	16	3-1/2		1	.38	8.5	.6	.18
Trojan - 3000	185	15	3-1/2		1	.41	8.5	.6	.18
Hough H-900	198	17	3		1	.41	9.0	.7	.19
EUC - 202	200	16	3-1/2		1	.42	9.5	.7	.19
HD-745	210	18	5		1	.35	9.5	.7	.20
Michigan 125 - 111A	220	18	4		1	.35	10.0	.7	.21
Hough H 1008	226	20	4		1	.34	10.0	.7	.22
CAT - 980	235	22	4		1	.35	11.0	.7	.23
Michigan 175 - 111	238	18	4-1/2		1	.40	11.0	.7	.23
Trojan - 4000	247	22	4-1/2		1	.40	11.5	.7	.24
Michigan 175 - 111A	290	21.5	5		1	.42	13.5	.7	.29
Hough H-120C	296	32	5		1	.42	13.5	.8	.30
CAT - 988	300	33	5-1/2		1	.42	13.7	.8	.31
Trojan - 404	318	25	5		1	.45	14.5	.8	.33
Scoopmobile 500	320	31.5	5		1	.45	14.5	.8	.33
Michigan 275 - 111A	380	31.5	6-1/2		1	.49	17.0	.9	.40

Table 7

EQUIPMENT SPECIFICATIONS: FRONT END LOADER

TYPE: Crawler, transportation required to operating site

Make & Model	Net Engine HP Rating	Weight including attachments (tons)	Capacity (cu yds)	Rating - chain speed (ft/min)	Labor Requirements (man-hrs per hour of equipment operation)		Fuel, Oil & Lube Reqmts. (per hour of equipment operation)		
					Equipment Operator	Maint. & Repair	Diesel Fuel (gal)	Lube (lb)	Oil (gal)
HD - 7-G	100	12	1-3/4	Not Applicable	1	.22	4.5	.5	.10
CAT - 955K	115	14	1-3/4		1	.22	5.0	.5	.11
IH - 175B	120	13.5	2		1	.22	5.5	.6	.12
EIMCO - 123C	150	19	2-3/8		1	.33	7.0	.6	.15
EIMCO - 115	154	21	1-1/2		1	.33	7.0	.6	.15
IH - 250B	160	19.5	2-1/2		1	.29	7.2	.6	.16
CAT - 977K	170	20.5	2-1/2		1	.28	7.5	.7	.17
HD - 12-G	185	21	2-3/4		1	.32	8.5	.7	.18
EIMCO - 126C	218	28	3		1	.35	10.0	.7	.21
HD - 21-G	254	37	4		1	.37	11.5	.9	.25

UNLOADING RAMP AND CONVEYOR SYSTEM

Principle of Operation

An unloading ramp and conveyor system, as shown in Fig. 14, should be considered as a method of transferring beach material picked up by motorized elevating scrapers directly into trucks or into stockpiles. The system can also include a screening system to separate oil-soaked debris, such as straw, from the oil-sand mixture.

Applicability

The use of an unloading ramp-conveyor system is dependent upon the magnitude of the beach restoration operations. In situations similar to that encountered during the Santa Barbara incident, where some 4,000 truck-loads of oil-contaminated sand and debris were hauled to disposal areas, a system of this type would have saved considerable cost and effort.

Several such systems may have to be installed if oil-contamination occurs over a significant length of beach. The hauling time from the operating area to the unloading area is a factor that has to be considered in locating such a facility.

The unloading ramp and conveyor-screening system illustrated in Fig. 14 can be installed for approximately $2000. A typical ramp system would consist of two cribs built out of railroad ties on each side of a hopper feeding a belt conveyor. The ramps contain approximately 100 cu yd of material, which may be found on site or brought in. A screening system can be attached to the discharge end of the conveyor system if required.

Factors that would influence the design of the unloading ramp and conveyor system are:

- Conveyor capacity - estimated volume of material per hour that will be produced by beach restoration procedures
- Conveyor length - height above ground required to load trucks

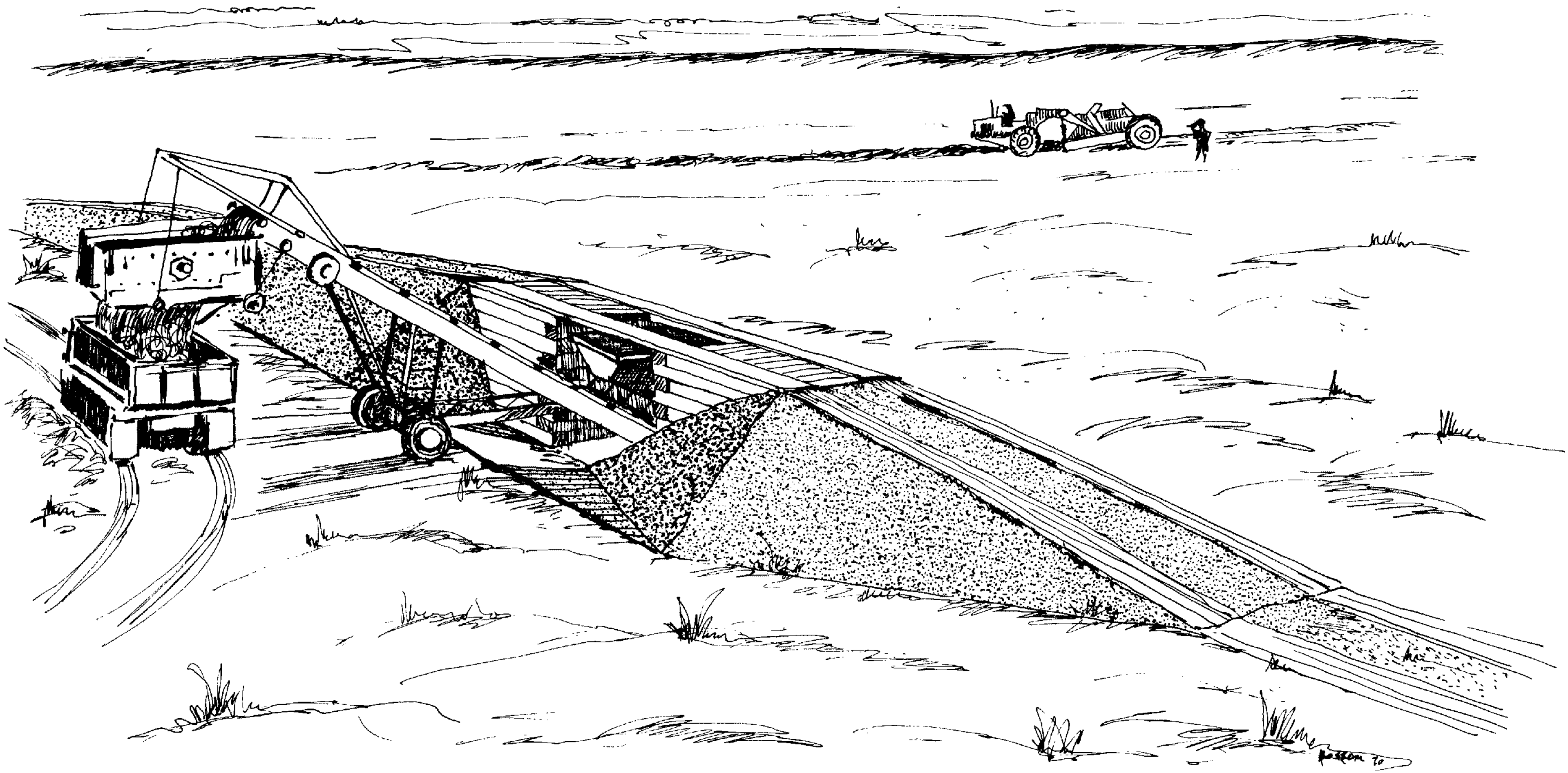


Fig. 14. Unloading Ramp and Conveyor-Screening System

- Hopper capacity - hopper should have sufficient capacity to receive total load of largest elevator scraper utilized
- Ramp height - depends on overall height of conveyor and hopper and depth of pit, if required
- Ramp width - maximum width of largest elevating scraper utilized

Table 8 lists the specifications of suitable belt loaders.

