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**CONTAMINATED SEDIMENT
REMOVAL PROGRAM**

*"The environment sector offers one of the
greatest opportunities for
technological innovation that
the world has ever seen.
Canada needs a guiding vision
to develop our 'green' industries."*

The Right Honourable Jean Chrétien

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INTRODUCTION

The 1978 Canada/United States Great Lakes Water Quality Agreement committed the two federal governments, in co-operation with the Province of Ontario and U.S. state governments, to the virtual elimination of persistent toxic substances.

Some U.S. environmental jurisdictions are considering options, other than removal, for contaminated sediment problems. Natural processes of degradation and overtopping with cleaner sediments are two options being considered.

This publication is about cleaning up contaminated sediment in the Great Lakes basin. It discusses a unique program - *Contaminated Sediment Removal* - bringing together governments, industry, communities and concerned citizens. It also outlines innovative technology, now achieving worldwide recognition, and commercial opportunities for Canadian companies to market this advanced technology abroad.

All of which will bring Canada a significant step closer to meeting its international obligations of virtual elimination of persistent toxic substances from the Great Lakes ecosystem.

The rapidly expanding world market for environmental technologies presents a major growth opportunity for Canadian companies

OVERVIEW

The Cleanup Fund, a component of the recently announced \$150 million federal Great Lakes 2000 Program, concentrates on the restoration of impaired beneficial uses in Canada's 17 Areas of Concern (AOCs).

It is part of the federal government's response to the Canada-United States Great Lakes Water Quality Agreement to improve water quality in the Great Lakes basin, which contains approximately 20 per cent of the world's freshwater.

The Cleanup Fund was established to test and demonstrate workable cost-effective technology that could help in cleanup of pollution hotspots in the Great Lakes. Simply put, this means cleaning up past mistakes.

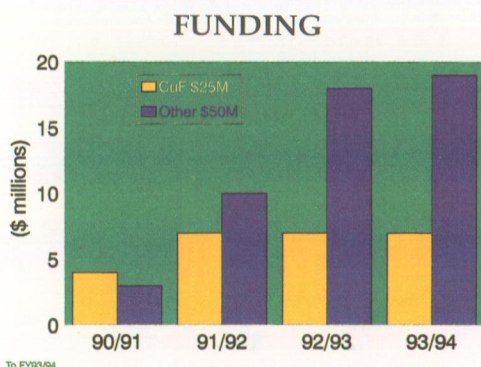
Priorities for funding include cleaning up contaminated sediment, combined sewer overflow control, stormwater management, municipal wastewater treatment (STPs) and habitat rehabilitation. To date, the Cleanup Fund has spent approximately \$25 million in support of more than 100 projects. As a result, another \$50 million has been contributed to these projects from 130 participating partners.

This approach to remediation of water quality problems involving government agencies, industry and community groups has shown that our partners are increasingly aware that jobs and livelihoods are at risk if the lakes are not cleaned up.

One of the Cleanup Fund's top priorities is remediation of contaminated sediment. This toxic mud at the bottom of some lakes, rivers and harbours threatens benthic organisms, fish, wildlife, and humans from direct exposure, or exposure through the food chain.

Technology for the removal of sediment is evaluated under the Cleanup Fund's Contaminated Sediment Removal Program, a key aspect of which is the transfer of technology between agencies and organizations potentially faced with sediment removal.

An important consideration, aside from benefits to the quality of our aquatic environment, is that the Fund's activities provide employment and commercial opportunities for Canadian companies to market this successful technology globally.



***A new sense of
common
purpose is
evolving***

***Governments
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in areas that
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Also promising is the potential for partnerships between regulatory agencies and industry for joint cleanup projects using this cost-saving technology.

Joint Canada-Ontario technical teams are developing Remedial Action Plans (RAPs) in co-operation with the public, municipal governments and private sector companies to restore impaired beneficial uses in AOCs. All but one of the AOCs have problems with contaminated sediment.

RAP teams, together with Public Advisory Committees, build partnerships between business and communities to generate involvement and public awareness of the stake people have in their communities.

