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Welland, Ontario
and
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Welland River Reef Cleanup Environmental Screening Report and Addendum

December 1997

P31201.02

Acres International Limited
Niagara Falls, Ontario

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1 Introduction

This addendum to the "Welland River Reef Cleanup Environmental Screening Report" (ESR) has been prepared to address changes in project design and implementation since the distribution of the draft final ESR in May 1995. Aspects of the project that have been changed or revised are as follows:

- project management and contracting
- dredging technology
- wetland retention features
- Atlas 42-in. floodplain mill scale pocket surface area and excavation volume
- location of laydown/work area and river access point
- operational water quality criteria
- treatment of fine sediments
- additional public notification.

During the tendering process, it became apparent that the project "as designed", could not be undertaken within the available budget. As a result a review of alternate methodologies and procedures was initiated to determine whether a project could be developed and undertaken during 1995 that remained within the established budgetary constraints. The changes noted in the following sections have generally resulted from this review process and the recent negotiations toward contract award with the preferred contractors.

2 Project Management and Contracting

The project, as initially envisioned and tendered, was to be carried out under a single contract with one contractor responsible for all aspects of project coordination and implementation. Subcontractors would be employed for individual components of the project, as required. From a contractual and environmental perspective, this was perceived as a beneficial situation. To the contractor however, it meant that sufficient contingency (monetary) had to be incorporated into their bids to deal with the management of risk(s) associated with the entire project. For this and other reasons, tendered bids were in excess of available funding for the project. As a result, the manner in which the project was to be managed and contracted had to be reevaluated in an effort to bring project costs down to budgeted levels.

The project will now be carried out under three smaller contracts. This allows for a tighter, more defined scope of work for each contract, and less contingency for unknowns. Atlas will assume greater risk associated with managing and coordinating the contractors.

The project will be contracted/managed according to the following:

Atlas Specialty Steels - as project proponent, will retain individual contractors to carry out the required work, and assume overall responsibility for the project including the management of unknowns and upset conditions.

Acres International Limited - will assist Atlas with the project management function and will coordinate the activities of the following contractors on site.

Normrock Industries Inc. - will remove the contaminated riverine sediments and transport them by slurry pipeline to the treatment facility located on Atlas property at the North Filtration Plant (NFP).

The Ontario Construction Company Limited - will provide site facilities, remove the pocket of mill scale near BH-301 adjacent to the Atlas 42-in. outfall reef, undertake the installation of the sheetpiling, and provide/place granular material and backfill after dredging/removal is complete at all locations.

Derrick Corporation - will provide equipment and training and supervisory services for the sediment treatment facility situated at the site of Atlas' NFP. Atlas will provide personnel to operate the sediment treatment facility.

Rochester Midland Limited - will provide polymer and flocculent and input regarding dosing (locations, rates and measurement of flows) for the treatment of liquid effluent as it passes through the physical treatment portion of the sediment treatment facilities.

3 Dredging Technology

3.1 Background

During the 1991 Welland River Dredging Demonstration a modified Mud Cat MC 915 dredge was used to remove contaminated sediment from the river. This dredge type was selected because it was well suited to the Welland River conditions and could be easily modified to operate in an environmentally acceptable manner. An impact assessment of its use, in conjunction with the presentation of appropriate mitigation recommendations, was included in the Environmental Screening Report (Acres, 1995) for the 1995 cleanup project.

Another specialized dredge, the "Amphibex", is now being considered for use in the 1995 dredging program. This section of the addendum examines the features of both dredges from an engineering and environmental perspective and provides an impact assessment for the "Amphibex" dredge. It also presents recommended mitigation measures to be implemented during operation of this dredge.

3.2 Operational Features of Dredges

Modified Mud Cat Dredge

The Mud Cat dredge is an hydraulic suction dredge, consisting of a boom-mounted horizontal auger cutterhead fitted on the front of a small barge which contains the pumping system and operator control area. During operation, the dredge is held in position with a cable traversing system that spans the area to be dredged. In the Welland River case the positioning cables would extend across the width of the river. Anchor points on each shore would be selected and rigged such that the travel cable can be moved laterally, allowing the dredge to position itself within the remediation area. The dredge would make a series of passes in the dredging area until the required depth of excavation is reached.

Due to the length of the areas to be dredged at the McMaster and Atlas 42-in. outfall areas, dredging will likely be carried out in sections. For the Mud Cat dredge this would require the occasional relocation of the cable traversing system anchor points. Dredged material removed by the dredge suction pump would be transferred via slurry pipeline to the treatment facility.

Amphibex Dredge

The Amphibex dredge is a combination mechanical-hydraulic suction dredge which requires no cables for anchoring. It has two spud legs at the rear of the dredge, and two stabilizer arms off either side near the front end of the dredge. The spud legs can be tilted, and in combination with the stabilizing arms and the excavating arm (backhoe style excavating arm) can effect movement of the dredge, both in the water and on land. The excavating arm can be equipped with a backhoe style bucket, or other attachments. During operation the main body of the dredge remains stationary and the attachment is extended over the front of the dredge for use.

The backhoe attachment is an excavating bucket fitted with a horizontal cutter bar and dual suction pumps which collect and transport the excavated material via a slurry pipeline to the treatment facility. Movement of the dredge in the water is achieved by pulling with the spuds and pushing off the riverbed with the bucket. For this project the dredge would begin excavating in the nearshore area and dredge an area within the sweep radius of the backhoe arm at the front of the dredge. The entire dredge would then be walked backward and repositioned. A new sweep radius could then be excavated. When an entire section of the reef had been removed the dredge would then be moved sideways along the reef and dredging would begin inshore at the new location.

3.3 Comparison of Dredges

Table 3.1 provides a summary of the various features of the Mud Cat and Amphibex dredges as they relate to parameters associated with dredging activities.

From an engineering perspective, the Amphibex dredge is favored over the Mud Cat. The Amphibex is capable of removing not only river sediment but also the Welland River floodplain materials which consist of organic rich sediments and root masses from aquatic vegetation. The horizontal auger of the Mud Cat dredge is not considered capable of handling root mass material and significant tangling of the root mass in the dredge head is likely to occur. The cleanup project has a requirement for the removal of some floodplain material in order to achieve an appropriate grade for shoreline stabilization following dredging at the McMaster Avenue reef area. Excavating equipment other than the Mud Cat dredge would be required for removal of this material.

The Amphibex is also much more suited to handling large or angular debris such as boulders, metal objects, pieces of wood, etc. Because this dredge utilizes a backhoe bucket and arm, it can lift large objects out of the river and place them into a floating scow if necessary. The Mud Cat does not have any removal capabilities when it comes to such large debris. In areas of extensive debris, the Amphibex can also be fitted with other heads such as a debris rake or a hammer which can assist in debris removal.

The Amphibex dredge offers more flexibility in terms of deployment. The Amphibex can be launched by crane into the water or, alternatively, it can lift itself and 'walk' across the shoreline into the water using the spuds, backhoe bucket and stabilizing arms. The Mud Cat is not capable of moving itself across land and relies on the use of a crane for deployment into the water.

The Amphibex holds its position in the river much better than the Mud Cat because it is firmly anchored on the riverbed using the near spuds and the side stabilizing arms. The Mud Cat, because it is held by a single traversing cable, can be pushed off course by wind or when dredging uneven bottom surfaces.

The Amphibex dredge offers greater flexibility on the part of the dredge operator to position the backhoe bucket in the sediment for optimum and complete removal. The flexibility is provided by the radial sweep capability of the backhoe arm and the articulation provided in the backhoe arm and bucket. The Mud Cat on the other hand relies on the forward movement of the dredge, the vertical movement of the boom and articulation of the dredge head to position itself for sediment removal.

A public safety issue is associated with the cross river cable traversing system employed by the Mud Cat dredge. The cable can however be lowered into the water during off hours to limit the potential hazard to navigation. No cross river cables are required for the Amphibex.

The Amphibex and the Mud Cat techniques are also very similar from an environmental perspective.

During the 1991 demonstration project, in which the Mud Cat dredged within a silt-curtained area, water quality monitoring indicated that there was a minimal and localized increase in turbidity in the vicinity of the dredge head during dredging. Based on these results it had originally been proposed to carry out the 1995 project using the Mud Cat technology without the use of a silt curtain. While no comparable demonstration water quality monitoring has been done with the Amphibex dredge, it is considered that it can also be operated in such a way as to create only a minimal and localized increase in turbidity at the dredge head. The Amphibex dredge, with its shorter 1.80-m bucket width (compared to the Mud Cat's 2.74-m auger width) and its dual suction intakes (compared to the Mud Cat's single suction intake) actually has an advantage over the Mud Cat in its ability to control sediment removal and resuspension at the dredge head. With either technology, the control of sediment resuspension is very dependent on the care and techniques used by the dredge operator.

The Mud Cat dredge is moved within the river by means of the cable traversing/winching system. As such, no part of the dredge comes into contact with the river bottom during dredge relocation activities, and there is no disturbance to bottom sediments. The Amphibex is moved by means of the rear spud legs and the backhoe bucket, and is then held in position with the spud legs and the side stabilizers which remain in contact with

Table 3.1

Comparison of Mud Cat and Amphibex Dredge Types

Parameter	Mud Cat	Amphibex
Working environment	Well suited to shallow riverine conditions. Capable of removing river material only. Likely unable to remove root mass material associated with floodplain.	Well suited to shallow riverine conditions. Can excavate both river sediments and root mass material associated with floodplain.
Method of transport/deployment	Trailer mounted for road transport. Must be crane lifted into the water.	Trailer mounted for road transport. Can be lifted by crane into the water or 'walked' across the floodplain. 'Walking' may cause localized minor floodplain damage.
Method of anchoring	Potential disturbance to navigation and safety concerns associated with cables traversing the river. No contact with bottom sediment for stabilization.	No cables required. Two spuds are deployed at rear of dredge. Two side stabilizing arms are used at front of dredge. Stabilizing arms may cause minor sediment disturbance during placement and retraction.
Method of movement	Dredge is moved by winching along the traversing cable. Potential disturbance to navigation and safety concerns associated with cables traversing the river.	Dredge is moved by a combination of pulling with spuds and pushing with bucket on bottom. Minor sediment disturbance may occur during movement. No cables are required.
Ability to hold position	Dredge can be pushed off course by wind or when dredging on irregular bottom surfaces.	Dredge holds its position well when firmly anchored.

Parameter	Mud Cat	Amphibex
Method of dredging and sediment transport	Forward movement of dredge allows dredge head to engage sediment. Positioning of dredge head is controlled by forward dredge movement, raising/lowering of boom, and rotating dredge head. Rotating horizontal auger engages sediment to loosen and move it to suction intake. Unable to handle highly cohesive sediments, cobbles and boulders. Excavated material transported by slurry pipeline.	Articulated backhoe arm and bucket and the radial movement of the arm allows operator flexibility in positioning dredge head (bucket) and engaging sediment. Sediment excavated by backhoe bucket fitted with rotating horizontal cutter bar to loosen sediment for removal by dual suction intake. Highly cohesive sediments, cobbles and boulders can be removed to floating scow with bucket.
Turbidity generated during dredging	Minimal and very localized increases in turbidity in the immediate vicinity of the dredge head. Single centrifugal pump at rear of 2.74-m wide auger limits suction capabilities and ability to remove excavated and resuspended solids. Generation of turbidity is very dependent on dredge operator.	Minimal and very localized increases in turbidity in the immediate vicinity of the dredge head. Dual centrifugal pumps at rear of 1.80-m wide backhoe bucket provides greater suction capabilities and ability to remove excavated and resuspended solids. Generation of turbidity is very dependent on dredge operator.
Debris effects	Unable to handle large debris or angular debris such as boulders, metal objects, branches, logs, etc.	Backhoe can lift and remove large pieces of debris. In areas of heavy debris dredge can be fitted with a debris rake.
Requirement for sediment control	Capable of operating without a silt curtain with minimal effects on water quality. Need for sediment control during dredging is very dependent on dredge operator.	Considered capable of operating without a silt curtain with minimal effects on water qualities. Sediment control during dredging is very dependent on dredge operator. Minor turbidity caused by spuds and stabilizer arms will occur intermittently.

the river bottom during dredging. These moving and positioning activities can result in localized disturbance and resuspension of river bottom and/or reef sediments. Such disturbances would not be continuous, as they would only occur when the Amphibex is being repositioned, and can be controlled to a large degree by the care exercised by the dredge operator.

3.4 Impact Assessment and Mitigation - Amphibex Dredge

From an engineering perspective, the Amphibex dredge has more flexibility to fulfill all aspects of the dredging requirements for this project. From an environmental perspective, the Amphibex is considered to be fully capable of completing the dredging without causing a significant negative impact to downstream water quality. However, some amount of sediment resuspension and turbidity associated with its movement, and potentially its dredging activities, is expected. While this is expected to be minor and localized, it is recommended, as a precautionary measure, that the Amphibex dredge be used in association with an appropriate silt curtain so as to eliminate any downstream movement of resuspended material. The curtained enclosure will need to be of sufficient dimension as to encompass the entire dredging operation, leaving sufficient room for operating and maneuvering the dredge. Preferably, the area enclosed by the silt curtain will be of sufficient size to allow for several days of dredging activity before it would be necessary to relocate the silt curtain.

Use of the silt curtain should effectively eliminate movement of resuspended sediment from the area being dredged. In order to monitor the effectiveness of the silt curtain, monitoring of turbidity will occur upstream and downstream of the enclosure. If turbidity levels outside of the silt curtain are determined to exceed background river concentrations by more than the limits set out in the operational water quality criteria (Section 8 of this addendum) the dredging operation will be shut down until the cause of this exceedance is determined and corrected. It is anticipated that dredging will be undertaken without a silt curtain when the water quality monitoring program indicates that sediment resuspension during dredging and dredge movement can be maintained within acceptable limits. The decision to dredge without the silt curtain will be made by the Technical Review Committee, which includes Atlas Specialty Steel, Environment Canada, Ontario Ministry of Environment and Energy, Ontario Ministry of Natural Resources, Regional Municipality of Niagara, City of Welland, Niagara River RAP-PAC, Wastewater Technology Center and a representative of the general public. If water quality cannot be maintained at acceptable levels the silt curtain will be replaced around the dredge for the remainder of the project. The public and downstream water uses will be notified of any decision to dredge without the use of the silt curtain.

Two silt curtains will be used to facilitate movement of the dredge between a completed section and the next area to be remediated being installed and moved in a 'leap-frog' like manner. The second curtain will be installed immediately downstream of and adjacent to the completed area, encompassing the next area to be dredged, such that a center panel divides the two areas. The center section of the initial curtain will be removed, allowing the dredge to move into the next remediation area, and then reinstalled to become the upstream portion of the new enclosure. The upstream portion of the silt curtain will be removed from the completed area only when turbidity levels inside the curtained area are in accordance with the operational water quality criteria for the project (Section 8).

As noted in Section 3, one of the engineering advantages of the Amphibex dredge is its ability to 'walk' across the floodplain of the river, thereby eliminating the need for a crane to deploy it. There is, however, a potential for some minor damage to the floodplain during this maneuver, caused by movement of this large machine through soft unconsolidated organic sediments. It is recommended that a crane be used for deployment, or that it be deployed in an area that will be disturbed by other aspects of the project.

The Amphibex dredge has obvious engineering advantages over the Mud Cat dredge for use on this project. Use of this dredge in combination with properly designed and installed silt curtains will minimize impacts from sediment resuspension. Monitoring of downstream water and sediment quality will serve to verify that the proposed protective measures are operating as anticipated.

4 Wetland Retention/Protection Features

Section 7.1.2 of the May 1995 ESR described the installation of sheetpiling as the preferred methodology to separate the contaminated riverine sediments (slated for removal) from the adjacent floodplain sediments (not slated for removal). A sheet-pile wall will be installed along the outer edge of the floodplain (i.e., at the water's edge). This procedure will allow dredging to proceed in the river without disturbing or undermining the adjacent wetland sediments or wetland surface (Typha bed).

In the May 1995 report, the sheet pile was to have been driven in two separate stages. During the first stage, the sheet pile would be driven to elevation 171.0 m nominally coinciding with the floodplain surface and river level. After the dredging and installation of granular material along the riverine side of the piling was completed, a second stage operation would be undertaken to redrive the sheet piling to its final depth with a top elevation of 170.65 m or approximately 35 cm below the wetland surface.

It is now proposed to drive the sheetpiling to the final depth during the initial installation, thereby eliminating the second stage of the process. This is primarily an economic decision, however, it is one that is not anticipated to result in any difference in environmental impact due to the process.

During the floodplain investigations undertaken in 1990 and 1992, it was determined that the root mat of the Typha covering the floodplain extends to approximately 0.5 m below the wetland surface. This serves to consolidate and stiffen the surficial sediments, such that they can support a person's weight. The top of the sheet piling will be within this root zone along most of the length of the sheet pile wall. It is not anticipated that there will be any slumping or loss of wetland sediment over the top of the sheet pile wall due to the containment provided by the Typha root mat.

5 Atlas 42-in. Floodplain Millscale Pocket

A pocket of millscale located within the floodplain (around BH-301) and associated with a former shoreline outfall (0.91-m diameter), located approximately 70 m downstream of the Atlas 42-in. outfall, is slated for removal as part of the 1995 cleanup project. It was indicated in the May 1995 ESR that the surface area required for the excavation would be approximately 100 m^2 (10 m by 10 m) and that the depth of excavation would be 3 m (300 m^3 volume to be removed).

Further investigations were undertaken in the vicinity of the borehole in late August 1995 to more closely define the limits of excavation for the contractor. These and earlier investigations now indicate that the millscale pocket at this location is somewhat 'lens-shaped', ranges in thickness from 5 to 55 cm, and is located from 1 to 2.85 m below the floodplain surface. The surface area of this deposit is irregular but is estimated at approximately 300 m^2, being roughly 10 m wide and about 30 m in length. Excavation depth is still proposed to be approximately 3 m. The area to be excavated will be enclosed with sheetpiling prior to excavation. As noted in the May 1995 report, removal will be undertaken with land-based equipment, with the materials being transferred to the Atlas NFP for treatment. An attempt will be made to remove and retain the vegetative cover (Typha bed) for replacement over the clear granular material once excavation and backfilling are complete.

Thus an additional 200 m^2 of wetland will be disturbed as part of the project, bringing the total area for which an Authorization under Section 35(2) of the Federal Fisheries Act is requested to approximately 530 m^2. As noted previously, the loss associated with the millscale pocket (300 m^2) will be temporary, until the area is restored. Other areas affected include the McMaster Avenue outfall reef (remains the same as originally noted at 200 m^2 - 2 m wide by about 100 m long), and the temporary dock area (30 m^2).

6 Construction Laydown/Work Area and River Access

A single construction laydown/work area has been selected for the project as opposed to the two areas adjacent to each reef area that were originally proposed (Figure 1). The proposed laydown/work area is located in a park area immediately south of the Region's gate chamber near the Atlas 42-in. outfall. The area is located between two parking lots, that will serve as access/egress points from the work area. Presently, the area is grassed, and sculpted for use as an ice skating rink during the winter. There are no large trees within that area that will need to be removed to gain sufficient laydown/work space.

A ramp will be installed (cut and fill operation) from this area to the river's edge, which will end at a temporary dock. This will be installed to facilitate the transfer of materials (sand and granular fill) from shore-based to marine equipment. A silt fence will be installed adjacent to the shoreline near the end of the ramp to filter any runoff originating from the ramp/laydown area.

A temporary dock will be installed (by The Ontario Construction Company Limited) as part of Contract C1-B - Floodplain Protection. Details of the installation process and ultimate removal are as follows:

- existing brush and woody vegetation will be cleared at the shoreline for a distance of 5 to 6 m

- a temporary mattress of Terratrack cloth will be lain over the entire affected floodplain area, extending onto the river bottom to the limit of the area to be infilled

- rubble will be installed over the cloth, proceeding from shore outward, to form a working berm

- a steel sheet pile bulkhead will be installed at the end of the Terratrack cloth to provide a vertical dock wall against which barges can be moored and loaded

- complete the infilling to provide a level, stable access road.

Installation of this temporary facility will result in the disturbance of approximately 30 m^2 (5-m x 6-m area) of wetland habitat.

A silt curtain will be deployed around the work area prior to installation of rubble to control potential releases of sediment, and will remain in place until the installation process is complete and any suspended solids settle to acceptable levels.

On completion of the work, the rubble near the bulkhead will be removed with an excavator to form a stable grade, at which point the sheet pile will be pulled. The remaining rubble will be removed, followed by the Terratrack cloth. Any debris will be cleaned up and removed from site. This process would also be undertaken within the confines of a silt curtain.

The contractor will regrade the laydown area as necessary, returning it to its original contours. Revegetation of the area will be undertaken in 1996 as part of the City of Welland's in-kind contribution to the project.

7 Operational Water Quality Criteria

The May 1995 version of the ESR presented a single operational water quality criteria for the project based on turbidity. It proposed an allowable increase in turbidity downstream of the dredging area as compared to background levels (measured upstream of the dredging area). Turbidity was selected as the preferred parameter for measurement as it can be quickly and easily measured in the field (as compared to total suspended solids), hence will provide a rapid means of assessing the operation of the dredge.

The development of the proposed criteria utilizes the relationship between total suspended solids and turbidity, as determined from data collected during the 1991 pilot scale project. It attempts to integrate both the Environment Canada (EC) and the Ministry of Natural Resources (MNR) guidelines for control of sediment loadings associated with construction or dredging activities into a single guideline, which would then be used to establish operational limits for the dredging contractor (i.e., acceptable operations, or unacceptable and requirement to shut down operations and stabilize area). However, since that proposed criteria was a blend of the two, it did not adhere explicitly to the guidelines of either agency. Thus, a revised operational criteria has been developed which adheres directly to the EC criteria for a permissible increase in sediment loading associated with dredging operations.

The revised criteria abides by the EC criteria of 25 mg/L total suspended solids (TSS) above background measured at 25 m from the dredge. The TSS criteria is then transformed to one based on turbidity, using the relationship between TSS and turbidity, as determined from Welland River data collected during the previous demonstration project (1991). That criterion is presented diagrammatically in Figure 2, and described in more detail in Annex 1 (letter from P.C. Miles, Acres to A. Yagi, MNR; June 23, 1995). The revised criteria has been forwarded to project reviewers at MOEE (R. Slattery and T. Gebrezghi), Niagara Peninsula Conservation Authority (S. Berdan), and EC (I. Orchard). All reviewers found the revised criteria to be acceptable, and hence it will be adopted as the operational criteria for evaluating water quality associated with in-water activities.

8 Treatment Facility Equipment/ Process Modifications

The sediment treatment process for the pumped slurry consists of physical removal of coarse particles, and subsequent chemical and physical treatment of the remaining liquid effluent to remove fine suspended materials. The physical separation process, as originally proposed for the 1995 project, consisted of a coarse scalping screen, a screw classifier, two sets of fine screens and two high-speed centrifuges. Liquid effluent originating from the fine screens would be directed to an existing thickener located within the Atlas NFP. Underflow from that thickener (high concentration of fine solids) would be directed to two horizontal centrifuges for dewatering. Thickener overflow (low concentration of fine solids) would be directed to a large (approximately 3500 m^3 capacity) temporary storage basin (TSB#2), subsequent to further chemical treatment (addition of coagulants and flocculents), where retention and settling of particulate matter would occur. Final effluent from that TSB would then pass through the NFP before being discharged back to the river via the Atlas 42-in. sewer outfall. A small storage basin (TSB#1, approximately 900 m^3 capacity), constructed and used during the 1991 demonstration project, would be used to receive and store any excess dredging flow that was over and above the treatment facility's design capacity.

A number of improvements to the treatment system have now been proposed to increase the operation efficiency of the treatment process. The revised treatment process is shown in Figure 3, and is essentially the same as noted above, except for the following changes.

1 - "Hi-G Dryer" units will now be used in place of the fine screens. Each unit is comprised of a hydrocyclone cluster (to separate out particles 40 to 50 microns and larger) and a set of fine screens (0.5-mm openings). The underflow (solids) from the cyclones flows onto the screens, while the overflow (liquid) from the cyclones will be routed to the existing thickener of the Atlas NFP. The underflow from the screens of the units will be routed back to the screw classifier.

Upon initial startup of the operation, it is expected that the cyclone underflow will be a dilute slurry, and will pass through the screens and be recirculated back to the screw classifier. After a short period of time (in the order of 10 to 20 min), the buildup of solids in this recirculating flow will produce a dense slurry in the underflow from the cyclones. This dense slurry will be dewatered by the fine screens, and the cake from the screens will be stockpiled for disposal. Solids and water passing through the screens will continue to be cycled back to the screw classifier.

2 - The centrifuges have been eliminated from the treatment process, hence the sludge from the NFP thickener will be routed directly to Temporary Storage Basin (TSB) #1. This approach has been selected to avoid previous operational problems with the centrifuges, which are not particularly amenable to the varying composition and quantity of inputs experienced within a dredging treatment system. Final thickening of the sludge will occur in TSB #1, after which the solids will be removed for disposal. Depending on the volume of sludge originating from the thickener, it may be necessary to route some of the thickener underflow to TSB #2 if the storage capacity of TSB #1 is exceeded.

3 - Overflow (effluent) from the thickener will be routed to TSB #2 for final treatment. It is proposed to use Polutrol 2000 flocculant/coagulant and Midfloc PW 1319E flocculant to complete the solids separation process before release of the final effluent to the settling basin of the NFP.

It is intended to control dredgeate flow at all times to within the capacity of the treatment facility. However, in the event that flows momentarily exceed the treatment system capacity, the overflow will be diverted to either TSB #1 or TSB #2.

Material that has accumulated in the TSBs at the end of the project will be allowed to naturally dewater, and be tested (slump, leachate and/or chemical testing) to determine final disposal options.

9 Additional Public Information

In March of 1995, a newsletter was widely distributed throughout the local area and a public meeting was held to inform the public and solicit their input regarding the project. At that time, it was anticipated that the project would start in mid July and be completed by late August of this year.

During the contract tendering process, it became apparent that the project would not proceed 'as designed', hence considerable additional time was spent exploring various other options for dredging, treatment, division of labor and management of various aspects of the project. These activities have negatively impacted the project schedule, resulting in approximately a 2-mo delay in project initiation.

Pending resolution of the various contract, project management and financial issues in late August, it became apparent that the project could still be undertaken in 1995. Subsequently, a second newsletter was prepared, and was distributed in the same manner as that undertaken for the March 1995 version. A copy of the updated newsletter and a listing of its distribution (persons/agencies and numbers) is presented in Annex 2.

As with the previous newsletter distribution, residents adjacent to the cleanup areas and those who attended the March 1995 public meeting, were mailed personalized copies to ensure that they were aware of the revised schedule and plans.

In addition, three visitor days are planned during the undertaking of the project. They will be directed toward particular interest groups being, the general public, educational institutions and industry/government agencies. Copies of the May 1995 Environmental Screening Report and this Addendum will be available during those days for any that are interested.

Figures

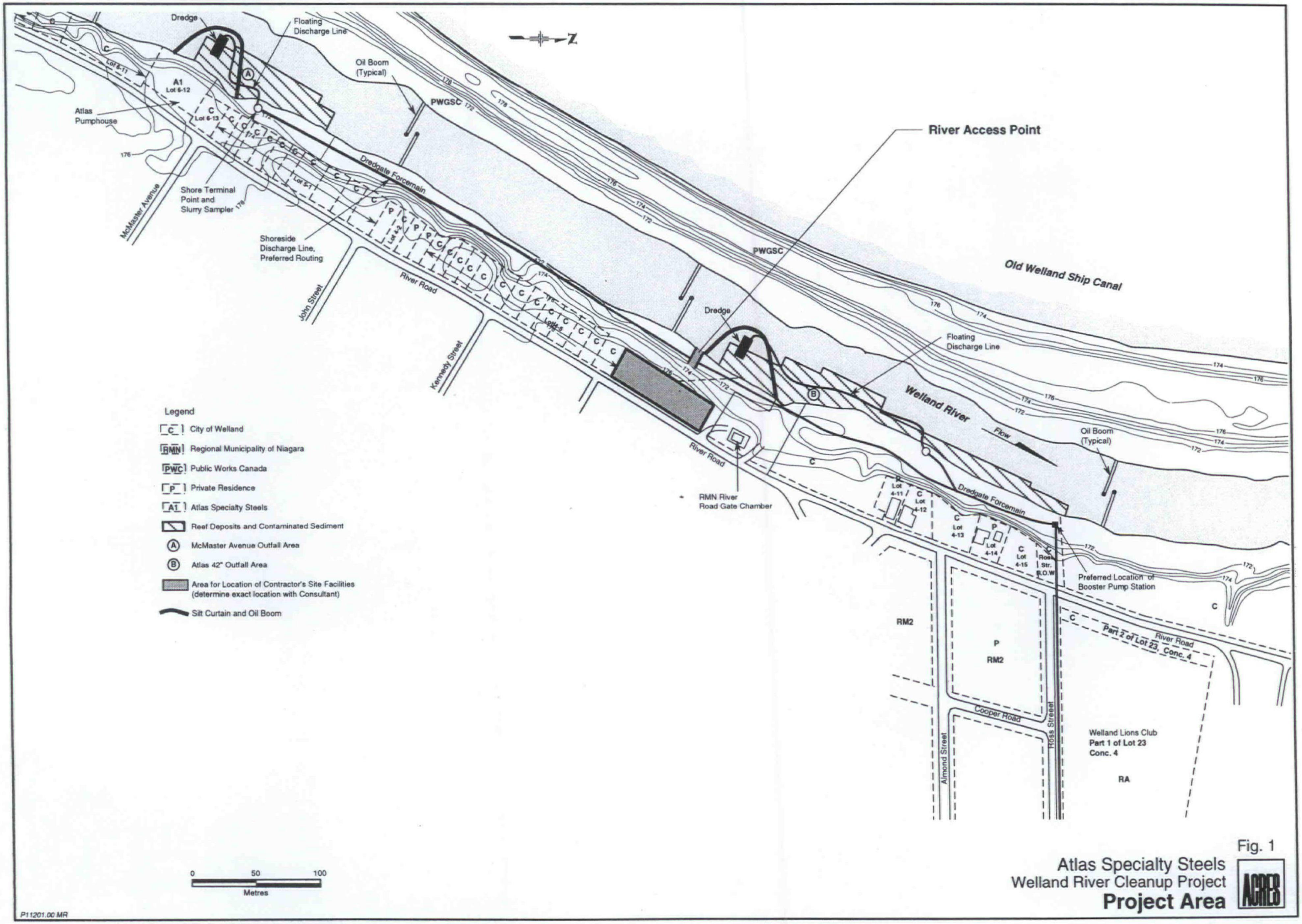

Fig. 1

Atlas Specialty Steels
Welland River Cleanup Project
Project Area

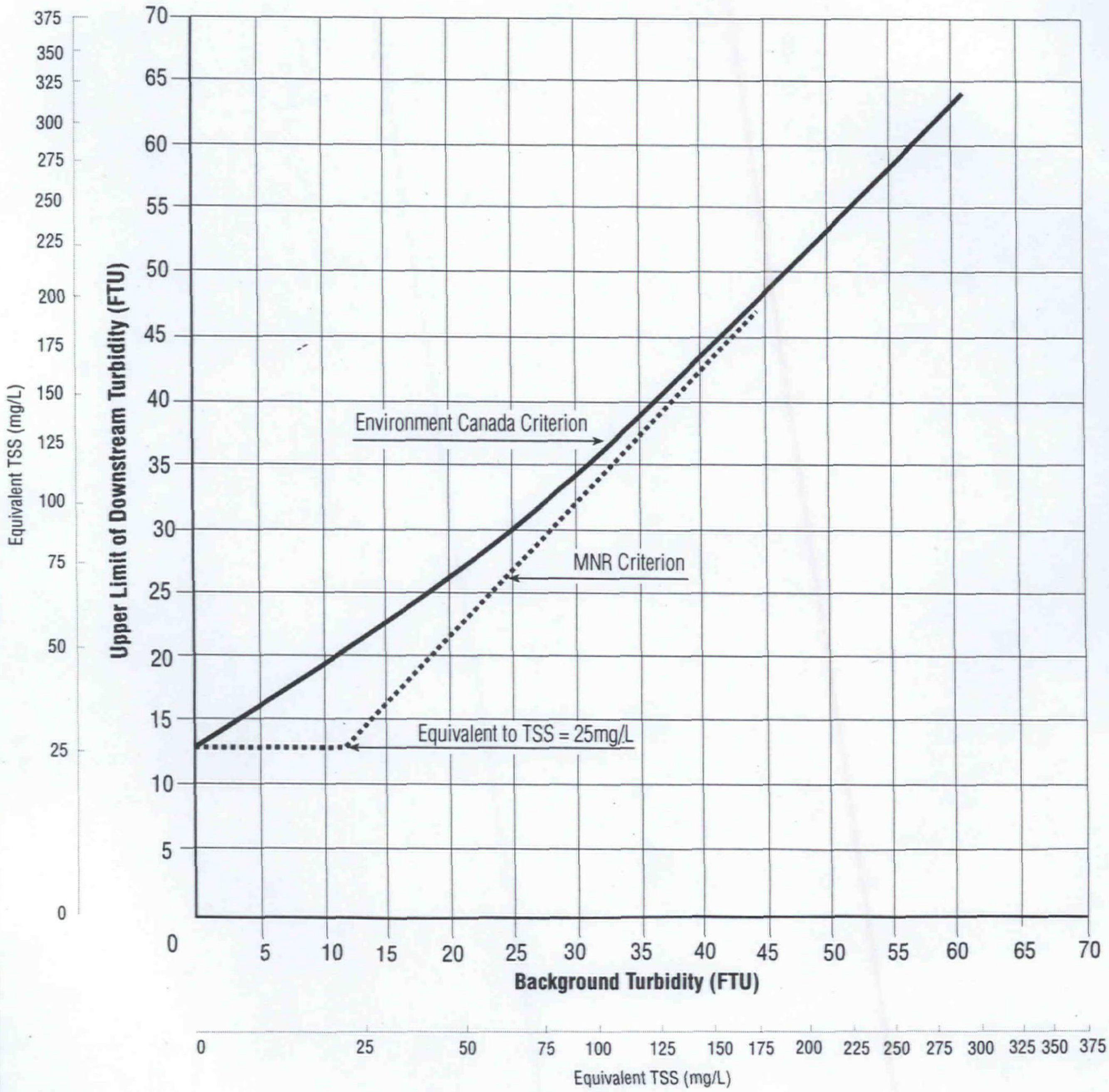

Fig. 2

Atlas Specialty Steels
Welland River Reef Cleanup Project
Welland River Water Quality Criteria

ACRES

3 Consultation Process

Consultation has been a key element since the beginning of the project. This can be seen in Table 3.1 which provides a chronology of the project.

