

Shoreline In Situ Treatment (Sediment Mixing and Relocation) Library Report

API TECHNICAL REPORT 1155-1

JUNE 2016



AMERICAN PETROLEUM INSTITUTE

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Executive Summary

The American Petroleum Institute (API) completed a study to improve the knowledge and understanding of shoreline sediment mixing and relocation techniques. The objective of the study is to provide the following tools:

- 1 Shoreline In Situ Treatment Library: an online library containing academic, scientific, technical, and operational literature, including links to electronic documents, where available;
- 2 Shoreline In Situ Treatment Fact Sheet: a non-academic educational guide, providing an overview of in situ treatment and Oil Particle Aggregate (OPA) formation for training and planning (API Technical Report 1154-2); and
- 3 Shoreline In Situ Treatment Job Aid: a non-academic operations tool for use during a response by Operations, the Environmental Unit (EU), and Shoreline Cleanup Assessment Technique (SCAT) teams for in situ treatment planning and operations, and to demonstrate to agencies how effectiveness and effects would be monitored (API Technical Report 1154-3).

This report describes the first item of this program, the Shoreline In Situ Treatment Library, which is intended to locate and make available documents relevant to shoreline in situ (sediment mixing and relocation) treatment techniques.

The library is provided in simple MS Excel spreadsheet and MS Access database formats, which are described in this report.

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Shoreline In Situ Treatment (Sediment Mixing and Relocation) Library Report

1 Introduction and Objectives

This report describes the Shoreline In Situ Treatment Library, which represents part of a study conducted by the American Petroleum Institute (API) to improve the knowledge and understanding of shoreline sediment mixing and relocation techniques. The objective of the study is to provide the following tools:

- 1 Shoreline In Situ Treatment Library: an online library containing academic, scientific, technical, and operational literature, including links to electronic documents, where available;
- 2 Shoreline In Situ Treatment Fact Sheet: a non-academic educational guide, providing an overview of in situ treatment and Oil Particulate Aggregate (OPA) formation for training and planning; and
- 3 Shoreline In Situ Treatment Job Aid: a non-academic operations tool for use during a response by Operations, the Environmental Unit (EU), and Shoreline Cleanup Assessment Technique (SCAT) teams for in situ treatment planning and operations, and to demonstrate to agencies how effectiveness and effects would be monitored.

This report describes item 1, the In Situ Treatment Library, which is intended to locate and make available documents relevant to shoreline in situ (sediment mixing and relocation) treatment techniques.

2 Use of the Library

The Shoreline In Situ Treatment Library is available as both an MS Excel spreadsheet and an MS Access database, and contains 156 documents. The library provides relevant information for each document (see Table 2.1), which may be searched using the table filters, for example, to search for a particular document type, or tactic, or (in MS Excel) "Find and Select" for a particular word or phrase. Screenshots of the libraries are provided in Figures 2.1 and 2.2.

If a document is available online, either for free or for purchase, a link is provided in the "Available" column. Approval has been sought from the authors of documents that are unavailable online to include a copy of those documents in the library. Documents for which approval has been obtained have been scanned/copied and the electronic PDF copies shall be provided to API.

Once published, this library (including links) shall be made available and maintained at:
www.shorelineinsitutreatment.com

Table 2.1—Document Information Provided in the Library

Title	Description	Options
ID	Library ID Number	1–156
Available	Links to documents available online, or documents for which approval has been acquired to copy. NOTE: Links to approved documents that are not available online will be added to the versions on the website.	<ul style="list-style-type: none"> • Available for free • Available for purchase • Request from Environment Canada (link provided) • Link to document
Year	Year published or written	1968–2011
Lead Author	Lead author of the document	—
Title	Document Title	—
Type	Document Type	<ul style="list-style-type: none"> • Field Trial (report/paper) • Guidance • Lab/Meso Study (report/paper) • Modeling (report/paper) • Oil Spill (report/paper) • Review
Tactic	Tactic(s) described in the document	<ul style="list-style-type: none"> • Biodegradation • Mineral Addition • Mixing • Multiple • Natural Cleaning • OPA Formation • Removal • Sediment Relocation
Location	Location of the oil spill or field trial (where applicable)	—
In	Title of journal, conference proceedings, or book	—
Volume	Volume of the relevant journal or conference proceedings in which the document was published	—
Issue	Issue of the relevant journal or conference proceedings in which the document was published	—
Pages	Page numbers within a document or total number of pages	—
Other Authors	Other authors of the document	2 nd to 17 th Author