The teams represent changing attitudes that governments are no longer perceived as working in isolation but co-operatively with the public in areas that affect lifestyle and commerce.

This publication will describe successful demonstrations under the Contaminated Sediment Removal Program, highlighting examples where innovative technologies and techniques were tested and evaluated. The cost-efficient results will continue to improve water quality in the Great Lakes basin and provide a link for creating a climate of commercial possibilities worldwide.

CONTAMINATED SEDIMENT REMOVAL PROGRAM

Sedimentation occurs as a result of natural erosion forces and onshore development. Sediment that is eroded by flowing water is deposited into water bodies through settling. When sediment is contaminated, water quality is diminished. This subsequently jeopardizes fish and wildlife populations, human health and development opportunities.

How can contaminated sediment be removed from a river or harbour without stirring up the bottom material and spreading contaminants through the water column?

This is the question the Contaminated Sediment Removal Program, created by Environment Canada's Great Lakes Cleanup Fund, set out to answer.

Introduced in 1990, the program's focus is primarily to demonstrate innovative technology that allows the removal of sediment, with the least disturbance and adverse environmental impact.

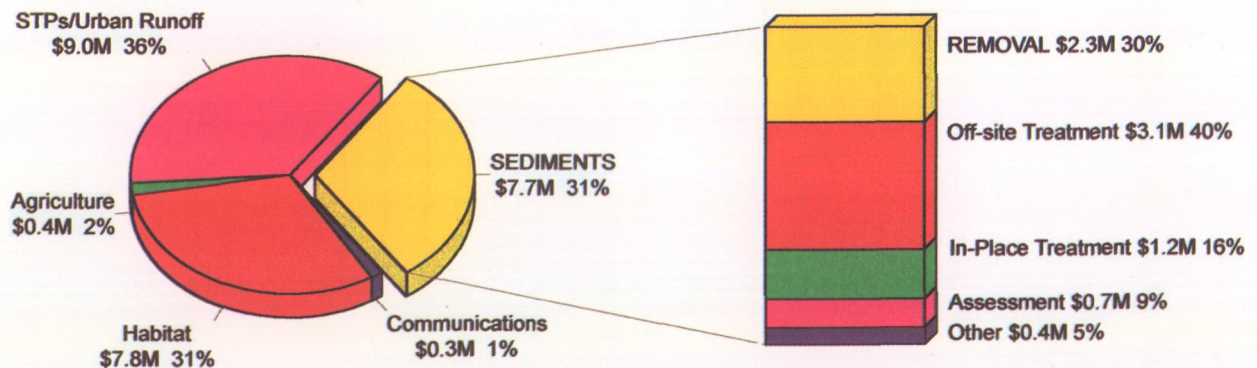
It is expected that this innovative technology will have a wide commercial application in such areas as routine navigational dredging of contaminated sediment across the Great Lakes basin. Additionally, this technology can be applied to dredge non-contaminated materials where greater efficiency and production are a priority.

Demonstrations of removal technologies have been successfully done in various Areas of Concern throughout the Great Lakes, including the Welland River (a Niagara River tributary), as well as Toronto, Hamilton and Collingwood Harbours.

Demonstrations of removal technologies have been successfully done in various Areas of Concern throughout the Great Lakes

CLEANUP FUND PRIORITIES

SEDIMENT PROGRAM



NIAGARA RIVER AREA OF CONCERN



Mud Cat dredge at Welland.

The Welland River project adapted existing dredging equipment in an effort to develop a more efficient and environmentally sound removal capability for rivers

The Welland River, part of the Niagara River Area of Concern, has a contaminated sediment problem in sections of its river bed. Here, the Cleanup Fund contributed to a project to develop an innovative technology for removing and treating contaminated river sediment, with minimal disturbance and no adverse environmental impact.

The process involved in removing contaminated sediment from river beds poses different challenges than lake bottoms. Removal operations must tackle not only an uneven bottom surface, but also the turbidity and sediment resuspension caused by river currents and fluctuating water flow. The Welland River project adapted existing dredging equipment in an effort to develop a more efficient and environmentally sound removal capability for rivers.