The need for remedial action to restore the environmental quality of the Welland River has been recognized since the mid-1980s, and culminated in the formation of the WRCC in 1990. The committee was established to bring agencies and interested parties with a stake in the Niagara River watershed together, so as to provide direction to future cleanup efforts. The Committee would also liaise with other advisory committees (i.e., Niagara River RAP and PAC) and would ensure that lines of communication were maintained between various resource and regulatory agencies, stakeholders and affected/interested persons. This committee has existed continuously, under this or similar title, to this day. The present committee, referred to as the Welland River (Welland) Cleanup Committee, is chaired by the NPCA, and comprises municipal, regional, provincial and federal representatives as well as environmental researchers, private industries and concerned public citizens. A smaller Planning Committee made up of provincial and federal government representatives, environmental researchers, industries and consultants was formed prior to the last demonstration project to review and assess the more limited scope of the dredging project. That committee met monthly throughout 1991 to plan the technical details of the development and demonstration. In addition to these two committees, the Niagara River RAP-PAC was also involved in reviewing the Welland River demonstration project. Table 3.2 provides an overview of the initial project participation and review committees as they existed for the previous pilot-scale and the current full-scale demonstration.

3.1 Pilot Scale Project

Prior to the previous demonstration project, a workshop and public open house (at Atlas) were held. These were attended by representatives of the various resource and regulatory agencies (DFO, MNR, MOEE, NRPAC, NPCA, City of Welland, WRCC) and interested parties (affected landowners) having a stake in the project. The workshop and open house assisted in the identification of issues and concerns related to the project, and in the determination of the extent of monitoring and mitigation to be undertaken in association with the demonstration project. Information on the workshop and open house was supplied in the previous screening document (Acres, 1991b). A stakeholders meeting including local property owners was held just prior to the dredging activities to explain the details of the demonstration. There were also a number of press releases to the local newspaper to update the public on the project.

The Planning Committee established to provide technical input to the pilot-scale demonstration was disbanded in early 1992 upon completion of the project.

3.2 Lead up to Full Scale Project

Throughout 1992, the main consultation process involved review of the report prepared on the dredging and treatment demonstration. The report was circulated to members of all three committees for their comments. There was a desire by Environment Canada to continue with the full-scale cleanup but felt that other users besides Atlas must be involved if the project was to go ahead. A core Planning Committee of the WRCC (set up of funding agencies and decision makers) was established to undertake detailed planning. This committee reported regularly to the larger WRCC.

In the spring of 1993, further encouragement for the cleanup came when the Planning Committee received endorsement from the Niagara River RAP-PAC to develop a plan for remediating the contaminated sediment in an 8-km stretch of the Welland River. To help develop this plan a workshop was undertaken in June 1993. The goal of the workshop was to bring members of the community together with those of local industry and government agencies to work collectively in planning the future cleanup of the river. Extensive efforts were undertaken to ensure that the general public and other local industries were aware of and offered the opportunity to express their interests and views. The details of the workshop are provided in Appendix A.

Over 100 letters were mailed out to agencies, industries, businesses, politicians, citizens organization and the general public (the mailing list is provided in Appendix A). In addition, over 400 letters were hand delivered to all residences on either side of the river (copy of the letter is provided in Appendix A).

The press from the five local newspapers (St. Catharines Standard, Welland Tribune, Niagara Falls Review, Fort Erie Times Review and the Port Colborne News) were invited to the workshop and a press release was also provided to all the papers. A newspaper advertisement was placed in the Welland Tribune. Announcements were provided to the Cable TV company, four local radio stations and CBC.

Table 3.1

Project Chronology

Date	Description of Event or Milestone
mid-1980s to present	Brock University researchers study impact of industrial contaminants in Welland River
December 1987	Atlas commits to river cleanup
March 1989	Acres initiates first Welland River sediment study focussing on the Atlas 42-in. outfall area
March 1990	Acres initiates second Welland River sediment study focussing on the McMaster Avenue outfall area and a downstream area
	Acres initiates preliminary Welland River floodplain study
May 1990	Welland River Reef Study (Addendum) report issued
June 1990	Welland River Reef Study report issued
	First WRCC meeting
November 1990	Acres initiates third Welland River sediment study
	MOE Water Resources Branch initiates sediment bioassay study
December 1990	Unsolicited proposal for Welland River Dredging Demonstration submitted to Environment Canada
	Atlas/Acres presentation of proposed project to RAP-PAC
January 1991	Meeting with RAP-PAC technical subcommittee to further discuss proposed project
February 1991	Meeting with RAP-PAC technical subcommittee to discuss floodplain issues
March 1991	Acres initiates followup to preliminary floodplain study
	Environment Canada approves proposal and Welland River Dredging Demonstration Project initiated

Table 3.1
Project Chronology - 2

Date	Description of Event or Milestone
March 1991 (cont'd)	First Welland River Dredging Demonstration Planning Committee meeting (held monthly)
	Phase I of project initiated
April 1991	Merger of WRCC and Demonstration Planning Committee
	Draft Dredging Equipment Design Requirement document issued
	Atlas sponsors Welland River environmental workshop
	Acres initiates detailed Welland River floodplain study
May 1991	First draft Environmental Screening Document issued
	Atlas hosts Welland River Dredging Demonstration open house
	Phase II of project initiated
June 1991	Permitting and approval process initiated
	Assessment of sediment treatment alternatives initiated
	Design of treatment facility initiated
July 1991	Unsolicited proposal for bench-scale testing submitted to Environment Canada and Wastewater Technology Centre
	Bench- and pilot-scale testing initiated for treatment facility design
	Background river water quality monitoring initiated
	Draft Dredging Demonstration Contract Documents issued
	Welland River Reef Study Report on November/ December 1990 Site Investigations issued
August 1991	Proposal for bench-scale testing approved by Wastewater Technology Centre

Table 3.1
Project Chronology - 3

Date	Description of Event or Milestone
August 1991 (cont'd)	Second draft Environmental Screening Document issued
	Dredging and/or treatment related documents submitted to regulatory agencies with applications for permits or approvals
September 1991	Final design of treatment facility completed
	Final Dredging Demonstration Contract Documents and Dredging Equipment Design Requirement document issued
	Report on Evaluation of Atmospheric Impact of Demonstration Project issued to MOE
October 1991	Phase III of project initiated
	Wet performance test of dredging equipment carried out in Baltimore, Md.
	Permits and approvals received from regulatory agencies
	Preparation of treatment facility site initiated
	Treatment facility equipment mobilized, assembled and commissioned
	Dredging equipment mobilized to site and further design changes carried out
	Dredging related equipment mobilized to site, set up and tested
	Dredge and treatment facility monitoring programs initiated
	Dredging in clean sediment initiated (October 25)
	Review meeting with Planning Committee (October 26)
	Dredging in contaminated sediment initiated (October 28)
November 1991	Dredging terminated (November 12)

Table 3.1
Project Chronology - 4

Date	Description of Event or Milestone
November 1991 (cont'd)	Treatment facility equipment decommissioned and demobilized
	Dredge and related equipment demobilized from site
	Long-term river sediment monitoring program initiated
	Phase IV of project initiated
November 1991 - August 1992	Long-Term Post Dredging Sediment Monitoring Program
December 1991	Data evaluation initiated
February 1992	Draft Bench-Scale Treatability Studies in Welland River Sediments Report issued
March 1992	Welland River Background Studies Report issued
	Draft Welland River Floodplain Study Report issued
May 1992	Draft Welland River Dredging and Treatment Demonstration Report issued
May 1992 - January 1993	Review of reports by stakeholders
February 1993	Final Report issued to Welland River Demonstration Planning Committee and Welland Reef Cleanup Committee
April 1993	Endorsement in principle by RAP-PAC to planned remediation of contaminated sediments
May - August 1993	Planning Committee meet regularly to organize public workshop
June 1993	WRCC workshop bringing together members of community, local industries and government agencies to plan future cleanup of river
1993 - 1994	Continued monthly meetings of Welland River Reef Cleanup Committee
Fall 1993	Environment Canada biological testing program undertaken

Table 3.1
Project Chronology - 5

Date	Description of Event or Milestone
Fall 1993 (cont'd)	Citizens subcommittee on debris problems formed and Brock University Sediment Sampling Program undertaken
April 1994	Special wetland working group formed
September 1994	Report to WRCC Project General Planning Committee from working groups on wetland and biological testing program
October 1994	Establishment of Welland River Reef Technical Review Committee to oversee full-scale dredging demonstration
October 1994 - April 1995	Regular meetings of the Technical Review Committee with interest groups, i.e., RAP-PAC to plan dredging program
March 21, 1995	Public meeting to present the proposed cleanup project to local residents and provide an opportunity to solicit their input and/or express their concerns
September 1995	Proposed commencement of dredging/treatment project

Table 3.2

Project Participation and Review

	Welland River Reef Cleanup Committee	Dredging Demonstration Planning Committee		Niagara River Remedial Action Plan - Public Advisory Committee (RAP-PAC)
		Pilot	Full Scale	
Ministry of Environment	●	●	●	
Ministry of Natural Resources	●	●	●	
Environment Canada	●	●	●	
Wastewater Technology Centre	●	●	●	
Public Works Canada		●		
Regional Municipality of Niagara	●	●	●	●
City of Welland (Engineering)	●	●	●	
Regional Niagara Department of Health	●			●
Brock University	●	●		●
RAP-PAC	●	●	●	
Niagara Peninsula Conservation Authority	●			●
Niagara Ecosystems Task Force	●			●
Niagara Falls Nature Club				●
Niagara River Angler Association				●
Local Industry/Tourism				●
Department of Fisheries and Oceans				●
Regional Niagara Council				●
Niagara Falls City Council				●
Public	●	●	●	●
Operation Clean Niagara				●
Canadians for a Clean Environment				●
Atlas Specialty Steels	●	●	●	●
Acres International Limited	●	●	●	

The agenda and summary of the workshop are provided in Appendix A. The workshop provided information to the general public and local industry about the conditions of the Welland River, the history of the cleanup to date and the benefits of continuing with the process. It was shown that contamination is from a number of sources both industrial and municipal. The Planning Committee had focused its attention on one 8-km section of river where there are numerous outfalls. The goal of the program was to identify the areas where remediation was most required and the method of cleanup. The workshop heard from RAP-PAC, Welland River Planning Committee and municipal representatives, as well as Jim Bradley, MPP and technical advisors on remediation alternatives. The workshop was not organized to identify polluters but to identify the condition of the river and how best to restore its beneficial uses. It was pointed out that the cleanup would involve a significant cost but as a community driven project it might be possible to take advantage of several sources of funding.

A total of 30 people attended the workshop. The main concerns and questions raised are also provided in Appendix A. These included

- the health risk associated with eating fish from the river

- interpretation of water quality and sediment results, and whether the contamination is limited to a certain depth

- understanding the Ontario Hydro and St. Lawrence Seaway operations and their impact on the flow of the Welland River, and their responsibility for the present problems in the river

- the Welland area sewer systems

- availability of government funding and fines for polluters.

After the workshop, the general planning committee held a followup meeting on July 22, 1993. All those noncommittee members who had attended the workshop were also invited to attend. A total of 21 attended this meeting. The results of the June workshop were distributed at the time (see Appendix A). The 'enlarged' group met again in November. A citizen group had formed to clean up debris in the river. The main focus of the group's efforts were in education through open houses and presentations to school and environmental groups.

The WRCC met again in December 1993, principally to request assistance both technically and financially from the Great Lakes Cleanup Fund, and identify any required work activities/data gaps. This committee met regularly on a monthly basis throughout 1994.

A special Wetlands Working Group of the Welland River Cleanup project was established at the beginning of 1994. The group's goal was to complete a report to the WRCC outlining existing information and data gaps pertaining to the wetland/floodplain remediation area. The working group consisted of DFO, MOEE, Acres, Atlas, NPCA, Ontario Hydro, MNR and Environmental Ecological Enterprises, and met three times during the spring and summer. They tabled their report at a General Planning Committee meeting held in September 1994, with the Planning Group meeting again in October.

3.3 Full-Scale Cleanup Project

In October 1994, Environment Canada's Cleanup Fund allocated funding toward the full-scale demonstration of Welland River sediment remediation project for the 1994/95 fiscal year. A technical subcommittee of the WRCC was again established (see Table 3.2) to undertake development of the logistics of the demonstration project including resolution of financial issues. The committee is made up of essentially the same funding partners and technical experts as assembled for the pilot-scale project. Meetings have been undertaken on at least a monthly basis up to the present to organize technical aspects of the cleanup work proposed for the fall of 1995.

An extensive public information program was initiated and undertaken during March 1995. This involved two main components: the development and distribution of a newsletter and the undertaking of a public meeting.

A copy of the newsletter is provided in Appendix A4. It was prepared to provide the public with information on the history of contamination in the Welland River, to explain the dredging, treatment and containment process used during the previous dredging demonstration, and to describe the upcoming work. The newsletter also presented the proposed dredging schedule and details of the upcoming public meeting. One thousand copies of the newsletter were printed and was widely distributed, as follows:

- Postal Route 51, City of Welland (includes area east of the Welland River, north of East Main Street and west of Atlas Specialty Steels), total of 503 houses, apartments and businesses

- Agency offices including

    - MOEE, Welland
    - MNR, Fonthill
    - NPCA, Allanburg
    - NRRAP-PAC, Niagara Falls
    - City of Welland
    - Regional Municipality of Niagara
    - New York Department of Environment

- Educational institutions

    - Welland Public Library
    - Niagara College
    - Brock University

- Interest Groups

    - Friends of the Welland River
    - Friend of Fort Erie Creek
    - Auberge Richelieu

- MPP and MP offices

    - Peter Kormos, MPP Welland
    - Gib Parent, MP Welland.

In addition, copies of the newsletter were available for general distribution at the March 14, 1995 Niagara River RAP-PAC meeting (Niagara Falls City Hall) and the March 15, 1995 "Healthy Landscape: Developing a Strategy for Niagara" meeting organized by the Planning and Development Department of the Region (Regional Municipal Building, Thorold).

The public meeting was held Tuesday, March 21, 1995 at 7:30 p.m. Extensive efforts were undertaken to ensure that the public was aware of the meeting and that their presence was important to the project. All directly affected landowners (i.e., all landowners adjacent to the proposed slurry pipeline route) were sent an individual letter of invitation. In addition, advertisements (see Appendix A5 for copy) were placed in three local newspapers, being the Regional Shopping News, the Tribune (Welland) and the

Cover Story. Information regarding the meeting was inserted in the Community Calendar section of the Tribune for 5 days prior to the meeting and an announcement was also placed on Maclean-Hunter Cable 10 community television service.

The meeting was well attended: about 25 members of the public were present as well as representatives from most of the stakeholders/partners of the project. An attendance list is provided in Appendix A5. The purpose of the meeting was to provide the public with the background to the project, explain the sediment removal and treatment process, including Atlas Specialty Steels and Environment Canada's role in the project, and then to solicit public input and determine if there were any questions or concerns. A copy of the agenda is provided in Appendix A4 as well as a summary of the Question and Answer session held after the formal presentations. There was no opposition voiced by the public to the proposed cleanup project. There was concerns expressed in relation to potential sediment releases if the silt curtain was not in place. However, when it was explained that there had been excellent results from the demonstration project, that constant monitoring would be undertaken to meet permit requirements, and that stop work procedures would be in place, the concerns seemed to be allayed. There were also discussions related to other areas of contamination and whether the river would ever be clean. There was the general expression that the meeting had been useful and there were no major issues of concern to the public. Beside the formal presentation at the public meeting, there were a number of display boards placed around the room which the public was encouraged to examine. Also, a video showing the highlights from the previous dredging demonstration was run. This gave the public an understanding of the type of operation which they could anticipate for the 1995 activities.

A questionnaire was provided at the meeting (see Appendix A4) for members of the public to express any additional concerns, etc. The public were asked to fill it out prior to leaving, however, none were completed. Copies of the questionnaire were subsequently forwarded to all members of the public who attended the meeting (cover letter in Appendix A5) requesting any additional comments or concerns. As of April 20, 1995, 5 replies had been received (19 sent out), expressing the following comments:

- had previously been told by environmental experts that river bottom sediments should not be disturbed as toxic

- if the treatment only took away the solids, the remaining suspended materials could be returned to the river

- potential impact on air quality from treatment process, including temporary storage basin on Atlas property near the east end of Almond Street.

Written responses were subsequently forwarded to those expressing concerns.

Since the public meeting, a decision has been made to delay the start of the project from early July to early September, in order to provide adequate time to complete final planning design and allow sufficient time to tender for a contractor. The newsletter will be updated and similarly distributed to keep interested parties informed of the schedule change.

4 Existing Conditions

4.1 Socioeconomic Environment

4.1.1 Land Use

The study area is generally urban with residential areas, commercial or industrial areas and open lands immediately adjacent to the river.

The City of Welland Zoning Bylaw (No. 2667, 1958) and Official Plan (1952) indicate that the land from the west shore of the river to the east shore of the old Welland Canal, known as Merritt Island, is zoned as open public lands and is owned by Public Works Committee (PWC). Title for some of this land may be transferred to the City of Welland in the near future. If this occurs, it is expected that the city would maintain the existing zoning.

The east shore, from the river to River Road is also open land owned publicly or privately, except for a parcel of land well downstream from the dredging site which is designated rural agricultural, and a small section adjacent to the river upstream from the dredging site which is designated high density residential.

To the east of River Road in the area of the project, land use is primarily residential and designated multiple unit (second density) residential. Farther back from the road is the Atlas plant, in an area designated as heavy industrial. Farther to the north (downstream) this area is zoned as rural agricultural or light industrial.

4.1.2 Noise

As the study area is situated in an urban and industrial area, ambient noise levels are relatively high. A sound survey conducted by Acoustex of Canada Ltd., on behalf of Atlas in 1974, indicated that sound levels outside of residences on Major, Ross, Melville, and Downsview streets ranged from 55 to 62 dB(A) during the day. These residents are approximately 400 m from the river but relatively close to Atlas.

Noise emission data was collected over a 10-d period prior to the start of the 1992 demonstration project to establish baseline conditions. The results are summarized in Table 4.1 and indicate that the neighborhood experiences fairly high ambient noise levels.

Table 4.1

Pre-Demonstration Noise Emission Data

Date (1991)		Average Decibel Reading (L_{ex})*		
		Location 1 (dBA)	Location 2 (dBA)	Location 3 (dBA)
Background Survey				
September	12	-	57.0	-
	16	-	-	65.4
	18	-	-	60.3
	27	-	-	65.2
October	1	-	55.9	54.0
	2	-	-	69.6
	3	55.8	56.0	-
	9	62.0	58.6	-
	9	64.5	-	-
	23	57.1	57.7	-

Notes:
Monitored Locations:
Location 1 - Atlas pump house fence
Location 2 - Hydro pole at Down's Drive and River Road
Location 3 - Atlas' North Filtration Plant (inside fence)

*L_{ex} - Equivalent exposure level as obtained from entire day reading with a noise dosimeter.

4.1.3 Traffic

Traditionally, River Road running along the river did not constitute a major thoroughfare. Most traffic was local, as the road and adjoining streets basically formed a crescent, beginning and ending on Main Street. Since the extension of Woodland Road over the Welland River and the subsequent joining of River Road to Woodlawn Road, traffic flow in the area has increased. River Road could then be used to access downtown Welland from Woodland Road, which will ultimately connect with the extended Highway 406. However, southbound traffic on River Road (toward downtown) was diverted eastward on to Ross Street by a "no entry" sign at the corner of River Road and the former Down's Drive. Hence, most traffic on the affected portion of River Road (approximately McMaster Avenue to Ross Street) can still be considered to be local.

With the exception of some large truck traffic during mobilization and demobilization of the dredge, the amount of additional traffic flow on River Road as a result of this project is expected to be negligible.

4.1.4 Resource Use

The City of Welland takes its water from the old Welland Canal, and the river is not a potable water supply for any of the downstream communities. Downstream industries, such as Cyanamid of Canada and B. F. Goodrich, however, do draw water from the river for industrial purposes. The flow of the Welland River is eventually diverted into the Queenston-Chippawa Power Canal at Niagara Falls which feeds the Sir Adam Beck generating stations.

Merritt Park on the west bank of the river receives moderate use, and the walking trail is also used by local residents for nature viewing. Access is restricted to pedestrian traffic only with no motorized vehicles allowed. To date, no resource use studies have been carried out for the park (Neadhery, 1995). The river itself in the study area is rarely used for boating due to a lack of launching facilities and the proximity of the old Welland Canal which is more intensively used by boaters; however, the reach is occasionally used by canoeists.

According to officials of MNR, the fishery resource in this stretch of the river is relatively sparse; however, some angling likely occurs along the banks (MNR, 1990). No records of furbearer harvest for this section of the river could be obtained (MNR, 1995a).

4.2 Aquatic Environment

4.2.1 Hydrology

The Welland River drains a catchment area of approximately 880 km^2, with the majority of the catchment being agricultural land of predominantly clay soils. That portion of the river that flows through the City of Welland, and encompasses the present study area, has been altered by the installation of two sets of siphons to cross the old and new Welland canals. The siphon beneath the old canal was modified in the 1970s to add 14.2 m/s (500 cfs) of flow to the Welland River to provide additional dilution capacity for the Region's WPCP located just downstream of the project area. A second factor affecting the hydrology of this and lower sections of river is the influence of the operation of Grass Island Pool and the offtake of water through the Chippawa Power Canal. Changes in operating level of the Grass Island Pool directly affect the level, and ultimately the flow, in the lower Welland River. Flow reversals in the section of river between the siphons is a common occurrence, and was noted during the previous demonstration project.

Natural flows in the river vary throughout the year, relative to rainfall and runoff, with typical daily water level fluctuations over a 3-yr period for a point immediately upstream of the Old Canal siphon (NPCA gauge) being shown in Figure 4.1. Level changes are small between June and September with the most significant changes occurring in the late winter and early spring. Typical daily water levels fluctuations during September and October are shown in greater detail in Figure 4.2.

4.2.2 Water Quality

Historical water quality information on the section of Welland River in question is available from two main sources:

- data from two water quality stations maintained by MOE (1990) as follows:

	Period of Record
- upstream from Atlas site at bridge south of the Welland Airport	(1977 - 1988)
- downstream from Atlas site at Port Robinson	(1965 - 1990)

- an environmental evaluation of the lower Welland River (Tarandus, 1992).

The data presented by Tarandus (1992) was obtained from primarily a one-point-in-time sampling program carried out in August 1990[1]. In total, 25 sites in the lower Welland River were sampled, 4 of which (Stations 9, 10, 10a, 11) are in proximity to the Atlas site. Two (Stations 22 and 23) are below the Chippawa-Queenston Power Canal takeoff and not of interest here. The results are presented in Table 4.2 for those stations adjacent to the project area and then compared to the range of concentrations obtained upstream, immediately downstream and with the PWQO or Interim Objectives (MOEE, 1994). A complete listing is presented in Appendix B.

These results show, that of 32 parameters measured, only 4 parameters, namely aluminum, copper, total phosphorus (TP) and total phenols exceed the PWQO for the protection of aquatic life within the vicinity of the Atlas outfalls. Iron levels were exceeded both upstream and downstream but not within the immediate area. For all parameters, the highest exceedances were mainly upstream of the study area. Generally, the data would suggest that background water quality in the river is good, although, it should be noted that these results are based on a single-sampling event and, as such, represent a point-in-time representation of water quality conditions in the river.

The high aluminum concentration may be due to the suspended clay content of the water, since the Welland River drains an area of predominantly clay soils. The PWQO of 0.075 mg/L is for clay-free samples, and the samples taken were not filtered to remove clay.

Table 4.3 shows selected parameter concentrations taken from the MOE data base. The numbers shown are means based on monthly sampling for the period of record identified.

It is difficult to draw any conclusions from these means of monthly data, since there was considerable variation between months in some cases, and the number of sampling events was not consistent for each parameter or each station. However, general observations would include the fact that, of the 17 parameters under consideration, the mean values for all but 4 of the parameters satisfy the current PWQOs. The four parameters showing exceedances are aluminum, iron, TP and total phenols.

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1 Data on a limited number of parameters is also available from a November 1990 sampling event.

Table 4.2

Lower Welland River Water Quality Results (August and November 1990)

Parameter	Results (mg/L unless otherwise stated)				Range for Upstream Stations 1-8	Range for Downstream Stations 12-21
	Station 9	Station 10	Station 10a	Station 11		
Metals						
Aluminum - August	0.12	0.12	0.13	0.11	0.2-1.74	0.24-0.34
- November	1.49	0.54	-	-	1.14-3.4	1.03-1.3*
Antimony (µg/L)	<2	-	-	-	<2*	<2*
Arsenic (µg/L)	<5	<5	<5	<5	<5	<5
Barium	0.02	-	-	-	0.04*	0.02*
Beryllium	<0.005	-	-	-	<0.005*	<0.005*
Cadmium	<0.002	<0.002	<0.002	<0.002	0.002	<0.002
Chromium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005-0.0075
Cobalt	<0.005				0.005*	<0.005*
Copper - August	0.02	0.01	0.005	0.015	0.013-0.05	0.005-0.035
- November	<0.005	0.01	-	-	0.005-0.01	<0.005-0.01*
Iron	0.095	-	-	-	2.1*	0.4-0.45*
Lead	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Magnesium	8.5	-	-	-	14.1*	8.9-9.2*
Mercury - August (µg/L)	<0.05	<0.05	<0.05	<0.05	<0.05-0.3	<0.05
- November	-	<0.05	-	-	<0.05*	<0.05*
Manganese	0.01	-	-	-	0.18*	0.01-0.02*
Molybdenum	<0.005	-	-	-	<0.005*	<0.005*
Nickel	<0.005	-	-	-	<0.005*	0.005*
Selenium (µg/L)	<1	-	-	-	<1*	<1*
Silver	<0.005	-	-	-	<0.005*	<0.005
Vanadium	<0.005	-	-	-	<0.005*	<0.005*
Zinc	<0.01	<0.01	0.02	<0.01	<0.01	<0.01
Nutrients						
Total phosphorus	0.016	0.016	0.013	0.066	0.024-0.15	0.041-0.064
Total Kjeldahl nitrogen	0.42	0.28	0.3	0.33	0.33-1.01	0.33-2.6
Ammonia - nitrogen	0.008	-	-	-	0.008*	0.008-0.33*
Nitrate	0.16	-	-	-	0.35*	0.31-0.55*
Nitrite	0.005	-	-	-	0.003*	0.023-0.04*
Other						
Total suspended solids	7	-	-	-	48*	14*
Turbidity (NTU)	0.3	0.3	0.3	0.8	0.5-7.3	0.4-1.1
pH -log [H^+]	8.13	8.1	8.2	8.25	7.9-8.15	8.05-8.45
Color (TCU)	3	-	-	-	48*	4*
Conductivity (µs/cm)	290	290	290	310	290-440	290-310
Total phenols						
- August	0.012	0.012	0.001	0.002	<0.001-0.029	0.001-0.031
- November	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cyanide	0.002	0.002	0.002	0.002	0.002	0.002

░ Exceedance of Provincial Water Quality Objective or Interim Objectives as defined by MOEE, 1994.
* Limited number of stations sampled.
Source: Tarandus, 1992.

Table 4.3

Mean of Monthly Water Quality Data from Two MOEE Sample Stations on the Welland River

Parameter	Mean Concentration (mg/L unless otherwise stated)	
	Bridge South of Welland Airport	Siphon at Port Robinson
Metals		
Aluminum	3.067	1.179
Cadmium	0.002	0.0002
Chromium	0.005	0.0030
Copper	0.004	0.004
Iron	3.534	1.96
Lead	0.006	0.006
Magnesium	15.3	10.7
Manganese	0.104	0.051
Mercury (μg/L)	0.02	-
Nickel	0.005	0.004
Zinc	0.012	0.012
Nutrients		
Total phosphorus	0.228	0.103
Total Kjeldahl nitrogen	1.48	0.75
Ammonia-nitrogen	0.43	0.177
Nitrate	1.85	0.693
Nitrite	0.054	0.042
Others		
Total phenols (μg/L)	2.3	1

Source: MOEE Sample Information System (SIS); printout obtained current to December 7, 1990.

These parameters (although iron concentrations were lower in the immediate study area) also exceeded the PWQOs during the 1990 sampling event, suggesting some source of these materials to the river. However, in the case of all these parameters, the levels measured during the 1990 sampling event are lower than the calculated means from the MOE historical data base (except for the upstream iron concentrations). In general terms, aluminum and TP levels are one order of magnitude lower in the 1990 samples while phenols are three orders of magnitude lower in the 1990 samples than the means measured over the previous 10 years. This would suggest that the loadings of these materials to the Welland River watershed may have decreased prior to the 1990 sampling, although it must be noted that the 1990 results are based on a single-sampling event.

In general, the background water quality of the Welland River can be considered good with a limited number of PWQOs being exceeded.

4.2.3 Sediment Quality

Background sediment quality data for the study area is available from two main sources:

- an environmental evaluation of the lower Welland River from the Welland Airport to the east side of the Queenston-Chippawa power canal was carried out in the summer and fall of 1990 (Tarandus, 1992)

- the Welland River background studies carried out to determine background sediment quality prior to the demonstration project (Acres, 1990a, 1990b, 1991a, 1992a).

Results of sampling at four stations adjacent to the project area during the 1990 lower Welland River study are shown in Table 4.4. Results are compared to the range of concentrations obtained upstream, immediately downstream and the PSQG (MOEE, 1993), an a complete listing is presented in Appendix B.

Sediment quality guidelines exist for 14 of the 28 parameters measured. At those locations adjacent to the proposed cleanup area (Stations 9 to 11), the LEL was exceeded for 13 of the 14 parameters for at least one of the four locations, while the range of values recorded for upstream and downstream sites exhibited similar trends. The SEL was exceeded for chromium and nickel at all four project area stations, while the SEL for iron, copper, magnesium, mercury and manganese, was exceeded for at

Table 4.4

Sediment Quality Results from Lower Welland River, 1990

Parameter	Aug. or Nov. Sample		Results (µg/g unless otherwise stated) Station 9	Station 10	Station 10a	Station 11	Upstream Stations 1-8	Downstream Stations 12-21
Metals			17 750	34 000	35 000	35 000	26 000-38 000	22 000-38 000
Aluminum	Aug		1				1	1
Antimony*	Aug		5	11	8	6	5-7	5.5-17
Arsenic	Aug		5	11	-	4	5	5-10
		Nov*	102.5	-	-	-	139	118-127
Barium*	Aug		1	1	-	-	1.5	1
Beryllium*	Aug		0.8	0.975	0.4	0.15	0.4-0.6	0.1-1.4
Cadmium	Aug		0.7	0.7	0.3	0.8	0.4-0.9	0.2-1.5
		Nov*	55.5	95	91	53	40-49	**43-300**
Chromium	Aug		**188.5**	**670**	**149**	**250**	43-50	**260-460**
		Nov*	10.75	-	-	-	14.5	13-19
Cobalt*	Aug		13.3	38	16.5	18.5	12-15	17-23
		Nov*	93.5	77	50	28	24-51	**26-115**
Copper	Aug		109.5	**168**	43	73	31-94	**52-138**
		Nov*	30 000	-	-	-	32 000	**35 000-58 000**
Iron*	Aug		35 000	**118 000**	**52 000**	**53 000**	28 000-38 000	**47 000-70 000**
		Nov*	74.5	86	38	25	26-85	21-62
Lead	Aug		93.5	87	38	63	36-73	23-91
		Nov*	15 900				9400	13 900-14 000
Magnesium*	Aug		**2.22**	0.18	1.4	0.02	0.04-0.4	0.02-0.68
Mercury	Aug		**3.11**	1.3	0.14	2	0.36-1.64	0.04-0.92
		Nov*	430	-	-	-	580	650-960
Manganese*	Aug		615	**1210**	810	740	570-850	730-995
		Nov*	1.75				0.5	3.5-24
Molybdenum*	Aug		54	-	-	-	33	**75-178**
Nickel*	Aug		**131**	**390**	**98**	**166**	34-41	**177-270**
		Nov*	0.5	-	-	-	0.5	0.5
Silver*	Aug		34.5	-	-	-	58	42-43
Vanadium*	Aug		335	550	270	98	97-135	69.5-620
Zinc	Aug		131	390	98	166	112-177	99-570
		Nov*						
Nutrients								
Total phosphorous*	Aug		1005	-		-	1020	1060-1300
Total Kjeldahl nitrogen*	Aug		1910	-		-	2800	290-800
Other								
Oil and grease	Aug		4550	2000	1990	250	845-2900	195-3200
		Nov	4850	3600	780	3400	540-2700	450-11 800
Loss on ignition (%)	Aug		7	7	5	2	7-14	2-6
Total phenols	Aug		0.01	0.01	0.01	0.01	0.01-0.02	0.01
PCBs*		Nov	0.11	0.045	-	-	<0.05-0.13	<0.05-0.142
pH (-log [H+])	Aug		7	7	7	7.3	6.8-7.3	7.1-7.5
Cyanide	Aug		<0.05	<0.05	<0.05	<0.05	<0.05-0.13	<0.05-0.18
Total organic carbon (%)*	Aug		3.55				7.4	0.92-1.13

*Limited number of stations sampled.
Source: Tarandus, 1992.