TABLE 8

Equipment Specifications: Belt Loaders

Type: Wheel, transportation required to operating site

Make and Model	Net Engine HP Rating	Weight including attachments (tons)	Capacity cu yds/hr	Width of Belt (in.)	Labor Requirements (man hrs/hr of equipment operations)		Fuel, Oil, Lube Requirements (per hour of equip. operation)		
					Equipment Operator	Maintenance and Repair	Diesel Fuel (gal)	Lube (lbs)	Oil (gal)
Barber-Greene PL-90	130	24	2000	48	1	.26	5.6	.3	.12
Hewitt-Nobins-450	170	28.5	2400	48	1	.28	7.5	.7	.17
Ko-Cal 4845-R	105	19	2800	48	1	.22	5.0	.3	.11
Ko-Cal 4860-R	154	25.5	2800	48	1	.30	6.5	.5	.15
Ko-Cal 4845-S	105	24	1800-2800	48	1	.22	5.0	.3	.11
Ko-Cal 4860-5	154	29	1800-2800	48	1	.30	6.5	.5	.15
Ko-Cal 4860-S	154	29	1800-2800	48	1	.30	6.5	.5	.15
Ko-Cal 3650	70	11.5	1200	36	1	.2	4.0	.3	.10
Ko-Cal 4250	97	13	1700	42	1	.22	4.5	.5	.10
Kolberg 348-50	130	24.5	2000	48	1	.26	5.6	.3	.12
Kolberg 448-60	154	30	2000	48	1	.30	6.5	.5	.15
Kolberg 1136-50	70	9.5	1000	36	1	.2	4.0	.3	.10
Kolberg 1148-50	130	15	2000	48	1	.26	5.6	.3	.12
Pioneer 4841	100	45.5	2000	48	1	.22	4.5	.5	.10

EQUIPMENT AND OPERATOR COSTS

Nationally averaged rental rates for the equipment recommended for use in beach restoration operations are given in Table 9. These rental rates do not include the cost of an operator and costs of fuel and lubricants. In addition to being national averages in dollar amounts, the rental rates reflect an averaging of age, condition and operating efficiency of the equipment.

It is general practice to base rates upon one shift of 8 hr per day, 40 hr per week, or 176 hr per month of a 30-consecutive-day period. Many distributors do not rent by the day or by the week, especially in the case of large equipment. If the equipment is rented by the day, the rate for overtime is 1/8 of the daily rate for each hour in excess of 8. If it is rented by the week, the rate for overtime is 1/40 of the weekly rate for each hour in excess of 40. If it is rented by the month, the overtime rate is 1/176 of the monthly rate for each hour in excess of 176 in any one 30-consecutive-day period.

Operator costs are tabulated in Table 10 for selected cities. These rates include fringe benefits. Overtime costs for operators are normally computed to be 150% to 200% of his straight-time wages.

In many instances, equipment and operators will be obtained through an earthmoving contractor, and the rental rates will include equipment rental, operator costs, maintenance costs, fuel, oil, and contractor's overhead and profit. An example* of such rental rates is listed below:

Equipment Type	Hourly Rate
Motorized grader - 26,000 lb	$22.00
Motorized elevating scraper - 9 cu yd	25.00
Front end loader - 1-3/4 cu yd	20.00
Bulldozer - D-6	22.00
Dump truck - 8 cu yd	14.25

* Rates quoted by Andreini Bros. Inc., Half Moon Bay, Calif.

Table 9

NATIONALLY AVERAGED RENTAL RATES

(Excluding Costs of Operator and Fuel)

		per month	per week	per day
		MOTOR GRADER		
		Diesel engine w/direct drive		
Net weight (lb)				
up to 10,000		542.00	186.00	61.75
10,001 to 20,500		650.00	217.00	70.00
20,501 to 22,500		*	*	*
22,501 to 26,000		1070.00	359.00	110.00
26,001 to 28,000		1167.00	*	*
		Diesel engine w/torque converter		
22,501 to 26,000		1326.00	436.00	142.00
26,001 to 28,000		1383.00		
28,001 to 30,000		1480.00	471.00	152.00
		MOTORIZED ELEVATING SCRAPER		
		2-wheel tractor with 2-wheel scraper		
HP range	Rated capacity (cu yd)			
121-144	8-9	1740.00	559.00	165.00
145-190	10-12	1973.00	700.00	229.00
191-288	13-19	2478.00	833.00	*
250-300	20-27	3445.00	1173.00	394.00
400-500	28-32	4829.00	1511.00	444.00
		4-wheel tractor with 2-wheel scraper		
121-144	8-9	1732.00	584.00	157.00
145-190	10-12	1990.00	625.00	193.00
		FRONT END LOADER/CRAWLER		
		Diesel engine-direct drive manual shift		
Rated capacity (cu yd)				
3/4		703.00	228.00	*
1		794.00	268.00	67.25
1-1/4		918.00	307.00	85.25
1-1/2		1035.00	357.00	109.00
2		1150.00	424.00	*
2-1/4		1513.00	533.00	168.00
		Diesel engine-torque converter, manual shift		
1		797.00	270.00	76.25
1-1/2		1135.00	359.00	*
2-1/4		1567.00	570.00	*

Continued

Table 9 (Contd)

NATIONALLY AVERAGED RENTAL RATES
(Excluding Costs of Operator and Fuel)