Using a modified Mud Cat dredge, a portable suction dredge with shallow water capabilities and specifically designed by Ellicott Machine Corporation for the Welland River project, the Contaminated Sediment Removal Program demonstrated the equipment in November, 1991.

This modified dredge, owned and operated by Auburn Contractors Incorporated, Sudbury, Ontario, removed contaminated sediment from the river bottom. The sediment was then transported in a flexible pipeline to a multi-stage sediment treatment plant about a kilometre away. Here, the sediment was treated in a solid/liquid separation technology, a system designed to separate solids into various fractions in order to reduce

significantly the volume of material requiring further treatment.

Demonstration results indicate two significant findings. First, the modified dredge can meet all operational and performance specifications developed by the Contaminated Sediment Removal Program for river sediment removal. Second, the modified Mud Cat model can remove sediment from shallow nearshore areas of the Great Lakes in a more efficient and environmentally sound manner than conventional dredging techniques.

The successful performance of the Mud Cat dredge in the Welland River contributed to its selection by the Province of Nova Scotia for a multi-million dollar long-term project for removal of contaminated sediment in the Sydney Tar Ponds, Nova Scotia.

Through this effort in the Welland River, the Cleanup Fund and its partners demonstrated what can be done to effectively remediate similar river contamination problems in the Great Lakes.

METRO TORONTO AND REGION AREA OF CONCERN



Cable Arm Environmental Bucket.

In Toronto Harbour, the Cleanup Fund supported the design, development and demonstration of a new, more mechanically efficient and environmentally sound model of dredging bucket

Given the sheer size of the Toronto shoreline, the environmental problems in this Area of Concern are complex and often interrelated. The waterfront of Canada's largest city has been affected by physical restructuring, the removal of the area's natural resources, the impact of nutrients and toxic contaminants, and the introduction of foreign species of plants and animals. And years of neglect.

The challenge of this cleanup is to develop new, inexpensive and effective ways to deal with contaminated sediment removal. Working with its partners and applying an array of new and innovative technologies, the Cleanup Fund demonstrated remediation methods that apply to large cities on the Great Lakes.

One way of removing lake bottom sediments is with conventional dredging equipment. This technique has several drawbacks, including resuspension of contaminated sediments and pitting of the lake bottom. In Toronto Harbour, the Cleanup Fund supported the design, development and demonstration of a new, more mechanically efficient and environmentally sound model of dredging bucket.

The Contaminated Sediment Removal Program demonstrated this new equipment in the inner harbour in June, 1992.

The new Cable Arm Environmental Bucket, manufactured by Cable Arm (Canada) Inc., is a precision clamshell bucket which removes the layer of contaminated material with less disturbance than a conventional bucket. To accomplish this several major design modifications were made. The traditional fixed arms of the bucket were replaced by cables yielding a lighter bucket with a horizontal bite that doesn't pit the bottom. In addition, the bucket's mouth has been sealed to minimize contaminant leakage once the bucket is closed and moves to the surface.

During the Toronto demonstration the Cable Arm Environmental Bucket removed sediment without significant recontamination from its operation. The sediment, in the form of a sludge, was treated at the Toronto Harbour Commission's Soil Recycling Pilot Plant in a three-stage treatment process of soil washing, metals extraction and bioremediation.

HAMILTON HARBOUR AREA OF CONCERN



Hamilton Harbour demonstration.

Hamilton Harbour is a challenge to new and cost-efficient cleanup technology. Projects like contaminated sediment removal are demonstrating successful aspects of cleanup in major industrial areas of the Great Lakes

Hamilton Harbour, on the west side of Lake Ontario, is the second largest Canadian port on the Great Lakes. It serves a large, heavily industrialized urban area and its waters receive contaminants and sewage discharges from many sources.

Identified as an Area of Concern in 1985, Hamilton Harbour is a challenge to new and cost-efficient cleanup technology. Projects like contaminated sediment removal supported by the Cleanup Fund, its partners and the public, are demonstrating successful aspects of cleanup in major industrial areas of the Great Lakes.