(shaded) = Exceedance of PSQG[1] lower effect level (LEL) but not severe effect level (SEL)
Bold = Exceedance of PSQG SEL.

1 Provincial Sediment Quality Guidelines as defined by MOEE, 1993.

least one of the four sites. Similar trends were also apparent at those sampling sites downstream of the project area. Nutrient (TKN and total phosphorus) concentrations and total organic carbon (TOC) were above the LEL at all locations. These results indicate that sediment quality is degraded throughout the lower Welland River, and that metals (particularly Cr, Ni, Fe) are significantly elevated in that stretch of the river downstream of the Old Welland Canal system.

The background concentration of numerous sediment parameters were determined from the Old Canal syphon to below the WPCP outfall as a prelude to the previous dredging demonstration to establish the dimensions of the area requiring remediation (Acres, 1990a, 1990b, 1991a). A portion of the early background data was presented in Section 2.2.1 while additional sediment data has been presented in conjunction with associated water quality and groundwater quality monitoring (Acres, 1992a). The overall results are in basic agreement with the above noted MOE/Tarandus study (i.e., Cr, Ni, and Fe exceed SEL), however, those studies more closely examined the areas of historical deposition adjacent to both the Atlas 42-in. and McMaster Avenue sewer outfalls.

Typically, Atlas' contribution to the river sediment contamination has been characterized by the high heavy metal concentrations. Observations from the 1991 study downstream of the Atlas 42-in. outfall, however, indicated high nutrient levels in the sediments which could not be attributed to Atlas's discharges (Table 4.5).

Total Kjeldahl Nitrogen (TKN), TP and TOC levels in the river sediments consistently exceeded the lowest effect levels. The concentration of TP in two of the sediment samples exceeded the severe effect level. The nutrient concentrations were always higher in the downstream boreholes farthest away from the Atlas 42-in. sewer outfall. The observed lower nutrient concentrations in the sediments closer to the Atlas 42-in. sewer outfall may have been due to the nature of the sediment in close proximity to the outfall. The majority of material deposited at the outfall and immediately downstream from it is a coarse, industrial mill scale, which may be mixed with varying, but generally small, fractions of fine river sediment. Normally, nutrients are associated with fine particulate matter such as organic silt and clay materials. The fine particulate content of the river deposits increases with distance downstream from the outfall, and associated with these fines are the nutrient contamination in the sediment.

The sediments generally contained metal concentrations well above the PSQG lowest effect levels and, in most cases, exceeding the severe effect levels. The Cr, Cu, Mn, Fe, Ni were substantially greater than the PSQG severe effect levels in all sediment samples. Chromium and iron levels were an order of magnitude higher than the severe effect levels. The Zn concentration was greater than the lowest effect level in three of the four samples but did not exceed the severe effect level in any of the samples.

The concentration of oil and grease ranged from 1100 to 14 000 mg/kg with the highest concentration occurring in sediment located 40 m downstream from the Atlas 42-in. outfall.

Table 4.5 also includes a summary of results from EPA method 624 analyses for volatile organic compounds in the river sediments. Only those EPA-624 compounds which were detected are listed in the table. The laboratory analyses of the sediment indicate that it contains small quantities of volatile organic constituents, namely benzene, toluene, xylene and petroleum hydrocarbons.

The results of Regulation 347 leachate testing are presented in Table 4.6. The contaminant concentration in the leachate is compared with the Regulation 347, Schedule 4, criteria. Even though Ba and Hg are found to slightly exceed the Schedule 4 concentrations in one or both of the analyses, the results indicate that the material is a nonhazardous, nonregisterable solid waste, in accordance with Regulation 347.

In general, the additional data collected during the 1991 study supports that of Tarandus (1992), indicating poor sediment quality in the vicinity of the study area.

4.2.4 Aquatic Vegetation

The study area is part of a provincially significant wetland as defined and determined by the Ontario MNR. The wetland in this section of the river exists as a strip of vegetated floodplains (primarily *Typha*) along each side of the river, which varies in width from a few metres or less, to up to 20 to 25 m downstream of the Atlas 42-in. sewer outfall. During the MNR wetland survey (MNR unpublished report, 1985), the following true aquatic plants and water-tolerant shrubs were identified in the section of river to be directly influenced by the proposed reef cleanup project.

Table 4.5

Welland River Monitoring Results for Limited Sediment Characterization

Conventional Parameters

Distance Downstream from Atlas-Gencorp Outfall	Depth (m)	BOD (mg/kg)	COD (mg/kg)	NH_3-N (mg/kg)	TKN (mg/kg)	NO_3+NO_2 (mg/kg)	NO_2 (mg/kg)	TP (mg/kg)	LOI (%)	MC (%)	TOC (%)	O&G (mg/kg)
10 m	0.00-0.80	4 800	130 000	13.1	1 112	<0.2	<0.2	1 751	2.9	56.1	4.9	7 100
20 m	0.00-0.50	1 000	130 000	0.9	766	<0.2	<0.2	1 406	2.0	10.4	4.9	2 200
40 m	0.00-0.60	6 000	170 000	0.4	2 510	<0.2	<0.2	3 453	6.1	112.5	6.4	14 000
54 m	0.00-0.70	4 700	150 000	0.7	1 850	<0.2	<0.2	2 785	5.0	108.3	6.0	1 100
PSQG lowest effect level		-	-	-	550	-	-	600	-	-	1	-
PSQG severe effect level		-	-	-	4 800	-	-	2 000	-	-	10	-

Volatile Organics

Distance Downstream from Atlas-Genscorp Outfall	Depth (m)	Benzene (μg/kg)	Toluene (μg/kg)	Chloro-Benzene (μg/kg)	Ethyl Benzene (μg/kg)	Dichloro-Benzene (μg/kg)	M, P-Xylenes (μg/kg)	O-Xylene (μg/kg)	Petroleum Hydrocarbon (μg/kg)
10 m	0.00-0.80	7.0	413*	53.6	27.2	-	106	48.0	25 100
20 m	0.00-0.50	-	-	-	-	170*	-	-	477
40 m	0.00-0.60	-	-	-	-	-	-	-	-
54 m	0.00-0.70	-	68.2*	16.8	38.9	-	124	68.2	24 500

Table 4.5
Welland River Monitoring Results
for Limited Sediment Characterization - 2

Metals

Distance Downstream from Atlas-Gencorp Outfall	Depth (m)	Cr (mg/kg)	Cu (mg/kg)	Fe (mg/kg)	PB (mg/kg)	Mn (mg/kg)	Ni (mg/kg)	Zn (mg/kg)
10 m	0.00-0.80	4 940	873	370 000	182	5 000	6 040	180
20 m	0.00-0.50	3 600	777	433 350	96	4 660	9 260	90
40 m	0.00-0.60	6 460	769	289 000	349	4 460	6 360	286
54 m	0.00-0.70	5 490	597	251 000	331	3 930	5 550	283
PSQG lowest effect level		26	16	20 000	31	450	16	120
PSQG severe effect level		110	110	40 000	250	1 100	75	820

Notes:

MC = Mass of water/mass of dry solids
PSQG = Provincial Sediment Quality Guidelines
\- = Data not available
* = Semiquantitative only

Table 4.6

Regulation 347 Test Results, 1991 Sampling

			Parameters 347 - Leach											
Distance Downstream from Atlas-Mansfield Outfall	Init pH (SU)	Acid Volume (mL/g)	As (mg/L)	Ba (mg/L)	B (mg/L)	Cd (mg/L)	Cr (mg/L)	Pb (mg/L)	Hg (mg/L)	Se (mg/L)	Ag (mg/L)	NO_3+NO_2 (mg/L)	NO_2 (mg/L)	PCB (mg/L)
20 m	9.2	0.75	<.002	1.7	<0.2	<.005	<.04	<.05	<.001	<.010	<.05	0.12	<.01	<.0002
40 m	7.7	4	0.004	5.4	<0.2	<.005	0.04	<.05	0.002	.010	<.05	0.31	0.15	<.0002
Regulation 347, Schedule 4			0.05	1	5	0.005	0.05	0.05	0.001	0.01	0.05	10	1	0.003

MNR Category	Plant's Common Name	Scientific Name
Robust Emergents	Cattails	*Typha latifolia*
Broad-Leaved Emergents	Arrowhead	*Sagittaria* sp
Narrow-Leaved Emergents	Burweed	*Sparganium* sp
Submerged Aquatics	Water milfoil Coontail	*Myriophyllum* sp *Ceratophyllum demersum*
Tall Shrubs	Willow Speckled alder Dogwood	*Salix* sp *Alnus incàna* *Cornus* sp

No rare or endangered, provincially significant or regionally significant aquatic plant species were identified during the MNR wetland survey of this section of the river, although that evaluation cannot be considered to be a detailed inventory of flora and fauna of the river.

Aquatic macrophyte distribution in the area downstream of the Atlas 42-in. outfall was used by Dickman et al (1990) to assess the degree of impact associated with outfall discharges. Macrophyte distribution displayed a zonation pattern along the east shore and downstream from the Atlas 42-in. sewer outfall. No zonation pattern was detected along the west shore. The zonation pattern ranged from a high impact zone within 10 m of the Atlas 42-in. outfall, where no higher plants were located, through a series of three recovery zones downstream to the WPCP, where higher aquatic plants had recovered to a community similar to that upstream. The point-quarter technique was used to map the distribution patterns. In this technique (Cottam, 1949 in Dickman et al, 1983), originally proposed for terrestrial forests, the nearest individual in each of four quadrants was identified, its basal area measured and distance from the point of the nearest individual in each of four transects was recorded at 1-m intervals along a series of transects aligned perpendicular to shore. Resultant data was plotted on a site figure, showing the change in dominant macrophyte groups (long-stemmed aquatics, short-stemmed aquatics, floating leaved aquatics and submersed aquatics) and species.

The first recovery zone, from 10 m to 15 m downstream from the outfall, was characterized by stunted emergent vegetation such as cattails (*Typha*), sedges (*Carex*) and bulrushes (*Phragmites*). The second recovery zone, 15 m to 120 m downstream, was delineated by the appearance of short-stemmed emergents, such as pickerel weed (*Pontederia*), arrowhead (*Sagittaria*) and burweed (*Sparganium*), and floating leafed plants including the water lilies (*Nuphar* and *Nymphaea*). The appearance of submergent vegetation, such as water milfoil (*Myriophyllum*) and waterweed (*Elodea*) delineated the third recovery zone, 120 m to 800 m downstream.

Aquatic vegetation was visually assessed in the vicinity of sediment sampling sites during the Tarandus (1992) study. Species noted to be common to the study area (Welland Airport to Niagara River) included water lily (*Nymphaea variegatum*), cattail (*Typha latifolia*), Eurasian milfoil (*Myriophyllum spicatum*), wild celery (*Vallisneria americana*), arrowhead (*Sagittaria latifolia*) and mud plantain (*Heteranthena dubia*). Twelve other species of aquatic vegetation were noted as being occasionally present or rare. Data was not specifically presented by sampling site, although it was noted that the zone immediately downstream of the Atlas 42-in. sewer outfall, previously identified as being devoid of aquatic vegetation (Dickman et al, 1990) was not observed as such during the Tarandus summer survey.

4.2.5 Benthic Invertebrates

Benthic invertebrate communities in the study area were studied between 1986 and 1990 by Dickman et al (1990). This study comprised the following:

- an examination of benthic communities along the length of the Atlas 42-in. reef to determine any patterns which might exist

- documentation of the incidence of labial plate deformities in chironomids, which may be indicative of the presence of mutagenic, carcenoginc or teratogenic substances in the sediments.

The density and diversity of the benthic community ranged from nonexistent, near the Atlas 42-in. outfall, increasing to more normal levels downstream toward the WPCP. Chironomid species richness and density was lower than at a control site, 800 m upstream of the discharge pipe.

There were no benthic invertebrates collected within 10 m of the outfall; between 10 and 15 m downstream from the outfall, pollution-tolerant species such as sludge worms (*Tubidificidae*) and dipteran blood worms (*Chironomidae*) were located; from 15 to 120 m invertebrate diversity and density began to increase, and between 120 and 800 m less pollution-tolerance species began to appear. In addition to reduced diversity and density of chironomid species in the impacted zone, those present had a relatively high frequency of labial plate deformities (27%) when compared with samples upstream of the affected area (9%). The observation of labial plate deformities upstream of the study area suggests an ambient level of background contamination, not associated with the Atlas industrial deposits.

Tarandus (1992) examined invertebrate samples collected along the length of the Welland River from upstream of the Atlas 42-in. area to the Niagara River to evaluation community structure. Cluster analysis revealed that four distinct communities are present in the lower Welland River, as described below.

Community 1 Associated with sites upstream of the Atlas 42-in. outfall

Community 2 Associated with sites beginning downstream from the Atlas 42-in. outfall (at the Welland WPCP) and running to the Chippawa power canal

Community 3 Associated with sites in the vicinity of the Atlas 42-in. outfall

Community 4 Associated with sites located between the Queenston-Chippawa power canal and the Niagara River.

Following this grouping, discriminate analysis revealed the following information.

- Communities 1, 2 and 3 are associated with sediments containing high concentrations of metals such as chromium, copper, aluminum, lead, mercury and arsenic, relative to those associated with Community 4. The sediments of Community 1 are characterized by lower concentrations of metals than Communities 2 and 3.

- Community 1 is associated with slightly higher levels of aluminum and loss on ignition (i.e., organic content) relative to sediments in Communities 2, 3 and 4.

The discriminate analysis suggests that differences in the benthic communities can be attributed to differences in the concentrations of parameters (particularly metals) in the sediments. Since Communities 2 and 3 are located downstream from industrial discharges, the increased metal concentrations appear to be influencing their structure. Community 1, associated with areas upstream of the Atlas 42-in. outfall, also appears degraded, although to a lesser extent than Communities 2 and 3. These results are consistent with the findings of Dickman et al (1990).

4.2.6 Fisheries

Tarandus (1992) carried out fisheries investigations in the lower Welland River during the summer and fall of 1990, using hoop nets to collect fish. The number of net sets was low [two sets (August and November) upstream of the Old Welland Canal, one set (August) in the section between the siphons, (downstream of Region, WPCP,) and two sets also between the Welland Canada and the Queenston-Chippawa power canal]. There was a relatively higher number of fish caught in the upstream area than in the two downstream areas (Table 4.7), however, the exact mechanisms influencing the distribution of fish in the river are not known. The lack of fish in the downstream areas may be due to the isolation of those sections of the river from upstream sections by the subcanal syphons, although this hypothesis has not been tested. No linkage was established between fish distribution and abundance and the presence/ level of toxic contaminants. The impact of industrial discharges on fish health cannot be commented on as no studies of body burden concentration of contaminants have been undertaken.

The results of the Tarandus (1992) investigation are confirmed by the local MNR. Lewies (1990) indicated that the study area is capable of sustaining a warm-water fishery; however, the community in the study area is relatively sparse due to a number of factors. These include poor habitat quality and the presence of the siphons which may at least partially, act to isolate the study area from the rest of the Welland River.

4.3 Terrestrial Environment

4.3.1 Wildlife

This stretch of the river is part of a provincially significant wetland and has the potential to host breeding populations, however, no detailed studies of wildlife have been undertaken (MNR, 1995b). Several bird species could potentially use the area for nesting, feeding or staging. Species which might utilize the area for at least one of these activities include waterfowl, waders, gulls and a variety of passerines. Species noted (casual observations) during the pilot-scale demonstration project included great blue heron, green heron, mallard ducks, American mergansers, pin tail ducks and black ducks. Gulls observed included ring billed and herring gulls.

Mammals observed in the area included muskrat, cotton-tailed rabbit and squirrels. Mice and moles may also frequent the upland habitat outside of the floodplain.

Larger mammals, such as deer and coyote, may frequent the area, although sitings are rare, most likely due to the developed industrial and residential areas adjacent to the river.

Table 4.7

Numbers of Fish Caught in Hoop Net Sets

Hoop Net	Upstream of Industrialized Area: Two Sets*	In Vicinity of Atlas 42-In. Outfall: One Set*	Between Atlas 42-In. Outfall and Chippawa Power Canal: Two Sets	Total
White Crappie	23	2	0	27
White Bass	2	0	0	2
White Perch	10	0	0	10
Channel Catfish	59	0	0	59
Gizzard Shad	6	0	1	7
Freshwater Drum	8	0	0	8
White Sucker	1	0	0	1
Yellow Bullhead	2	0	0	2
Shorthead Redhorse	1	0	1	2
Carp	1	0	0	1
Pumpkinseed	1	0	0	1
Rock Bass	0	0	3	3
Total	**114**	**2**	**5**	**121**

* Two sets - one each, August and November
One set - August only.

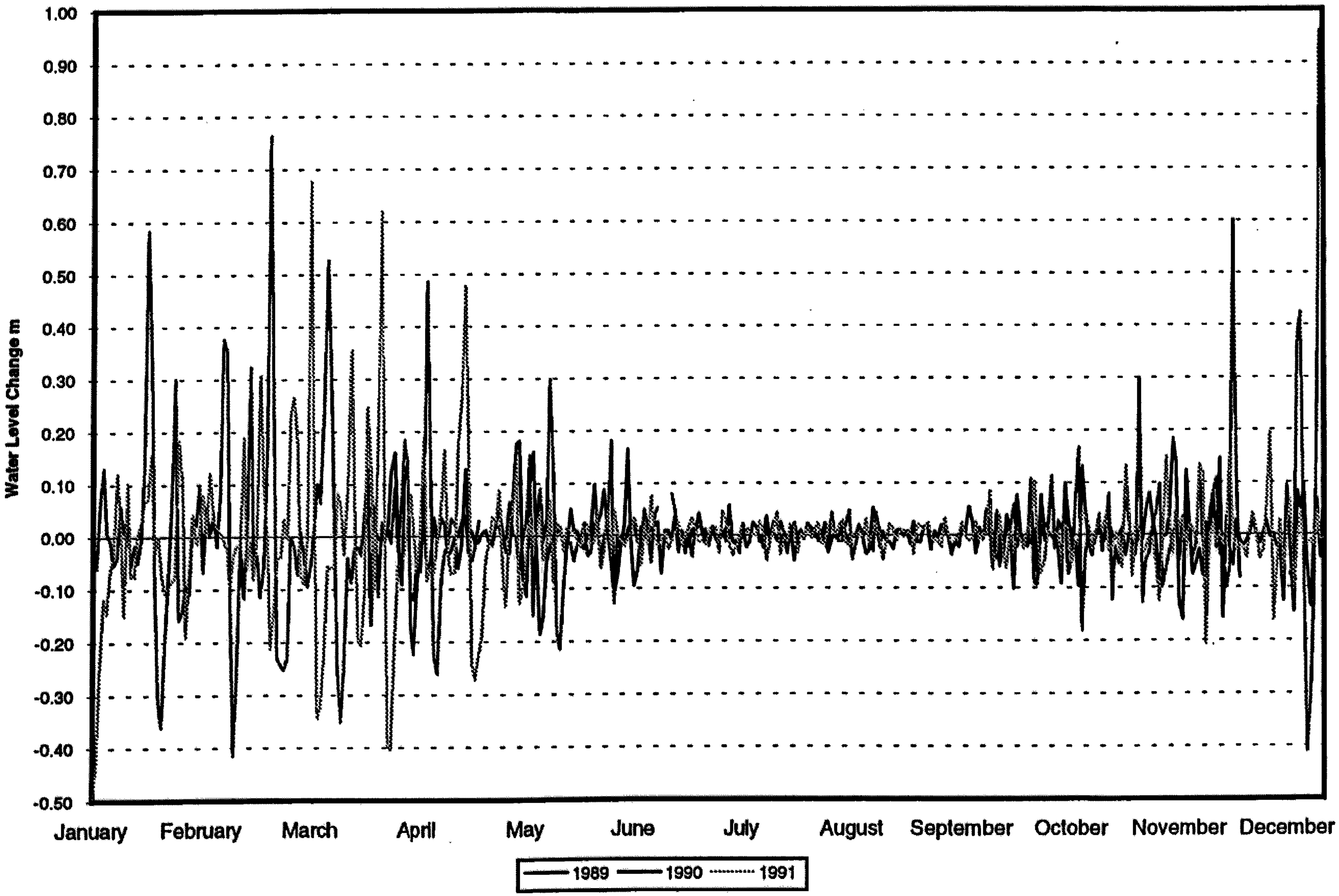


Fig. 4.1

Atlas Specialty Steels - Environmental Canada

Welland River Reef Cleanup Environmental Screening

Annual Water Level Fluctuations - 1989 to 1991

ACRES

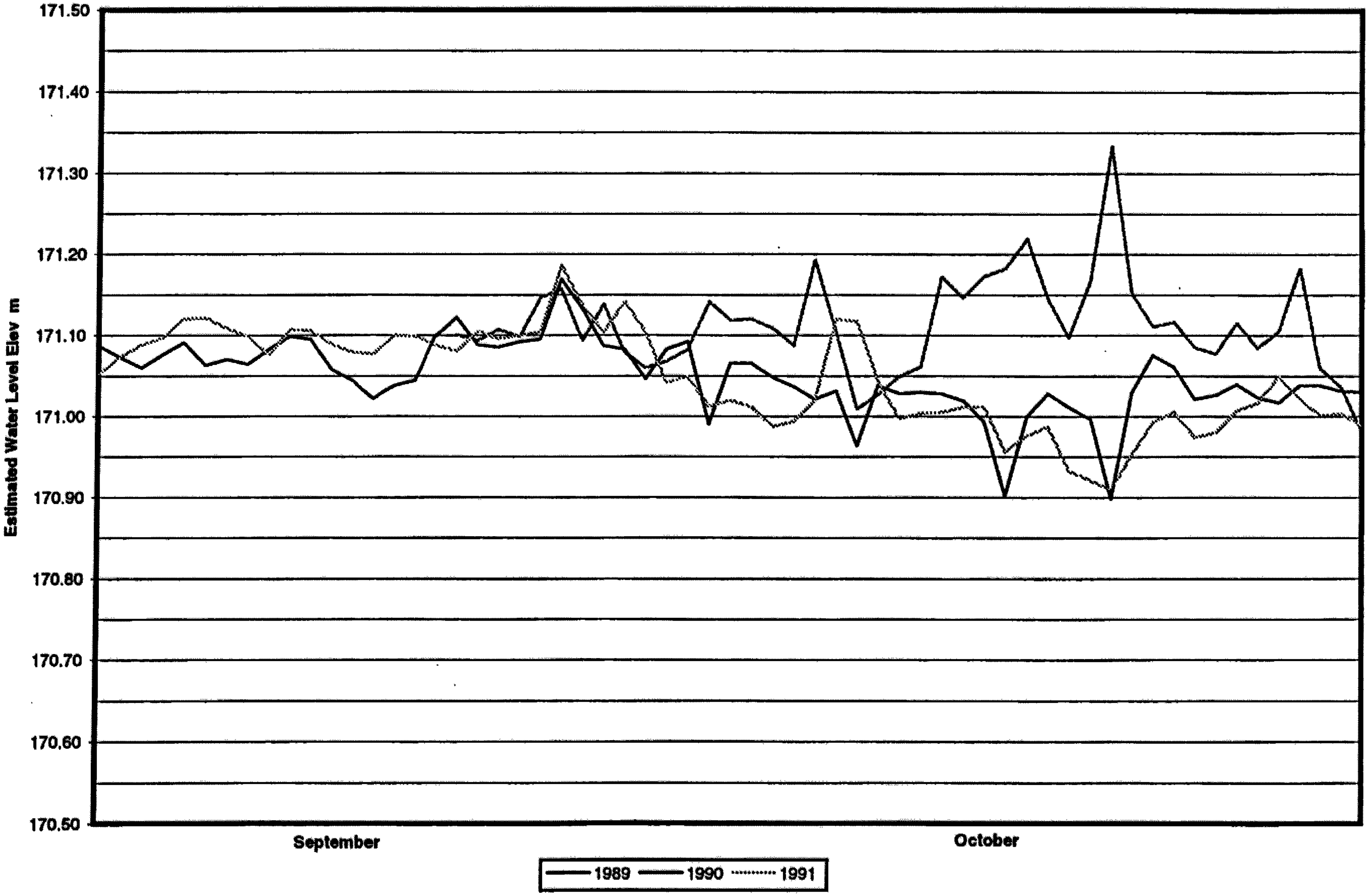


Fig. 4.2

Atlas Specialty Steels - Environmental Canada

Welland River Reef Cleanup Environmental Screening

Typical Water Level Fluctuations - September and October

ACRES

5 Project Description

The project involves the removal of approximately 7000 m^3 of contaminated river reef deposits, comprised mainly of industrial metallic particles and finer clay-silt sediments, from the Welland River at two locations adjacent to existing sewer outfalls (McMaster Avenue and Atlas 42-in.). The McMaster Avenue reef contains approximately 1550 m^3 of material while the Atlas 42-in. reef contains approximately 5450 m^3 of material. An allowance has been provided in the quantity estimate for overdredging at the reef locations, and some additional small amount related to hand-directed dredging adjacent to the specific sewer outfalls. The extent and composition of materials in the reef deposits, adjacent to the reef in the river and in the floodplain was determined by a series of studies undertaken for Atlas from 1989 to 1995 (Acres 1990a, 1990b, 1991a, 1992a, 1992b) while the biological impact of reef deposits was established by two MOE studies (Bedard and Petro, 1991; Jaagumai, 1991). An additional 300 m^3 of materials, associated with two specific pockets of contamination within the floodplain, centered around boreholes AH 8 (McMaster) and BH 301 (Atlas 42-in.) will also be removed during the project.

A pilot-scale demonstration of the proposed removal and treatment technologies for the reef materials was undertaken in the fall of 1991 (October/November) to assess the feasibility of these technologies for a full-scale cleanup. Briefly, the demonstration used a modified MC-915 ENV Mud Cat dredge (hydraulic suction dredge), which with the aid of a booster pump, supplied the dredged material in the form of a slurry to a treatment facility located at the site of Atlas' NFP. The treatment facility consisted of (in the following order) a scalping screen (to remove coarse material and debris), a screw classifier (to remove mill scale), vibrating screens (to remove fine organic matter), a sludge thickener unit which was part of Atlas' existing NFP and a high-speed centrifuge (to remove clay/silt fractions). Wastewater from the process was directed to and treated at Atlas' NFP, while dewatered solids were either stockpiled (in the case of mill scale) or landfilled at Atlas' industrial landfill. Appropriate chemical additions were provided throughout the treatment process to aid in flocculation and settling of suspended material, and a temporary storage basin was established to receive excess sludge from the thickener and excess slurry from the dredging operation. The removal of reef materials from the river and its treatment was designed and operated as a continuous process, with the removal rate matched to the capability of the treatment facility. A full description of the removal and treatment processes is presented in the "*Welland River Dredging and Treatment Demonstration*" report (Acres, 1993).

The present project will utilize essentially the same technologies and many of the same procedures as established for the previous pilot-scale demonstration, modified as appropriate to take into account the results obtained during monitoring of the previous demonstration, and incorporating recommended technological improvements identified at the end of the previous project and in ongoing consultations with the TRC. Common elements of and changes from the previous project are presented below for the main components of the present project, while a further discussion of the alternatives considered is presented in Section 6.

5.1 Removal and Transfer

Major aspects of the present project which are common to the previous demonstration include

- use of a horizontal auger hydraulic suction dredge as the preferred sediment removal technology. Some further modifications to the dredge head will be undertaken to increase material removal rates and reduce blockage of the suction intake slot and suction pump.

- the floating pipeline from the dredge to the shoreline will consist of intermixed flex/solid sections. Clamp and band style couplings between individual sections will be used to ensure that there are no separations and/or leakage at section joints. A check valve (one-way valve assembly) will be installed in the initial portion of the shore-based pipeline to prevent backflow should a rupture of the offshore pipeline occur.

- the shore-based transfer pipeline will be a solid, fused joint line. It will extend from the point of entry of the flex line to shore to the treatment facility. A booster pump will be installed next to the river at the foot of Ross Street (formerly Down's Drive) to facilitate transfer of slurry to the treatment area. A pinch valve will be placed in-line downstream of the booster pump as well.

- monitoring of the dredging and treatment process and associated environmental parameters will be undertaken to assess the suitability of the process for similar and wider commercial applications.

Changes from the demonstration project include

- the dredging process will proceed perpendicular to shore (i.e., offshore to onshore) as opposed to the alongshore direction previously used. This will allow for more efficient sediment removal, and is expected to significantly increase production rates from those recorded during the previous demonstration. The dredge's cable traversing system will be modified to suit the cross-river dredging pattern. Employing the cross river dredging pattern, the dredge will remediate a 20- to 50-m section of the river, starting upstream and moving downstream before relocating to the next location (i.e., next 20- to 50-m section).

- sheetpiling will be installed, prior to the commencement of any dredging operations along the outer edge of the floodplain vegetation throughout the length of the Atlas 42-in. sewer outfall reef. This piling will create a distinct separation between riverine and floodplain sediments, and will form the inshore limit of dredging. Installation of the piling will result in no significant loss of wetland at this location. A similar process may be employed at the McMaster Avenue outfall reef if on-site investigations indicate that a relatively steep slope (approximately 2:1 HV) cannot be attained within the excavated floodplain sediments at this location.

- a contractor will be hired through the competitive bidding process to undertake the sediment removal process, and will have overall responsibility for the treatment aspects as well.

- it is not anticipated that a silt curtain will be required to surround the dredging operation as was utilized during the pilot-scale demonstration project. Monitoring of turbidity and suspended solids in association with the pilot-scale demonstration indicated that resuspension and drift of materials away from the dredge head was well below those operational limits established by MOE, MNR and DFO for the project. Water quality data from the pilot-scale demonstration has been used to develop an appropriate shutdown criteria based on turbidity, which will provide a quick, effective means of verifying/evaluating the contractor's performance. Should the contractor not be able to meet these criteria, modifications to the dredge or the dredging procedure will be required. If the contractor is still not able to meet these criteria, a silt curtain may be required. An absorbent oil boom will be deployed upstream and downstream of the dredging operation to retain any solvent extractables (oil and grease) released during the reef cleanup.

- pockets of mill scale within the floodplain at locations AH 8 and BH 301 will be removed with shore-based equipment. Total containment of those materials will be required during transport from the floodplain to their insertion into the treatment train located at the Atlas NFP.

5.2 Treatment and Disposal

Elements of the treatment process that are common to the pilot-scale demonstration include

- a scalping screen for removal of large objects, debris and coarse materials

- a screw classifier, which worked well to separate heavy mill scale from other finer, lightweight materials

- vibrating fine screens will be used for removal of fine materials. More efficient designs (i.e., 'Hi-G Dryer' units which offer a combination of cyclone and fine screen technologies) may be offered by the contractor to meet anticipated production rates.

- effluent from the fine screens and classifier will be routed to the sludge thickening unit which is part of the existing NFP

- centrifuge(s) for dewatering sludge produced by the thickener unit

- a temporary storage basin (TSB) to accept diversion (excess) slurry flow from the dredging operation and limited unthickened underflow from the thickener. Bottom drainage from the TSB will be directed to Atlas' existing settling pond

- separated mill scale to be added to Atlas' stockpile of recyclable materials, while other solids pending testing (Regulation 347) and approval to be directed to industrial landfill or potentially municipal landfill (if suitable).

Changes from the demonstration include

- magnetic separator not to be used

- overflow from the thickener will be directed to a second TSB to be constructed at the NFP site. Effluent from that basin will be directed to Atlas' existing wastewater settling pond for further treatment.

5.3 Public Input, Review and Project Approvals

The need for remedial action to restore the environmental quality of the Welland River has been recognized since the early 1980s, and resulted in the formation of the WRCC in 1990 which has existed continuously, under this or similar title, to this day. The present committee is referred to as the Welland River (Welland) Cleanup Committee, and consists of representatives from Atlas, Acres, various resource and regulatory agencies (federal, provincial, regional and municipal), Niagara River PAC, and interested members of the public.

An ad hoc Planning Committee was established in March 1991 to provide technical input and review to the pilot-scale demonstration. Membership comprised many of the members of the WRCC.

Prior to the previous demonstration project, a workshop and public open house (at Atlas) were presented, being attended by representatives of the various resource and regulatory agencies (DFO, MNR, MOEE, NRPAC, NPCA, City of Welland, WRCC) and interested parties (affected landowners) having a stake in the project. The workshop and open house assisted in the identification of issues and concerns related to the project, and in the determination of the extent of monitoring and mitigation to be undertaken in association with the demonstration project. Extensive monitoring of the previous dredging program was undertaken to ensure that the contract objectives were achieved (in terms of sediment removal and treatment) and that the process did not have significant adverse effects on the environment.

The pilot-scale demonstration Planning Committee was disbanded in early 1992 upon completion of the project. However, most of the members thereof are also members of the ongoing WRCC, and have maintained regular contact and interest in the full-scale cleanup.

In June 1993, another workshop was undertaken to present the results of the demonstration project and solicit input for the full-scale cleanup of the remaining reef materials. Substantial efforts were undertaken (newspaper advertisements, radio and television announcements, and door-to-door handouts in the project area) to ensure that the general public and other local industries were aware of and offered the opportunity to express their interest and views. Concerns/views expressed during that workshop are presented in Appendix A.