Rated capacity (cu yd)	per month	per week	per day
	Diesel engine-torque converter, power shift		
1	808.00	285.00	80.00
1-1/4	984.00	345.00	101.00
1-1/2	1202.00	383.00	115.00
1-3/4	1585.00	467.00	143.00
2	1593.00	502.00	163.00
2-1/2	2107.00	730.00	241.00
2-3/4	2325.00	800.00	270.00
	FRONT END LOADERS — WHEELED		
	Gasoline engine-torque converter, power shift		
1	661.00	226.00	68.50
1-1/4	760.00	249.00	78.25
1-1/2	910.00	294.00	84.75
2	1009.00	354.00	111.00
2-1/2	1039.00	362.00	115.00
	Diesel engine-torque converter, power shift-rigid frame		
1	735.00	245.00	81.75
1-1/4	836.00	283.00	84.75
1-1/2	985.00	321.00	99.75
2	1153.00	397.00	119.00
2-1/2	1388.00	446.00	141.00
2-3/4	1475.00	487.00	156.00
3	1602.00	572.00	176.00
3-1/2	1730.00	598.00	184.00
4-1/2	2138.00	725.00	224.00
5	2536.00	775.00	*
6	2933.00	991.00	*
	Diesel engine-torque converter, power shift-articulated steering		
2	1205.00	414.00	142.00
2-1/2	1448.00	520.00	164.00
2-3/4	1600.00	588.00	196.00
3	1827.00	622.00	201.00
3-1/2	1993.00	657.00	208.00
4	2425.00	803.00	255.00
4-1/2	2464.00	825.00	266.00
5	3222.00	1035.00	313.00
6	3268.00	1086.00	317.00
10	5667.00	*	*

Continued

Table 9 (Contd)

NATIONALLY AVERAGED RENTAL RATES
(Excluding Costs of Operator and Fuel)

Rated Capacity (cu yd)	per month	per week	per day
	2-wheel drive gasoline engine-direct drive, manual shift		
1/2	424.00	*	*
5/8	518.00	170.00	55.25
3/4	518.00	170.00	55.25
1-1/2	607.00	184.00	58.25
	Gasoline engine, torque converter, power shift		
5/8	504.00	182.00	58.25
3/4	572.00	193.00	65.25
1-1/4	719.00	249.00	88.00
	Diesel engine-direct drive, manual shift		
1/2	442.00	151.00	42.00
5/8	566.00	195.00	55.00
3/4	566.00	195.00	55.00
1	672.00	220.00	57.00
	BELT LOADING CONVEYORS (Belt width 12-18 in.)		
conveyor length (ft)			
20- 26	213.00	72.50	24.25
26- 30	*	*	*
30- 36	291.00	98.75	38.25
36- 46	350.00	123.00	45.50
46- 56	468.00	163.00	57.50
	Belt width 18-24 in.		
30- 36	363.00	125.00	43.00
36- 46	483.00	161.00	53.25
46- 56	521.00	163.00	*

*Insufficient information received.

Source: Nationally Averaged Rental Rates, compiled by Associated Equipment Distributors.

Table 10

EQUIPMENT OPERATOR WAGE RATES FOR SELECTED CITIES
($/hr + fringe benefits. As of Feb. 1, 1970)

City	Classification			
	Tractor/F.E. Loader	Motorized Scraper	Motorized Grader	Truck Driver
Atlanta	5.50	5.50	5.00	3.25
Baltimore	5.72	6.17	6.17	3.48
Birmingham	4.85	4.50	4.85	3.54
Boston	6.81	6.81	6.81	4.61
Dallas	6.15	6.15	6.15	7.51
Los Angeles	7.61	7.61	7.71	7.51
New Orleans	6.00	6.00	6.00	4.25
New York	8.12	7.36	7.01	6.28
Philadelphia	6.81	6.81	7.44	4.71
San Francisco	8.11	7.91	7.66	6.81
Seattle	7.03	6.97	6.92	6.72

Source: Engineering News-Record, 1/29/70.

ANNEX I

PRELIMINARY EVALUATION TESTS

Full-scale tests on beach areas were conducted during Phase I to determine the performance of the earthmoving equipment selected for use in beach restoration operations. The tests were conducted at three beach sites along the San Mateo County, California, coastline during the month of November, 1969.

Seventeen series of tests were conducted utilizing a motorgrader, motorized scrapers, and front end loaders, singly and in combination. Optimal equipment configurations, including blade angles, depth of cut, rate of operation, and necessary modifications to improve performance, were determined for each piece of equipment evaluated. The equipment evaluated included:

- Motorgrader - Caterpillar Model 12, rubber tired, 12-ft blade, 115 hp
- Motorized Elevating Scraper - International Harvester Model E-200, rubber tired, 9-cu-yd capacity, 135 hp, two-wheel drive.
- Motorized Scraper - Caterpillar Model 10, rubber tired, 12-cu-yd capacity, 120 hp, four-wheel drive.
- Front End Loader - Caterpillar Model 955, crawler tractor, 4-in-1 bucket, 1-3/4-cu-yd capacity, 115 hp
- Front End Loader - International Harvester Model 175B, crawler tractor, 4-in-1 bucket, 2-cu-yd capacity, 120 hp

The choice of make and model of equipment evaluated was determined only by equipment availability at the time of testing. These items, however, are representative of their classes, as given in Tables 2 through 7.

To improve the performance on sand, the motorgrader was equipped with 23.5X25, 10-ply flotation tires on all four driving wheels in place of the standard 13.00X24, 10-ply tires. The motorized elevating scraper was also equipped with two optional features designed to improve operating performance on sand. These consisted of the following:

(a) The installation of a high-speed, low-torque motor cartridge kit to increase the elevator speed approximately 29%.

(b) A transmission change consisting of a turbine and drive gear modification to reduce the ground speed from a maximum speed in first gear of 6 mph to 2.72 mph and a reduction in second gear high range from 24 mph to 16.6 mph.

The operating characteristics of each piece of equipment in removing the surface layer of sand was determined at the three separate beach test sites under different beach conditions as indicated in Table 11. In several tests, oil was utilized in tidal zone areas, and in one instance on the backshore area. Also, as indicated in Table 11, in several tests the test area was covered with straw or a test area was selected that was covered with kelp and other debris.

Each piece of candidate equipment was tested individually to determine its operating characteristics and performance in removing a thin surface layer of sand under various beach conditions. The motorgrader was then operated in combination with the elevating scraper and the front end loader to determine the effectiveness of combined operations.

During both the individual tests and the combined equipment tests, the various pieces of heavy equipment were operated at different speeds, depths of cut, and blade angles to determine the optimum operating characteristics for equipment performance on a sandy beach. The basic test procedure was to operate the equipment on a 100- by 30-ft test area and to time and photograph the operations and obtain appropriate measurements, including width of cut, depth of cut, size of windrows and visual observations of effectiveness (i.e. amount of spillage). Finally, several tests were run to determine cycle time (i.e., a complete loading cycle, which includes loading, hauling, dumping, and return to loading position). In some of these tests, longer test areas were used to approximate actual conditions. For example, the scraper will normally operate in one direction and continue loading until its capacity is reached instead of making short, 100-ft passes.

Table 11

BEACH TEST CONDITIONS

EQUIPMENT EVALUATED	TIDAL ZONE AREA				BACKSHORE AREA	
	Without Oil	With Oil	With Straw	With Kelp	Without Oil	With Oil
Motorized Grader	x	x	x	x	x	
Motorized Elevating Scraper	x	x	x	x	x	
Motorized Scraper	x				x	
Front End Loader	x	x			x	x
Motorized Grader with Motorized Elevating Scraper	x	x	x	x	x	
Motorized Grader with Front End Loader						

The major observations concerning the testing are given in Tables 12 through 19. Included are descriptions and locations of each beach test area, the equipment tested, the type of operation performed, detailed data on each test, including depth of cut, width of cut, length of cut, material removed, area cleaned, time of operation and cycle time (where applicable), and comments on the performance of the equipment.