ID	Availab	Year	Lead Author	Title	Type	Tactic	Location	In/For	Volu	Iss	Page
1	Purchase	1972	Owens, E.H.	The Cleaning of Gravel Beaches Polluted by Oil	Oil Spill	Removal	Nova Scotia	Coastal Engineering Conference, BC	-	-	2549-2556
2	Free	1973	Owens, E.H.	Changes in Beach Profiles at Chedabucto Bay, Nova Scotia, Following Large-Scale Removal of Sediments	Oil Spill	Removal	Nova Scotia	Canadian Journal of Earth Sciences	10	8	1226-1232
3	Link	1976	Owens, E.H.	Coastal Environments and Oil Spill Residues in Chedabucto Bay, Nova Scotia	Oil Spill	Removal	Nova Scotia	Canadian Journal of Earth Sciences	13	7	908-928
4	Link	1978	Owens, E.H.	Mechanical Dispersal of Oil Stranded in the Littoral Zone	Review	Natural Cleaning	Nova Scotia	Journal of the Fisheries Research Board of Canada	35	5	563-572
5	Free	1979	Bellier, P.	The Amoco Cadiz Oil Spill Cleanup Operations - An Overview of the Organization, Control, and Evaluation	Oil Spill	Sediment Relocation/Dry Mixing	France	International Oil Spill Conference	-	-	141-146
6	Request	1981	Woodward-Clyde	Shoreline Countermeasures - 1980 Study Results. (BIOS) Baffin Island Oil Spill Working Report 80-4, Envir	Field trial	Natural Cleaning	NW Territories	Environment Canada	-	-	83pp
7	Request	1982	Owens, E.H.	Shoreline Countermeasures - 1981 Study Results. (BIOS) Baffin Island Oil Spill Working Report 81-4, Envir	Field trial	Natural Cleaning	NW Territories	Environment Canada	-	-	123pp
8	Request	1983	Owens, E.H.	Shoreline Countermeasures - 1982 Study Results. (BIOS) Baffin Island Oil Spill Working Report 82-4, Envir	Field trial	Natural Cleaning	NW Territories	Environment Canada	-	-	129pp
9	Request	1984	Owens, E.H.	Shoreline Countermeasures - 1983 Study Results. (BIOS) Baffin Island Oil Spill Working Report 83-4, Envir	Field trial	Natural Cleaning	NW Territories	Environment Canada	-	-	-
10	Free	1985	Graves, N.A.	A Northern Idaho Gasoline Spill and Cleanup Using Stream Bed Agitation	Oil Spill	Wet Mixing	Idaho	International Oil Spill Conference	-	-	189-191
11	Free	1987	Owens, E.H.	Experimental Design and the Retention of Oil on Arctic Test Beaches	Field trial	Natural Cleaning	NW Territories	Arctic	1	-	230-243
12	Free	1987	Owens, E.H.	A Field Evaluation of Selected Beach-Cleaning Techniques	Field trial	Natural Cleaning	NW Territories	Arctic	1	-	244-257
13	Free	1987	Levine, R.A.	Operational Aspects of the Response to the Arco Anchorage Oil Spill, Port Angeles, Washington	Oil Spill	Wet Mixing	Washington	International Oil Spill Conference	-	-	3-7p
14	Free	1987	Miller, J.A.	Beach Agitation for Crude Oil Removal from Intertidal Beach Sediments	Oil Spill	Wet Mixing	Washington	International Oil Spill Conference	-	-	85-90
15	Link	1990	Bragg, J.R.	Experimental Studies of Natural Cleansing of Oil Residue From Rocks in Prince William Sound by Wave/Ti	Oil Spill	Natural Cleaning	Alaska	Exxon Production Research Comp	-	-	-
16	Link	1991	Owens, E.H.	Berm Relocation During the 1990 Shoreline Cleanup Program Following the "Exxon Valdez" Spill	Oil Spill	Sediment Relocation	Alaska	Arctic and Marine Oil Spill Program	-	-	607-630
17	Request	1992	Humphrey, B.	The Fate and Persistence of Stranded Crude Oil: A Nine-year Overview from the BIOS Project, Baffin Island	Field trial	Natural Cleaning	N.W.T.	Environment Canada Report EPS 3/S	-	-	-
18	Free	1993	Benson, R.L.	A Mechanized Approach to Beach Cleanup in Saudi Arabia	Oil Spill	Mixing	Saudi Arabia	International Oil Spill Conference	-	-	123-126
19	Purchase	1993	Watt, I.	Intertidal Clean-up Activities and Natural Regeneration on the Gulf Coast of Saudi Arabia from 1991 to 19	Oil Spill	Mixing	Saudi Arabia	Marine Pollution Bulletin	27	-	325-331