A second ad hoc committee, called the Welland River Reef Cleanup Project Technical Review Committee (TRC) was formed in November 1994 to provide technical input in the full-scale reef cleanup project. The TRC regularly reports to and solicits views from the WRCC. Finally, a public meeting was undertaken during March 1995 to inform the general public and local residents of the nature of the full-scale cleanup project, and to solicit their input.

The pilot-scale demonstration project received permits/approvals/letters of consent from a number of federal (DFO, CCG), provincial (MOEE, MNR) regional (Region, NPCA, NRPAC), and municipal agencies (City of Welland), and affected landowners prior to its commencement. A similar process will be undertaken for the full-scale reef cleanup project.

6 Analysis of Alternatives

In the development of the currently proposed full-scale cleanup project, numerous alternative technologies for accomplishing the desired result have been examined, as well as various means of applying those technologies. Much of that discussion is presented in the "Welland River Dredging and Treatment Demonstration Report" (Acres, 1993) and will not be discussed further here, as the technologies are the same as utilized during the pilot-scale project. This section does, however, present the key alternatives that were examined in arriving at the proposed project, as well as the implications of the 'do-nothing' alternative.

6.1 The Do-Nothing Alternative

The 'do-nothing' alternative generally assumes that the situation is not considered of significant concern, will correct itself or that other individuals or organizations will take the required action to correct the problem. In this case, the 'do-nothing' alternative is not considered a viable option given the following.

- Chemical testing of the reef sediments has indicated that they are well above the provincial sediment quality SEL for numerous metals, and are therefore expected to have detrimental effect on the majority of benthic species. Subsequent biological testing [in situ community survey, three organisms (chironomid, mayfly and fathead minnow) bioassay and bioaccumulation study] confirmed the toxicity of the reef materials, and the ability of specific compounds (i.e., Ni, Cu, Pb) to be bioaccumulated by the test organism. These sediments clearly require remedial action.

- The nature of the contaminants in question are not such that they would 'remediate themselves' over time. Oils and grease within the sediments could in time be expected to be degraded/consumed by micro-organism action if the high levels of metals were not present. This is not however the case. Natural degradation of the metals would not be expected to occur within the reef structure, and the potential for resuspension of reef sediments by an extreme hydraulic event (1-in-100-yr flood) is cause for concern.

- There are no other individual/agencies who will take action or responsibility for the problem. The current project is being undertaken with a partnership approach, and include the full range of participants who could potentially be involved in the resolution of this kind of problem (i.e., private industry and citizens, federal, provincial, regional and municipal government agencies, and local/region interest and advisory groups.

6.2 Extent of Reef Removal

A number of alternatives to the full-scale cleanup project were examined by Acres and presented to the TRC on March 24, 1995 in an effort to present alternate work plans that would bring project costs more in line with anticipated funding availability. Each alternative (of three in total) would result in the complete removal of the McMaster Avenue outfall reef, however, the amount of Atlas 42-in. sewer outfall reef to be removed was modified to create three potential scenarios (A, B and C). These ranged from complete removal of all contaminated sediments associated with that reef to removal of only a core section adjacent to the outfall point which contains the highest concentration of coarse mill scale. Cross-sectional representatives of each alternative is shown in Figure 6.1, while plan views and additional information related to each alternative are presented in Appendix D. Each alternative included the premise that an excavated side slope would form the interface between the reef and the floodplain sediments.

Briefly, Alternative A (Figure 6.1) was the originally proposed work plan, and would remove the entire Atlas 42-in. outfall reef and develop a stable side slope within the floodplain sediments. In order for all contaminated 'in river' sediment to be removed, a significant portion of adjacent floodplain would also need to be removed in the downstream portion of the reef in order to develop a stable side slope in that area (due to 'soupy' nature of floodplain sediments in downstream portion of floodplain). This side slope would then be covered with erosion protection materials. Alternative B would remove the core section of the Atlas 42-in. outfall reef structure, and a sufficient thickness of sediments along the 'tail' portion of the reef (see Alternative B, downstream cross section) to allow placement of a layer of erosion protection. The concept was that the river cross section would not be affected, yet materials in the 'tail' section (also considered highly toxic) would be protected from erosive forces until a decision was made regarding the need to remediate the associated floodplain. This alternative still however resulted in the removal of a considerable amount of floodplain sediment and surface area, due to the unconsolidated nature of the sediments and the need to develop a stable side slope within those sediments. Alternative C would remove the core portion of the Atlas 42-in. outfall reef only (Figure 6.1) and the remaining 'tail' section would be left as is or coated with protective materials to increase its ability to withstand erosion. As shown in Figure 6.1, the removal of the core portion of the reef was the same for each alternative.

Pending considerable discussion between TRC representatives, it was agreed that the project should undertake removal of the entire reef deposit (Alternative A). It was recommended that alternate methods of addressing the reef-floodplain interface be investigated to reduce the anticipated impacts of the excavated side slope on adjacent wetland area, and minimize the area of side slope sediments (also contaminated) that are exposed to river waters.

6.3 Reef-Wetland Interface

Closely tied with the examination of the extent of the project was an evaluation of the various alternatives for addressing the reef-floodplain interface.

The pilot-scale demonstration project had restricted its activities to the outer portion of the McMaster Avenue sewer outfall reef, and had not addressed the manner in which reef sediments could be removed relative to adjacent floodplain sediments and the associated wetland.

Initially, it was proposed that an excavated side slope would be developed within floodplain sediments so as to allow complete removal of contaminated sediments (reef deposits) within the river. This side slope could be covered with a filter material (geotextile or potentially sand) and a layer of granular fill (75 mm minus) to effect erosion protection (see Appendix D for details). Concerns expressed about the extent of wetland loss and the subsequent exposure of a large surface area of contaminated sediments predicated the examination of other alternatives to that process.

Five alternative solutions, ranging from complete removal of the associated floodplain/wetland, to the installation of a berm longitudinally along the margin of the floodplain, to undermining of the floodplain root mat, to installation of a sheet pile wall along the reef-wetland interface were developed and presented to members of the TRC in comparison to the excavated side slope option. These options are presented in detail in Appendix D. Each would have different levels of impact on the associated wetland and/or specific engineering challenge or shortcomings which would affect both its feasibility and ultimate cost. Those differences are noted in Tables 6.1 and 6.2. Techniques for wetland valuation and sample wetland valuation costs were also presented (Appendix D).

After due consideration and discussions by members of the TRC, the sheet pile containment option was chosen as the preferred alternative (Figure 6.2). This alternative minimizes the impact on the adjoining wetland, fulfills the mandate of the project (i.e., removal of riverine sediments) and provides considerable flexibility in that it does not restrict future planning options for the adjacent wetland. If future studies indicate that the sediments underlying the wetland need to be removed, the sheet pile could act as an offshore containment structure (with some modifications) such that shore based removal techniques could be undertaken. If future studies indicate that there is no need for removal of floodplain sediments, the sheet pile could be left in place or subsequently removed at a convenient time in the future. The TRC recommended that the sheetpiling be left in place until those further studies and decisions regarding the wetland sediments are undertaken.

6.4 Treatment Alternatives

A number of alternatives to increase the efficiency and ability of the treatment process to handle production capacity flows were investigated in developing the specifications for the contract tender document.

An additional storage basin is proposed to handle thickener overflow to increase its residency time within a confined environment prior to its release to Atlas' existing wastewater settling pond. The additional basin will allow better treatment of that effluent (with flocculant and coagulant) so as to reduce its suspended solids content. Alternative treatment chemicals (flocculants, coagulants) have also been investigated.

Other alternative treatment techniques examined include 'Hi-G dryer' units, which offer a combination of cyclone and fine screen technologies, and a larger scalping screen than utilized during the pilot-scale project. The contractor will operate within the specifications outlined in the tender document, but will be allowed some flexibility to propose alternate, proven pieces of technology to meet specific needs.

Table 6.1

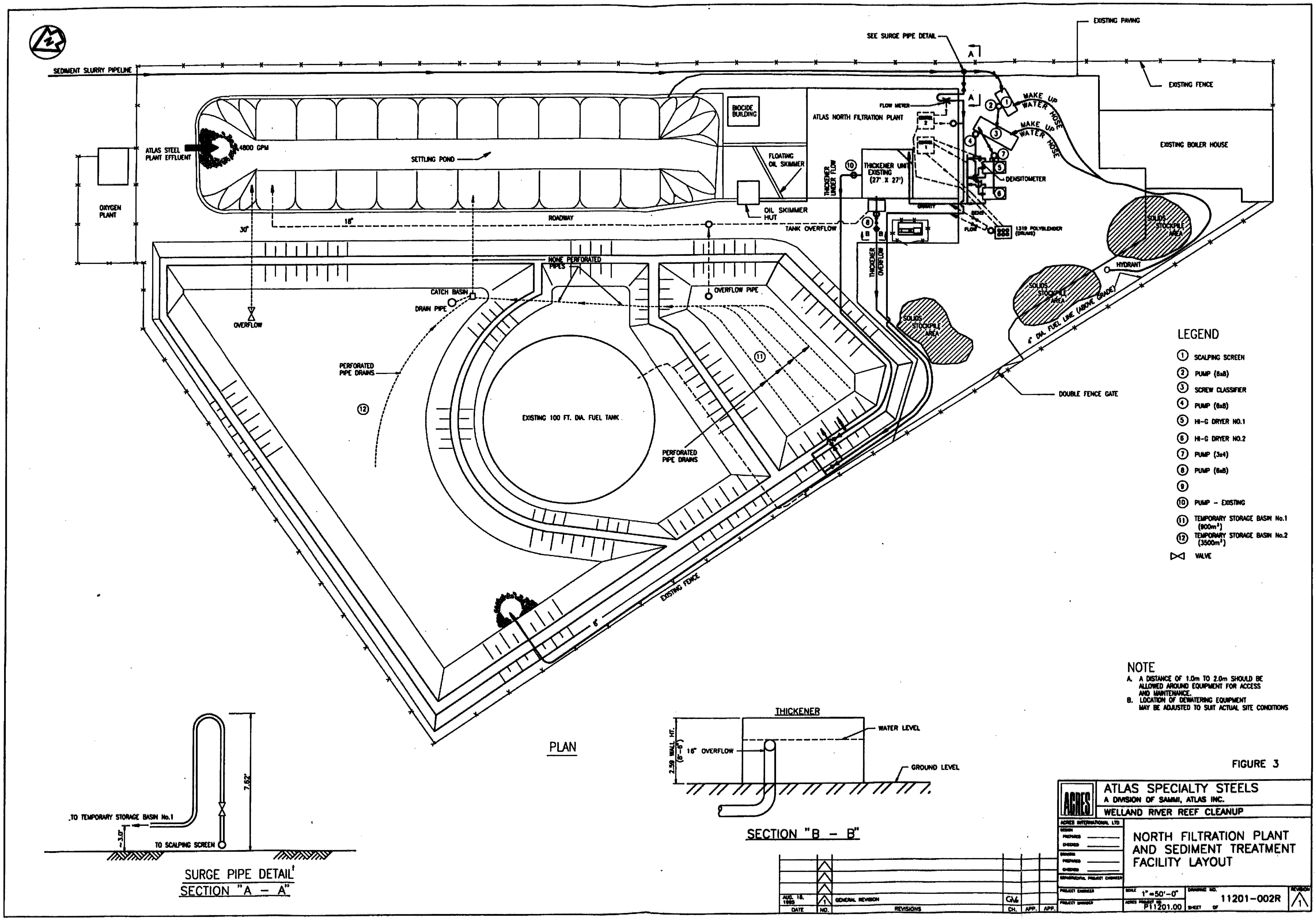
Impact on Atlas 42-in. Wetland Area

	Approximate Floodplain Area Impacted (m^2)
Alternative 1	
- Full Removal of Floodplain	4700
Alternative 2	
- Dredging to a 6H:1V Slope	4000
Alternative 3	
- 'Undermining' of Floodplain Root Mat	3200
Alternative 4	
- Containment Berm	2850
Alternative 5	
- Sheet-pile Containment	700

Table 6.2

Impact on Project Cost

	Total Cost ($\$x10^6$)
Alternative 1 - Full Removal of Floodplain	3.20
Alternative 2 - Dredging to a 6H:1V Slope	3.30
Alternative 3 - 'Undermining' of Floodplain Root Mat	3.25
Alternative 4 - Containment Berm	3.15
Alternative 5 - Sheet-pile Containment	3.00



SEDIMENT SLURRY PIPELINE
SEE SURGE PIPE DETAIL
EXISTING PAVING
EXISTING FENCE
A
ATLAS STEEL PLANT EFFLUENT
4800 GPM
SETTLING POND
BIOCIDE BUILDING
ATLAS NORTH FILTRATION PLANT
FLOW METER
MAKE UP WATER HOSE
MAKE UP WATER HOSE
EXISTING BOILER HOUSE
FLOATING OIL SKIMMER
OIL SKIMMER HUT
THICKENER UNDER FLOW
THICKENER UNIT EXISTING (27' X 27')
DENSITOMETER
1319 POLYBLENDER (DRUMS)
OXYGEN PLANT
ROADWAY
18"
30"
TANK OVERFLOW
THICKENER OVERFLOW
B
SOLIDS STOCKPILE AREA
HYDRANT
NONE PERFORATED PIPES
CATCH BASIN
DRAIN PIPE
OVERFLOW
OVERFLOW PIPE
PERFORATED PIPE DRAINS
EXISTING 100 FT. DIA. FUEL TANK
PERFORATED PIPE DRAINS
4" DIA. FUEL LINE (ABOVE GRADE)
DOUBLE FENCE GATE
EXISTING FENCE
8"
PLAN
LEGEND
1 SCALPING SCREEN
2 PUMP (6x8)
3 SCREW CLASSIFIER
4 PUMP (6x8)
5 HI-G DRYER NO.1
6 HI-G DRYER NO.2
7 PUMP (3x4)
8 PUMP (6x8)
9
10 PUMP - EXISTING
11 TEMPORARY STORAGE BASIN No.1 (900m³)
12 TEMPORARY STORAGE BASIN No.2 (3500m³)
VALVE
NOTE
A. A DISTANCE OF 1.0m TO 2.0m SHOULD BE ALLOWED AROUND EQUIPMENT FOR ACCESS AND MAINTENANCE.
B. LOCATION OF DEWATERING EQUIPMENT MAY BE ADJUSTED TO SUIT ACTUAL SITE CONDITIONS
TO TEMPORARY STORAGE BASIN No.1
TO SCALPING SCREEN
7.62
SURGE PIPE DETAIL
SECTION "A - A"
THICKENER
WATER LEVEL
2.59 WALL HT. (8'-6")
16" OVERFLOW
GROUND LEVEL
SECTION "B - B"
FIGURE 3
ACRES
ATLAS SPECIALTY STEELS
A DIVISION OF SAMMI, ATLAS INC.
WELLAND RIVER REEF CLEANUP
ACRES INTERNATIONAL LTD
NORTH FILTRATION PLANT AND SEDIMENT TREATMENT FACILITY LAYOUT
1"=50'-0"
P11201.00
11201-002R
AUG. 18, 1995
GENERAL REVISION
DATE
NO.
REVISIONS
CH.
APP.
Plot Date SEPT 07, 1995 - 11:31:31

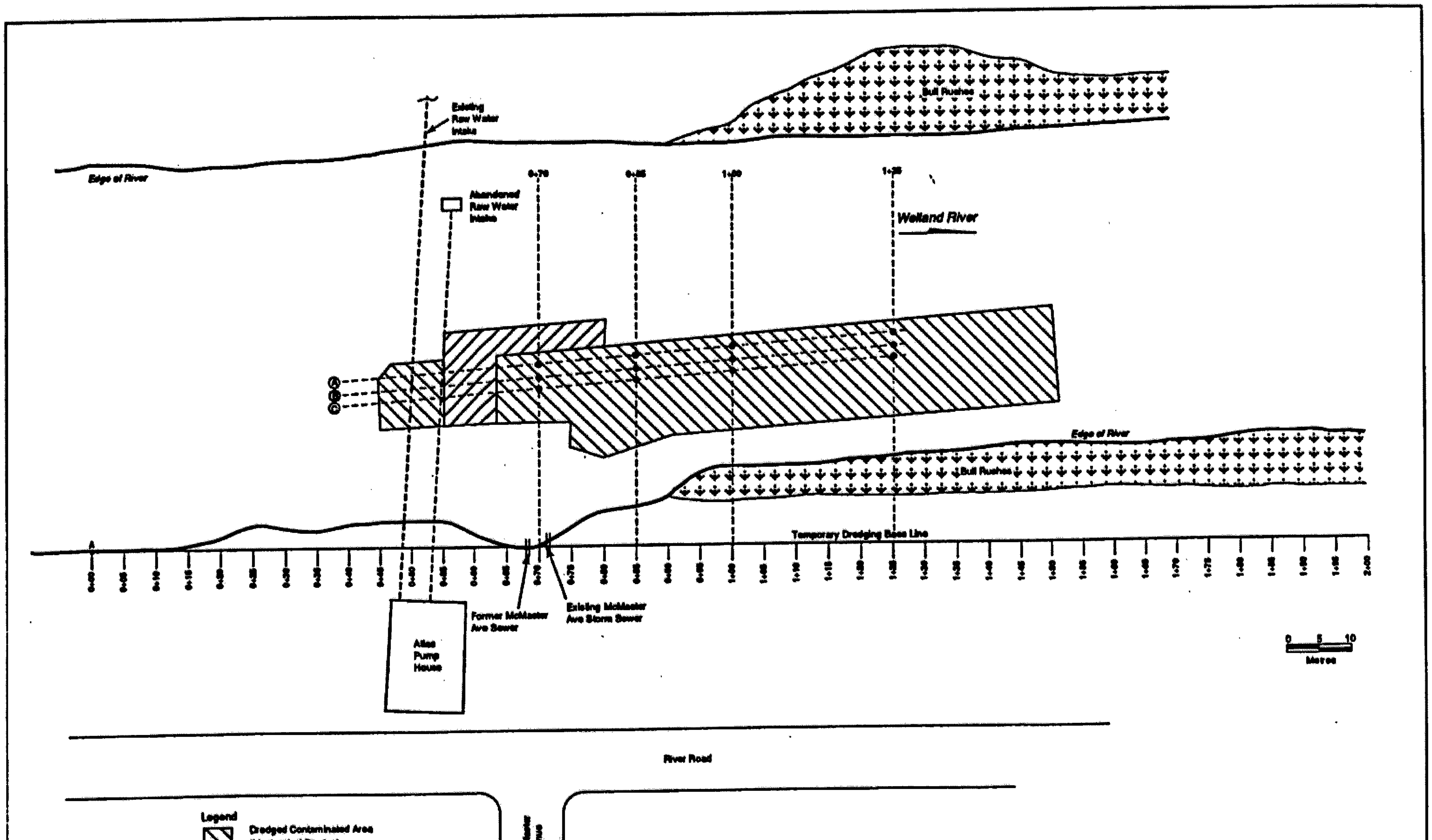


Fig. 2.3

Atlas Specialty Steels - Environment Canada
Welland River Reef Cleanup Environmental Screening
McMaster Reef Post-Dredging

Annex 1

Operational Water Quality Criteria - Correspondence

ACRES

June 23, 1995
P11201.01.04

Ministry of Natural Resources
P.O. Box 1070, Hwy #20
Fonthill, Ontario
L0S 1E0

Attention: Ms. A. Yagi

Ms. Yagi :

Welland River Reef Cleanup Project
Proposed Operational River Quality
Quality Criteria

This letter provides background information and a rationale for river water quality criterion and a monitoring program being proposed, herein, for implementation during the above-noted cleanup project to ensure compliance with regulatory requirements and to allow evaluation of the dredge performance.

The proposed criterion and program are different from those which appear in the current Environmental Screening Report (ESR) and the technical specifications (TS) of the original issue (May 18, 1995) of the Contract C1 tender document. In fact, the criteria in the ESR and the TS are not in complete agreement. For this reason and because Acres is not in a position to set regulatory criteria, the water quality criteria and the monitoring program in the TS have recently been changed (Addendum No. 2 to the tender document) and now reflect programs based on regulatory criteria issued for the 1991 Demonstration Project in the absence of any criteria pertaining directly to the proposed reef cleanup project. A further change to the tender/contract document would be required if the proposed program, as outlined below, were to be accepted.

It is acknowledged that establishment of such water quality criteria is the responsibility of the regulatory agencies having jurisdiction in the project, namely Environment Canada (EC), the Department of Fisheries and Oceans (DFO), the Ministry of Natural Resources (MNR) and the Ministry of Environment and Energy (MOEE).

Criteria from the 1991 Demonstration Project have been used as a basis for developing the proposed 1995 criteria and water quality monitoring program. One objective of the 1995 program is to establish **a single water quality criterion** that would be acceptable to all regulatory agencies and could be used to monitor and evaluate the contractor's dredging operations as well as provide a shut-down criterion for the dredging should the criterion be exceeded. The monitored parameter(s) must be measurable in the field, and have a sufficiently quick analytical response time that action could be taken to modify or halt the dredging operation, as necessary.

1991 Demonstration Water Quality Criteria

During the 1991 demonstration, both turbidity and total suspended solids (TSS) were measured in association with dredging operations to meet the requirements of the various funding and

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regulatory agencies involved in the project (EC, DFO, MNR and MOEE). Operating limits established for the project were as follows:

Environment Canada

- TSS	25 mg/L above background at 25 m from dredge
- Turbidity	30% above background at 25 m from dredge

Ministry of Environment

- Turbidity	80 FTU above background at 100 m downstream from silt curtain

DFO/Ministry of Natural Resources

- TSS	the greater of 25 mg/L or 10% above background at 100 m downstream from silt curtain

Sampling was undertaken using various sampling protocols and at various locations upstream and downstream of the dredging operation in accordance with the requirements of the specific agency. For the EC program, one set of depth composited grab samples, (1/4, 1/2 and 3/4 water depth) was collected 10 m upstream and 10 m downstream of the dredge in association with each dredging test run. For the DFO/MNR program, similar depth composited grab samples (surface, mid-depth and bottom) were collected twice daily from three locations across the river (1/4, 1/2 and 3/4 river width) at 100 m upstream and 100 m downstream of the operation. The MOEE program used the same transect locations as the DFO/MNR program (100 m upstream and downstream) and also included a sampling point within the silt curtain. The MOEE program utilized automatic samplers to collect composited daily samples (15-min sampling interval) at a point 10 to 15 m offshore and 1 m off bottom. Grab samples were also collected for TSS analysis at 1/4, 1/2 and 3/4 depth once each day at the same location to supplement the automatic sampler data.

These samples were all analyzed for turbidity and TSS, as well as a variety of other parameters depending on the focus of the particular agency (i.e., MOEE samples analyzed for nutrients, metals, etc to assess contaminant loadings).

Turbidity was also measured in the field with a sensor on the dredge head, and in samples collected adjacent to the dredging operation. The dredge head sensor provided an instantaneous readout of turbidity, which was also recorded in an on-board datalogger. Water samples were analyzed for turbidity in an on-site trailer, and the same samples were subsequently taken to Acres Analytical for analysis for TSS. The turn around time for TSS samples was/is approximately 4 hours including travel and analytical time.

A review of the above-noted description of the 1991 sampling programs indicates that there was considerable duplication and that one common sampling program should be able to satisfy the requirements of all agencies. In addition, assuming that an acceptable relationship can be established between turbidity and TSS, turbidity would be the preferred parameter for evaluating the dredging operation, as it can be field measured in a short turn around time (a matter of minutes).

The relationship between turbidity and TSS, however, is not always well defined, as each measures different properties of the sample (i.e. TSS measures the total suspended solids which may be particles of various shapes and sizes, while turbidity measures the ability of a beam of light to pass through a sample and can be strongly influenced by the shape and size of the particles within the sample). If a relationship is to be valid, it is generally considered that one must be developed on a site by site basis.

Two plots of turbidity vs TSS for those samples collected during the 1991 Welland River Demonstration (from Table C1.3 of the ESR) are presented in Figures 1 and 2 (Figure 1 a direct plot, Figure 2 a log-log plot). Regressions on the data sets used to develop Figures 1 and 2 are presented in Tables 1 and 2, respectively. The R squared value is good for both data sets (normal and log transformed), and the log transformed data provides a reasonably straight line relationship. However, the hand-drawn curve shown in Figure 1 would appear to be as good a representation as any, particularly as the relationship is likely more complex than a straight line. An important observation is, however, that most of the TSS and turbidity data points are less than 50 mg/L and 20 to 25 FTU, respectively. Above these levels, the relationship is not as well established, but can be approximated by the curve shown in Figure 1. Also, the relationship has been developed with data from the same section of the river as the currently proposed project and under similar conditions (i.e., during dredging) as will be experienced during this project.

In order to develop the proposed 1995 criteria based on turbidity, TSS values were converted to turbidity using Figure 1 data. Regulatory limits (as turbidity) were then plotted against background turbidity as shown in Figure 3. The EC 1991 turbidity criterion of 30% above background is not considered to be compatible with their TSS criterion of 25 mg/L above background and for this reason has not been plotted. Also, the MOEE criterion was not plotted because it was found to be easily met by the MNR criterion.

The EC and MNR criteria represented in Figure 3 cannot easily be compared because the EC criterion applies to monitoring at a distance of 25 m from the dredge, while the MNR's applies to monitoring at a distance of 100 m downstream from the silt curtain.

Proposed 1995 Water Quality Criteria and Monitoring Program

Recent discussions with I. Orchard/R. Santiago have indicated that the following (or similar) performance/shutdown criterion will be proposed by Environment Canada for implementation during the full-scale demonstration project.

The criterion would require that, in order for dredging to continue, the turbidity measured at a distance 25 m downstream from the dredge must not exceed the limits identified by the solid line curve shown in Figure 3 (this curve is equivalent to 25 mg/L above background), averaged over a 1-hour period. Environment Canada would propose that three automatic, continuous turbidity monitors be set up during the project as follows

- one at the dredge head (for data collection and dredge evaluation only)
- two at 25 m downstream from the dredge at different locations across the river.

Note: Additional continuous monitoring of background turbidity upstream of the dredge will be required to evaluate compliance with regulatory requirements.

If the criterion is exceeded at any single downstream monitoring location the dredging can be required to terminate until appropriate actions are taken by the contractor to return turbidity during dredging to acceptable levels.

Environment Canada are investigating the loan of appropriate turbidity monitors from CCIW for use during the project.

In the absence of continuous turbidity monitors, Acres would propose that the same criterion be used, but that it be based on turbidity measured in grab samples collected at intervals of not less than 2 hours and averaged over a 4-hour period. That is, any decision regarding dredging would be based on an average of 3 turbidity measurements at any one location, over a 4-hour period. It is also considered important that the contractor's actions and the trend in the measured turbidity levels be given some consideration in deciding if the contractor will be allowed to continue dredging.

Depth integrated or depth composite grab water samples would be collected from three locations on each of two transects across the river. One transect would be located 50 to 100 m upstream of the dredging site and would be used to identify background turbidity levels. The other transect would be located 25 m downstream of the dredge. Turbidity monitoring at the dredge head could be done using either a continuous monitor or grab samples collected during dredging.

Grab sampling as described above cannot realistically be carried out at intervals of less than 2 hours. This alone would require a crew dedicated full time to water quality monitoring. The continuous monitoring (or the minimum 2-hour grab sample monitoring) would be proposed for, say, the first 5 days of dredging at the McMaster Avenue outfall area, for the first 2 to 3 days at the Atlas 42-in. outfall area and again for 2 days when the downstream end of the Atlas 42-in. outfall reef is being dredged, or until it can be determined that the dredging is not impacting the downstream water quality. At this time the monitoring frequency would be reduced to intermittent daily continuous monitoring based on visual assessment or need, or twice daily grab sample monitoring. TSS would be measured in selected water samples early in the monitoring program to further develop the TSS vs turbidity relationship. If required, other parameters (e.g., metals, TOC) can also be measured in the collected water samples.

Finally, the specifications for the project require that the contractor continuously measure and data-log turbidity levels at the dredge head during all operational periods. It was noted during the 1991 pilot-scale demonstration, that operator control of the dredging process was a significant factor in the resuspension of sediment from the dredge head. Given that data from the upstream and downstream sampling programs will be available to the contractor for his information, we anticipate that the correlation between dredge head turbidity levels, dredge feed rate and downstream turbidity levels will quickly be established. The contractor will then be able to utilize the information being presented by the on-board readout of dredge head turbidity to ensure that the downstream turbidity limits are not exceeded. Thus, the initially intensive sampling program will provide not only information to assess regulatory compliance, but will also be of use to the contractor in establishing operational limits and achievable performance standards.

The foregoing is presented with the intention that the criterion proposed herein form the basis of serious discussion to enable the regulatory agencies having jurisdiction over the Welland River water quality to develop a single water quality criterion for use during the planned 1995 dredging project. This issue will be raised for discussion at the next Welland River (Welland) Cleanup Committee meeting.

Comments from all recipients of this letter are invited. Responses should be directed to L. King or the undersigned at Acres Niagara Falls office (905) 374-5200.

Yours very truly,

P. C. Miles

PCM:gf

P. C. Miles
Project Manager

Attach

cc D. Marr, Atlas
D. Cook, City of Welland
J. Furgal, Regional Municipality of Niagara

Distribution

S. Berdan, NPCA
T. Gebrezghi, MOEE
I. Orchard, Environment Canada
R. Slattery, MOEE
A. Yagi, MNR

Welland River Dredging Demonstration

Turbidity vs TSS Data

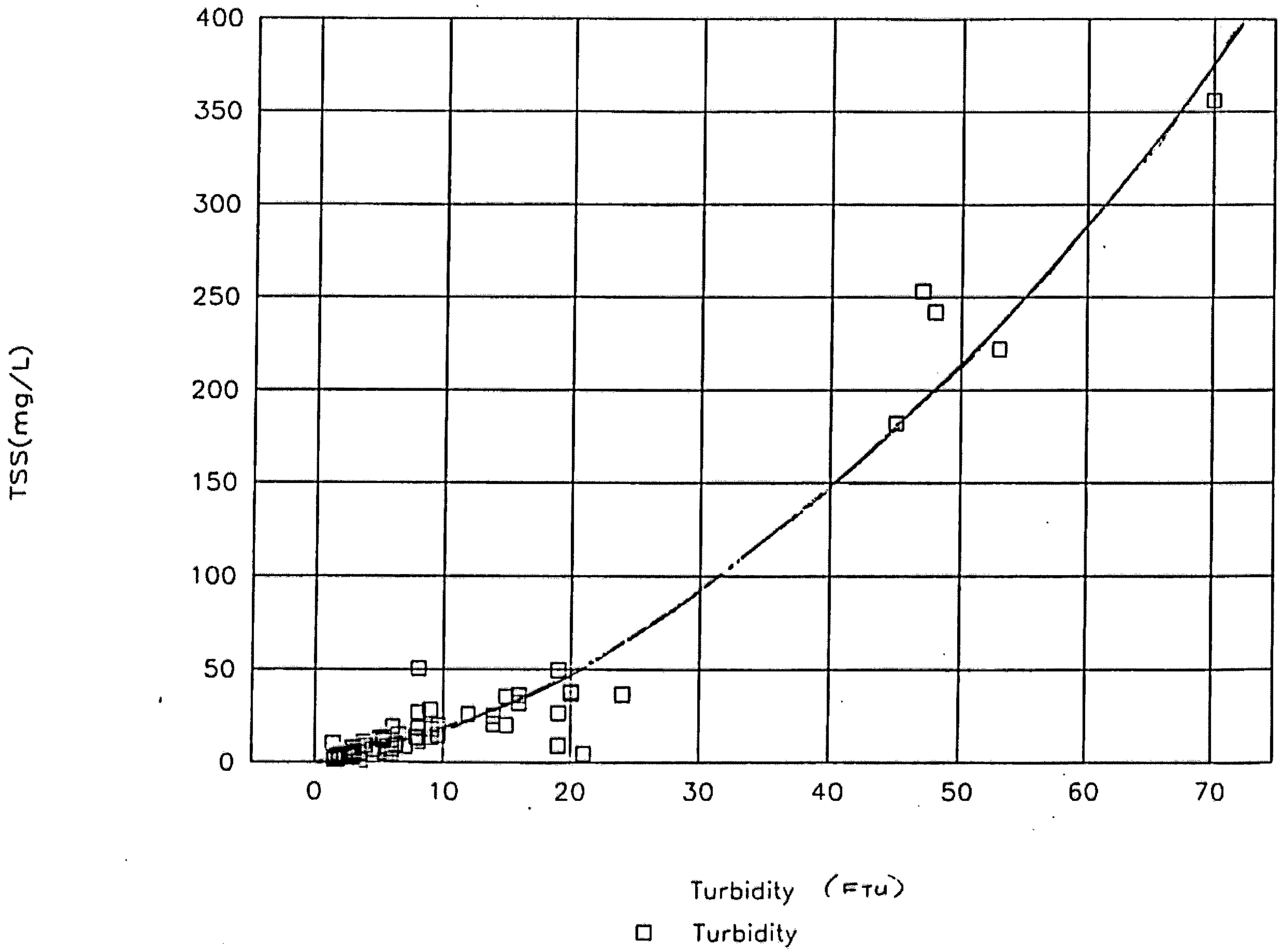


FIGURE 1

TURBIDITY VS TSS.