A measure of effectiveness is the amount of contaminated sand removed during a beach-restoration operation. For each operation, the volume of sand (in cubic yards) removed per acre of beach cleaned was calculated from the data tabulated in Tables 12 through 19. The results, given in Table 20 show that the smallest amount of material per acre was removed with the motorgrader and motorized elevating scraper working in combination (Restoration Procedure A, Table 1). The motorized elevating scraper operating alone was the next best procedure. The most inefficient operation utilized a front end loader to scrape up and remove the material.

The range of values given are based on several tests. An important parameter in calculating the total volume removed is the depth of cut, and in each test an average depth of cut was measured. In some instances, due to the bearing surface of the test area and topography, it was difficult for the operator to maintain a constant depth of cut.

Another measure of effectiveness is the rate (acres cleared per hour) at which beach areas are cleared. Table 21 presents the rate of clearing in acres per hour for the various pieces of equipment evaluated and combinations of equipment. The calculations are based on those operations in which cycle times were taken. The values given for each equipment item and/or combination of items is based on equipment performing under optimum conditions (i.e., the motorized elevating scraper loading in first gear and hauling and returning from the dump area in second gear; the motorgrader operating in second gear for both forward and reverse; and the front end loader operating in first gear for scraping and the second gear for hauling and dumping).

The calculated values are based on the haul distances given in Table 21 for each operation. Increasing or decreasing these distances would increase or decrease the rates accordingly. When a motorgrader is used in combination with a motorized elevating scraper or front end loader, the indicated rates may be increased with the use of additional scrapers or front end loaders. The motorgrader is capable of producing windrows continuously and several motorized elevating scrapers or front end loaders can be utilized to pick up and remove the windrows.

As indicated in Table 21, the motorgrader-motorized elevating scraper combination is the most efficient for an equivalent length of haul. The least efficient is the front end loader, working singly. An example of how production decreases with increased haul distance (one-way) is shown in Fig. 15 for the motorgrader-motorized elevating scraper combination.

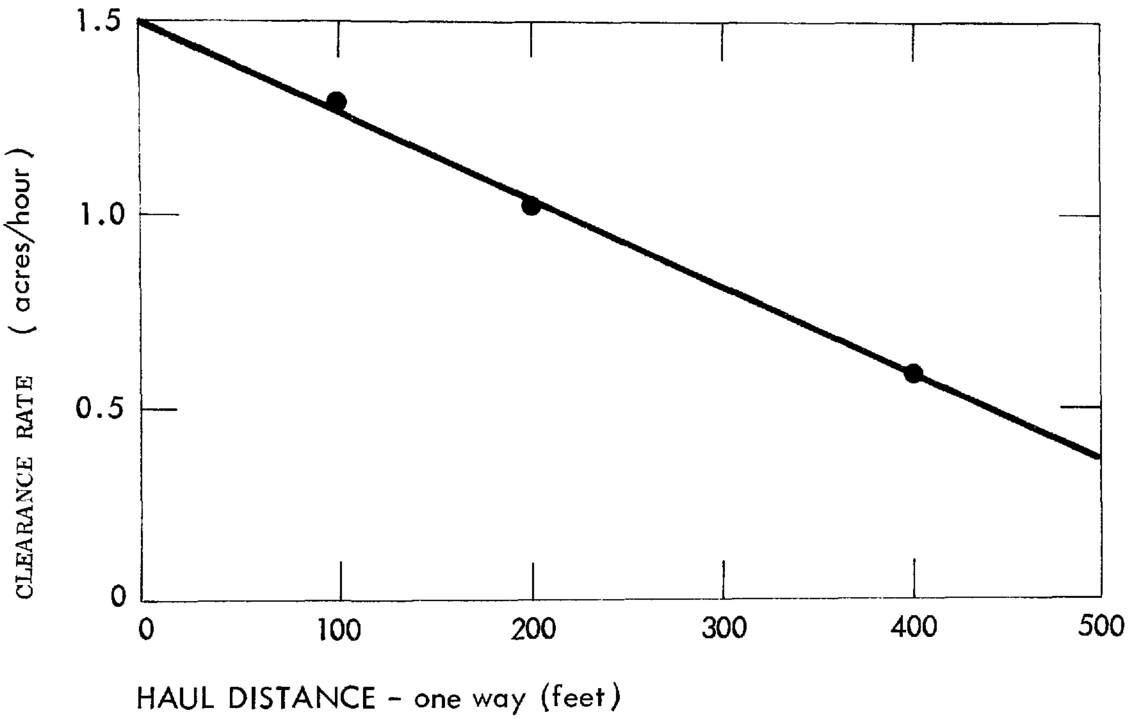


Fig. 15. Clearance Rate Vs Haul Distance by Motorgrader and Motorized Elevating Scraper Combination

TABLE 12

DATA SUMMARY

BEACH: TUNITAS
Beach Condition: Tidal zone, wet, hard-packed, fine-grained sand
Equipment: CAT 12 Motorgrader
Gear: Second
Length of Run: 100 ft
Date: November 14, 1969

TEST NO.	OPERATION	ANGLE (deg)	CUT WIDTH	CUT DEPTH (in.)	TIME (sec)	MAIN WINDROW HEIGHT (in.)	MAIN WINDROW WIDTH	AREA CLEANED (sq yd)	VOLUME REMOVED (cu yd)	SPEED (mph)	COMMENTS
C-1-1	Three passes over 100' ×30' test area with different blade angle each pass. 1" and ½" depths of cut.	40	9' 5"	1	30	8.5	2' 4"	104	2.9	2.3	Smaller blade angles (40°) cause greater spillage around leading edge of blade. Larger blade angle (50°) causes little or no spillage
C-1-2		50	8' 7"	1	30	8	2' 6"	95	2.6	2.3	
C-1-3		55	7' 2"	0.5	30	7	1'11"	80	1.1	2.3	
C-2-1	Three passes over 100' ×30' area. Blade angle (60°). Large windrow. 1" depth of cut.	60	6' 8"	1	27	6.5	1' 9"	74	2.06	2.5	Blade control difficult at 60° angle. By third pass, sand buildup caused major spillage at leading edge on last 30' of run.
C-2-2		60	6'11"	1	27	10	2' 8"	77	2.14	2.5	
C-2-3		60	6'10"	1	27	15	3' 6"	76	2.1	2.5	
TOTAL			16' 5"	1				183	5.1		
C-3-1	Three passes over 100' ×30' area. Blade angle (50°). Large windrow. 1' depth of cut.	50	8' 6"	1	30	6	2' 5"	94	2.6	2.3	Almost no leading edge spillage. Sand buildup but no excessive spillage.
C-3-2		50	8' 6"	1	27	18	3'	94	2.6	2.5	
C-3-3		50	8' 6"	1	27	18	4'	94	2.6	2.5	
TOTAL			20'10"	1				232	6.35		

TABLE 13

DATA SUMMARY

BEACH: TUNITAS
Beach Condition: Tidal zone, wet, hard-packed, fine-grained sand
Equipment: IH E-200 Motorized Elevating Scraper
Gear: First
Date: November 17, 1969