20	Link	1994	Bragg, J.R.	Clay-Oil Flocculation as a Natural Cleansing Process Following Oil Spills: Part 1 - Studies of Shoreline Sedi	Review	Natural Cleaning	Various	Arctic and Marine Oil Spill Program	-	-	1-23p
21	Link	1994	Owens, E.H.	Clay-Oil Flocculation as a Natural Cleansing Process Following Oil Spills: Part 2 - Implications of Study Res	Review	Sediment Relocation	N/A	Arctic and Marine Oil Spill Program	-	-	25-37
22	Purchase	1994	Owens, E.H.	Natural Cleaning of Oiled Coarse Sediment Shorelines in Arctic and Atlantic Canada	Review	Natural Cleaning	N/A	Spill Science and Technology Bulletin	1	1	37-52
23	Purchase	1995	Bragg, J.R.	Clay-Oil Flocculation and its Role in Natural Cleansing in Prince William Sound Following the Exxon Valde	Oil Spill	Natural Cleaning	Alaska	Exxon Valdez Oil Spill: Fate and Effect	-	-	178-214
24	Link	1995	Bragg, J.R.	Shoreline Cleansing by Interactions Between Oil and Fine Mineral Particles	Review	Natural Cleaning	N/A	International Oil Spill Conference	-	-	219-227
25	Link	1995	Owens, E.H.	Beach Cleaning and the Role of Technical Support in the 1993 Tampa Bay Spill	Oil Spill	Sediment Relocation/Dry Mixing	Florida	International Oil Spill Conference	-	-	627-634
26	Purchase	1995	Lunel, T.	Monitoring the Effectiveness of Response Options during the Sea Empress Incident: A Key Component of	Oil Spill	Sediment Relocation	Wales	Spill Science and Technology Bulletin	2	2	99-112
27		1996	Smith, G.C.	Hydrocarbon Concentrations in Two Intertidal Areas of Saudi Arabia following Remediation with	Oil Spill	Mixing	Saudi Arabia	A Marine Wildlife Sanctuary for the	-	-	40-53
28	Link	1996	Lunel, T.	Shoreline Clean up During the Sea Empress Incident: The Role of Surf Washing (Clay-Oil Flocculation), Dis	Oil Spill	Sediment Relocation	Wales	Arctic and Marine Oil Spill Program	-	-	1521-1540
29	Purchase	1996	Lee, K.	Enhanced Oil Biodegradation with Mineral Fine Interaction	Lab/mes	OPA Formation	N/A	Spill Science and Technology Bulletin	3	4	363-367
30	Link	1996	Lee, K.	Enhanced Oil Biodegradation with Mineral Fine Interaction	Lab/mes	OPA Formation	N/A	Arctic and Marine Oil Spill Program	-	-	715-722
31		1997	Wood, P.	Clay-Oil Flocculation - Laboratory Tests Interim Report	Lab/mes	OPA Formation	N/A	AEA Technology Report (Marine Poll	-	-	-
32		1997	Wood, P.	Investigation into the Role of Clay-Oil Flocculation: Final Report	Lab/mes	OPA Formation	N/A	AEA Technology Report (Marine Poll	-	-	-
33	Link	1997	Wood, P.	Clay-Oil Flocculation During Surf Washing at the Sea Empress Incident	Oil Spill	Sediment Relocation	Wales	Arctic and Marine Oil Spill Program	-	-	1085-1105
34		1997	Lee, K.	Enhanced Oil Biodegradation with Mineral Fine Interaction	Lab/mes	OPA Formation	N/A	In-Situ and On-Site Bioremediation	4	-	635-370
35	Free	1997	Lee, K.	Shoreline Cleanup by Acceleration of Clay-Oil Flocculation Processes	Oil Spill	Sediment Relocation	Wales	International Oil Spill Conference	-	-	235-240
36	Free	1997	Molden, A.	Response to the Apollo Sea Oil Spill, South Africa	Oil Spill	Sediment Relocation	South Africa	International Oil Spill Conference	-	-	777-781
37	Free	1997	Weise, A.M.	The Effect of Clay-Oil Flocculation on Natural Oil Degradation	Lab/mes	Natural Cleaning	N/A	International Oil Spill Conference	-	-	955-956
38	Free	1998	Arctic Council EP	Field Guide for Oil Spill Response in Arctic Waters	Guidance	Multiple	Arctic	-	-	-	5.60-5.63
39	Link	1998	Wood, P.	Influence of Oil and Mineral Characteristics on Oil-Mineral Interaction	Lab/mes	OPA Formation	N/A	Arctic and Marine Oil Spill Program	-	-	51-77
40	Link	1998	McCourt, J.	Interaction Between Oil and Suspended Particulate Matter in the Yukon River	Lab/mes	OPA Formation	Alaska	Arctic and Marine Oil Spill Program	-	-	79-88