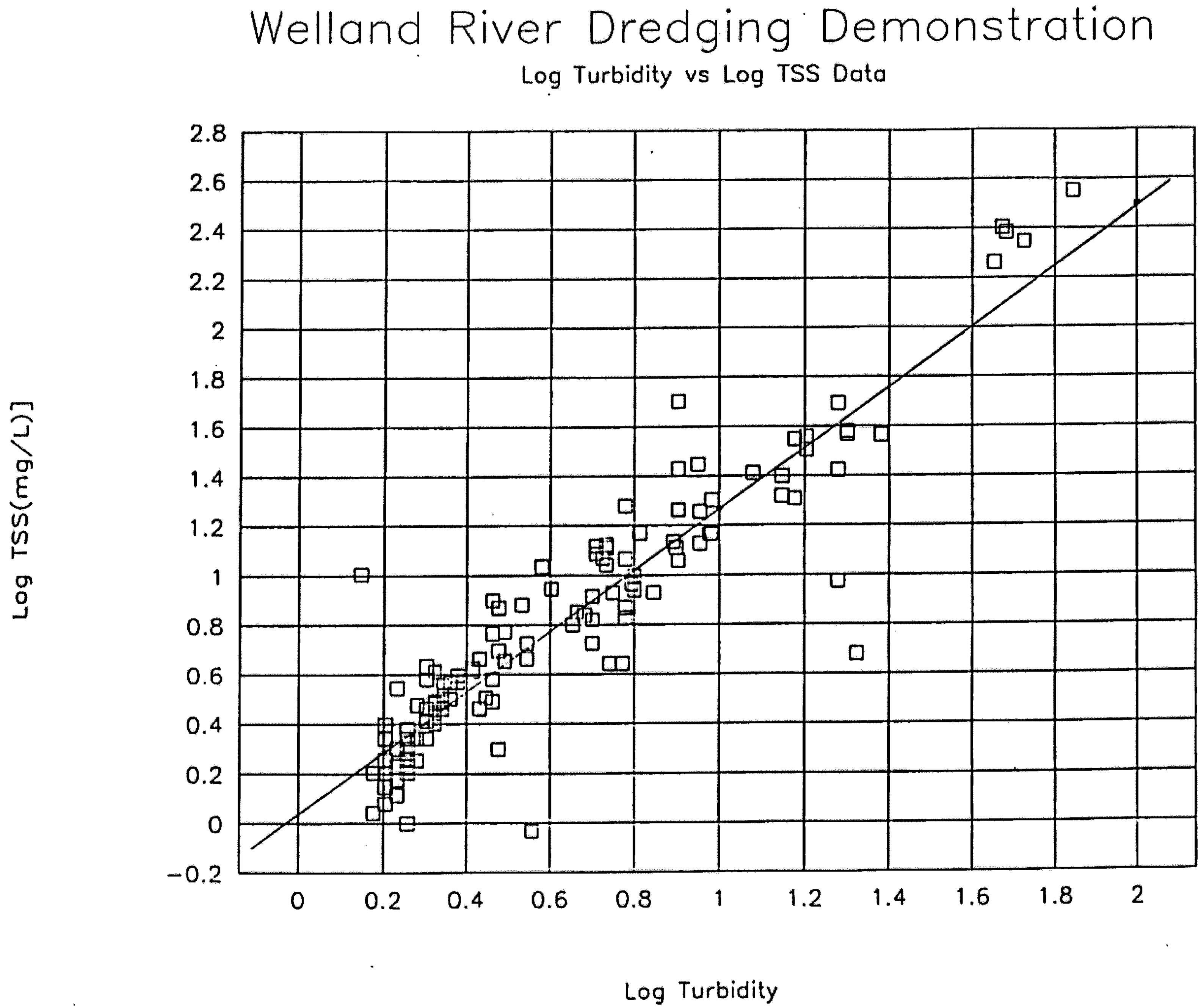


FIGURE 2

LOG TURBIDITY VS LOG TSS

Annex 2

Additional Public Information

Table 1
Turbidity vs TSS Regression

Regression Output:Turb vs TSS		
Constant		-12.8601
Std Err of Y Est		17.27199
R Squared		0.882572
No. of Observations		124
Degrees of Freedom		122
X Coefficient(s)	4.394669	
Std Err of Coef.	0.145129	

Table 2
Log Turbidity vs Log TSS

Regression Output:Log Turb vs Log TS		
Constant		0.042404
Std Err of Y Est		0.207639
R Squared		0.848735
No. of Observations		124
Degrees of Freedom		122
X Coefficient(s)	1.226748	
Std Err of Coef.	0.046887	

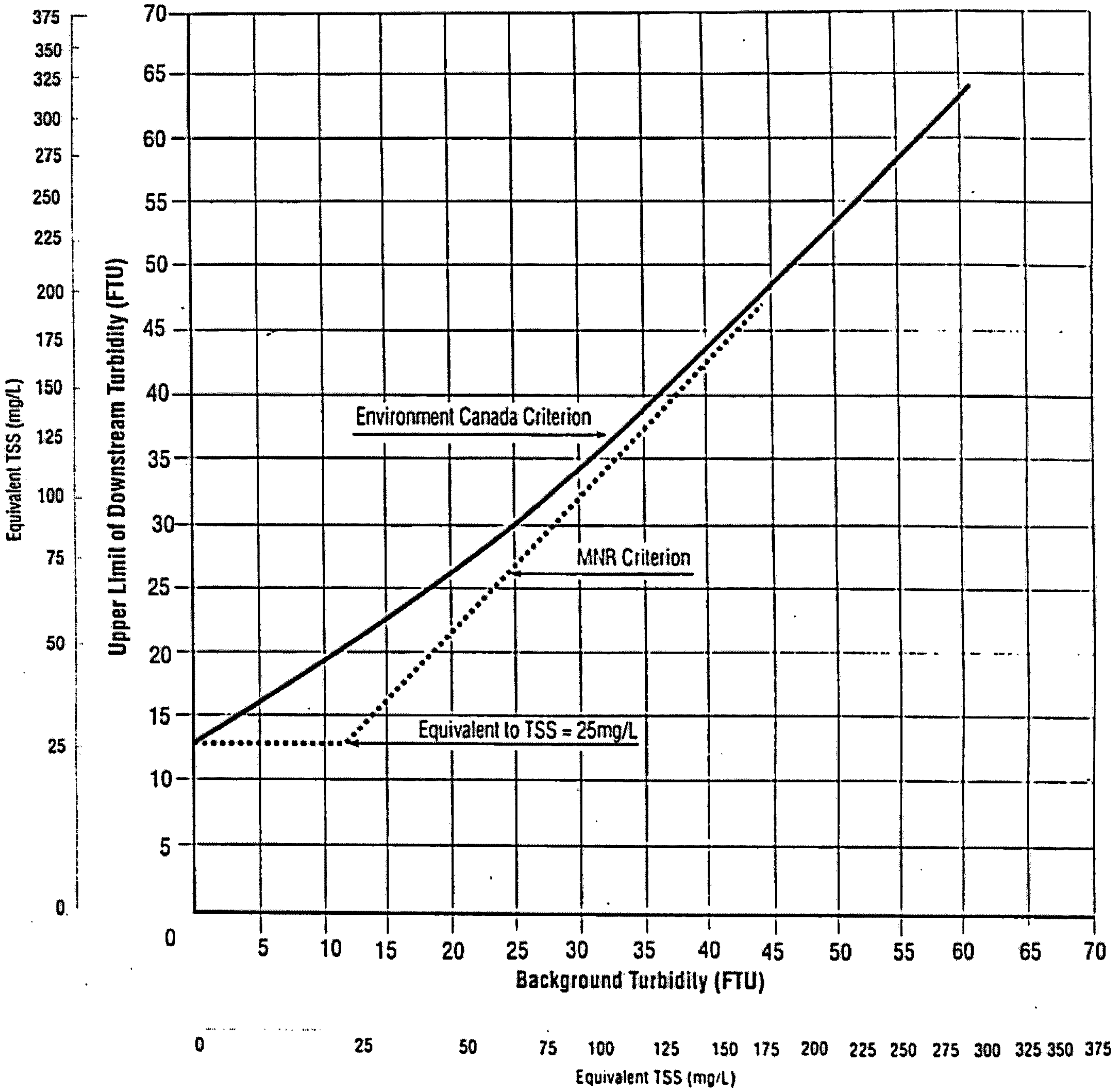


Fig. 3

Atlas Specialty Steels
Welland River Reef Cleanup Project
Welland River Water Quality Criteria

ACRES

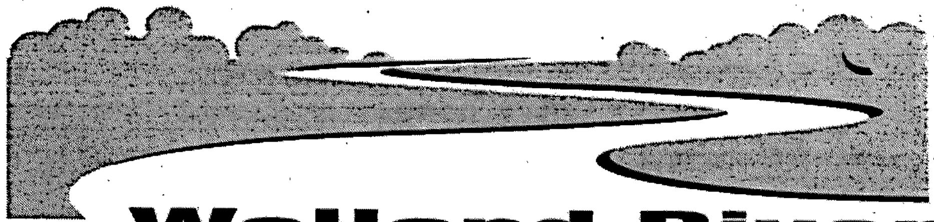
Newsletter Distribution List - 28-31 Aug. 1995

1. Postal Walk 51 - 503 (Local residents indicated that their copies were delivered on Aug.29)
2. NRRAP-RAP (V. Cromie) - 50 (asked to distribute to Brock University)
3. Welland Library, 140 King St. - 30
4. Friends of the Welland River - 20
5. Welland City Hall - 30
6. Niagara College - Joan Morrison - 15, General Distribution - 15
7. MOEE - 25
8. MNR - 30
9. NPCA - 50
10. Regional Niagara (J. Furgal) - 10
11. Peter Kormos - 20
12. Gib Parent - 20
13. Auberge Richelieu - 5
14. Atlas - 50
15. Personal letters to all 'close' residents (6) and those who attended the public meeting (17)
16. All members of WRRCC
17. Environment Canada - 100
18. Ontario Construction Co - 15

Information Update

Key Dates/Events

- Project Mobilization Week of August 28, 1995
- Start of Dredging Week of September 18, 1995
- Complete Dredging Week of October 23, 1995
- Demobilization and Cleanup Week of November 12, 1995



Welland River Cleanup Project

Background

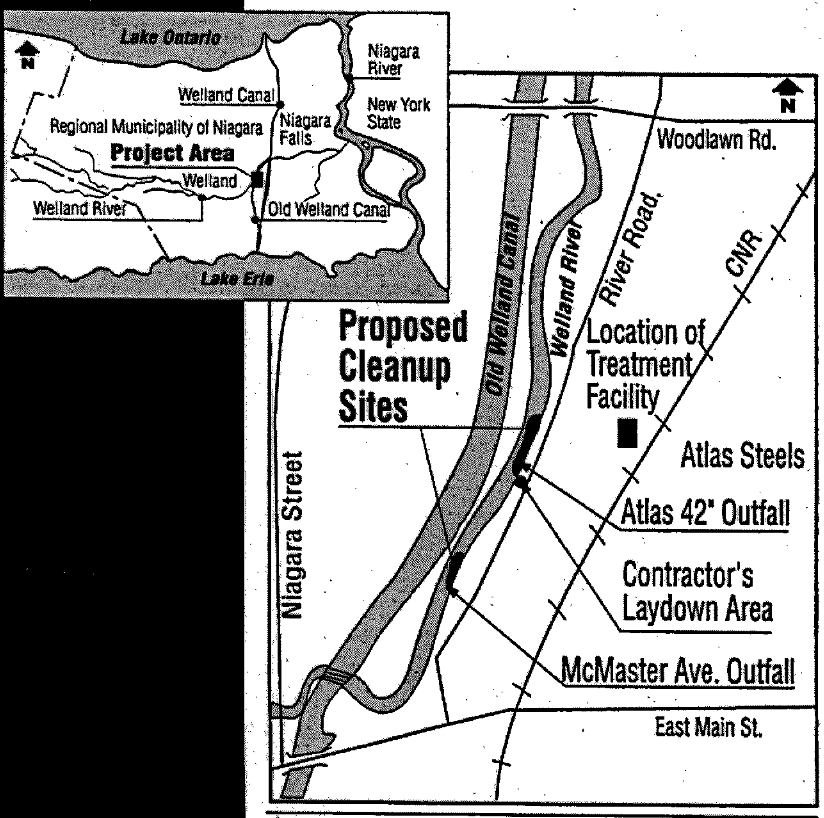
In March this year, an information sheet was issued describing the Welland River Cleanup Project. This is an update to that report.

The current Welland River Reef Cleanup Project had its beginnings in the late 1980's when researchers at Brock University discovered heavy metals and oil and grease-contaminated sediments in the lower Welland River. Reef-like deposits were found adjacent to two sewer outfalls utilized over the previous 50 to 60 years by Atlas Specialty Steels and other local dischargers (industrial and municipal). Atlas acknowledged responsibility for the metallic mill-scale portion of the reef deposits in 1987, and initiated studies of the local riverine environment to determine the extent of the contamination and provide background data for the development of remedial plans.

A demonstration project undertaken in the fall of 1991 removed approximately 130 cubic metres of contaminated sediment from the Welland River and confirmed the effectiveness of the dredging and treatment process. It also confirmed that there was negligible environmental impact associated with either process.

The current project builds on this earlier experience and will remove the rest of the industrial contaminated sediment (approximately 7000 cubic metres).

The cleanup has been developed under the guidance of the Welland River Cleanup Committee and is planned as a remediation project within the Niagara River Area of Concern. It has received the endorsement of the Niagara River Remedial Action Plan (RAP) Public Advisory Committee and the RAP team.



▲ *Location Map*

Cleanup to Commence in September

It had been anticipated last spring that the removal of the two contaminated reefs would have been completed by early September. For several reasons the schedule has been delayed; however, contracts have now been awarded and the project will be commencing in September, with scheduled completion in early November.

The project will be managed/contracted as follows:

Atlas Specialty Steels will have overall management responsibility for the project.

Acres International Limited will continue as consultant to Atlas and will assist Atlas with the project management and coordination of the contractors' activities. **Normrock Industries Incorporated** will be responsible for dredging activities and operation of the slurry pipeline.

The Ontario Construction Company Limited will be responsible for installation of sheet piling and placement of granular material to stabilize the dredged streambed/floodplain slope.

Derrick Corporation will provide treatment equipment, and training and supervisory services for the operation of the sediment treatment facility by Atlas.

Welland River Cleanup Committee

Niagara Peninsula Conservation Authority (Chair)

Atlas Specialty Steels*

Environment Canada*

Wastewater Technology Centre

Ontario Ministry of Environment and Energy*

Ontario Ministry of Natural Resources

Regional Municipality of Niagara*

City of Welland*

Niagara River RAP PAC

Niagara Ecosystems Task Force

Members of the Public

Friends of the Welland River

Acres International

*Providing Financial Support

Cleanup Activities

It is proposed to remove the contaminated reef materials at the McMaster Avenue and the Atlas 42 inch sewer outfalls (see figure on reverse side). The material will be dredged from the river bed and pumped through a slurry pipeline to Atlas' North Filtration Plant where a temporary facility will be established to treat and dewater the dredged material.

Some project design changes have been required since the March 1995 newsletter and the public meeting of March 21 1995.

The main change has been in the choice of dredge. It is now proposed to use an Amphibex dredge (see photograph) rather than a Mud Cat-type dredge. The Amphibex is a combination backhoe/hydraulic suction dredge with the capability of excavating most sediment types and pumping them in slurry form to a designated discharge point. The bucket feature of the dredge allows for removal of large material including rocks, boulders or pieces of debris (i.e. logs or discarded objects). The Amphibex is positioned by deploying spuds (feet) into the bed of the river, in combination with side stabilizing arms which rest on the riverbed. It does not require anchoring cables stretched across the river, as would be needed with the Mud Cat-type.

The Amphibex dredge allows for greater flexibility of positioning and operation. Because the side stabilizer arms and excavating bucket are in contact with the river sediment, some resuspension of sediment may occur. To prevent the resuspended sediment from being transported downstream, it is proposed to encircle the dredging activities with a silt curtain. Turbidity monitoring will be undertaken both inside and outside of the silt curtain to evaluate the impact of the dredge and effectiveness of the silt curtain. The dredging operation will be shut down if the turbidity levels exceed the operational limits as set by Environment Canada, and the Ministries of Natural Resources and Environment and Energy.

To avoid removal of existing wetland near the Atlas 42 inch outfall and to separate contaminated river sediments from floodplain sediments, another change is proposed. Sheetpiling will be installed at the water's edge using a low noise vibratory technique. Once the contaminated sediment has been removed, granular material will be backfilled against the sheet piles to provide stable slope conditions at the river bank. The top of the backfill will be at the same elevation as the wetland surface and the sheetpiling will remain in place invisible below water level.

To minimize inconvenience to the public and disturbance to the river bank, the contractors will have only one equipment laydown area. It will be located just south of the Atlas 42 inch outfall and all access to the river will be from a temporary dock built there. After completion of the work, the area will be rehabilitated as needed.

Any Questions?

For further information please contact:

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Cate Mee/Larry King,
Acres International Limited, Niagara Falls
905-374-5200

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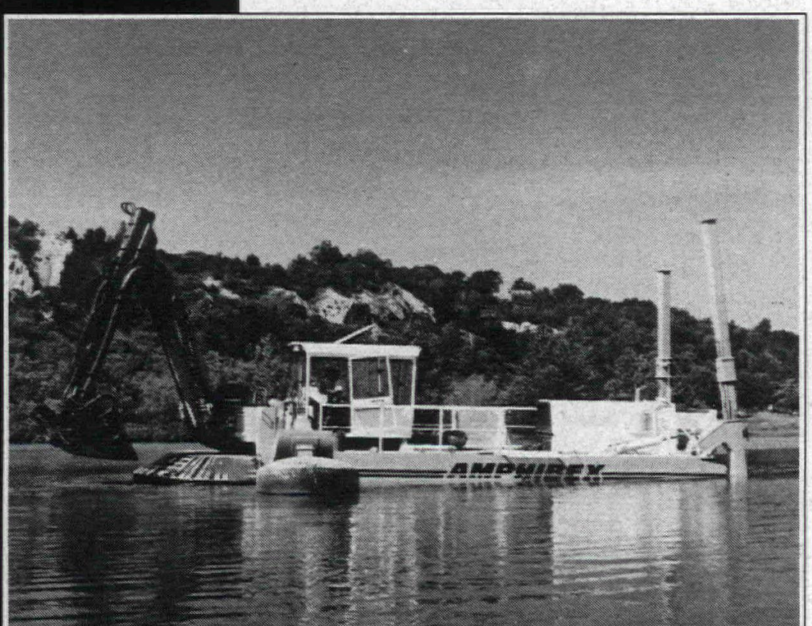
Niagara River Remedial Action Plan,
Public Advisory Committee
905-374-8113

The project is being funded by Atlas Specialty Steels, Environment Canada's Remediation Technologies Program (through the Great Lakes 2000 Cleanup Fund), the Ontario Ministry of Environment and Energy, the City of Welland and the Regional Municipality of Niagara.



◀ *Amphibex Dredge*

Atlas Specialty Steels
Welland, Ontario
and
Environment Canada
Toronto, Ontario

Welland River Reef Cleanup Environmental Screening Report

May 1995

P11201.00

Acres International Limited
Niagara Falls, Ontario

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Glossary of Abbreviations

Acres	Acres International Limited
AOC	Areas of Concern
Atlas	Atlas Specialty Steels
DOF	Department of Fisheries and Oceans
EARP	Environmental Assessment and Review Process
EPA	Environmental Protection Act
FTU	Forzamin Turbidity Units
LOI	loss of ignition
LEL	lower effect level
MOEE	Ontario Ministry of Environment and Energy
MNR	Ontario Ministry of Natural Resources
NPCA	Niagara Peninsula Conservation Authority
NFP	North Filtration Plant
PAH	polycyclic aromatic hydrocarbons
PSQG	Provincial Sediment Quality Guidelines
PAC	Public Advisory Committee
PWC	Public Works Committee
PWGSC	Public Works and Government Services Canada
PWQO	Provincial Water Quality Objective
Region	Regional Municipality of Niagara
SEL	severe effect level
TRC	Technical Review Committee
TSB	temporary storage basin
TOC	total organic carbon
WPCP	Water Pollution Control Plant
WRCC	Welland Reef Cleanup Committee
WRRC	Welland River Reef Cleanup

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1 Introduction

Atlas Specialty Steels (Atlas) proposes to undertake a cleanup of two contaminated sediment deposits (reef formations), in the Welland River adjacent to its site of operations (Figures 1.1 and 1.2). The reefs are primarily associated with two specific sewer outfalls, and are comprised of industrial mill scale (metallic particles) and solvent extractable contaminants (oils and grease) released by Atlas and other sources into the river over a period of 50 to 60 years, prior to the 1980s. The reef materials exceed the Severe Effect Level (SEL) of the provincial sediment quality guidelines for a variety of metals (notably Ni, Cr, Cu, Fe, Pb and Zn) and have been found to be toxic to sediment dwelling organisms during biological sampling and testing in the field and laboratory. Although it is known that various levels of contamination also exist within the floodplain sediments adjacent to and downstream of the proposal removal areas, the evaluation of the risk associated with those sediments and the need for their removal/rehabilitation is not part of this project. The goal of the current project is the removal and treatment of the contaminated riverine sediments, without significantly impacting associated floodplain sediments or wetland, or limiting future planning options for those areas. The project is part of a long-term multistakeholder, multiphase plan to improve the quality of the Welland River and its watershed. Financial support for the project is being provided by Atlas, Environment Canada, Ontario Ministry of Environment and Energy (MOEE) (pending), Regional Municipality of Niagara (Region) and City of Welland.

A pilot-scale demonstration of the proposed innovative dredging technology and associated treatment process was undertaken during the fall of 1991 to assess its suitability and feasibility for a larger scale cleanup. That project concluded that the dredging and treatment technologies utilized were viable and appropriate for a larger scale demonstration, and that the environmental impact of the process could be controlled/mitigated with existing technology(s). This project will build upon the experience gained during the previous demonstration and will evaluate the viability of the selected technologies and processes during a full-scale, production-oriented remediation project.

Public consultation has been a key element in project development since its inception, consisting of two workshops (one before and one after the pilot-scale demonstration), an open house (prior to the pilot-scale project) and most recently a public meeting with associated local distribution of newsletters. In addition, the project development process has been reviewed and guided by the Welland River (Welland) Cleanup Committee (WRCC) and its associated Technical Review Committee (TRC), as well as the Niagara River Remedial Action Plan Public Advisory Committee (PAC). Efforts have been made throughout the project development process to inform and solicit input from the public and interested parties. A partnership approach has been applied throughout the process in terms of funding, project direction and review.

This document summarizes and addresses the environmental concerns and issues associated with the previous demonstration and the proposed larger scale cleanup. It evaluates the environmental effects of the proposed reef cleanup project, and identifies and evaluates mitigative measures that have been implemented to minimize adverse effects/enhance positive effects of the project. It is also intended to fulfill the requirements of the Environmental Assessment and Review Process (EARP) for federal agency financial assistance to the project (i.e., Environment Canada). The report is also intended to satisfy the requirements of the various other federal, provincial and local agencies [Department of Fisheries and Oceans (DFO), Ontario Ministry of Natural Resources (MNR), MOEE, Region, City of Welland, and the Niagara Peninsula Conservation Authority (NPCA)], involved in the review and approval of the proposed project.

1.1 Study Area

The study area is located in the Welland River within the Welland city limits (Figures 1.2 and 1.5). The area is situated between two siphons which allow the river to flow under the old and new Welland canals. Upstream from the contaminated deposits is the Region water treatment plant which draws water from the old Welland Canal, while downstream is the Region Water Pollution Control Plant (WPCP). Several other municipal and industrial outfalls also occur along this stretch of the river.

The west side of the river in the project area is Merritt Island which was formed during the construction of the old Welland Canal. The island is a park owned by Public Works and Government Services Canada (PWGSC). In the future all or portions of Merritt Island may be transferred to the City of Welland, to be used as parkland. The east shore of the river is mixed residential, industrial and unused open field or woodlot.

The Welland River from its mouth at the Niagara River to the Old Welland Canal siphon is designated as a provincially significant (Class I) wetland. A fairly substantial floodplain has developed along both banks of the river. The floodplains range in width from a few meters to approximately 20 m in the area of the reef deposits. The floodplains are vegetated by emergent wetland plants dominated by cattails *(Typha).*

The 1991 demonstration project concentrated on removal of a portion (127 m^3) of the industrial mill scale and contaminated clay/silt sediment reef located at the foot of McMaster Avenue (Figure 1.3). This material was transferred by pipeline to a treatment facility established on Atlas property adjacent to their North Filtration Plant (NFP) at which point solids were separated and dewatered for disposal. The end product of this process can be classified as a nonregisterable, nonhazardous solid industrial waste, suitable for industrial landfilling. Liquid effluents were blended with and treated by the existing NFP. Operational discharges of the NFP remained within their Certificate of Approval (water) limits throughout the demonstration.

1.2 Proposed Project

The goal of the current project is the removal of the remainder of the reef at the McMaster Avenue sewer outfall and the removal of the reef associated with the Atlas 42-in. outfall (Figures 1.4 and 1.5). Similar dredging and treatment technologies as utilized during the demonstration project will be employed taking into account improvements/ refinements forthcoming from that demonstration, and the individual comments/ suggestions of the numerous agencies associated with the previous project. It is recognized that this project is one phase of a larger plan to remediate the Welland River, being part of the larger Niagara River Areas of Concern (AOC). The project is one of the remedial activities recommended in the Stage 2 Niagara River RAP document, (Recommendation 16), and has received the endorsement of both the Niagara River PAC and the RAP Team. It also addresses the Canada-Ontario Agreement regarding the cleanup of severely contaminated sediments. The specific goals for the rehabilitation of the affected floodplain will be established by a subcommittee of the WRCC in consultation with the public and appropriate resource and regulatory agencies (primarily MNR and DFO). This project will strive to ensure that future planning options for the floodplain and adjacent wetlands are not restricted by the proposed remediation and slope stabilization processes selected for the project.

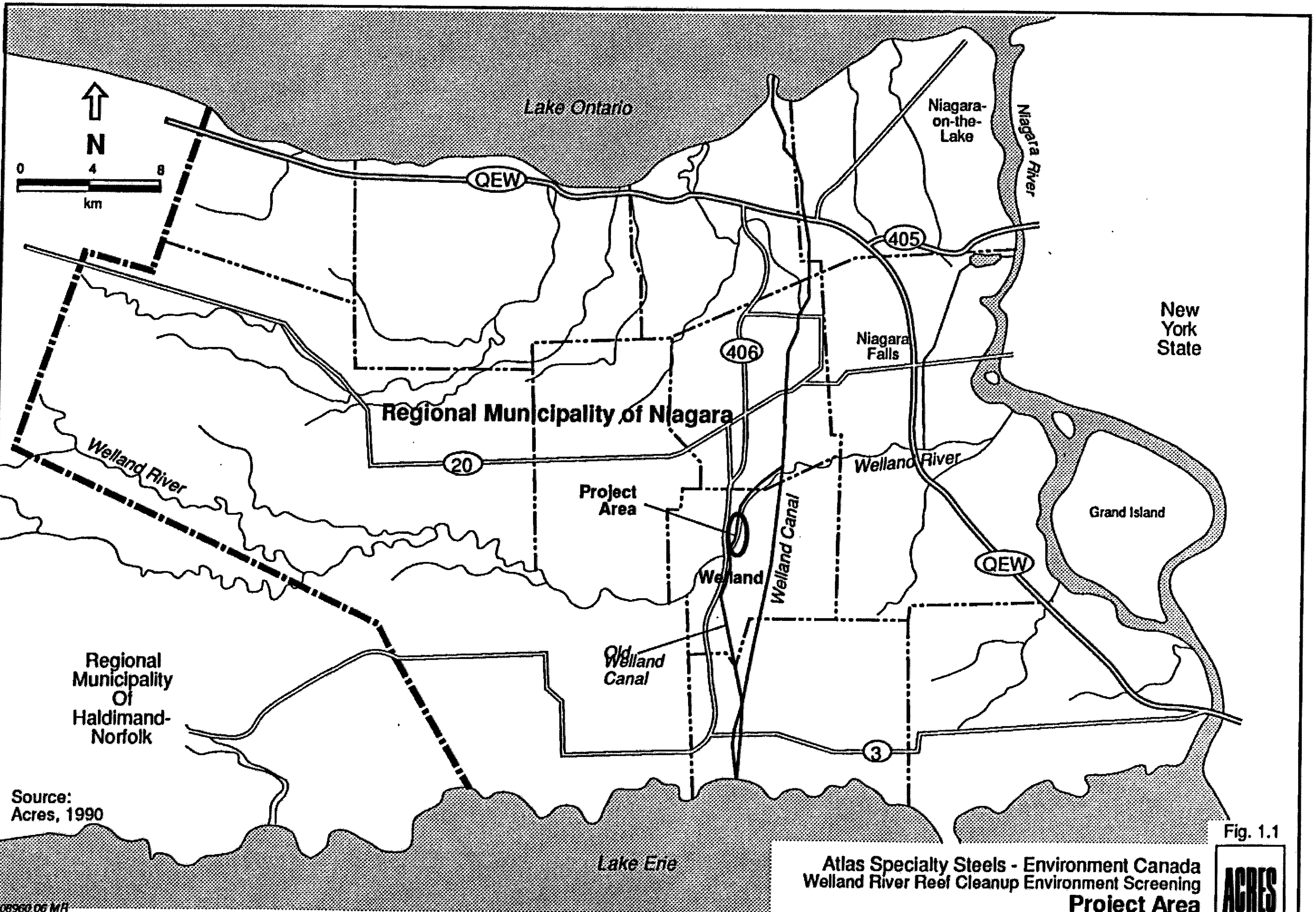


Fig. 1.1

Atlas Specialty Steels - Environment Canada
Welland River Reef Cleanup Environment Screening
Project Area

ACRES

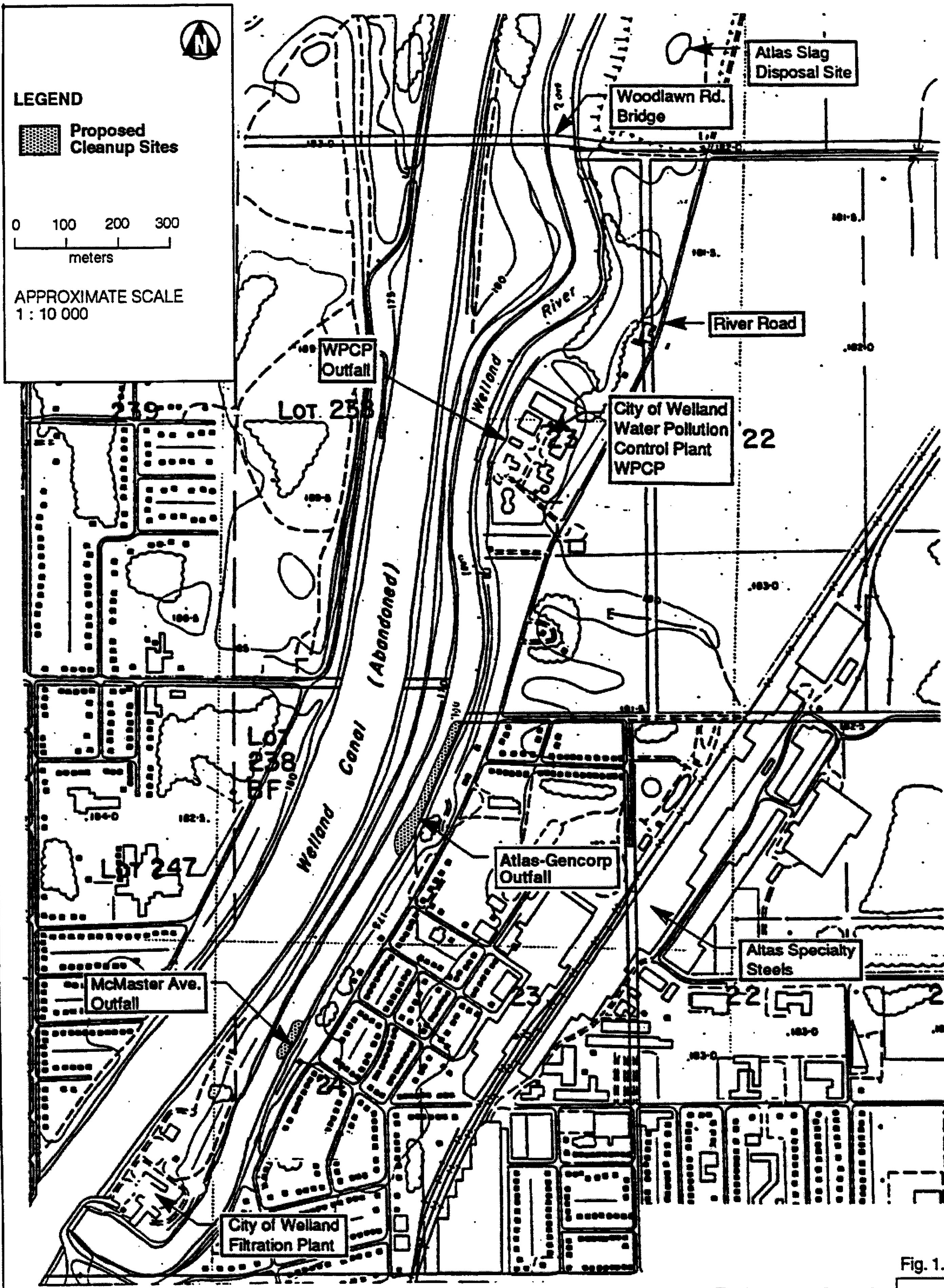
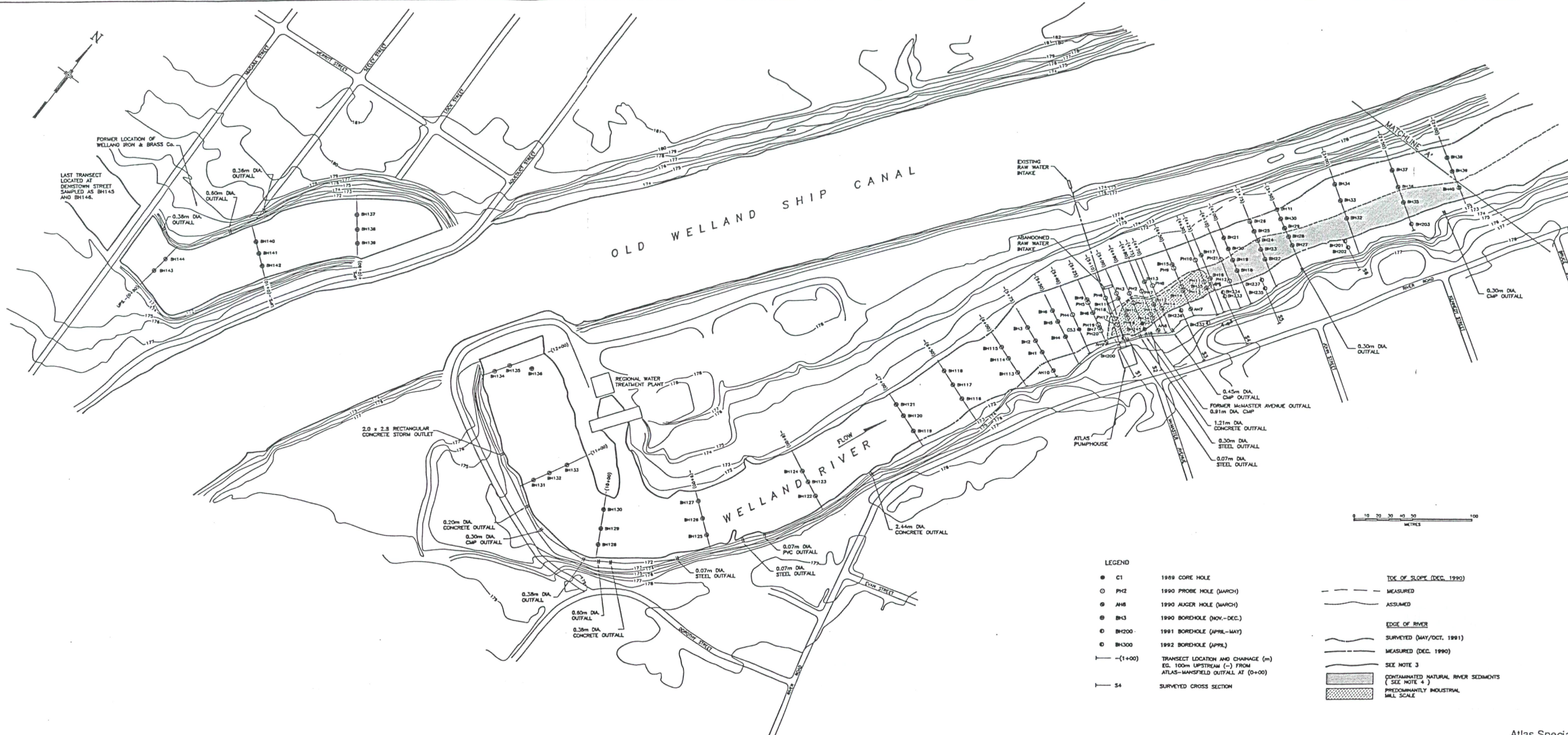