TEST NO.	OPERATION	LENGTH (ft)	CUT WIDTH	DEPTH (in.)	TIME (sec)	MATERIAL IN BOWL EST (cu yd)	AREA CLEANED (sq yd)	VOLUME REMOVED CALC (cu yd)	SPEED (mph)	COMMENTS
D-1-1	Three passes over 100' ×30' area. Various cutting depths.	100	8' 2"	4	27	9	91	12.2	2.5	Less spillage around scraper bowl edge when thinner (less than 2") cut is made. Excessive spillage when bowl closed and filled.
D-1-2		100	7'11"	2	25	6	88	4.9	2.7	
D-1-3		90	8'	2	20	5	80	4.4	3.4	
TOTAL		96	20' 3"				216	16		
F-1-1	Four passes at various depths of cut (1 to 4") picked up kelp, debris and sand	106	8'	2.5	35	8	94.2	6.5	2.1	Picked up debris and kelp, leaving clean cut with minimum amount of spillage.
F-1-2		180	8'	1	–	9	160	4.3	–	
F-1-3		158	8'	4	60	9	140	15.5	1.8	
F-1-4		160	8'	–	35	9	142	–	3.1	

TABLE 14

DATA SUMMARY

BEACH: TUNITAS
Beach Condition: Tidal zone, wet, hard-packed, fine-grained sand
Equipment: CAT 12 Motorgrader (Blade angle 50°),
IH 175B Front End Loader
IH E-200 Motorized Elevating Scraper
Length of Run: 100 ft
Date: November 17, 1969

TEST NO.	OPERATION	CUT		TIME	EQUIPMENT	MAIN WINDROW		AREA	VOLUME	SPEED	COMMENTS
		WIDTH	DEPTH (in.)	(sec)	TYPE	HEIGHT (in.)	WIDTH (in.)	CLEANED (sq yd)	REMOVED (cu yd)	(mph)	
E-1-1	Three passes over 100' ×30' area with motorgrader forming one large windrow. Windrow removed by elevating scraper.	9'	1	25	Motor-grader	7	20	99		2.7	Windrow formed by motorgrader picked up by scraper worked well. Scraper took cut deeper than 2" and some spillage occurred on edges of scraper bowl.
E-1-2		15'6"	1	20	Motor-grader	8	31	171		3.4	
E-1-3		27'	1	20	Motor-grader	9	40	300		3.4	
E-1-4		8'	2	20	Scraper			300	8.1	3.4	
G-1	Three passes over 100' ×30' area with motorgrader forming one large windrow. Windrow removed by front end loader			20	Motor-grader					3.4	Excessive spillage around edge of front end loader bucket when picking up windrow. Front end loader tracks ripped up beach badly.
G-2				25	Motor-grader					3.4	
G-3				25	Motor-grader	12	42	300		2.7	
G-4				480	Front End Loader (2 yd)						

TABLE 15

DATA SUMMARY

BEACH: TUNITAS
Beach Condition: Tidal zone, wet, hard-packed, fine-grained sand
Equipment: IH E-200 Motorized Elevating Scraper
Date: November 19, 1969

TEST NO.	OPERATION	LENGTH (ft)	CUT DEPTH (in.)	WIDTH	TOTAL TIME FOR OPERATION (min)	GEAR	SPEED PER PASS AVG (mph)	AREA CLEANED (sq yd)	VOLUME REMOVED CALC (cu yd)	SAND REMOVED (sq yd /min)	SAND REMOVED (cu yd /min)	COMMENTS
H-1-1*	Long pass to fill bowl, 200' to dump area, returned for 3 passes per trial. Different gears tried to find best operating speed.	100	2.5	21'3"	4:20	1st	–	236	16.3	54.5	3.8	Difficulty in controlling the cut and spillage in second gear. Better control in first gear with less spillage.
H-1-2**		250	2	20'6"	6:50	1st	3.4	569	31.3	83.3	4.6	
H-1-3**		250	1.5	27'	4:50	2nd	4.6	750	30.7	155.2	6.4	
L-1-1	Three passes over 100' ×30' test area. Test area covered with straw.	100	1.5	8'	0:25	1st	2.7	88.6	3.7	–	–	Little difficulty picking up sand-straw combination. Straw appears to cut down spillage when scraper is operating and when bowl is raised and closed.
L-1-2		100	1	8'	0:20	1st	3.4	88.6	2.5	–	–	
L-1-3		100	1	4'6"	0:20	1st	3.4	50	1.4	–	–	
TOTAL		100	1-1.5	20'				222	7.7			

* No dumping in between 100-yd passes.
** 100 ft to dump

TABLE 16

DATA SUMMARY

BEACH: TUNITAS
Beach Condition: Tidal zone, wet, hard-packed, fine-grained sand
Equipment: CAT 12 Motorgrader (Blade angle 50°),
IH E-200 Motorized Elevating Scraper
Date: November 19, 1969

TEST NO.	OPERATION	EQUIPMENT TYPE	LENGTH (ft)	CUT WIDTH*	CUT DEPTH* (in.)	GEAR	TOTAL TIME FOR OPERATION (min)	SPEED PER PASS AVG (mph)	AREA CLEANED (sq yd)	SAND REMOVED (cu yd)	SAND REMOVED (sq yd /min)	SAND REMOVED (cu yd /min)	COMMENTS
J-1-1	Three passes over 200' ×30' area with motor-grader forming large windrow. Windrow removed by elevating scraper	Motor-grader	200	28'	1	2nd	2:43	4.1	622	17.3	226	6.3	Motorgrader most effective operating in second gear. Poor control of blade in third gear. Motorized elevating scraper most effective in first gear.
J-1-2		Elevating Scraper	150	4'4"	22	1st	1:55	1.1	72	21.5			
J-1-3		Motor-grader	200	28'	0.5	1st	4:00	2.6	622	8.7	155	2.2	
J-1-4		Elevating Scraper	100	4'	10	1st	1:30	2.3	44	16.1		4.1	
J-1-5		Motor-grader	200	30'4"	0.5	3rd	2:32	6.2	674	9.3	266	3.7	
J-1-6		Elevating Scraper	120	3'6"	10	2nd	1:10	2.3	46.6	16.4		5.5	
J-1-5+6		Combination	120				4:10		674	6.4	164	1.6	
K-1-1	Three passes over 100' x30' area with motor-grader forming large windrow. Windrow removed by elevating scraper. Area covered with straw.	Motor-grader	100	8'	1	2nd	0:23	3.0	89	2.5	232	6.5	Combination picked up sand-straw easily. Straw appeared to give sand more body. Less spillage occurred around edges of scraper bowl.
K-1-2		Motor-grader	100	8'	1	2nd	0:20	3.4	89	2.5	267	7.5	
K-1-3		Motor-grader	100	8'	1	2nd	0:19	3.6	89	2.5	281	7.9	
TOTAL				27'	1				300	8.3			
K-1-4		Elevating Scraper	70	4'8"	23	1st	0:22	2.2		6.6		18	
K-1-5		Elevating Scraper	30			1st	0:15	1.4		5.0		20	

* For scraper this is the height of windrow + width.