In October, 1992 the Contaminated Sediment Removal Program demonstrated the Cable Arm Environmental Bucket, manufactured by Cable Arm (Canada) Inc., in a highly polluted area in the harbour. ←

The objectives for this demonstration were threefold. First, to test the applicability of the bucket to open water conditions. Second, to find out what structural modifications would enhance the bucket's operational performance. Third, to supply harbour sediment to the Grace Dearborn bioremediation demonstration in Hamilton Harbour.

Contaminated sediment was removed, transported in lugger boxes and off-loaded to the treatment facility.

The Cable Arm Environmental Bucket proved particularly impressive in its ability not only to minimize sediment disturbance, but also in its handling of off-loading material.

Site evaluation and monitoring showed that the bucket met and in some cases exceeded operational and performance standards established by the program for field testing of the technology. All performance standards were developed prior to demonstration.

Since these demonstrations, the commercial value of the Cable Arm Environmental Bucket has received significant recognition throughout North America, not only for its environmental use, but also for its ability to decrease operational costs.

Based on these positive demonstration results, this removal technology was used by Ontario Hydro at the Pickering Nuclear Power Plant to remove sediment from

The Cable Arm Environmental Bucket proved particularly impressive in its ability not only to minimize sediment disturbance, but also in its handling of off-loading material

the cooling water intake channel. The technology is now being commercially marketed by Ontario Hydro International.

Transport Canada is considering use of the Cable Arm for dredging in Prescott, Ontario and it is expected that Ford Motor Co. will use the technology for a dredging project in the Rouge River, which flows into the Detroit River in the United States.

The Cable Arm Environmental Bucket demonstration in Hamilton Harbour has proved the technology to be effective, environmentally friendly and commercially viable. However, a major demonstration using the technology for a full-scale removal project of highly hazardous material in the harbour still remains to be done. A demonstration project of this nature is currently being planned for Hamilton Harbour by the Contaminated Sediment Removal Program.



Hamilton Harbour.

COLLINGWOOD HARBOUR AREA OF CONCERN



Pneuma Pump at Collingwood.

Collingwood Harbour was chosen by the Contaminated Sediment Removal Program to demonstrate an innovative technology for the removal of marginally contaminated sediment in November, 1992

Until recently, Collingwood Harbour had a problem with urban discharges and marginally contaminated sediment.

Selected for its chemical and physical sediment characteristics, Collingwood Harbour was chosen by the Contaminated Sediment Removal Program to demonstrate an innovative technology for the removal of marginally contaminated sediment in November, 1992.

A Pneuma airlift pumping system, manufactured by Pneuma s.r.l., was used for the demonstration. This technology uses hydrostatic pressure to fill containers with sediment. When the cylinders are full, the sediment is forced up a delivery tube by compressed air. The pump has no rotating parts or mechanisms in contact with the sediment, minimizing resuspension problems.

Contaminated sediment was removed from the harbour and transported through a pipeline to a confined disposal facility nearby.

Using this technology, a full-scale cleanup of contaminated sediment remaining in the harbour has been completed. The results show that the pumping system is most efficient when semi-submerged in sediment.

After cleanup, Transport Canada used the Pneuma Pump to supply fill and cap material for a confined disposal facility in Collingwood Harbour, with excellent results achieved ahead of schedule.

It is expected that these operations will play a role in the delisting of Collingwood Harbour as an Area of Concern and eventually pave the way for a return to recreational use of the harbour by the community.

ENVIRONMENTAL RESULTS

FROM DEMONSTRATION TO COMMERCIALIZATION



Debris from Collingwood Harbour.

***The MUD CAT
DREDGE is owned
and operated by
Auburn
Contractors
Incorporated,
Sudbury, Ontario***

***The CABLE ARM
ENVIRONMENTAL
BUCKET,
manufactured by
Cable Arm (Canada)
Inc. of Pickering,
Ontario, evolved from
a grab bucket used
for the loading and
unloading of bulk
cargoes***

Working with a consortium of partners, the Contaminated Sediment Removal Program has successfully demonstrated innovative and cost-efficient technology that provides Canadian industry with promotional and marketing opportunities worldwide.