Figure 2.1—Screenshot of the Shoreline In Situ Treatment Library (First 40 Documents) (MS Excel Version)

In Situ Treatment Library												
ID	Link	Year	Lead Author	Title	Document Type	Tactic	Location	In	Volume	Issue	Pages	2nd Author
1	Purchase	1972	Owens, E.H.	The Cleaning of Gravel Beaches Polluted by Oil	Oil Spill	Removal	Nova Scotia	Coastal Engineering Conference, BC	-	-	2549-2556	-
2	Free	1973	Owens, E.H.	Changes in Beach Profiles at Chedabucto Bay, Nova Scotia, Following Large-Scale R	Oil Spill	Removal	Nova Scotia	Canadian Journal of Earth Sciences	10	8	1226-1232	Drapeau, G.
3	Link	1976	Owens, E.H.	Coastal Environments and Oil Spill Residues in Chedabucto Bay, Nova Scotia	Oil Spill	Removal	Nova Scotia	Canadian Journal of Earth Sciences	13	7	908-928	Rashid, M.A.
4	Link	1978	Owens, E.H.	Mechanical Dispersal of Oil Stranded in the Littoral Zone	Review	Natural Cleaning	Nova Scotia	Journal of the Fisheries Research Board	35	5	563-572	-
5	Free	1979	Bellier, P.	The Amoco Cadiz Oil Spill Cleanup Operations - An Overview of the Organization, C	Oil Spill	Sediment Relocation/Dry Mixing	France	International Oil Spill Conference	-	-	141-146	Massart, G.
6	Link	1981	Woodward-Clyde	Shoreline Countermeasures – 1980 Study Results. (BIOS) Baffin Island Oil Spill Wor	Field trial	Natural Cleaning	NW Territorie	-	-	-	83pp	-
7	Link	1982	Owens, E.H.	Shoreline Countermeasures – 1981 Study Results. (BIOS) Baffin Island Oil Spill Wor	Field trial	Natural Cleaning	NW Territorie	-	-	-	123pp	Harper, J.R.
8	Link	1983	Owens, E.H.	Shoreline Countermeasures – 1982 Study Results. (BIOS) Baffin Island Oil Spill Wor	Field trial	Natural Cleaning	NW Territorie	-	-	-	129pp	Harper, J.R.
9	Link	1984	Owens, E.H.	Shoreline Countermeasures – 1983 Study Results. (BIOS) Baffin Island Oil Spill Wor	Field trial	Natural Cleaning	NW Territorie	-	-	-	-	-
10	Free	1985	Graves, N.A.	A Northern Idaho Gasoline Spill and Cleanup Using Stream Bed Agitation	Oil Spill	Wet Mixing	Idaho	International Oil Spill Conference	-	-	189-191	-
11	Free	1987	Owens, E.H.	Experimental Design and the Retention of Oil on Arctic Test Beaches	Field trial	Natural Cleaning	NW Territorie	Arctic	1	-	230-243	Robson, W.
12	Free	1987	Owens, E.H.	A Field Evaluation of Selected Beach- Cleaning Techniques	Field trial	Natural Cleaning	NW Territorie	Arctic	1	-	244-257	Robson, W.
13	Free	1987	Levine, R.A.	Operational Aspects of the Response to the Arco Anchorage Oil Spill, Port Angeles,	Oil Spill	Wet Mixing	Washington	International Oil Spill Conference	-	-	3-7p	-
14	Free	1987	Miller, J.A.	Beach Agitation for Crude Oil Removal from Intertidal Beach Sediments	Oil Spill	Wet Mixing	Washington	International Oil Spill Conference	-	-	85-90	-
15	Link	1990	Bragg, J.R.	Experimental Studies of Natural Cleansing of Oil Residue From Rocks in Prince Will	Oil Spill	Natural Cleaning	Alaska	Exxon Production Research Company	-	-	-	Yang, S.H.