TABLE 17

DATA SUMMARY

BEACH: HALF MOON BAY HARBOR
Beach Condition: Backshore area, loosely packed, coarse-grained sand
Equipment: CAT 12 Motorgrader,
CAT 10 Motorized Scraper,
IH E-200 Motorized Elevating Scraper
Date: November 24, 1969, "M" Tests
November 25, 1969, "O" Tests

TEST NO.	OPERATION	EQUIPMENT TYPE	CUT LENGTH (ft)	CUT WIDTH (ft)	CUT DEPTH (in.)	MAIN WINDROW WIDTH (ft)	MAIN WINDROW HEIGHT (in.)	TIME SINGLE PASS AVG (sec)	TIME CYCLE (min)	SPEED SINGLE PASS (mph)	AREA CLEANED (sq yd)	VOLUME REMOVED (cu yd)	COMMENTS
M-1-1	Three passes over 100' x30' area with motor-grader forming one	Motor-grader	100	27.2	1	3	6	18	1:15	3.8	300	8.3	On soft sand, great degree of spillage around grader leading edge and scraper bowl.
M-1-2	large windrow. Wind-row removed by eleva-ting scraper.	Elevating Scraper	100	8	1.5			30		2.3			
O-1-1	Motorized elevating scraper and motorized scraper making one pass	Motorized Scraper	50	8.5	3.5			15		2.3	47.2	4.6	The motorized scraper operated for 50', picked up 4 cu yd of sand and became immobilized.
O-1-2	for comparison of operation.	Elevating Scraper	100	8	3.5			30		2.3	89	8.6	The motorized elevating scraper had no difficulty.

TABLE 18

DATA SUMMARY

BEACH: HALF MOON BAY HARBOR
Beach Condition: Tidal zone, wet, firm-packed, medium-grained sand
Equipment: CAT 12 Motorgrader,
CAT 10 Motorized Scraper,
IH E-200 Motorized Elevating Scraper
Date: November 24, 1969, "M" Tests
November 25, 1969, "O" Tests

TEST NO.	OPERATION	EQUIPMENT TYPE	CUT LENGTH (ft)	CUT WIDTH (ft)	CUT DEPTH (in.)	MAIN WINDROW WIDTH (ft)	MAIN WINDROW HEIGHT (in.)	TIME SINGLE PASS AVG (sec)	TIME CYCLE (min)	SPEED SINGLE PASS (mph)	AREA CLEANED (sq yd)	AREA CLEANED (sq yd /min)	VOLUME REMOVED (cu yd)	VOLUME REMOVED (cu yd /min)	COMMENTS
M-2-1	Three passes over 100' x30' area with motorgrader forming one large windrow. Windrow removed by elevating scraper	Motor-grader	100	27	0.5	3.3	9	19	2:15	3.6	300	133	4.2	1.9	Much less spillage from motorgrader and elevating scraper on firma sand.
M-2-1		Elevating Scraper	100	8	0.5			31	1:11	2.2				3.5	
TOTAL			100	27	0.5				3:26		300	87.4		1.2	
M-3-1	Motorized elevating scraper picking up kelp along surf line	Elevating Scraper	200	8	0.5			51		2.7	178	209	2.5	2.9	Motorized elevating scraper had no difficulty picking up kelp and seaweed.
M-3-2		Elevating Scraper	290	8	0.5			74		2.7	258	209	3.6	2.9	
O-1-3	Motorized elevating scraper and motorized scraper making one pass for comparison.	Motorized Scraper	60	8.5	3			24		1.7	57	142	4.7	11.7	The motorized scraper operated for 60' and became immobilized. Elevator scraper had no difficulty operating.
O-1-4		Elevating Scraper	190	8	0.5			45		2.9	169	225	2.4	3.2	

TABLE 19

DATA SUMMARY

OIL CONTAMINATED BEACH CLEANUP
Oil Used: 5 gallons – aged 1 week
Equipment: CAT 12 Motorgrader,
IH E-200 Motorized Elevating Scraper,
Front End Loader – 1.75 cu yd

TEST NO.	OPERATION	BEACH CONDITION	OIL SPREAD DATA: WIDTH (ft)	OIL SPREAD DATA: LENGTH (ft)	OIL SPREAD DATA: DEPTH of PENETRATION (in.)	AREA COVERED APPROX (sq yd)	TOTAL TIME FOR REMOVAL (min)	TOTAL AREA CLEANED (sq yd)	SAND REMOVED (cu yd)	SAND REMOVED (sq yd /min)	COMMENTS
A-2	Front End Loader used as bulldozer to scrape oil-contaminated sand into pile. Then used as loader to haul material to disposal area.	Backshore area. Dry, loosely-packed, coarse-grained sand.	16	24	0.5	64	55	70	12	1.2	Difficulty in adjusting depth of cut; more sand moved than necessary. Spillage excessive around blade edges
B-1	Front End Loader using bucket as scraper removing oil-contaminated sand to disposal area.	Tidal zone, wet, loosely-packed, coarse-grained sand	16	31	0.5	45	55	50	12	0.9	4-in-1 bucket as scraper and loader made deeper cut than necessary. Tracks of vehicle tore up beach considerably, pushed surface layer of contaminated oil deeper into beach.
N-1	Motorgrader scraping oil-contaminated sand into windrow. Elevating scraper removing windrow to disposal area.	Tidal zone, wet, firm-packed, medium-grained sand.	16	35	0.25	60	5	264	3.5	53	Overall operation of grader/scraper combination effective. Front wheels of motorgrader pressed thin layer of oil-contaminated sand deeper into beach. Minimum amount of clean sand was removed compared to the front end loader when tested under similar circumstances.

Table 20

SAND REMOVAL DURING VARIOUS BEACH RESTORATION OPERATIONS

	VOLUME OF SAND REMOVED (Cu yd/acre of beach cleaned)		
	Loose Sand or Backshore Area	Firm Hard-Packed Beach	Firm Beach With Straw Applied @ 100 Bales/Acre
Motorgrader and Motorized Elevating Scraper	130-145	70-100	180-200
Motorized Elevating Scraper	300-400	200-250	
Motorgrader and Front End Loader		300-325	
Front End Loader	800-1200		

Table 21

ACRES CLEARED AND HAULED BY VARIOUS TYPES AND COMBINATIONS OF EQUIPMENT

	CLEARANCE RATES (hr/acre)	HAUL DISTANCE (ft) TO DUMP (one way)
Motorgrader and Motorized Elevating Scraper	0.77-1.67	160-100
Motorized Elevating Scraper	0.95	100
Motorgrader and Front End Loader	2.78	100

ANNEX II

DOCUMENTATION OF BEACH RESTORATION OPERATIONS: PROPOSED DATA REQUIREMENTS

To evaluate the manpower and equipment costs associated with beach restoration operations, a review of recent oil-pollution/beach-contamination incidents was conducted as part of Phase I. It was very quickly determined that there has been little to no effort directed towards the systematic collection of data needed to accurately determine the cost and effectiveness of previous beach restoration operations. Generally, only overall costs have been reported, and costs associated with onshore operations could not be separated from the total costs.