Fig. 1.2

Atlas Specialty Steels - Environment Canada
Welland River Reef Cleanup Environmental Screening
Project Location

ACRES



0 10 20 30 40 50 100
METRES

LEGEND

●	C1	1989 CORE HOLE
⊙	PH2	1990 PROBE HOLE (MARCH)
	AH8	1990 AUGER HOLE (MARCH)
⊕	BH3	1990 BOREHOLE (NOV.-DEC.)
	BH200	1991 BOREHOLE (APRIL-MAY)
	BH300	1992 BOREHOLE (APRIL)
⊢—	-(1+00)	TRANSECT LOCATION AND CHAINAGE (m) EG. 100m UPSTREAM (-) FROM ATLAS-MANSFIELD OUTFALL AT (0+00)
⊢—	S4	SURVEYED CROSS SECTION

TOE OF SLOPE (DEC. 1990)

- MEASURED
- ASSUMED

EDGE OF RIVER

- SURVEYED (MAY/OCT. 1991)
- MEASURED (DEC. 1990)
- SEE NOTE 3
- CONTAMINATED NATURAL RIVER SEDIMENTS (SEE NOTE 4)
- PREDOMINANTLY INDUSTRIAL MILL SCALE

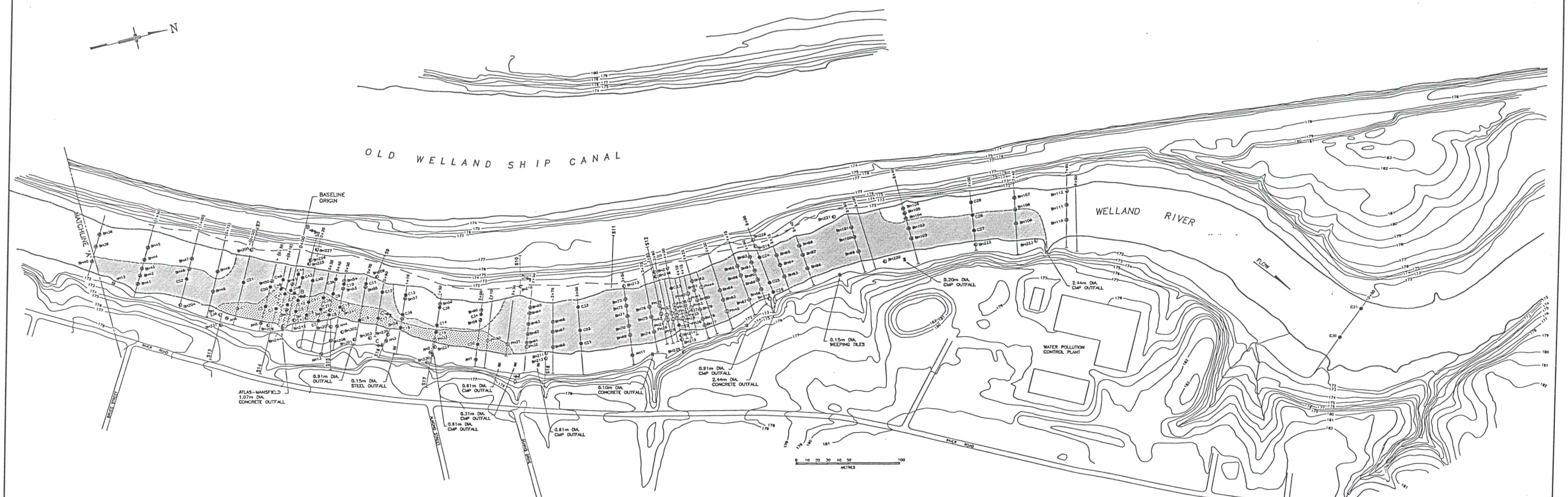
NOTES

1. FOR RIVER CROSS SECTIONS AT TRANSECT LOCATIONS REFER TO NOV./DEC. SITE INVESTIGATIONS REPORT (ACRES, JULY 1991)
2. GROUND SURFACE CONTOURS IN METERS
3. ORIGINAL TOPOGRAPHY AND RIVER BOUNDARIES TAKEN FROM NIAGARA PENINSULA CONSERVATION AUTHORITY MAPPING (SCALE 1:2000) FORMING PART OF 1985 FLOOD LINE MAPPING REPORT BY M.M. DILLON LTD. SOURCE AIR PHOTOGRAPHY IS APRIL 1980. RIVER BOUNDARY HAS BEEN MODIFIED AS SHOWN BASED ON PROJECT SURVEYS.
4. THE CONTAMINATED NATURAL RIVER SEDIMENTS SHOWN SHADED GENERALLY CONTAIN CONTAMINANT CONCENTRATIONS WHICH STATISTICALLY WERE FOUND TO EXCEED THE UPSTREAM AMBIENT CONCENTRATIONS.
5. FOR SAMPLING LOCATIONS IN THE VICINITY OF ATLAS-MANSFIELD OUTFALL AND DOWNSTREAM, REFER TO FIGURE 2.2.

Fig. 1.3

Atlas Specialty Steels - Environment Canada
Welland River Reef Cleanup Environmental Screening
Site Investigations - McMaster Avenue Outfall

ACRES



LEGEND

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- MEASURED
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EDGE OF RIVER

- SURVEYED (MAY/OCT. 1991)
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- PREDOMINANTLY INDUSTRIAL MILL SCALE

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5. FOR UPSTREAM SAMPLING LOCATIONS REFER TO FIGURE 2.1

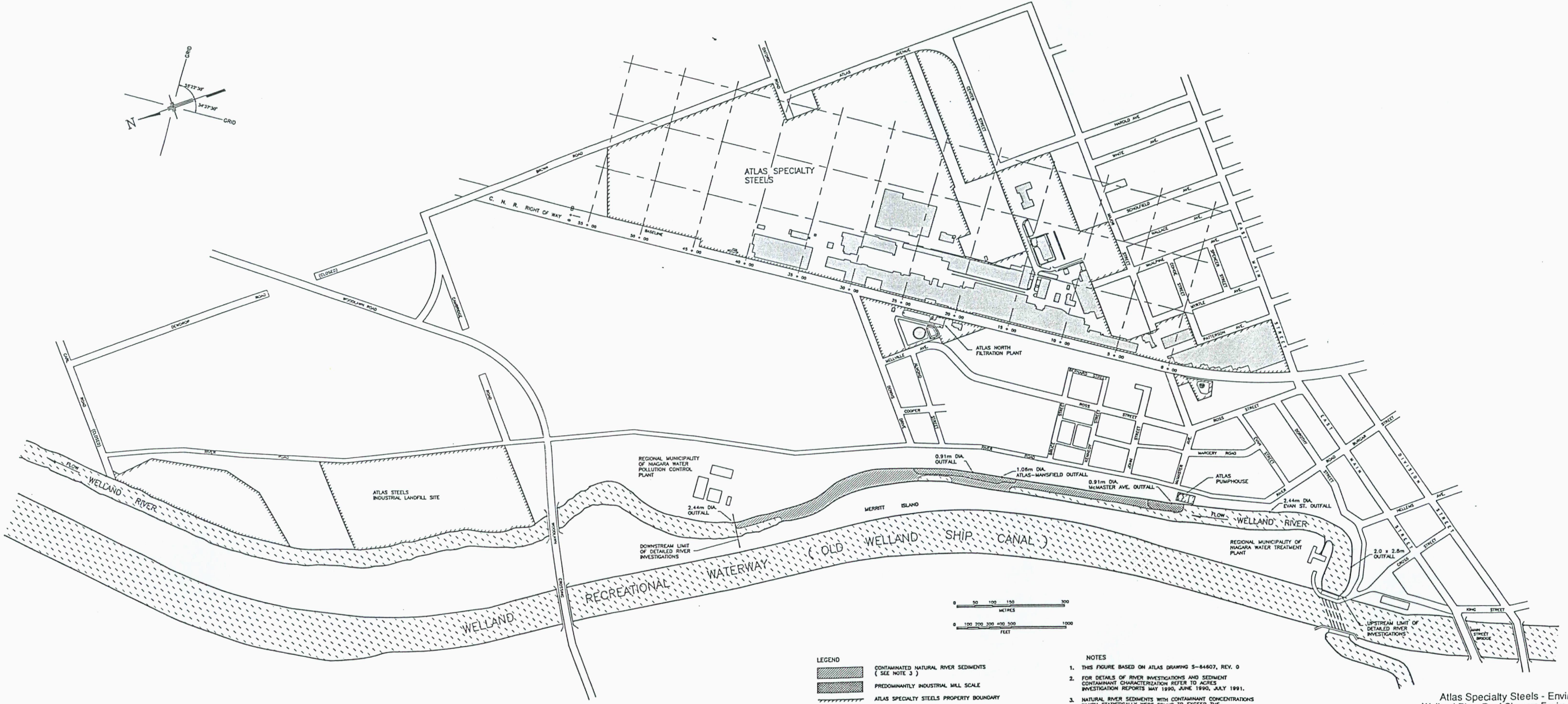
Fig. 1.4

Atlas Specialty Steels - Environment Canada

Welland River Fieef Cleanup Environmental Screening

Site Investigations - Atlas 42-in. Outfall and Downstream

ACRES



LEGEND

- CONTAMINATED NATURAL RIVER SEDIMENTS (SEE NOTE 3)
- PREDOMINANTLY INDUSTRIAL MILL SCALE
- ATLAS SPECIALTY STEELS PROPERTY BOUNDARY

NOTES

1. THIS FIGURE BASED ON ATLAS DRAWING S-84607, REV. 0
2. FOR DETAILS OF RIVER INVESTIGATIONS AND SEDIMENT CONTAMINANT CHARACTERIZATION REFER TO ACRES INVESTIGATION REPORTS MAY 1990, JUNE 1990, JULY 1991.
3. NATURAL RIVER SEDIMENTS WITH CONTAMINANT CONCENTRATIONS WHICH STATISTICALLY WERE FOUND TO EXCEED THE UPSTREAM AMBIENT CONCENTRATIONS.

Fig. 1.5

Atlas Specialty Steels - Environment Canada
Welland River Reef Cleanup Environmental Screening
General Site Layout

ACRES

2 Project Background

2.1 Agency Studies

In the early 1980s, Brock University Professors I. D. Brindle and M. Dickman, with funding from MOE and in cooperation with Atlas, undertook a preliminary investigation of inorganic contaminants in sediments of the Welland River, and reported on variations in aquatic vegetation above and below the Atlas 42-in. outfall along the east bank of the river between Bruce and Almond Streets in Welland. The results of the initial sediment sampling and chemical testing indicated that an area of heavy metal contamination existed in the Welland River in the vicinity of the Atlas 42-in. sewer outfall. Further sampling and testing by Brindle and Pidwerbesky (1989) revealed a reef-type deposit of heavy metals adjacent to the sewer outfall. Chromium and nickel were found to be the major contaminants.

The extent of the contamination was not accurately determined during the preliminary investigation; however, the reef material was recognized as being a sizeable and unsightly deposit as identified in 1987 by Atlas. A small portion of the deposit was, and continues to be, visible above water level at the Atlas 42-in. outfall.

The environmental impact of the deposit on the river's biological community was investigated in the late 1980s by Professor M. Dickman, J. R. Yung, and I. D. Brindle working under grants from governmental and nongovernmental organizations (Dickman et al 1990). The distribution of aquatic biota downstream from the outfall was used to define a primary impact zone and various recovery zones based on higher aquatic plants, diatoms and benthic invertebrates communities. Impacts were reported to extend at least to the Welland WPCP, some 800 m downstream from the Atlas 42-in. sewer outfall.

In 1990, the MOE, as part of the Niagara River Improvement Project, commissioned a study of the lower Welland River water and sediment quality, and aquatic flora and fauna (Tarandus, 1992). That study found that water quality parameters, including iron, copper and total phosphorus frequently exceeded Provincial Water Quality Objectives (PWQOs) at various locations throughout the lower river (Welland Airport to beyond Queenston-Chippawa Power Canal) while other metals, nutrients and organics (PAHs, PCBs and organochlorine pesticides) were below detection limits. Only copper was above the PWQO in the vicinity of the Atlas outfalls. Sediment quality was variable over the same section of river with concentrations of lead, chromium, mercury, cadmium, zinc, iron, nickel, copper, arsenic, TKN, TOC, total phosphorus (TP) and PCBs exceeding the lower effect level (LEL) of the Ontario Provincial Sediment Quality Guidelines (PSQG) at a number of stations. Degraded sediment quality, as indicated by concentrations of several metals above the SEL (primarily Cr, Fe, Ni) were found at a number of stations in the lower Welland River between the siphons, including those upstream of and downstream of the Atlas Steel outfalls. Numerous stations exhibited elevated levels of oil and grease, as compared to the current (1990) Open Water Disposal Guidelines. PAHs exceeded the LEL at four stations in that section.

Fish and benthic invertebrate communities were also sampled as part of the same study. Benthic invertebrate total abundance and number of taxa at the sampling locations adjacent to the Atlas outfalls was not substantially different (more than less) than that observed at other upstream or downstream sampling sites. Diversity indices (Shannon-Weaver and Brillouin) were both high (above the level considered to indicate unpolluted conditions) at stations in the vicinity of the Atlas sewer outfalls. These locations (9, 10, 10a and 11) were similar to each other (in terms of benthic communities) yet uniquely different from other groups at upstream or downstream locations as determined by cluster analysis, principal components analysis and discriminant analyses. The similarities between the individual sampling locations was related to the ability of organisms at these locations to live in sediments with very high mercury, lead, zinc and loss on ignition (LOI). This separated them from other upstream or downstream locations, but also grouped them closely to adjacent downstream sampling locations (to the Queenston-Chippawa power canal) in terms of their association with sediments having high concentrations of chromium, copper, mercury, zinc and arsenic relative to upstream communities. Sampling points were approximately mid-river at all locations, and no attempt was made to specifically sample nearshore point source outfalls.

As input to the pilot-scale demonstration project, the MOEE undertook two separate sampling events in November 1990 to define the extent and impacts of contamination. The one study examined sediment contaminant levels and the benthic community structure at nine locations in the river (Jaagumagi, 1991) while the second study undertook bioassays with sediment from five sampling locations (Bedard and Petro, 1991). Both programs sampled the reef deposits, as well as upstream and downstream locations.

The sediment and benthos sampling program found metal concentrations (As, Cd, Cr, Cu, Fe, Pb, Mn, Hg, Ni and Zn) to be relatively high at all sampling sites, and above the SEL for Cr, Fe Mn and Cu at all reef and downstream stations (stations from McMaster outfall reef to beyond Region's WPCP outfall). Copper exceeded the SEL at six locations from the McMaster outfall reef to downstream of the Atlas 42-in. outfall reef, while chromium and nickel were the two metals that exceeded the SEL by the largest amounts at most locations. Station 4 (located on the Atlas outfall reef) had the highest sediment concentrations of most metals (except copper). PCBs and organochlorine pesticide levels were below the analytical detection limits for all parameters at all locations. PAH concentrations were elevated at a number of sites and were highest at Stations 2 and 4 (McMaster and Atlas 42-in. outfall reefs). Concentrations were generally well correlated with metals, indicating that these compounds likely originated from the same source. Levels of individual PAHs were highly correlated among themselves, suggesting that oils may be the source of the PAHs, which was in good agreement with visible signs of oil contamination of sediments. The concentration of total PAHs did not however, exceed the SEL at any station. The benthic community was reduced in both density and diversity at all stations downstream of Station 2 (McMaster Avenue outfall). The fauna at Station 2 was similar in species composition and density to Station 1, although contaminant levels were significantly higher at Station 2. The greatest effect on the benthic community was apparent at Stations 4 and 5 (on Atlas 42-in. outfall reef). Molluscs and oligochaetes were the only organisms represented at Station 4, while some additional limited representation of Trichoptera and Amphipoda was also present at Station 5. Oligochaetes were the dominant organisms at Station 4, which is unusual in the sense that as a burrowing organism they would encounter substantial exposure to sediment contaminants, although they are fairly resistant to contaminant effects as well. Although contaminant levels were lower at Station 5, the significant reduction in benthic community diversity and density may have been a result of lower organic matter content of the sediment, which is known to heighten contaminant effects. Density of organisms remained low throughout the remainder of the downstream sites (compared to upstream control site), although there was some reappearance of taxa beginning at Station 6 (first site downstream of Atlas 42-in. outfall reef), and continuing downstream to the last sampling point (immediately downstream of Region's WPCP). The overall reduction in diversity and density of benthic organisms at the most highly contaminated sites (i.e., with trace metals) is consistent with other findings reported in the literature. However, given the extremely high metals concentrations at those sites, the data suggests that much of the metal may be unavailable, as biological effects are not as pronounced as would be expected.

Sediment bioassays were performed (Bedard and Petro, 1991) with sediment from five locations, including an upstream control, both reefs and two downstream locations (downstream of Atlas 42-in. sewer outfall reef). Sediments from location 4 (Atlas 42-in. outfall reef) resulted in complete mortality of two test organisms (chironomids and fathead minnows) and significant (96%) mortality of the third organism (mayfly nymphs). Lethal and sublethal effects were apparent at the upstream control site (Station 1), with the sediment dwelling organism (chironomid) showing the largest effect. At the McMaster Avenue reef (Station 2), chironomid survivorship was poor and growth was impaired, although to a much lesser extent than at the Atlas 42-in. outfall reef. For the most part, sediments with the highest metal and PAH concentrations (measured values similar to those recorded during the sediment and benthos study), combined with low TOC, produced measurable biological effects. However, the question of chemical bioavailability of contaminants to chironomids and mayfly nymphs could not be addressed due to the absence of tissue analysis. Minnows were, however, analyzed for accumulations of metals in tissues, and bioaccumulation factors were calculated. Tissue concentrations of Ni associated with Stations 2 (McMaster) and 6 (just below Atlas 42-in. outfall reef) were highly correlated with bulk sediment levels, and were 6 to 7 times higher than control and downstream sediments. Cu and Pb tissue concentrations were also correlated to bulk sediment concentrations. Tissue concentrations of Hg, Mn, Cd, and Zn were similar among test and control sediments, and were not significantly correlated with bulk sediment concentrations. Bioaccumulation factors (BAFs) were low (<0.2) for Cu, Mn, Ni and Pb, while tissue concentrations of Cd and Zn were equal to or marginally less than concentrations in the bulk sediments. Tissue concentrations of Hg were elevated at least two times above sample concentrations for those stations tested, however, there was also an unusually high Hg tissue concentration reported for the negative control animals, and may represent background levels due to the experimental conditions or analytical problems (Bedard and Petro, 1991).

Finally, 22 locations upstream, adjacent to and between, and downstream of the two reefs were examined in June and December 1994 to determine the chemical composition of these sediments, and the associated benthic community structure (Jaagumagi et al, 1995). The reefs themselves were not specifically sampled during this program as they had been the object of the earlier (Bedard and Petro, 1991, and Jaagumagi, 1991) programs. Benthic organisms (oligochaetes or chironomids) were collected for tissue residue analysis (to evaluate bioaccumulation) and surficial sediment was collected to perform a series of laboratory bioassays. The results of the study indicate that sediment metals concentrations in the area near the reefs are very high, while areas upstream of the reefs were characterized by moderate levels of metals. Those areas adjacent to and downstream of the reefs had significantly higher sediment concentrations, which were often many times (up to 20) in excess of the SEL. The area between the first and second reefs had high sediment levels of chromium, copper, nickel, iron and manganese. Chromium and nickel would be of primary concern due to higher potential biological toxicity of these compounds, as compared to iron and manganese.

Benthic community analysis indicated that there was no impairment of the benthic community, despite the higher sediment metals concentrations. Benthic community density and diversity were high and a relatively diverse benthic community existed in the downstream areas. Benthic community structure was likely most affected by differences in habitat such as the presence of macrophytes, rather than by sediment metals concentrations. Metals can be present in high concentrations in sediment but, due to the formation of insoluble complexes, can be biologically unavailable.

Results of the June sediment bioassays showed an increase in mortality among some of the test organisms at some of the locations where high sediment metals concentrations were recorded. The only significant finding was the increase in chironomid mortality at Stations 12 and 13 (ranged from 84 to 97%), which are located just upstream and downstream of the Atlas 42-in. reef, respectively. Mayfly mortality also increased at Stations 10, 11 and 13, though the increase in mortality was much lower than among the chironomids, and ranged only between 16.6 and 26.6%. The test sediments shared similar physical characteristics, being primarily fine-grained substrates with moderate amounts of organic matter. Substrate type did not directly explain the differences in organism response.

As Station 10 was the only sampling site submitted for bioassay in June 1994, and was found to be located on or close to the edge of the Atlas 42-in. reef, additional sampling was undertaken in December in order to assess the toxicity of sediments between the two reefs (i.e., at Station 8 and a new station located midway between Stations 8 and 10). The December test results indicated there were no significant toxic effects on the chironomids, which were the most sensitive organisms in the June bioassays. Sediment chemical data is not yet available for comparison with toxic response data.

These results do not provide a strong indication of toxicity due to sediment metal contamination. The June results indicated that there is potential for adverse effects on some organisms at Stations 10 and 13, while the December tests showed no effects. When these results are compared to in situ (benthic community) tests, the results indicate that effects are likely to occur only upon disturbance of the sediments (i.e., only one test organism was affected). At other locations as heavily or more contaminated than these stations (e.g., Stations 14 and 16 downstream of the Atlas 42-in. reef), there was no significant mortality associated with those sediments. Correlation analysis did not detect any significant relationships between biological effects in the laboratory tests and those metals of greatest concern, which were found in the highest concentrations in the sediment.

The lack of consistency in the finding suggests that other factors besides sediment metals concentrations may be involved in the toxicity, and suggests only moderate biological effects in this area.

The sediment bioassay tests conducted with fathead minnows indicate that there do not appear to be water column effects from sediment contaminants since no mortality was observed and tissue residue levels were well below sediment concentrations. The suggestion made earlier, that the metals are generally biologically unavailable is further supported by these findings.

Tissue residue analysis showed very little difference in tissue residues between organisms collected in contaminated areas and those collected in relatively uncontaminated sites. There did not appear to be any increase in tissue residue levels despite significant increases in sediment concentrations of these metals. The results suggest that availability of the metals under natural conditions, even from heavily contaminated sediments is very low. Most differences in uptake appear to be related to the type or organism used, rather than to sediment concentrations. Chironomids, which were collected for analysis at all but the most upstream location are generally sediment surface grazers, and preferentially feed on microorganisms, rather than indiscriminantly ingesting sediment.

The final recommendation of the study was that the removal of the reefs should proceed, based on the evidence from the 1990-1991 investigations. The removal program should also include a suitable buffer zone to ensure that all of the potentially toxic metal has been removed. The biological availability of metals within adjacent sediments was not sufficiently consistent to also warrant their removal.

2.2 Atlas Specialty Steels Studies

2.2.1 River Studies

Recent international, federal and provincial efforts to clean up the Niagara River and surrounding tributaries, coupled with Atlas' recognition of its corporate and community responsibilities, led to a commitment from Atlas in December 1987 to clean up the river contamination. Since that time, further investigations and studies have been carried out by Acres on behalf of Atlas.

On the basis of cleanup criteria issued for the overall cleanup project in March 1989 by the MOE, site investigations were carried out by Acres during the summer/fall of 1989 (Acres, 1990b) and again in the spring of 1990 (Acres, 1990a). Data gathered during the summer/fall 1989 and spring 1990 site investigations and analytical testing programs have allowed a reasonable characterization of the physical and chemical nature of three areas with highly elevated levels of contamination. A subsequent study carried out in November/December 1990 (Acres, 1991a), allowed a further delineation of the contamination in natural sediments upstream of the project area (siphon to immediately upstream of McMaster Avenue reef). Further characterization of the river sediment contamination was provided on completion of the floodplain and bench scale treatment investigations.

The first area with highly elevated levels of contamination is shown in Figure 1.4, and originates from the Atlas 42-in. sewer outfall (Chainage 0+00). An industrial deposit of mill scale (metallic particles) and solvent extractable organics (oil and grease), resembling a reef, was observed in this area. The deposit boundaries were, for the most part, inferred on the basis of echo-sounding and sediment core data. The total length of the deposit is estimated to be approximately 300 m, and extends approximately 45 m upstream from the sewer outfall. Contaminant upstream from the outfall is believed to have been carried there by backwater currents created by the outfall discharge or possibly by river current reversals which sometimes occur associated with Ontario Hydro operations farther downstream. The deposit is approximately 40 m wide at its widest point in the area of the outfall, tapering to about 10 to 20 m wide in both the upstream and downstream directions.

The second area with highly elevated levels of contamination was located near the McMaster Avenue outfall. A reef type deposit of industrial material was also observed in this area. The deposit boundaries of the second area, shown in Figure 1.3, were inferred on the basis of laboratory analytical results as well as echo sounding and probe hole data. Contaminant was found in probe holes as far as approximately 25 m upstream and 75 m downstream from the sewer outfall with the total length of the deposit estimated to be approximately 100 m. The deposit is believed to be approximately 35 m wide at its widest point in the area of chainage (4+90), slightly upstream from the outfall.

The boundary of the third deposit located downstream of the above-noted Atlas 42-in. reef deposit (Figure 1.4), has been inferred on the basis of laboratory analytical results and probe hole data. No reef-type deposits were observed here. Data indicates the presence of an area of elevated industrial contamination between approximately chainage 3+95 and chainage 4+85. The contaminated area is believed to be approximately 80 m long and have a maximum width of 40 m.

A variety of natural sediments were also found in the river within the surveyed areas with highly elevated levels of contamination. The predominant sediment type is a soft to firm mixture of clay and silt with a trace of sand. Other sediments consist of sand or mixtures of sand and silt with varying minor amounts of clay and gravel. The thickness of natural sediment ranges from 0 to at least 0.6 m. Probe hole data indicates that natural sediments tend to accumulate toward the sides of the channel and not in the center. Physical evidence of contamination in the natural sediments is indicated by blackening and release of an oily odor on exposure of the sediment to the atmosphere. The extent of contaminated sediments (industrially deposited) or from other anthropogenic sources in the river identified during the investigation is shown in Figure 1.5.

Underlying the natural sediments is a reddish-brown, firm to very stiff, clayey till. All recovered till samples had no characteristics (color, odor) indicating contamination, which was confirmed by chemical analysis.

The surface of the reef-type deposits is irregular to only slightly irregular, and was covered with water up to a maximum depth of about 4 m during field investigation in 1990. Depending on the water level in the river, a small area of the Atlas 42-in. reef may be exposed to the air immediately offshore from the outfall pipe. No part of the McMaster Avenue reef deposit was exposed above water level during field investigations in 1990 nor are they anticipated to be.

The reef-type deposits are composed of a black, coarse granular, metallic material occasionally interlayed with soft black clay, sand or organics, overlying the natural river bottom sediments. The granular material is judged to be generally compact (estimated at 35% to 65% relative density) in its underwater environment, but on exposure to the atmosphere, it forms a 30- to 300-mm thick surface oxidation crust. At the Atlas 42-in. outfall all reef samples gave off an oily odor, and an oily texture or oily sheen was sometimes noted in the samples.

In July 1990, the MOE issued the draft document "*The Provincial Sediment Quality Guidelines*" (reissued as drafts in October 1990 and March 1991, and finalized August 1993). The draft document contained cleanup criteria or guidelines which superseded the March 1989 criteria which had previously been issued by the MOE, and on which all site investigations and cleanup considerations had been based. The stricter PSQG resulted in a need to carry out further site investigations in the Welland River to define the 'new' limits to the areas requiring remediation. Such investigations were initiated in mid-November 1990, and completed in mid-December (Acres, 1991a).

The March 1991 draft and the subsequent final version of the PSQG (MOEE, 1993) define three levels of ecotoxic effects for a variety of organic and inorganic compounds or elements as follows.

"***The No Effect Level***
This is the level at which the chemicals in the sediment do not affect fish or the sediment-dwelling organisms. At this level no transfer of chemicals through the food chain and no effect on water quality is expected.

Sediment that has a No Effect Level rating is considered clean and no management decisions are required. Furthermore, it may be placed in rivers and lakes provided it does not physically affect the fish habitat or existing water uses, for example, a water intake pipe.

The Lowest Effect Level
This indicates a level of contamination which has no effect on the majority of the sediment-dwelling organisms. The sediment is clean to marginally polluted.

Dredged sediments containing concentrations of organic contaminants--PCBs or pesticides, for example--that fall between the No Effect Level and the Lowest Effect Level may not be disposed of in an area where sediment at the proposed disposal site has been rated at the No Effect Level or better.

Contamination in sediment that exceeds the Lowest Effect Level may require further testing and a management plan.

The Severe Effect Level
At this level, the sediment is considered heavily polluted and likely to affect the health of sediment-dwelling organisms. If the level of contamination exceeds the Severe Effect Level then testing is required to determine whether or not the sediment is acutely toxic.

At the Severe Effect Level a management plan may be required. The plan may include controlling the source of the contamination and removing the sediment."

The present biologically based PSQG guidelines for sediment-related issues are derived from an accumulation of data from across the Province of Ontario. Realizing that site-specific aquatic biota effect levels may vary from those presented in the PSQG, the MOE is encouraging the use of site-specific bioassays and biomonitoring data to establish site-specific cleanup levels. Continued biomonitoring is also recognized as the only means of assessing the effectiveness of a cleanup.

As prelude to the 1991 pilot-scale dredging/treatment demonstration, Atlas, the MOE and Environment Canada undertook site investigations in November/December 1990 to collect sediment for bioassay studies and analysis of the benthic community (Bedard and Petro, 1991, and Jaagumagi, 1991). Those studies were intended to provide data on the impact of the contaminants on local organisms which would form a basis for evaluating the effectiveness of the planned cleanup demonstration. Unfortunately, those results were not immediately available, and another means of establishing a reasonable cleanup criteria was required. It was subsequently deemed appropriate that the ambient concentration of various contaminants in river sediments upstream from the McMaster Avenue outfall would provide an acceptable cleanup level for the pilot-scale demonstration project. Therefore, part of the November/December 1990 site investigations involved sampling and chemical analyses of sediment upstream from the McMaster Avenue reef deposit in an attempt to establish ambient levels of contamination for heavy metals of concern and for oil and grease (Table 2.1).