16	Link	1991	Owens, E.H.	Berm Relocation During the 1990 Shoreline Cleanup Program Following the "Exxon O	Oil Spill	Sediment Relocation	Alaska	Arctic and Marine Oil Spill Program	-	-	607-630	Teal, A.R.
17	Purchase	1992	Humphrey, B.	The Fate and Persistence of Stranded Crude Oil: A Nine-year Overview from the BI	Field trial	Natural Cleaning	N.W.T.	Environment Canada Report EPS 3/SP/4-	-	-	-	Owens, E.H.
18	Free	1993	Benson, R.L.	A Mechanized Approach to Beach Cleanup in Saudi Arabia	Oil Spill	Mixing	Saudi Arabia	International Oil Spill Conference	-	-	123-126	LeGore, R.S.
19	Purchase	1993	Watt, I.	Intertidal Clean-up Activities and Natural Regeneration on the Gulf Coast of Saudi	Oil Spill	Mixing	Saudi Arabia	Marine Pollution Bulletin	27	-	325-331	Woodhouse, T.
20	Link	1994	Bragg, J.R.	Clay-Oil Flocculation as a Natural Cleansing Process Following Oil Spills: Part 1 - Stu	Review	Natural Cleaning	Various	Arctic and Marine Oil Spill Program	-	-	1-23p	Owens, E.H.
21	Link	1994	Owens, E.H.	Clay-Oil Flocculation as a Natural Cleansing Process Following Oil Spills: Part 2 - Im	Review	Sediment Relocation	N/A	Arctic and Marine Oil Spill Program	-	-	25-37	Bragg, J.R.
22	Purchase	1994	Owens, E.H.	Natural Cleaning of Oiled Coarse Sediment Shorelines in Arctic and Atlantic Canad	Review	Natural Cleaning	N/A	Spill Science and Technology Bulletin	1	1	37-52	Humphrey, B.
23	Purchase	1995	Bragg, J.R.	Clay-Oil Flocculation and its Role in Natural Cleansing in Prince William Sound Foll	Oil Spill	Natural Cleaning	Alaska	Exxon Valdez Oil Spill: Fate and Effects	-	-	178-214	Yang, S.H.
24	Link	1995	Bragg, J.R.	Shoreline Cleansing by Interactions Between Oil and Fine Mineral Particles	Review	Natural Cleaning	N/A	International Oil Spill Conference	-	-	219-227	Owens, E.H.
25	Link	1995	Owens, E.H.	Beach Cleaning and the Role of Technical Support in the 1993 Tampa Bay Spill	Oil Spill	Sediment Relocation/Mixing	Florida	International Oil Spill Conference	-	-	627-634	Davis, R.A.
26	Purchase	1995	Lunel, T.	Monitoring the Effectiveness of Response Options during the Sea Empress Incident	Oil Spill	Sediment Relocation	Wales	Spill Science and Technology Bulletin	2	2	99-112	Swannell, R.
27	Link	1996	Smith, G.C.	Hydrocarbon Concentrations in Two Intertidal Areas of Saudi Arabia following Rem	Oil Spill	Mixing	Saudi Arabia	A Marine Wildlife Sanctuary for the Ara	-	-	40-53	-
28	Link	1996	Lunel, T.	Shoreline Clean up During the Sea Empress Incident: The Role of Surf Washing (Cla	Oil Spill	Sediment Relocation	Wales	Arctic and Marine Oil Spill Program	-	-	1521-1540	Lee, K.
29	Purchase	1996	Lee, K.	Enhanced Oil Biodegradation with Mineral Fine Interaction	Lab/meso study	OPA Formation	N/A	Spill Science and Technology Bulletin	3	4	363-367	Weise, A.M.
30	Link	1996	Lee, K.	Enhanced Oil Biodegradation with Mineral Fine Interaction	Lab/meso study	OPA Formation	N/A	Arctic and Marine Oil Spill Program	-	-	715-722	St-Pierre, S.
31	Link	1997	Wood, P.	Clay-Oil Flocculation - Laboratory Tests Interim Report	Lab/meso study	OPA Formation	N/A	AEA Technology Report (Marine Polluti	-	-	-	Lunel, T.