A set of data collection sheets has been included in this annex as an example of the forms to be used by FWPCA personnel who become involved in future oil-spill incidents.

As in all operations of this type, photography, both still and motion picture, proves to be invaluable during subsequent analysis of the data. Care must be taken, however, to properly document the photographic effort, i.e., date, time, location; etc.

A sketch or quadrangle map showing beach location and important features, such as breakwaters, groins, roads, and other shoreline installations, would assist in subsequent analysis of the cleanup operation.

BEACH RESTORATION PROCEDURES
DATA SHEET INSTRUCTIONS

Separate data sheets should be prepared for each separate event, type of beach, variation of beach characteristic, or restoration procedure.

If it is necessary to use more room for entries than that provided on the sheet, use the reverse side of the form.

Identify each separate page by including beach name, its location, and the data at the top.

Section A: Event description - include what spilled, from where, what caused spill (collision, explosion, grounding, pipeline failure).

Section B: This information is pertinent for prediction of weathering effect on contaminant.

Section C: Data in this section will be utilized to assist in the evaluation of the cost and effectiveness of the beach restoration operation and to correlate trafficability (mobility) factors with equipment type. Sand samples should be taken in both the tidal and back-beach zones for sand grain size determination. If it is necessary to clarify data or obtain additional information, the persons reporting or submitting the data forms will be contacted.

Section D: This section is to be used for equipment actually cleaning the beach and does not include hauling operations. A daily estimate of area cleaned and cost should be recorded.

Participating organizations would include the names of agencies, (FWPCA, API); companies (oil companies, private research or consulting firms); contracting firms; local and state authorities which were directly involved in clean-up procedures. The organizations should be listed, where applicable, across the top of the daily record squares.

If equipment is under contract, rented or leased, it should be shown as a note under Comments, Observations.

If certain equipment is immobilized by a low-bearing beach, this should also be noted. Record all information possible; although, partial reporting of data may be all that is available.

Section E: Hauling operations, exclusive of beach cleanup, should be included here. If contaminated sand and debris are hauled to several disposal areas, include specific details on reverse side of form.

Participating organizations would include the names of agencies, (FWPCA, API); companies, (oil companies, private research or consulting firms); contracting firms; local and state authorities which were directly involved in sand disposal operations. The organizations should be listed, where applicable, across the top of the daily record squares.

Section F: If a change in type of absorbent, or dispersal methods occurs during the seven days covered by these sheets, but all else remains relatively unchanged, write additional information on reverse of form.

BEACH RESTORATION PROCEDURES

BEACH: Name ____________ Location ____________ Dates ____________

A. DESCRIPTION OF EVENT: ____________

B. OIL CHARACTERISTICS:

1. Date and time of spill: ____________
2. Type of oil: Bunker C, diesel, other ____________
3. Source: tanker, pipeline, platform ____________
4. Amount spilled (est. gallons): ____________
5. Spill stopped or continuing: ____________
6. Initial beach contamination: date ____________ time ____________
7. Physical appearance of oil on beach: hard, tacky, liquid, globs (size), other ____________
8. How is beach contaminated: ____________
   continuous film, mixed with debris or straw, puddled, other
9. Subsequent contamination: date ____________ time ____________

C. BEACH CHARACTERISTICS

10. Surface: rocky, sandy, other ____________
11. Surface condition: kelp, debris, litter, clean, other ____________
12. Contaminated zone: tidal, backshore, both ____________
13. Tidal zone: average slope (%) ____________
14. Contaminated area (yds): length ______ width ______ total (sq yds) ______
15. Oil penetration depth (in): maximum ____________ average ____________
16. Grain size (median): tidal zone ____________ backbeach ____________
17. Accessibility to heavy equipment for restoration operations: ____________
    easy, possible, hazardous, can build road, impossible
18. Can beach surface support equipment mobility: yes ______ no ______ can't tell ______

Data reported by: ____________

____

Submitted by: ____________

A URS Systems Affiliate

BEACH: Name ______________________ Location ______________________ Dates ______________________

D. RESTORATION PROCEDURES

By Day:	1	2	3	4	5	6	7
a. Method used:							
b. Total area cleared							
c. Depth of sand removed (in.)							

d. EQUIPMENT: scraper, motorgrader, front-end loader, bulldozer, other

Type, Make/Model, Size		1	2	3	4	5	6	7
	number used							
	$ cost							
	number used							
	$ cost							
	number used							
	$ cost							
	number used							
	$ cost							
	number used							
	$ cost							
	number used							
	$ cost							

Comments, Observations:

BEACH: Name ____________ Location ____________ Dates ____________

e. MANPOWER FOR CLEANUP - EQUIPMENT OPERATIONS

Supervisory — Participating organizations:

By Day:	1	2	3	4	5	6	7
number used							
hours worked							
$ cost							

Equipment Operators — Participating organizations:

By Day:	1	2	3	4	5	6	7
number used							
hours worked							
$ cost							

Laborers — Participating organizations:

By Day:	1	2	3	4	5	6	7
number used							
hours worked							
$ cost							

Comments, Observations :

BEACH: Name ______________ Location ______________ Dates ______________

By Day: 1 2 3 4 5 6 7

E. OIL-SAND DISPOSAL

a. Procedures used: ramp, conveyor-screening system, hauling, other ______________

b. Hauling distance from pickup to disposal: (average) ______________

c. Location of disposal site: ______________

d. Number of unloading sites: ______________

e. HAULING VEHICLES:

	1	2	3	4	5	6	7
size (cu yd)							
number used							
number of trips							
$ cost							
size (cu yd)							
number used							
number of trips							
$ cost							
size (cu yd)							
number used							
number of trips							
$ cost							

BEACH: Name ______________ Location ______________ Dates ______________

e. MANPOWER FOR DISPOSAL OPERATIONS

Supervisory — Participating organizations:

By Day:	1	2	3	4	5	6	7
number used							
hours worked							
$ cost							

Operators/Drivers — Participating organizations:

By Day:	1	2	3	4	5	6	7
number used							
hours worked							
$ cost							

Laborers — Participating organizations:

By Day:	1	2	3	4	5	6	7
number used							
hours worked							
$ cost							

F. ABSORBENTS USED ON BEACH

Type: chemical, physical, other ______________

Substance: straw, foam, other ______________

Amount used (gal, bales, lb): ______________ $ cost: ______________

Dispersal methods: ______________ $ cost: ______________

Manpower utilized: ______________ $ cost: ______________

BEACH RESTORATION PROCEDURES

BEACH: Name ____________ Location ____________ Dates ____________

A. DESCRIPTION OF EVENT: ____________

B. OIL CHARACTERISTICS:

1. Date and time of spill: ____________
2. Type of oil: Bunker C, diesel, other ____________
3. Source: tanker, pipeline, platform ____________
4. Amount spilled (est. gallons): ____________
5. Spill stopped or continuing: ____________
6. Initial beach contamination: date ____________ time ____________
7. Physical appearance of oil on beach: hard, tacky, liquid, globs (size), other ______
8. How is beach contaminated: ____________
   continuous film, mixed with debris or straw, puddled, other
9. Subsequent contamination: date ____________ time ____________