Chemical analyses on river sediment samples stretching from the upstream end of the McMaster Avenue reef to approximately 230 m downstream of the Atlas 42-in. reef (Table 2.2) indicated that, compared to the PSQG, the material comprising the main reef deposits contained high concentrations of several metals, including copper (Cu), chromium (Cr), iron (Fe), lead (Pb), manganese (Mn), nickel (Ni) and zinc (Zn), at levels exceeding severe effect levels. In addition, a number of locations upstream and downstream from the main reef deposits, contain concentrations of several metals which exceed the PSQG lowest effect levels.

Analyses for polychlorinated biphenyls (PCBs) and trichloroethylene (TCE) in the sediments indicate concentrations very near or below the analytical detection limits for these two compounds (Table 2.2). All reef samples indicate that the reef material is a non-PCB material according to Ontario Regulation 11/82 of the Environmental Protection Act (EPA) (Waste Management - PCB regulations). Two of the samples had PCB concentrations of 0.2 and 0.3 mg/kg which slightly exceed the PSQG lowest

Table 2.1

Upstream Ambient Conditions
Chemical Analyses

Chainage	Borehole Number	Sample Number	Cr (mg/kg)	Cu (mg/kg)	Fe (%)	Pb (mg/kg)	Mn (mg/kg)	Ni (mg/kg)	Zn (mg/kg)	Oil and Grease (mg/kg)
−(6+00)	BH−113	BS−1	10.0	16.0	1.5	18.0	686.0	12.0	91.0	<100
	BH−114	BS−1	11.0	20.0	2.3	42.0	968.0	17.0	88.0	<100
	BH−115	BS−1	36.0	49.0	2.1	40.0	374.0	53.0	156.0	110
−(6+50)	BH−116	BS−1	26.0	24.0	2.2	52.0	726.0	44.0	70.0	<100
	BH−117	BS−1	13.0	22.0	2.5	15.0	915.0	21.0	62.0	100
	BH−118	BS−1	35.0	63.0	2.8	93.0*	481.0	160.0*	241.0	2700
−(7+00)	BH−119	BS−1	11.0	19.0	2.1	21.0	942.0	17.0	87.0	<100
	BH−120	BS−1	11.0	22.0	2.0	20.0	741.0	18.0	60.0	<100
	BH−121	BS−1	27.0	33.0	2.1	73.0	421.0	25.0	124.0	120
−(8+00)	BH−122	BS−1	14.0	22.0	2.5	20.0	696.0	20.0	72.0	<100
	BH−123	BS−1	27.0	35.0	2.8	24.0	605.0	23.0	111.0	170
	BH−124	BS−1	19.0	27.0	2.4	18.0	819.0	42.0	92.0	<100
−(9+00)	BH−125	BS−1	19.0	24.0	1.9	25.0	756.0	19.0	68.0	<100
	BH−126	BS−1	23.0	28.0	2.1	52.0	809.0	19.0	134.0	<100
	BH−127	BS−1	13.0	29.0	2.7	25.0	1596.0 *	18.0	261.0 *	210
−(10+00)	BH−128	BS−1	58.0 *	76.0 *	1.9	329.0*	856.0	65.0 *	268.0 *	1800
	BH−129	BS−1	43.0 *	41.0	2.0	81.0*	362.0	56.0	352.0 *	3500
	BH−130	BS−1	7.0	13.0	1.2	19.0	359.0	11.0	64.0	<100
−(11+00)	BH−131	BS−1	28.0	76.0 *	2.7	126.0	286.0	55.0	996.0 *	3200
	BH−132	BS−1	14.0	33.0	1.8	24.0	269.0	25.0	242.0	480
	BH−133	BS−1	79.0 *	146.0 *	6.3 *	339.0*	794.0	140.0 *	2236.0 *	16300
−(12+00)	BH−134	BS−1	140.0 *	66.0	1.9	67.0	397.0	94.0 *	183.0	3200
	BH−135	BS−1	30.0 *	91.0 *	3.5	68.0	452.0	98.0 *	931.0 *	5300
−(11+90)	BH−136	BS−1	45.0 *	102.0 *	5.4 *	194.0*	416.0	76.0 *	2428.0 *	4500
	Mean (all data)		30.8	44.9	2.5	74.4	646.9	47.0	392.4	
	STD Deviation		28.3	32.4	1.1	88.3	291.3	39.9	632.5	
	Mean (Ambient)		20.0	31.0	2.2	35.0	606.0	28.0	114.0	
	STD Deviation		9.0	14.8	0.5	11.0	223.0	20.1	60.0	

Note

* Sample not used in calculation of mean

Table 2.2

Laboratory Test Results

(Concentrations exceeding the upstream ambient concentrations are shown shaded.)

Borehole Number	[1] Chainage (m)	Sample Number	Cr (mg/kg)	Cu (mg/kg)	Fe (mg/kg)	Pb (mg/kg)	Mn (mg/kg)	Ni (mg/kg)	Zn (mg/kg)	Oil and Grease (mg/kg)	PCB (mg/kg)	TCE (mg/kg)
PSQG[2] – Severe Effect Level			110	110	40,000	250	1,100	75	820	–	530	–
PSQG[2] – Lowest Effect Level			26	16	20,000	31	460	16	120	–	0.07	–
Upstream Ambient (all data)	–(12+00) to –(6+00)	–	30.8	44.9	25,000	74.4	647	47	392	–	–	–
BH–1	–(5+75)	BS–1	30	32	27,000	85	1,045	24	90	<100	–	–
BH–3		BS–1+BS–2	41	39	29,000	108	509	36	140	130	–	–
BH–4	–(5+50)	BS–1	57	51	21,000	169	376	71	205	350	–	–
BH–6		BS–1	27	22	14,000	102	256	13	114	<100	–	–
C53	–(5+40)	C53a	30	30	250,000	21	660	48	140	700	<0.2	<0.001
		C53b	28	24	20,000	33	500	32	100	400	<0.2	<0.001
BH–7	–(5+25)	BS–1	30	31	25,000	131	909	22	99	<100	–	–
BH–9		BS–1	21	17	19,000	47	388	16	394	<100	–	–
PH–6	–(5+10)	ES–R6	17	33	13,000	49	320	120	290	–	–	–
PH–17		ES–R17	1,100	290	71,000	56	1,500	630	75	5,300	–	–
BH–11	–(5+00)	BS–1	27	39	26,000	92	488	28	476	<100	–	–
		BS–2	20	20	21,000	49	789	19	107	130	–	–
		BS–3	23	17	21,000	63	684	17	106	<100	–	–
BH–10 [3]		BO–1	628	195	78,000	122	1,080	354	449	1,700	<0.1	–
PH–14	–(4+70)	ES–R14	470	220	24,000	87	430	310	130	8,500	–	–
BH–15	–(4+50)	BS–1	17	26	26,000	78	804	23	84	<100	–	–
BH–17	–(4+25)	BS–1	43	34	35,000	112	539	33	155	160	–	–
PH–12	–(4+10)	ES–R12	50	38	16,000	14	350	37	49	400	–	–
BH–18	–(4+00)	BS–1	48	12	24,000	28	286	40	63	<100	–	–
BH–19		BS–1	49	24	27,000	55	1,210	34	100	<100	–	–
BH–22	–(3+75)	BS–1	15	18	34,000	29	615	17	154	<100	–	–
BH–24		BS–1	28	28	24,000	77	786	33	78	<100	–	–
BH–26		BS–1	39	53	42,000	407	665	64	405	<100	–	–
BH–28	–(3+50)	BS–1	438	124	62,000	82	873	310	105	<100	–	–
BH–31		BS–1	39	65	43,000	125	651	60	495	220	–	–
		BS–2	29	26	27,000	64	903	24	88	<100	–	–
		BS–3	23	16	26,000	38	748	22	82	<100	–	–
BH–32	–(3+00)	BS–1	145	175	52,000	200	665	626	913	420	–	–
BH–34		BS–1	51	19	27,000	62	398	92	127	6,700	–	–
BH–35	–(2+50)	BS–1	166	230	52,000	166	664	113	795	<100	–	–
BH–37		BS–1	29	55	39,000	58	678	77	440	<100	–	–
BH–38 [3]	–(2+00)	BS–1	46	41	41,000	139	683	64	252	<100	<0.1	–
		BS–2	34	121	52,000	146	568	72	913	330	–	–
BH–39		BS–1	44	45	28,000	121	507	27	154	<100	–	–
BH–40		BS–1	41	27	32,000	92	631	31	106	100	–	–
BH–42	–(1+50)	BS–1	40	84	37,000	123	489	55	527	220	–	–
BH–45		BS–1	37	27	39,000	91	683	71	223	<100	–	–
BH–47	–(1+00)	BS–1	39	64	36,000	35	559	35	292	260	–	–

Notes:

[1] Chainages represent distance downstream (+) or upstream (–) of the Atlas–Mansfield outfall located at Chainage 0+00 [e.g., Chainage –(5+40) is located 540 m upstream of outfall].

[2] Provincial Sediment Quality Guidelines (MOE, 1991)

[3] Samples from BH–10, BH–38, BH–92 and BH–106 were also analyzed for PAHs and found to have concentrations below detection limits

Table 2.2 (cont)
Laboratory Test Results – 2

Borehole Number	Chainage (m)	Sample Number	Cr (mg/kg)	Cu (mg/kg)	Fe (mg/kg)	Pb (mg/kg)	Mn (mg/kg)	Ni (mg/kg)	Zn (mg/kg)	Oil and Grease (mg/kg)	PCB (mg/kg)	TCE (mg/kg)
BH–49		BS–1	22	31	27,000	22	761	36	73	<100	–	–
C1	–(0+45)	C1a	200	210	6,200	180	620	550	1,300	25,400	–	–
C51		C51a	120	65	380,000	70	640	100	290	2,500	–	–
C2	–(0+20)	C2a	3,400	830	170,000	120	6,600	4,400	90	2,900	–	–
BH–50		BS–1	28	29	29,000	34	531	55	112	<100	–	–
		BS–2	26	19	33,000	33	763	45	241	<100	–	–
		BS–3	21	28	28,000	41	729	44	80	<100	–	–
C3	–(0+10)	C3a	2,900	860	39,000	130	3,900	6,300	36	2,100	–	–
		C3b	2,100	410	150,000	340	1,600	2,200	690	45,300	–	–
		C3c	32	30	32,000	21	640	72	120	600	–	–
BH–51	0+00	BS–1	16	10	18,000	16	399	27	198	<100	–	–
C4		C4a	3,500	700	41,000	190	6,100	5,600	120	4,800	<0.2	<0.001
		C4b	2,200	450	210,000	160	2,400	2,900	220	22,400	0.2	<0.001
		C4c	55	35	38,000	35	620	75	180	4,800	0.3	<0.001
C46		C46a	36	17	20,000	15	470	37	75	900	–	–
C42	0+10	C42a	5,000	840	420,000	140	5,900	11,000	60	3,000	–	–
		C42b	77	31	29,000	34	540	110	110	2,800	–	–
C6	0+20	C6a	5,000	820	380,000	300	5,600	6,500	180	19,300	–	–
		C6b	3,900	660	250,000	670	3,900	3,700	340	31,100	–	–
C41		C41a	4,900	640	260,000	540	5,300	6,300	220	21,900	–	–
		C41b	54	41	33,000	35	660	83	250	4,900	–	–
C40		C40a	60	45	340,000	33	630	93	270	3,300	–	–
C37	0+30	C37a	4,100	520	310,000	260	4,700	5,800	180	13,900	–	–
C38		C38a	3,700	490	200,000	270	4,100	4,400	220	23,400	–	–
C8	0+40	C8a	4,000	580	260,000	340	3,900	4,100	260	23,400	–	–
C15	0+50	C15a	5,000	560	240,000	460	4,000	5,000	250	24,900	–	–
C10		C10a	59	34	33,000	35	560	68	92	1,200	–	–
BH–54		BS–1	31	52	37,000	39	616	87	294	180	–	–
C16	0+70	C16a	3,800	530	200,000	300	3,200	3,600	270	24,900	–	–
BH–55		BO–1	40	84	43,000	164	528	42	1,008	280	–	–
C17	0+90	C17a	4,600	650	270,000	410	4,000	5,000	250	24,500	–	–
C12		C12a	35	23	280,000	20	510	59	92	1,200	–	–
C18	1+10	C18a	4,300	510	180,000	510	2,700	3,500	320	28,500	–	–
BH–57		BS–1	18	23	24,000	22	516	47	110	180	–	–
C19	1+50	C19a	4,500	470	160,000	450	2,300	3,100	330	24,500	–	–
C14		C14a	32	29	32,000	26	400	37	150	1,200	–	–
C35		C35a	29	44	32,000	36	610	65	310	1,300	–	–
BH–58		BS–1	31	27	32,000	78	417	52	160	140	–	–
C20	2+00	C20a	990	380	110,000	250	1,100	1,100	1,200	39,400	–	–
BH–59		BS–1	20	15	28,000	19	823	33	69	<100	–	–
BH–60		BS–1	26	32	33,000	37	516	51	262	370	–	–
BH–61	2+50	BS–1	31	24	29,000	46	496	40	77	320	–	–
BH–65		BS–1	802	155	49,000	174	613	466	475	8,500	–	–
BH–67	2+75	BS–1	16	8	13,000	12	240	17	721	<100	–	–
BH–68		BS–1	47	36	46,000	52	774	75	296	120	–	–

Notes:

[1] Chainages represent distance downstream (+) or upstream (–) of the Atlas–Mansfield outfall located at Chainage 0+00 [e.g., Chainage –(5+40) is located 540 m upstream of outfall].

[2] Provincial Sediment Quality Guidelines (MOE, 1991)

[3] Samples from BH–10, BH–38, BH–92 and BH–106 were also analyzed for PAHs and found to have concentrations below detection limits

Table 2.2 (cont)
Laboratory Test Results – 3

Borehole Number	Chainage (m)	Sample Number	Cr (mg/kg)	Cu (mg/kg)	Fe (mg/kg)	Pb (mg/kg)	Mn (mg/kg)	Ni (mg/kg)	Zn (mg/kg)	Oil and Grease (mg/kg)	PCB (mg/kg)	TCE (mg/kg)
C33		C33a	33	44	36,000	33	670	59	320	1,700	–	–
BH–70	3+50	BS–1	53	33	38,000	56	669	56	224	<100	–	–
		BS–2	32	30	36,000	36	598	59	151	260	–	–
BH–73		BS–1	131	76	38,000	111	482	112	506	740	–	–
		BS–2	20	11	26,000	30	382	35	95	110	–	–
BH–74	3+75	BS–1	30	19	32,000	46	627	41	83	240	–	–
BH–76		BS–1	2,009	402	221,000	76	2,729	2,523	424	210	–	–
PH–39	3+90	ES–R39	24	19	14,000	32	260	26	120	800	–	–
BH–77	4+00	BS–1	35	21	32,000	38	673	50	109	130	–	–
C23		C–23a	490	140	37,000	250	560	310	330	4,000	–	–
PH–22		ES–R22	10	17	13,000	<10	240	22	210	<100	–	–
PH–38		ES–R38	180	70	27,000	34	440	250	170	900	–	–
PH–26	4+05	ES–R26	12	18	15,000	14	290	21	170	500	–	–
PH–42	4+15	ES–R42	550	140	60,000	56	880	660	110	3,800	–	–
BH–81	4+25	BS–1	1,385	384	173,000	209	2,168	1,679	256	950	–	–
		BS–2	36	28	32,000	26	584	50	164	<100	–	–
		BS–3	23	17	28,000	25	700	30	78	<100	–	–
BH–82		BS–1	203	130	40,000	333	653	333	585	1,500	–	–
PH–44	4+30	ES–R44	260	61	14,000	58	200	110	97	7,300	–	–
BH–83	4+50	BS–1	33	17	31,000	54	627	38	97	110	–	–
PH–45		ES–R45	1,500	230	49,000	220	640	550	450	38,600	–	–
BH–85	4+75	BS–1	722	270	100,000	79	1,274	786	223	750	–	–
BH–86		BS–1	109	23	41,000	33	734	116	106	<100	–	–
BH–88	4+90	BS–1	41	19	24,000	51	834	39	121	<100	–	–
BH–90		BS–1	1,596	207	142,000	40	1,645	2,305	178	<100	–	–
BH–92 [3]		BS–1+BS–2	216	75	35,000	114	591	187	269	930	<0.1	–
BH–93	5+15	BS–1	73	35	35,000	60	887	94	260	350	–	–
BH–97	5+40	BS–1	633	120	60,000	70	1,285	681	98	<100	–	–
BH–99	5+90	BS–1	41	23	38,000	41	926	50	93	<100	–	–
BH–101		BS–1	156	112	42,000	45	648	212	88	300	–	–
BH–104	6+40	BS–1	246	121	54,000	24	1,055	457	225	<100	–	–
		BS–2	32	21	27,000	21	771	40	75	<100	–	–
		BS–3	370	130	65,000	47	1,156	714	281	<100	–	–
BH–106 [3]		BS–1A	43	118	50,000	104	563	72	953	560	–	–
		BS–1B	–	–	–	–	–	–	–	–	<0.1	–
C27	7+00	C27a	90	12	14,000	<0	280	54	89	1,100	–	–
C29		C29a	34	23	27,000	24	540	35	100	1,500	–	–
BH–107	7+40	BS–1	22	23	23,000	49	719	43	118	<100	–	–
BH–109		BS–1	59	26	25,000	43	865	97	77	<100	–	–
BH–110	7+90	BS–1	103	38	33,000	17	770	143	370	<100	–	–
BH–112		BS–1	25	27	21,000	23	458	22	92	100	–	–
C30	10+00	C30a	29	28	28,000	16	650	48	140	1,600	–	–

Notes:

[1] Chainages represent distance downstream (+) or upstream (–) of the Atlas–Mansfield outfall located at Chainage 0+00 [e.g., Chainage –(5+40) is located 540 m upstream of outfall].

[2] Provincial Sediment Quality Guidelines (MOE, 1991)

[3] Samples from BH–10, BH–38, BH–92 and BH–106 were also analyzed for PAHs and found to have concentrations below detection limits

effect level. There was no correlation evident between solvent extractable concentrations and PCB or TCE concentrations.

Analyses for base/neutral extractable organic compounds, including polycyclic aromatic hydrocarbons (PAHs), show concentrations for the compounds below detectable limits or at trace levels in the very low μg/g (ppm) range (Table 2.3). The concentration of total PAHs was determined to be approximately 10 μg/g in one sediment sample which slightly exceeds the PSQG lowest effect levels for these organic compounds and may have a minor effect on aquatic organisms. Atlas does not use and has not used coking ovens as part of their process and thus there is no mechanism for the generation of PAHs by them.

Results of leachate tests (Table 2.4) carried out on reef material prior to the previous demonstration project using standard MOE protocols indicate that it may be disposed at an approved nonhazardous industrial waste disposal facility based on Regulation 347 (formerly Regulation 309) criteria, subject to slump testing on the treated dredged solids.

Those analyses, combined with the previous ones, defined a fairly large area where concentrations of metals exceeded upstream ambient metal concentrations. The primary area of contamination extends from approximately the Atlas pumphouse at McMaster Avenue, downstream to the Regional WPCP, generally concentrated on the east side of the river (Figure 1.5). In some locations, the contaminants have migrated across the full width of the river. The concentrations of metals in some areas on the west side of the river were noted to be very similar to the concentrations in the upstream ambient area and much less than the concentrations in the sediment and reef material from the east side. In order to demonstrate these observations, statistical analyses were conducted to compare the level of contamination between the different sample locations. An approximate 't' test and a nonparametric test (Wilcoxon matched pairs sign test) were used to determine the equality of means and distribution between populations. Based on an upstream ambient level of contamination as the cleanup criteria, the previous evaluation indicated an estimated 30 000 m^3 of contaminated sediment and reef material may eventually require removal.

Table 2.3

Analysis for Base/Neutral Compounds

Chainage **Oil & Grease** (mg/kg)	0+50 30 000	2+00 39 400	-(5+00) 1700	-(2+00) 330	4+90 930	6+40 N/A
Compounds	Sample C15a (µg/g)	Sample C20a (µg/g)	Sample BH-10 (µg/g)	Sample BH-38 (µg/g)	Sample BH-92 (µg/g)	Sample BH-106 (µg/g)
2 - Methyl naphthalene	5.1	-	-	-	-	-
1 - Methyl naphthalene	TR	-	-	-	-	-
Phenanthrene	3.6	TR	-	-	-	-
Di-n-butyl phthalate	-	TR	-	-	-	-
Pyrene	-	TR	-	-	-	-
Chrysene	-	TR	-	-	-	-
Bis-2-ethyl hexyl phthalate	4.5	-	-	-	-	-

Legend:
TR = Trace
N/A = Not Analyzed
µg/g = ppm

- Only compounds detected are reported.
- For complete analyses for base/neutral compounds, refer to Appendix C.

Table 2.4

Regulation 347 Leach Test Results (Formerly Regulation 309)

Sample	Description	Regulation 347							
		Pb (mg/L)	As (mg/L)	Cd (mg/L)	Cr (mg/L)	Ag (mg/L)	Ba (mg/L)	Hg (mg/L)	PCB (mg/L)
	MOE Registerable Limit*	0.5	0.5	0.5	0.5	0.5	10.0	0.01	0.03
C3a	Reef Material	0.001	<0.005	<0.001	<0.005	<0.02	2.9	<0.001	<0.003
C15a	Black Soft Silty Clay	0.045	0.008	<0.005	0.120	<0.05	43.0	<0.001	-
C20a	Reef Material	0.051	0.034	<0.005	0.070	<0.05	7.9	<0.001	-

* Ten times Regulation 347, Schedule 4 criteria.

mg/L = ppm

- Samples and concentrations exceeding registerable limit

2.2.2 Floodplain Studies

The Welland River from the siphon at the Old Welland Canal to its mouth at the Niagara River is designated as a provincially significant wetland (Class I). Floodplains have developed on both banks in the study area, and range in width from a few metres up to approximately 25 m.

Prior to the initiation of the demonstration project, members of the WRCC suggested that the floodplain may be contaminated and might also require remediation. A subsequent preliminary investigation of the east floodplain was carried out in March 1990 for identification of its chemical and physical features. Further limited sampling and testing of the top 10 cm of sediment and *Typha* stalks was carried out in March 1991, while a detailed study of those floodplain areas adjacent to the contaminated river sediments at McMaster Avenue and the Atlas 42-in. outfall was carried out in April and May 1991. A limited follow-up investigation of the east floodplain was undertaken in April 1992 and additional studies are currently being undertaken to more accurately define the limit of mill scale distribution at the interface between the reefs and the floodplain, and at those two locations where mill scale has been found within the floodplain itself.

Data were presented to the WRCC and the ad hoc Planning Committee as they were collected and analyzed, while all of the previous studies were summarized and reported in a floodplain study report (Acres, 1992b). The physical, geotechnical and chemical conditions of the floodplain are presented below.

Physical Conditions

Fine-grained black or brown organic sediments comprising predominantly clayey silt, silt, and silty sand with minor layers or lenses of sand and gravel have been deposited in both the east and west floodplains in thicknesses up to approximately 3 m.

The volume of sediments comprising the east floodplain from chainage -(5+25) to chainage 7+70 is estimated to be 16 790 m^3. The volume of sediments comprising the west floodplain from chainage -(0+60) to chainage 1+00 and from chainage 2+20 to chainage 6+20 is estimated to be approximately 12 010 m^3 The total volume of floodplain sediments contained within these chainages, which define the study limits, is estimated to be approximately 28 800 m^3. The silt-rich sediments appear to be concentrated in the east floodplain in the areas downstream from the McMaster Avenue and the Atlas 42-in. outfalls.

Granular, metallic, mill scale was observed in only two investigation holes [AH-8 at chainage -(4+80) and BH-301 at chainage 0+69], both located in the east floodplain. AH-8 was 10 m downstream from the McMaster Avenue outfall while BH-301 was at the location of a 0.91 m diameter outfall 69 m downstream from the Atlas 42-in. outfall. The McMaster Avenue and the Atlas 42-in. outfalls have been confirmed as past discharge points of mill scale. Borehole data indicates that this third outfall may also have been a past discharge point.

The floodplain sediments are underlain by inorganic postglacial sediments comprising mainly clayey silt and clay and silt till. The steepened east bank of the river beyond the floodplain is generally formed by natural postglacial sediments, however, fill material was occasionally encountered. The steepened west bank of the river may contain considerable fill material resembling either the floodplain sediments or the postglacial sediments in appearance. Much of this fill material is believed to have been placed during the construction of the old Welland Canal.

Geotechnical Conditions

The east and the west floodplain sediments, encountered during the site investigations, can be described as follows.

- The black or brown clayey silt floodplain sediment was soft to very soft, highly plastic and compressible with a significant organic content. Liquid limits ranged from 76% to 166%. The natural water content averaged 113%. Natural water contents generally exceeded the soil liquid limits. Zones of liquified black clayey silt were encountered in BH-301, BH-302 and BH-303 during the site investigation. The black clayey silt and, occasionally, the brown clayey silt had an oily odor and visible oil in the form of a sheen was sometimes observed on soil samples. Roots from surface vegetation were observed down to depths of approximately 1 m. The clayey silt had a relatively low bulk density (average 1.293 t/m^3) indicative of organic soils. The soil had a low undrained shear strength averaging 9 kPa for laboratory vane tests and 19 kPa for in situ vane tests. The sensitivity was variable ranging from 3 (low) to greater than 100 (greater than 16 is quick) in laboratory tests.

- The black or brown silt with sand and clay was loose to very loose (soft to very soft) and, like the clayey silt, was also highly plastic and compressible with a high organic content. Liquid limits ranged from 56% to 158%. The natural water contents averaged 108% and generally exceeded the liquid limits. The brown silty soil usually had an organic odor, occasionally noted as being septic, while the black variety had an oily odor and an occasional oily sheen. Bulk densities were found to be low (1.217 t/m^3 and 1.413 t/m^3) similar to the black clayey silt. Laboratory undrained shear strengths were found to be low with an average of 5.5 kPa (average of 2 tests) and a maximum of 8 kPa. The in situ undrained strengths averaged 28 kPa in BH-237 but were very low (0 kPa and 8 kPa) in BH-239. The soil is judged to be quick with laboratory measured sensitivities of 14 and greater than 100.

- The soft and low strength floodplain sediments will have a very low bearing capacity and will be incapable of supporting significant loads without some form of foundation strengthening. While the soils are classified as highly plastic, their natural water contents generally exceed their liquid limits, which indicate that they will tend to flow when disturbed by dredging or excavation equipment. The high sensitivity values measured during laboratory vane testing indicate the floodplain sediments to be generally quick.

The postglacial sediments comprising mainly the light-gray clayey silt and the reddish-brown clay and silt till are significantly different from the overlying floodplain sediments. They are described as follows.

- The light gray clayey silt was generally soft to firm with low to medium plasticity. Liquid limits ranged from 25% to 51%. Natural water contents are believed to be intermediate between the plastic and liquid limits. The soils are inorganic in origin. No visible signs of contamination or oily odors were found in the clayey silt. The light-gray clay had bulk densities of 1.524 t/m^3 to 2.206 t/m^3, which is significantly greater than the floodplain sediments. The average undrained shear strength from laboratory vane tests was 16.5 kPa, which again is higher than for the floodplain sediments. The in situ undrained strength averaged 22 kPa. Sensitivities range from 5 (medium) to greater than 100 (quick).

- The reddish-brown clay and silt till was generally firm to stiff. No visible contamination was noted in the sediment. A faint oily odor was noted in the till samples from BH-301 and BH-303. The natural water content was lower than all overlying sediments and averaged 19%. The soil is considered to be inorganic in origin, having low to medium plasticity. In situ vane tests yielded an average undrained shear strength of 37 kPa, which is higher than all other tested sediments.

Chemical Conditions

An attempt to simplify the interpretation of the chemical data contained in the floodplain report was made by considering the ratio of the heavy metals Cr and Ni within a certain band as indicators of industrial contamination, which may have originated from past discharges by Atlas. Oil and grease and TP were studied as indicators of possibly wider sources of contamination. Analyses for conventional parameters, volatile organic compounds, hydrocarbon characterization and leachate characterization were carried out to allow a fuller characterization of the contaminated sediments. Limited analyses were also carried out on floodplain vegetation.

Results of the floodplain contaminant distribution are presented in Figures 2.1 and 2.2, while conclusions regarding contaminant chemistry are summarized below.

- Cr and Ni are the two industrial contaminants with concentrations in the floodplain sediments most frequently exceeding the PSQG severe effect levels. The surface of both east and west floodplain sediments frequently contain Cr and Ni concentrations exceeding the PSQG severe effect levels. The deeper zones of the floodplain sediments generally show decreases in Cr and Ni concentrations and may contain concentrations less than the upstream ambient levels of contamination. Concentrations in the west floodplain sediments do not reach the same high levels as in the east floodplain.

- Cr and Ni contaminant concentrations downstream from the Atlas 42-in. outfall are significantly greater than those downstream from the McMaster Avenue outfall. Dilution of Atlas' past south plant effluent by other municipal and local industrial effluent flowing within the McMaster Avenue sewer system at that time may be responsible for the reduced contaminant levels in the vicinity of this outfall.

- The highest Cr and Ni concentrations are found in the east floodplain sediments (from chainage 0+00 to chainage 1+52) downstream from the

Atlas 42-in. outfall and, specifically, in borehole BH-239 at chainage 0+97. The contaminated sediments are thickest in this area reaching an estimated thickness of approximately 3.0 m in AH-3 at chainage 1+00. Other Cr and Ni 'hot' spots in the east floodplain are near the McMaster Avenue outfall [chainage -(4+80) and chainage -(4+50)], from chainage 2+70 to chainage 3+50, and at chainage 4+95.

- A layer or lens of industrial mill scale found in east floodplain borehole BH-301 at chainage 0+69 suggests that a 0.91 m diameter outfall located at this location may be the source of past industrial discharges. The outfall is positioned at the bottom of the riverbank and past discharges would have been directed onto the area now occupied by the floodplain. Such discharges may be partially responsible for the high levels of Cr and Ni contamination noted in the above paragraph between chainage 0+00 and 1+52.

- East floodplain sediments, upstream from the McMaster Avenue outfall, appear to have reduced levels of Cr and Ni contamination. The volume of sediments comprising the east floodplain from chainage -(5+25) to chainage 7+70 and having a Cr concentration greater than 31 mg/kg is estimated at 11 530 m^3. The volume of sediments comprising the west floodplain from chainage -(0+60) to chainage 1+00 and from chainage 2+20 to chainage 7+70 and having a Cr concentration greater than 31 mg/kg is estimated at 9340 m^3.

- Concentrations of up to 19% oil and grease were found in the area from chainage -(5+75) to chainage -(3+85) around the McMaster Avenue outfall. Other areas with high oil and grease concentrations are from chainage 0+43 to chainage 1+52 and at chainage 3+50. Other local east bank sewer outfalls (e.g., the Evan Street outfall at chainage -(7+50) or the large storm sewer outfall at chainage -(11+30) upstream from the McMaster Avenue outfall) are believed to have been a significant source of oils and other solvent extractable contaminants. Oily contamination from auger holes AH-3 and AH-10 has been identified as paraffinic hydrocarbons using infrared analytical techniques. Analysis by gas chromatography/mass spectrometry on a sample from BH-236 indicates the presence of only 0.35% nonpurgeable hydrocarbons in the range C8 to C32 (kerosene to mineral oil). Oil and grease concentrations in the west floodplain are lower than the east, reaching a maximum of 1.9% opposite the Atlas 42-in. outfall.

- In the upper layers of sediment, in both the east and west floodplains, concentrations of TP generally exceed the upstream ambient concentration. TP concentrations exceed the PSQG severe effect level at two locations in the east floodplain downstream from the Atlas 42-in. outfall. One is the area of chainage 0+43 and chainage 0+97, and the second is at chainage 2+70. In the west floodplain, TP exceeds the severe effect level at chainage 5+80.

- Analyses for conventional parameters on east floodplain sediment indicate TKN and TP consistently exceed PSQG severe effect levels. TOC exceeds the lowest effect level in three samples and exceeds the severe effect level in one sample.

- Analyses for volatile organics in east floodplain sediments indicate they contain small quantities of toluene, xylene and petroleum hydrocarbons.

- Regulation 347 leachate testing indicates that the floodplain sediments may contain one element, Ba, which exceeds 10 times the Schedule 4 criteria which would render the soil a nonhazardous registerable solid waste for disposal purposes.

- The postglacial sediments are considered to be generally uncontaminated by the overlying floodplain sediments; however, the top of the postglacial sediment strata may be softened and contain some floodplain sediment contaminants.

- Floodplain vegetation (*Typha*) stalks take up and store P, Fe, Mn and Zn from the sediment in the greatest concentrations.

- A comparison of data from the analyses of two floodplain groundwater samples from wells BH-207 and BH-239 with other available river water quality data indicates that the floodplain groundwater may be impacting the river water with elevated levels of TOC, TDS, Ni and Zn. However, Regulation 347 test data indicates that sediment from BH-239 is nonleachate toxic. No estimates of groundwater flow into the river are currently available.

2.3 Pilot-Scale Dredging and Treatment Demonstration

The demonstration involved the dredging and treatment of approximately 127 m^3 of industrial mill scale and contaminated clayey silt sediments from the upstream section of the McMaster Avenue reef (Figure 2.3) (Acres, 1993). The industrial deposits and the sediments contain elevated concentrations of several metals (including chromium, copper, iron, lead, manganese, nickel and zinc), phosphorus and oil and grease which generally exceed ambient concentrations in upstream river sediments and frequently exceed the Ontario MOE sediment quality guidelines SELs.

