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Project Summary

A Mobile Stream Diversion System for Hazardous Materials Spills Isolation

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This program was undertaken to design and develop a practical prototype mobile stream diversion system for quick rerouting of a stream flow around a contaminated area.

Spill scenarios were analyzed to establish design criteria for a completely self-contained, independent system that would maintain flow continuity around a region undergoing decontamination processing. The system was designed to use stock items available nationwide, to be easily maintained, and to be readily repairable. To provide flexibility and reliability, the system has been assembled as two totally independent units mounted on trailers. These trailers do not require permits for hauling over state or interstate highways and they can also be moved over unimproved roads to gain access to spill sites. Components are fastened on the trailers so that they can be quickly unloaded for air shipment to more distant locations. Once onsite, the system can be assembled and placed in operation by a crew of five in a matter of hours.

Unit operation and ability to deliver a flowrate of 0.35 m³/s (5,600 gpm) a distance of 0.3 km (1,000 ft) over unprepared ground were evaluated in a shakedown test.

Alternative modes of operation have been defined and capabilities indicated. The system can deliver a flowrate of 0.09 m³/s (1,425 gpm) a nominal distance of 1 km (3,280 ft), or a flowrate of 0.35 m³/s (5,600 gpm) a distance of 0.3 km (1,000 ft).

This Project Summary was developed by EPA's Municipal Environmental Research Laboratory, Cincinnati, OH, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

This report discusses the design and development of a practical prototype mobile stream diversion system (MSDS) to be used for quick rerouting of a stream flow around a contaminated area.

Spill cleanup scenarios often involve contamination of small streams by insoluble, sinking hazardous materials. An analysis of the proposed list of designated hazardous substances indicates that approximately 45% of these materials either are insoluble sinkers or form insoluble precipitates on contact with water.

These materials can be cleaned up in several ways, including hand-vacuuming and dredging. But the use of these methods can lead to problems resulting from spread of contamination downstream or treatment of contaminated dredge water. Another approach is to dam the stream above the affected area and bypass the normal flow; this procedure allows the contaminated stream bed to dry and, thus, facilitates mechanical cleanup.

In the case of smaller streams, a bypass can be achieved through gravity flow. But stream flows greater than 0.0063 m^3/s (100 gpm) generally require that a pumping and piping system be used to bypass the flow. Suitable systems are not always readily available, and valuable time is lost while attempting to engineer a system.

Scientific Services, Inc., of California, under the sponsorship of the U.S. Environmental Protection Agency's (EPA) Oil and Hazardous Materials Spills Branch, Edison, New Jersey, undertook a project to build a mobile, pre-engineered pumping and piping system designed to bypass streams affected by spills of insoluble, sinking hazardous materials. The stream diversion system developed as a result of this study is shown in Figure 1.

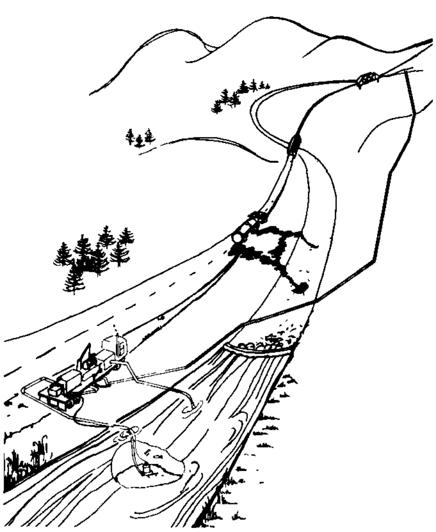

Figure 1. MSDS spill application.