32	Link	1997	Wood, P.	Investigation into the Role of Clay-Oil Flocculation: Final Report	Lab/meso study	OPA Formation	N/A	AEA Technology Report (Marine Polluti	-	-	-	Lunel, T.
33	Link	1997	Wood, P.	Clay-Oil Flocculation During Surf Washing at the Sea Empress Incident	Oil Spill	Sediment Relocation	Wales	Arctic and Marine Oil Spill Program	-	-	1085-1105	Lunel, T.
34	Link	1997	Lee, K.	Enhanced Oil Biodegradation with Mineral Fine Interaction	Lab/meso study	OPA Formation	N/A	In-Situ and On-Site Bioremediation	4	-	635-370	Weise, A.M.
35	Free	1997	Lee, K.	Shoreline Cleanup by Acceleration of Clay-Oil Flocculation Processes	Oil Spill	Sediment Relocation	Wales	International Oil Spill Conference	-	-	235-240	Lunel, T.
36	Free	1997	Molden, A.	Response to the Apollo Sea Oil Spill, South Africa	Oil Spill	Sediment Relocation	South Africa	International Oil Spill Conference	-	-	777-781	-
37	Free	1997	Weise, A.M.	The Effect of Clay-Oil Flocculation on Natural Oil Degradation	Lab/meso study	Natural Cleaning	N/A	International Oil Spill Conference	-	-	955-956	Lee, K.
38	Free	1998	Arctic Council EPPR	Field Guide for Oil Spill Response in Arctic Waters	Guidance	Multiple	Arctic	-	-	-	5.60-5.63	-
39	Link	1998	Wood, P.	Influence of Oil and Mineral Characteristics on Oil-Mineral Interaction	Lab/meso study	OPA Formation	N/A	Arctic and Marine Oil Spill Program	-	-	51-77	Lunel, T.
40	Link	1998	McCourt, J.	Interaction Between Oil and Suspended Particulate Matter in the Yukon River	Lab/meso study	OPA Formation	Alaska	Arctic and Marine Oil Spill Program	-	-	79-88	Shier, L.
41	Free	1998	Prince, R.C.	The Role of Biodegradation in the Weathering of Oil from the 1970 Arrow Spill	Oil Spill	Natural Cleaning	Nova Scotia	Arctic and Marine Oil Spill Program	-	-	717-728	Garrett, R.M.
42	Link	1998	Owens, E.H.	Sediment Relocation and Tilling - Underused and Misunderstood Techniques for th	Review	Sediment Relocation/Mixing	N/A	Arctic and Marine Oil Spill Program	-	-	857-872	-
43	Free	1998	Sergy, G.A.	The Svalbard Shoreline Oilspill Field Trials	Field trial	Sediment Relocation/Mixing	Norway	Arctic and Marine Oil Spill Program	-	-	873-890	Guenette, C.C.
44	Link	1998	Lee, K.	Formation and Structure of Oil-Mineral Aggregates in Coastal Environments	Lab/meso study	OPA Formation	N/A	Arctic and Marine Oil Spill Program	-	-	911-921	Stoffyn-Eglin, P.
45	Link	1998	Jezequel, R.	The Influence of Microorganisms on Oil-Mineral Fine Interactions in Low-Energy Co	Lab/meso study	OPA Formation	N/A	Arctic and Marine Oil Spill Program	-	-	957-962	Le Floch, S.

Figure 2.2—Screenshot of the Mechanical Treatment Library (First 45 Documents) (MS Access Version)

Acknowledgements

The Shoreline In Situ Treatment Library and this report were prepared by Helen Dubach (Owens Coastal Consultants), Ed Owens (Owens Coastal Consultants), and Bob Castle (RCE Inc.).



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