C. BEACH CHARACTERISTICS

10. Surface: rocky, sandy, other ____________
11. Surface condition: kelp, debris, litter, clean, other ____________
12. Contaminated zone: tidal, backshore, both ____________
13. Tidal zone: average slope (%) ____________
14. Contaminated area (yds): length ______ width ______ total (sq yds) ______
15. Oil penetration depth (in): maximum ____________ average ____________
16. Grain size (median): tidal zone ____________ backbeach ____________
17. Accessibility to heavy equipment for restoration operations: ____________
    easy, possible, hazardous, can build road, impossible
18. Can beach surface support equipment mobility: yes ____ no ____ can't tell ____

Data reported by: ____________

Submitted by: ____________

URS A URS Systems Affiliate

BEACH: Name ______________ Location ______________ Dates ______________

By Day:	1	2	3	4	5	6	7
D. RESTORATION PROCEDURES							
a. Method used:							
b. Total area cleared							
c. Depth of sand removed (in.)							

d. EQUIPMENT: scraper, motorgrader, front-end loader, bulldozer, other

Type, Make/Model, Size		1	2	3	4	5	6	7
	number used							
	$ cost							
	number used							
	$ cost							
	number used							
	$ cost							
	number used							
	$ cost							
	number used							
	$ cost							
	number used							
	$ cost							

Comments, Observations:

BEACH: Name ______________ Location ______________ Dates ______________

By Day: 1 2 3 4 5 6 7

e. MANPOWER FOR CLEANUP - EQUIPMENT OPERATIONS

Supervisory — Participating organizations:

	1	2	3	4	5	6	7
number used							
hours worked							
$ cost							

Equipment Operators — Participating organizations:

	1	2	3	4	5	6	7
number used							
hours worked							
$ cost							

Laborers — Participating organizations:

	1	2	3	4	5	6	7
number used							
hours worked							
$ cost							

Comments, Observations :

BEACH: Name ______________ Location ______________ Dates ______________

By Day: 1 2 3 4 5 6 7

E. OIL-SAND DISPOSAL

a. Procedures used: ramp, conveyor-screening system, hauling, other ______________

b. Hauling distance from pickup to disposal: (average) ______________

c. Location of disposal site: ______________

d. Number of unloading sites: ______________

e. HAULING VEHICLES:

	1	2	3	4	5	6	7
size (cu yd)							
number used							
number of trips							
$ cost							
size (cu yd)							
number used							
number of trips							
$ cost							
size (cu yd)							
number used							
number of trips							
$ cost							

BEACH: Name ______ Location ______ Dates ______

e. MANPOWER FOR DISPOSAL OPERATIONS

Supervisory — Participating organizations:

By Day:	1	2	3	4	5	6	7
number used							
hours worked							
$ cost							

Operators/Drivers — Participating organizations:

By Day:	1	2	3	4	5	6	7
number used							
hours worked							
$ cost							

Laborers — Participating organizations:

By Day:	1	2	3	4	5	6	7
number used							
hours worked							
$ cost							

F. ABSORBENTS USED ON BEACH

Type: chemical, physical, other ______

Substance: straw, foam, other ______

Amount used (gal, bales, lb): ______ $ cost: ______

Dispersal methods: ______ $ cost: ______

Manpower utilized: ______ $ cost: ______

BEACH RESTORATION PROCEDURES

BEACH: Name ____________ Location ____________ Dates ____________

A. DESCRIPTION OF EVENT: ____________

B. OIL CHARACTERISTICS:

1. Date and time of spill: ____________
2. Type of oil: Bunker C, diesel, other ____________
3. Source: tanker, pipeline, platform ____________
4. Amount spilled (est. gallons): ____________
5. Spill stopped or continuing: ____________
6. Initial beach contamination: date ____________ time ____________
7. Physical appearance of oil on beach: hard, tacky, liquid, globs (size), other ______
8. How is beach contaminated: ____________
   continuous film, mixed with debris or straw, puddled, other
9. Subsequent contamination: date ____________ time ____________

C. BEACH CHARACTERISTICS

10. Surface: rocky, sandy, other ____________
11. Surface condition: kelp, debris, litter, clean, other ____________
12. Contaminated zone: tidal, backshore, both ____________
13. Tidal zone: average slope (%) ____________
14. Contaminated area (yds): length ______ width ______ total (sq yds) ____________
15. Oil penetration depth (in): maximum ____________ average ____________
16. Grain size (median): tidal zone ____________ backbeach ____________
17. Accessibility to heavy equipment for restoration operations: ____________
    easy, possible, hazardous, can build road, impossible
18. Can beach surface support equipment mobility: yes ____ no ____ can't tell ______

Data reported by: ____________

____

Submitted by: ____________

A URS Systems Affiliate

BEACH: Name ____________ Location ____________ Dates ____________

D. RESTORATION PROCEDURES

By Day:	1	2	3	4	5	6	7
a. Method used:							
b. Total area cleared							
c. Depth of sand removed (in.)							

d. EQUIPMENT: scraper, motorgrader, front-end loader, bulldozer, other

Type, Make/Model, Size		1	2	3	4	5	6	7
	number used							
	$ cost							
	number used							
	$ cost							
	number used							
	$ cost							
	number used							
	$ cost							
	number used							
	$ cost							
	number used							
	$ cost							

Comments, Observations:

BEACH: Name ______________ Location ______________ Dates ______________

By Day: 1 2 3 4 5 6 7

e. MANPOWER FOR CLEANUP - EQUIPMENT OPERATIONS

Supervisory — Participating organizations:

	1	2	3	4	5	6	7
number used							
hours worked							
$ cost							

Equipment Operators — Participating organizations:

	1	2	3	4	5	6	7
number used							
hours worked							
$ cost							

Laborers — Participating organizations:

	1	2	3	4	5	6	7
number used							
hours worked							
$ cost							

Comments, Observations :

BEACH: Name ______________ Location ______________ Dates ______________

By Day: 1 2 3 4 5 6 7

E. OIL-SAND DISPOSAL

a. Procedures used: ramp, conveyor-screening system, hauling, other ______________

b. Hauling distance from pickup to disposal: (average) ______________

c. Location of disposal site: ______________

d. Number of unloading sites: ______________

e. HAULING VEHICLES:

	1	2	3	4	5	6	7
size (cu yd)							
number used							
number of trips							
$ cost							
size (cu yd)							
number used							
number of trips							
$ cost							
size (cu yd)							
number used							
number of trips							
$ cost							

BEACH: Name ______________________ Location ______________________ Dates ______________________

e. MANPOWER FOR DISPOSAL OPERATIONS

By Day:	1	2	3	4	5	6	7
Supervisory — Participating organizations:							
number used							
hours worked							
$ cost							
Operators/Drivers — Participating organizations:							
number used							
hours worked							
$ cost							
Laborers — Participating organizations:							
number used							
hours worked							
$ cost							

F. ABSORBENTS USED ON BEACH

Type: chemical, physical, other ______________________

Substance: straw, foam, other ______________________

Amount used (gal, bales, lb): ______________________ $ cost: ______________

Dispersal methods: ______________________ $ cost: ______________

Manpower utilized: ______________________ $ cost: ______________