Discussion

For the MSDS to be reliable and financially viable, the selection of components had to be made principally from commercial items that were stocked and readily available nationwide. Such components also simplify system maintenance and repair. The major design task of this study became one of choosing from available products to achieve maximum operational flexibility at an acceptable cost. At the same time, the system had to meet certain operational specifications; it had to be:

1. Completely self-contained (on a maximum of two trailers) and capable of independent operation (with liquid fuels supplied separately),
2. Self-propelled, as a tractor-trailer, over interstate highways without special permits,
3. Able to be fully assembled on site in 4 hr by five men,
4. Capable of diverting a volume flowrate of 0.35 m^3/s (5,600 gpm) a distance of 0.3 km (1,000 ft), or a lower flow volume a distance of 0.91 km (3,000 ft),
5. Continuously operable for 21 days (500 hr) without dropping below 50% capacity in the event of any single component failure, and
6. So mounted that the components could be quickly and easily removed when the need arose for them to be shipped by air.

Specifications for individual components also had to be met.

Component Selection

The major components of the system were identified as the following:

1. Booster pumps
2. Submersible pumps
3. Generator
4. Pipes, hoses, and fittings
5. Crane
6. Transportation system
7. Lighting system

Compatibility of these components was an important factor in the design and selection analysis. Because the booster pumps were available as surplus U.S. government property, their capacities were chosen as an appropriate starting point for the analysis. The booster pump specifications indicated that their use would place certain demands on the system. A hierarchy of selection criteria for the other components was developed based on how well the components could meet these demands and on their availability and cost. The costs were analyzed both in terms of the initial investment and subsequent operating cost.

The report discusses in detail the rationale involved in the selection process for all major components and ancillary equipment such as electrical hookups, pipe racks, and dollies. A list of the items that were eventually selected is given in the report.

System Operation

The mobile stream diversion system has been designed to allow for maximum flexibility, reliability, and practicability by providing two totally independent units. The two-unit system allowed the development of units having access to state as well as interstate highways without special permit. In addition, should one unit be delayed or lost in an accident, it would not affect the operation of the other unit. The system is capable of a number of different operational modes, which gives added flexibility for use in various terrains. Table 1 contains a list of the operational modes.

The design philosophy, performance specifications, and rationale for selecting the components (including manufacturer's model number and performance specifications) are described in the full report. Photographs and figures illustrate the system; explanations of the various operational modes are intended as an aid in using the system effectively and efficiently.

The full report was submitted in fulfillment of Contract No. 68-03-2458 by Scientific Service, Inc., Redwood City, California 91320, under the sponsorship of the U.S. Environmental Protection Agency.

Table 1. *Mobile Stream Diversion System (MSDS) Operational Modes*

Mode	Volume Flow Rate @ .3 km Q (m³/s)	(gpm)	Volume Flow Rate @ .6 km Q (m³/s)	(gpm)	Volume Flow Rate @ .9 km Q (m³/s)	(gpm)	If Series Staged With Additional Pipe: Stages	Q (m³/s)	(gpm)	Range km	ft	Pipe Required km	ft
1. s s	.11	1,750	.09	1,425	.06	950	4	.09	1,425	2.4	7,900	2.4	7,900
2. s s	.22	3,500					2	.18	2,900	1.2	3,900	2.4	7,900
3. s s s	.18	2,900	.10	1,600	.07	1,100							
4. s s	.35	5,600					1	.10	1,600	0.6	2,000	1.2	3,950
5. s B s B	.10	1,600	.10	1,600	.09	1,425	4	.09	1,425	11	36,000	11	36,000
6. s B s B	.20	3,200					2	.18	2,900	5	16,400	11	36,000
7. s B s B s B	.18	2,900	.18	2,900	.11	1,750							
8. s B s B	.35	5,600					1	.35	5,600	1.1	3,600	2.2	7,200

Note: Submersible pumps s and booster pumps B may be used singly or jointly, in series or parallel, with individual or common pipelines. The mode symbols used are descriptive of such arrays. Volume rate of flow for the system has been indicated for the two specified and one intermediate distance in the lefthand columns, possible future options in the right.

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Frank J. Freestone is the EPA Project Officer (see below).

The complete report, entitled "A Mobile Stream Diversion System for Hazardous Materials Spills Isolation," (Order No. PB 82-109 679; Cost: $6.50, subject to change) will be available only from:

National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Telephone: 703-487-4650

The EPA Project Officer can be contacted at:
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