The MUD CAT DREDGE used in the Welland River demonstration, is owned and operated by Auburn Contractors Incorporated, Sudbury, Ontario. The successful demonstration in the Welland River led to the Government of Nova Scotia using the technology for the multi-year cleanup of the Sydney Tar Ponds.

The manufacturers are now considering incorporating the successful principles demonstrated by the removal program for use in its production models. The innovations demonstrated are not only environmentally friendly and economically sound but also have commercial application here and abroad.

The CABLE ARM ENVIRONMENTAL BUCKET, manufactured by Cable Arm (Canada) Inc. of Pickering, Ontario, evolved from a grab bucket used for the loading and unloading of bulk cargoes. The environmental principles incorporated into the bucket design allow for increased efficiency and minimal environmental impact.

As a result of the successful demonstration in Toronto and Hamilton Harbours in 1992, the Cable Arm Environmental Bucket won significant commercial dredging contracts in Ohio, Georgia, Michigan, San Francisco Bay and Ontario Hydro's Pickering Nuclear Power Plant. Transport Canada is considering using the technology in Prescott, Ontario and it is expected the Ford Motor Co. will also use the technology for dredging the Rouge River. Vancouver Port Corporation has recognized the Cable Arm Environmental Bucket's capabilities and has included the technology in its dredging specifications. Revisions to the technology have allowed commercialization and international marketing by Ontario Hydro.

***The PNEUMA
PUMP dredging
technology was
developed by a
consortium of
three companies
- two Canadian
and one Italian***

The PNEUMA PUMP dredging technology, developed by a consortium of three companies (two Canadian and one Italian), was demonstrated successfully in Collingwood Harbour in 1992. As a result of this demonstration, the technology was then used in a full-scale removal project in Collingwood, managed by Environment Canada, and funded by a group of participating partners. Transport Canada has subsequently used the pump commercially in Collingwood to supply fill and cap material in the harbour. A similar pumping system has been used by the City of Santa Barbara, California, to maintain water levels in Gibraltar Lake, which supplies the city with water.



Cable Arm commercial use at Pickering.

CONCLUSION

The Cleanup Fund's Contaminated Sediment Removal Program is unique. No other program like it exists anywhere. The need and market for innovative technology demonstrated under this program have a broad commercial application in North America and internationally.

To date, all the technologies supported by the program have subsequently been used commercially, demonstrating that removal of contaminated sediment is a viable long-term remedial option for the Great Lakes Areas of Concern.

The demonstrations showed that meeting stringent operational and performance criteria had little effect on the production and performance capability of the equipment used. Consequently, the trade-off between environmental concerns versus profit and efficiency is minimal.

With emphasis on full-scale removal projects, the Contaminated Sediment Removal Program is advising Remedial Action Plan teams in specific Areas of Concern on the use of this innovative technology, underlining the co-operation between government and industry in ventures that link commerce with awareness and understanding of benefits to communities.

This successful technology to remove contaminated sediment throughout the polluted Great Lakes basin is now achieving recognition outside Canada - in the United States, Europe, and worldwide.

The Cleanup Fund's focus will continue to be on achieving effective results, environmental safety, and co-operative partnerships designed to find the most cost-efficient way to restore long-lasting beneficial uses in the Great Lakes basin, home to one-third of Canadians.

The rewards for such investment and effort are greater than a cleaner Ontario harbour or river. These successfully demonstrated results can be applied to other harbours, waterfronts, rivers and bays beyond the identified Areas of Concern.

They can also become part of a wider solution to worldwide environmental problems and provide Canadian companies with opportunities to market this innovative technology commercially all over the world.

The federal government is committed to supporting the environmental industry sector. In order to achieve environmental sustainability partnerships must be encouraged and public awareness raised.

This publication confirms that partnerships between government and the private sector can work and should continue to be put together to tackle environmental problems.

It also emphasizes that removal of contaminated sediment remains the focus of the federal government's commitment under the Canada/United States Great Lakes Water Quality Act to virtual elimination of persistent toxic substances.

***Canada can
turn
environmental
needs at
home and
abroad into
economic
opportunities***

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