The sediment removal equipment consisted of a specially modified Mud Cat MC-915 suction dredge, manufactured by Ellicott Machine Corporation, as well as a booster pump and pipeline to transport the dredged slurry to the treatment site over a distance of approximately 1500 m. The main modifications to the Mud Cat dredge included a special dual-convergence variable pitch, multiflight horizontal auger and boom assembly; a pivoting auger head; a permanent full rear shroud behind the auger; a removable vibrating front shroud; and instrumentation including a nucleonic densitometer, electromagnetic flowmeter, dredge head vibration sensor, dredge head turbidity sensor, cab-mounted analog displays and a cab-mounted data logger. The sediment removal incorporated the use of a silt curtain and river water quality monitoring programs to ensure minimal impact from the dredging on water quality and to allow a performance evaluation of the technology.

The sediment treatment demonstration involved the construction of a temporary facility, including a temporary storage basin, at Atlas' NFP. The facility was an innovative application of existing technologies comprising a coarse screen, screw classifier, fine screens, thickener, centrifuges, settling basin and filtration plant designed by Acres and Derrick to provide efficient separation of solid/liquid phases and size fractions in a continuous-feed, high-volume operation. The screens and centrifuges were made by Derrick Manufacturing Corp. and operated by Derrick Environmental Services. The effectiveness of a pilot-scale magnetic separator was also tested during the demonstration. A sampling and monitoring program formed part of the operation of the facility to allow evaluation of the technology upon completion of the demonstration.

Results of monitoring and evaluation programs indicate that the dredge can be effective in removing the industrial mill scale and river sediments without having a significant impact on the surrounding river water quality. The vacuum suction of the dredge played a major part in minimizing resuspended solids during dredging. Various modifications to the dredge head were evaluated during the demonstration. The intake screens on the dredge head shroud limited the movement of sediment to the auger and sometimes became partially blocked by weeds and river debris. Operating the dredge without the dredge head screens resulted in the lowest turbidity levels at the dredge head (overall average 5.35 Formazin Turbidity Units [FTU]) but also resulted in frequent blockages of the intake or dredge pump with river debris. The shroud-mounted vibrators did not appear to have a significant positive affect on the performance of the dredge. Allowing the dredge operator more flexibility in running the dredge based on his experience and the instrument readings, resulted in an increase in slurry production rates with an associated slight increase in turbidity immediately around the dredge head. The removal of the auger shroud and replacement of the modified auger with an auger with cutting teeth resulted in increases in turbidity (overall average 17.64 FTU) at and around the dredge head and also improved the sediment removal efficiency.

The overall average percent solids (by weight) in the pumped slurry was low (2.13% excluding pipeline rinsing) and varied considerably during the demonstration due to the planned structure of the dredging program (with frequent starts, stops and flushing of the pipeline) and the generally cautious approach to the dredging to minimize environmental concerns. A prime objective of the demonstration was to minimize the environmental impact of the dredging on downstream river water quality. This was met, in part, by sacrificing high percent solids in the dredged slurry.

The mill scale was dredged at a higher percent solids (by weight) than the river sediments. Based on the evaluated data, the average percent solids achievable during full-scale dredging in mill scale and river sediments have been conservatively estimated at 10% and 5%, respectively.

Results of water quality monitoring inside and outside the silt curtain during dredging show that water quality was consistently within MNR and MOE guidelines beyond 10 m from the dredge head. The silt curtain functioned well in isolating the dredging site from the rest of the river and prevented any loss of suspended sediment to downstream reaches of the river. The silt curtain was costly to install and remove and suffered significant damage during removal. A simpler anchor design and a tighter control over the installation and removal will be required if a curtain is to be used in the full-scale cleanup. Data suggests that the dredging could have been performed without the use of the silt curtain, without significantly impacting the river water quality.

The dredging pipeline consisted of a floating section and a land based section. The land based section of fusion welded polyethylene pipe performed trouble free throughout the demonstration. The floating section of pipeline, however, experienced four separations during the dredging. While the separations caused no significant impact on the river water quality it was necessary to modify the pipeline couplings and the operation of the dredge to eliminate this problem.

The temporary treatment facility operated successfully during the demonstration without any major problems. The overall efficiency (by weight) of the treatment facility for the removal of suspended solids from the slurry was 99.4%. The overall removal efficiency for metals of concern ranged from 94.4.% for nickel to 99.3% for iron and copper. Concentrations of volatile organics in the effluent from the treatment facility were below levels of concern.

The operation of Atlas' existing NFP was such that additional flow capacity was available to allow the effluent from the treatment facility to be further treated with the normal North Plant process water in the NFP. Blending the effluent from the sediment treatment facility with the Atlas wastewater had no adverse impact on the quality of the NFP effluent. The suspended solids concentrations were within the Atlas NFP design criteria.

A very efficient separation of coarse solids greater than 2 mm in size was achieved by the coarse screen.

The screw classifier removed mainly high specific gravity sand-sized metallic mill scale particles from the slurry by sedimentation. The screw classifier removed the largest mass of metals of all the treatment process units.

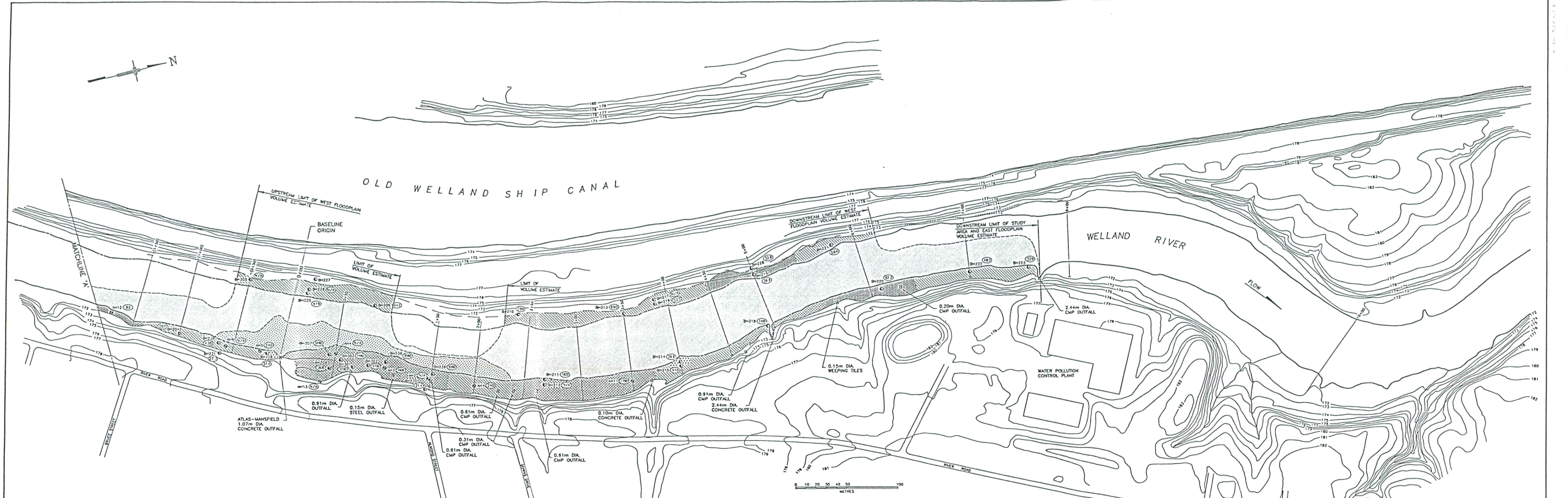
The test of the pilot-scale magnetic separator indicated that this technology could be effectively used to remove magnetically charged metallic particles from the dredged slurry. The removal efficiency ranged from 50% for aluminum to 91% for tin.

The vibrating screens removed a significant amount of low specific gravity natural organic matter from the slurry. Vibrating screen solids contained the highest concentrations of conventional parameters and oil and grease. Twenty percent of the solids retained by the vibrating screens had a particle size smaller than the screen opening (0.075 mm) indicating a somewhat inefficient solid separation. The separation could be improved by distributing the slurry flow to an additional vibrating screen.

The sludge retained in the thickener was efficiently dewatered by the centrifuge to produce solid cake with an average moisture content of 54.4%. The quality of the centrifuge overflow was extremely variable due to insufficient polymer dosage and a variable solids content in the centrifuge feed sludge. For the full-scale cleanup a flocculation tank is recommended ahead of the centrifuge to produce a thickened feed sludge with a constant solids concentration.

The solids generated and separated by the treatment process are disposal ready and can be classified as nonregisterable, nonhazardous solid industrial waste according to MOE Regulation 347 leachate and slump tests. Some of the solids contain high nutrient levels and may qualify for spreading on agricultural land provided the application rates are adjusted to meet heavy metal concentrations in the applicable guidelines. The separated mill scale solids are being considered for recycling by Atlas. A comparison of the chemistry of the solids to existing MOE decommissioning guidelines indicates that without any further treatment the only acceptable disposal option for the separated solids is municipal or industrial landfilling.

Noise emission survey data collected before and during the demonstration indicate that background levels were higher at the Atlas NFP, at the Atlas pumphouse and at the corner of Down's Drive and River Road (near the booster pump location) during the demonstration. However, no complaints were received from area residents.



LEGEND

AH8		1990 AUGER HOLE (MARCH)
BH200		1991 BOREHOLE (APRIL–MAY)
BH300		1992 BOREHOLE (APRIL)
(475)		MAXIMUM Cr CONCENTRATION IN mg/kg SEE NOTE 5. (N/A INDICATES NO CHEMICAL DATA)
–(1+00)		TRANSECT LOCATION AND CHAINAGE (m) EG. 100m UPSTREAM (–) FROM ATLAS–MANSFIELD OUTFALL AT (0+00)

TOE OF SLOPE (DEC. 1990)

- MEASURED
- ASSUMED

EDGE OF RIVER

- SURVEYED (MAY/OCT. 1991)
- MEASURED (DEC. 1990)
- SEE NOTE 2
- CONTAMINATED NATURAL RIVER SEDIMENTS (SEE NOTE 3)
- PREDOMINANTLY INDUSTRIAL MILL SCALE
- Cr CONCENTRATIONS LESS THAN THE UPSTREAM AMBIENT RIVER SEDIMENT Cr CONCENTRATION OF 31 mg/kg
- Cr CONCENTRATIONS BETWEEN THE UPSTREAM AMBIENT RIVER SEDIMENT Cr CONCENTRATION OF 31 mg/kg AND THE PROVINCIAL SEDIMENT QUALITY GUIDELINES SEVERE EFFECT LEVEL Cr CONCENTRATION OF 110 mg/kg
- Cr CONCENTRATIONS BETWEEN ONE AND TEN TIMES THE PROVINCIAL SEDIMENT QUALITY GUIDELINES SEVERE EFFECT LEVEL Cr CONCENTRATION OF 110 mg/kg
- Cr CONCENTRATIONS EXCEEDING TEN TIMES THE PROVINCIAL SEDIMENT QUALITY GUIDELINES SEVERE EFFECT LEVEL OF 110 mg/kg

NOTES

1. GROUND SURFACE CONTOURS IN METERS
2. ORIGINAL TOPOGRAPHY AND RIVER BOUNDARIES TAKEN FROM NIAGARA PENINSULA CONSERVATION AUTHORITY MAPPING (SCALE 1:2000) FORMING PART OF 1985 FLOOD LINE MAPPING REPORT BY M.M. DILLON LTD. SOURCE AIR PHOTOGRAPHY IS APRIL 1980. RIVER BOUNDARY HAS BEEN MODIFIED AS SHOWN BASED ON PROJECT SURVEYS.
3. THE CONTAMINATED NATURAL RIVER SEDIMENTS SHOWN SHADED GENERALLY CONTAIN CONTAMINANT CONCENTRATIONS WHICH STATISTICALLY WERE FOUND TO EXCEED THE UPSTREAM AMBIENT CONCENTRATIONS.
4. FOR UPSTREAM SAMPLING LOCATIONS REFER TO FIGURE 2.1
5. WHERE CHEMICAL ANALYSES HAVE BEEN PERFORMED ON FLOODPLAIN BOREHOLE SEDIMENTS THE MAXIMUMM MEASURED CHROMIUM CONCENTRATION IS SHOWN, REGARDLESS OF DEPTH OF OCCURRENCE.
6. CONTAMINANT CHARACTERIZATION OF FLOODPLAIN SEDIMENTS HAS BEEN CARRIED OUT AT VARYING DEPTHS AT AUGERHOLE AND BOREHOLE LOCATIONS ONLY. EXTRAPOLATION OF THE DATA HAS BEEN ATTEMPTED TO DEFINE GENERAL FLOODPLAIN CONDITIONS. ACTUAL CONDITIONS BETWEEN LOCATIONS OF INVESTIGATION MAY VARY FROM THOSE INDICATED OR INFERRED.

Atlas Specialty Steels - Environment Canada

Welland River Reef Cleanup Environmental Screening

Simplified Plan of Floodplain Contamination - Atlas 42-in. Outfall and Downstream

Fig. 2.1

ACRES

Plot Date NOV 18 1992 - 10:16:24

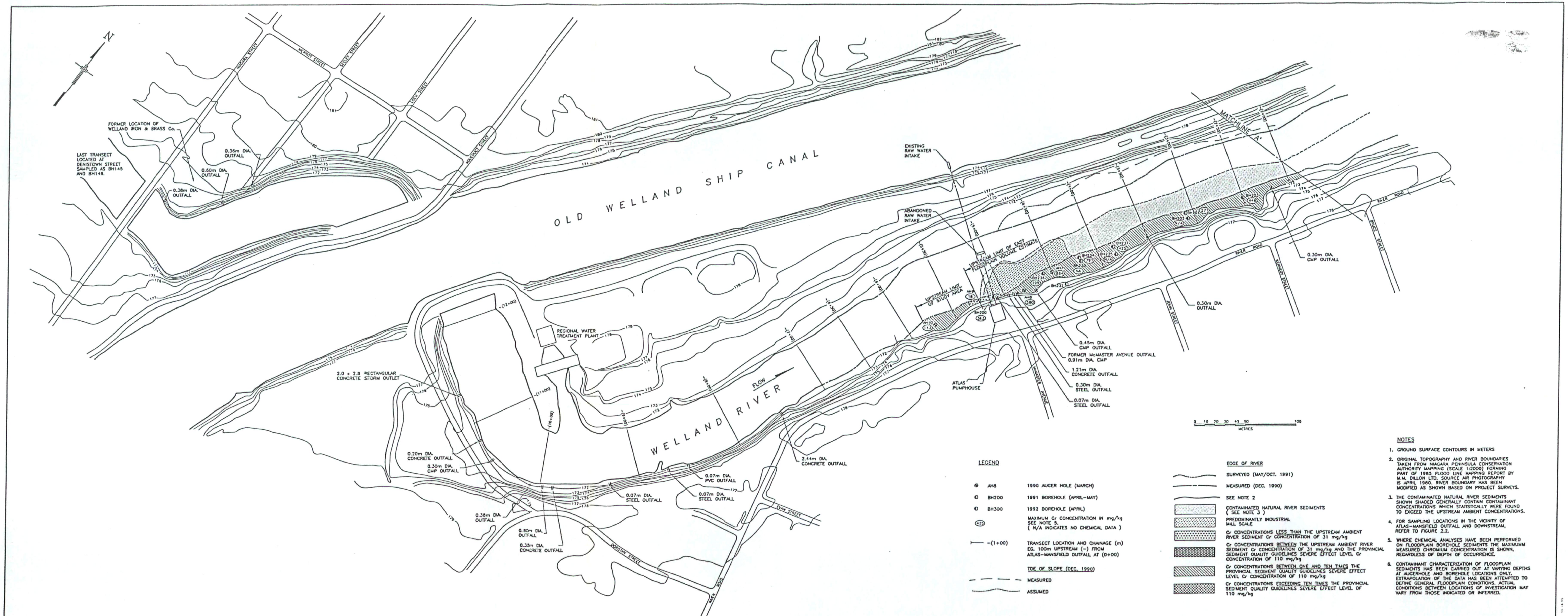
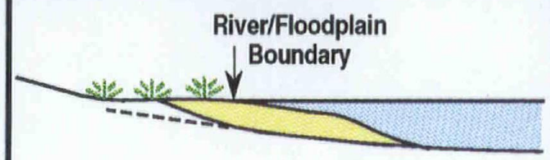
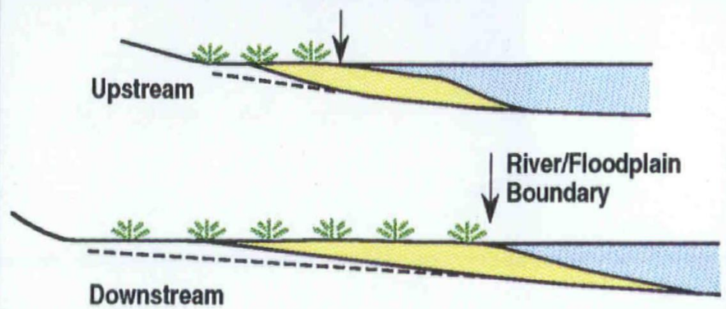
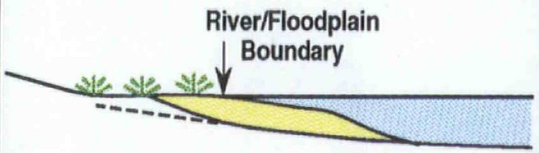
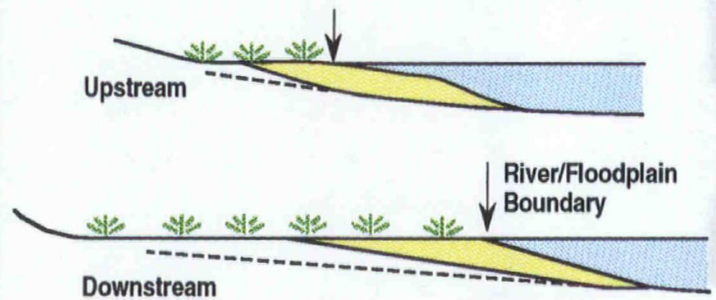
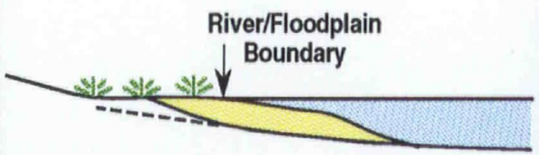
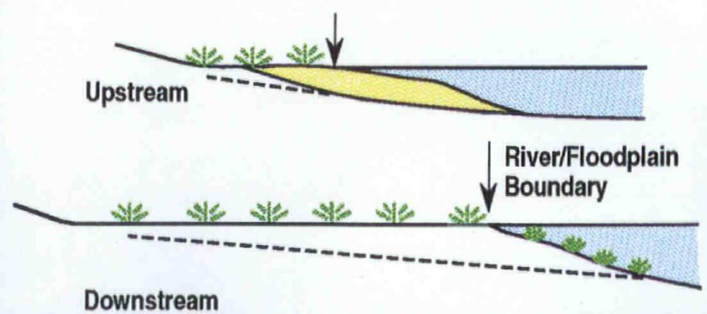


Fig. 2.2

Atlas Specialty Steels - Environment Canada
Welland River Reef Cleanup Environmental Screening
Simplified Plan of Floodplain Contamination - McMaster Avenue Outfall

ACRES

Clean-up Alternatives

Alternative	Objective	Typical Extent of Dredging: McMaster Outfall Area	Typical Extent of Dredging: Atlas 42 inch Outfall Area
A	• Removal of Mill-Scale in Outfall Areas (McM and A-42") • Removal of Contaminated Sediment to Edge of River (A-42")		
B	• Removal of Mill-Scale in Outfall Areas (McM and A-42") • Increased Protection of Contaminated Sediment against Erosion (A-42")		
C	• Removal of Mill-Scale in Outfall Areas (McM and A-42") • Contaminated Sediments to Remain in Present Condition (downstream part of A-42")		

Material to be Removed

----- Base of Highly Contaminated Materials

P11201.00 MR

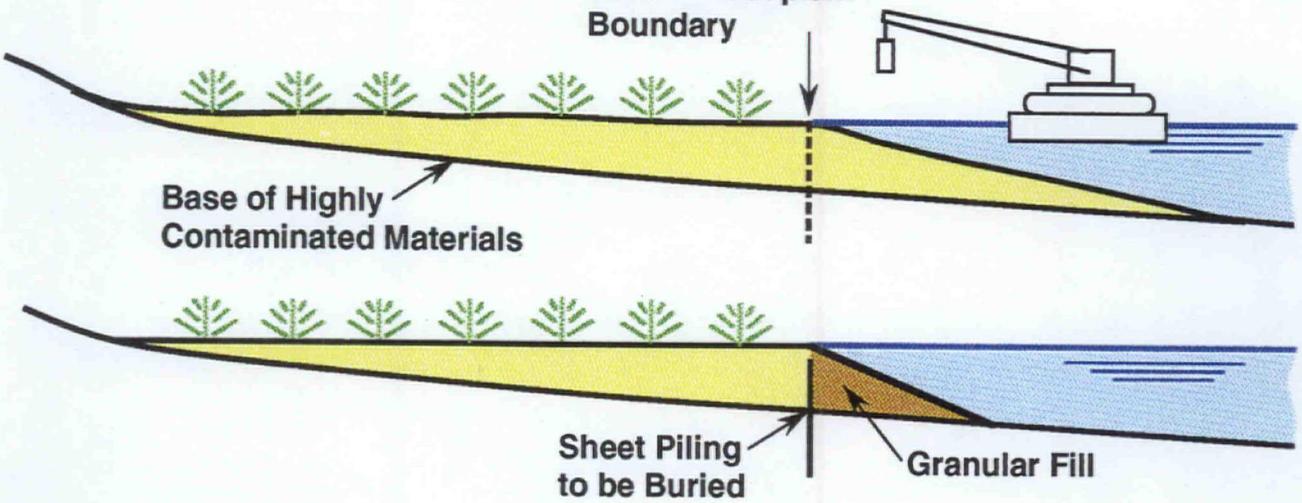
Fig. 6.1

Atlas Specialty Steels - Environment Canada
Welland River Reef Cleanup Environmental Screening
Reef Removal Alternatives

ACRES

Alternative 5

Sheet Pile Containment



- Minimum impact on floodplain
- Dredging can continue up to the river/ floodplain boundary without affecting the stability of the floodplain
- Vibratory methods can be used to install piles, minimizing noise effects
- Minimizes dredging and treatment quantities
- No contaminated sediments remain below river
- Sheet piling can be utilized for containment during future removal of remaining floodplain sediments (if necessary)
- Sheet piling is a temporary measure and can be removed after remediation of floodplain or as part of the 1995 works

7 Project Effects and Mitigative Measures

The potential effects of the demonstration project were discussed during the 1991 workshop and open house, while issues and concerns relating to the full-scale reef cleanup were discussed during the 1993 workshop, and are an ongoing topic of discussion during Welland River (Welland) Cleanup Committee and the TRC meetings. Monitoring undertaken during the demonstration project has provided the information with which to address many of the previously expressed concerns, and to assess the success and/or need for specific mitigative measures. This section summarizes the environmental concerns which were identified and provides mitigative measures to address those concerns and others raised during ongoing consultations with WRCC members. Contingency plans are presented to deal with potential upset conditions.

7.1 River Dredging

7.1.1 Cleanup Criteria

The driving force behind the cleanup of the study area is the restoration of productive aquatic habitat in the affected stretch of the river. Consequently, a primary question is how much of the contaminated sediment needs to be removed to meet this goal. Early in the discussions for the demonstration project, it became clear that removal of sediment to a level of contamination similar to the upstream sediments would be most appropriate, as removal beyond those levels would not result in lower sediment contamination levels, as moderately contaminated sediments from upstream would subsequently be deposited over the remediated area in due time.

The chemical and biological testing undertaken for the project has indicated that the reef deposits are the most severely contaminated sediments and have a demonstrated biological effect. The intermediate areas adjacent to and between the reefs and the area downstream of the Atlas 42-in. reef contain no mill scale, but do contain contaminant levels above the upstream ambient levels and in some cases, above the SEL for specific metals. These areas, although contaminated, do not exhibit consistent biological effect, likely due to the lack of biological availability of the materials (Jaagumagi, 1995). The focus of the present cleanup project is then the two previously identified reef deposits containing oily metallic particles intermixed with finer river sediments.

The cleanup criteria to be applied to the contaminated riverine sediments is defined as the physical absence of metallic particles or oil contaminated sediment directly associated with the two reef deposits, and the presence of underlying river bottom sediments that do not exceed the SEL of the Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario (PSQGs), (MOEE, 1993). These criteria were developed by and approved by the project TRC.

The maximum depth of excavation at the *Typha* bed/open water interface at various sections along the Atlas 42-in. reef has been defined as a result of studies conducted along that interface during the spring of 1995 and has been used to estimate the total volume of materials slated for removal (approximately 7000 m^3). Additional bathymetric investigations were undertaken at the same time to define the shape of the reef deposits and the extent of dredging required to accomplish complete removal. The contract specifications have been developed to provide a suitable buffer zone around the perimeter of the reef deposits, and an allowance for overdredging has been provided to allow for additional depth penetration (approximately 100 mm over surface area of reef bottom) during dredging, or the need to remove unanticipated pockets of contaminated sediment within the river bottom.

Specific pockets of coarse mill scale located within the floodplain at boreholes AH-8, (near the McMaster Avenue outfall), and BH-301, (downstream from the Atlas 42-in. outfall) will also be removed as part of this project. It is anticipated that shore-based removal techniques will be used at these locations. The contract tender documents specify that total containment of that material will be required during transfer to the Atlas NFP for treatment.

Biological criteria are another means of assessing the effectiveness of the cleanup process, and the use of specific organisms as indicator species has been broadly used in the past to characterize sediment quality. Currently, the National Water Research Institute in Burlington is assisting Environment Canada in the development of biologically based guidelines for sediment quality in the Great Lakes. These types of indicators are useful in delineating the extent of contamination that requires remediation, but are not particularly useful for immediate assessment or verification of cleanup. Chemical and physical indicators provide a more useful means, in the short-term, of assessing the degree of cleanup. Biological indicators are more appropriate for assessing the long-term success of the cleanup effort.

7.1.2 Sediment Stability at Reef-Floodplain Interface

With respect to the previous demonstration, there were concerns that removal of a portion of the river sediment would result in the formation of an unstable exposed face at the edge of the excavation. The exposed material would be low in strength and may be subject to slumping if excavated too steeply. Additionally, any contaminant newly exposed by the dredging would be subject to the natural erosional forces of the river. In that project, deliberate efforts were taken to avoid the edge of the floodplain where the depth of an exposed face would be the largest, in order to reduce the potential for slumping of contaminated floodplain sediment (refer to Section 2.2.2, Geotechnical Conditions). Thus, all dredging undertaken during the demonstration project was aligned parallel to shore in order to minimize the formation of steep, unsupported side slopes. This process was, however, very inefficient, as often only one corner of the dredge head was in contact with the sediment when working on the sloping reef deposits.

For the presently proposed project, dredging will proceed from the outer margin of the reef (near the center of the river) across the river toward the floodplain. This sediment removal process will continue in an upstream to downstream direction, completing individual 20- to 50-m sections, prior to relocating to the next section.

Atlas 42-in. Reef

In order to stabilize the reef-floodplain interface, and provide an inshore limit for the dredging operations, sheetpiling will be installed along the length of the Atlas 42-in. outfall reef at the edge of the existing *Typha* bed prior to the commencement of the dredging operations. This procedure will provide a clean stable edge between the two areas, that will prevent loss of adjoining wetland surface area, and effectively resist erosion. This approach minimizes the area of the resulting face of contaminated sediments that will be exposed to river water and provides some significant but unquantified degree of protection from subsequent transfer of contaminants to river waters. Although it is not expected that groundwater transfer of contaminants from floodplain sediments to the river would result in measurable changes to river water quality, this transfer will be investigated and quantified (if possible) during subsequent investigations of the wetland.

As noted previously in Section 6, this procedure also provides flexibility to be able to undertake or develop future plans for the associated wetland area. The sheet pile wall could readily be modified in the future to act as an offshore dam (so as to allow shore-based floodplain remediation to take place) should wetland removal be deemed necessary. The studies needed to determine whether the wetland should or should not be removed, can be undertaken after the dredging project is complete.

The sheetpiling will be redriven to at least 170.65-m elevation or 30 cm below the surface of the wetland upon completion of dredging. The 170.65-m elevation is the lower limit of the river water level, while 30 cm below grade would maintain the top of the sheet pile within the existing *Typha* root mat. Granular fill (75 mm minus) will be placed along the offshore edge to develop a stable (2.5:1 HV) shore slope.

The granular material will be sized to resist erosion and downstream transport (1-in-100-yr event). Infilling of the granular material with fine sediment will in time develop a more natural shoreline. Positioning the top of the sheetpiling below the surface of the wetland will reduce its influence on wetland functions (i.e., excess groundwater flow that cannot infiltrate sheet pile wall can overtop it without coming to the surface and will not be a barrier to wildlife) and site aesthetics.

McMaster Avenue Reef

Pending the results of further on-site investigations at the time of contract initiation, a similar process as presented for the Atlas 42-in. reef may also be employed along the edge of the McMaster Avenue floodplain. If sheetpiling is not used, (i.e., floodplain sediments are more cohesive than anticipated), the interface area would be developed at the steepest stable side slope possible (not less than 2:1 HV). Given that the average depth of mill scale and contaminated sediment is approximately 1 m at the reef-floodplain interface, the amount of wetland area lost along this interface would be approximately 200 m^2 (100 m long by 2 m wide). Potentially, the *Typha* bed root mat would allow a steeper excavation angle than 2:1.

If the excavated side slope approach is followed, it is considered preferable that the side slope be restabilized within 1 to 2 days after the dredging is completed by application of a filter material (sand) and a layer (up to 60 cm) of clean granular fill (sand and gravel). Should resuspension of sediment become a concern during installation of the filter and placement of the fill, the section would be isolated from the remainder of the river by means of a small (30- to 60-m long) portable silt curtain, which would be moved downstream to new sections concurrently with slope stabilization activities.

The immediate goal of the slope stabilization process will be to prevent slumping and erosion of the slope. The granular material would be selected to resist erosional forces, based on an 1-in-100-yr flood event.

Bottom Sediment

Concern was expressed prior to the 1991 demonstration project that removal of a portion of the contaminated sediment or the placement of a silt curtain in the river could alter the flow pattern in that part of the river in such a way that the remaining sediment would have an increased potential for erosion and transport downstream. Although this was not considered to be a significant factor at the time, hydraulic analysis of the dredging demonstration site was carried out (Acres, 1991d) using an existing backwater model of the Welland River to provide design criteria for the silt curtain and validate sediment transport assumptions. Both unrestricted flow conditions and restricted flow conditions (simulating the placement of a silt curtain in the river) were evaluated. Flow velocities, and river bottom shear stresses were calculated for a wide range of river discharges. In consideration of the downstream movement of river sediment during dredging (restricted flow), it was determined that there would be some potential for movement of the fine silt and clay sediments on the outside of the silt curtain when flow in the river reached 20 m^3/s [probability of exceedance 10% (October), 27% (November)] under average downstream water levels. After dredging and removal of the silt curtain (unrestricted flow) some movement of exposed till may occur when river discharges reach 50 m^3/s [probability of exceedance <10% (October through February), maximum 23%, March].

In response to this evaluation, bedload samplers were installed upstream, within and downstream of the demonstration site area (November 1991 to August 1992) to assist in the assessment of postdredging movement of upstream sediment back into the dredged area and/or mobilization of sediments from the dredged area farther downstream. Those studies found that there was mobilization of contaminated material following the dredging project (i.e., a generally lower ratio of Fe/Cr in bedload material collected near the downstream end of the dredged area indicating more contaminated material than present upstream), although the results were not consistent during all peak flow periods.

As no silt curtain is to be used during the full-scale reef cleanup, it is proposed to install sediment samplers to monitor drift of suspended materials in association with the cleanup project. Environment Canada has indicated that they will undertake long-term monitoring of the site to evaluate recolonization of the dredged area by benthic organisms and, any subsequent movement of contaminants from the surrounding area and/or their uptake by newly resident organisms. The program would be similar to that undertaken by the MOEE prior to the full-scale cleanup, and would also be expected to include sediment quality evaluation with the biologically based evaluation criteria currently being developed by Environment Canada (at NWRI, Burlington).

7.1.3 Water Quality

One of the major concerns of the pilot-scale demonstration project was that sediment would be resuspended during the dredging operations and subsequently transported downstream, thereby adversely affecting water quality. Many of the alterations to the Mud Cat dredge were intended to reduce the potential downstream loss of sediment, however, a silt curtain was still deployed around the dredging operation to further minimize this potential effect. Consideration was also given to conducting the operation during the low flow summer period, however, this would have resulted in a delay in the project until the following year. Reduction of flow through the siphons from the Old Welland Canal into the river was also considered, but this appeared to be unfeasible, and the reduced flows could adversely influence the capacity of the river to assimilate the effluent discharge from the Region's Water Pollution Control Plant. It was considered that the combination of dredge alterations and the silt curtain would be sufficient to control the downstream loss of material during the demonstration project.

The silt curtain and all structure anchorages were designed as temporary protection works, based on a 1-in-20-yr event. For October, the 1-in-20-yr event corresponded to a river discharge of 28 m^3/s and typical unrestricted river velocities of 0.24 m/s (Acres, 1991c).

An extensive monitoring program was established for the previous demonstration project to evaluate the effectiveness of the dredging process (in terms of suspension of particulates and release of contaminants to the waters of the river) and the effectiveness of the silt curtain in retaining any suspended material within its borders.

The potential for contaminant loading to the river was assessed by monitoring an extensive suite of chemical parameters 100 m upstream of, within, and 100 m downstream of the silt curtain, the results of which are presented in Appendix C (Table C1.1). They indicate that a large number of metals and conventional chemical parameters had a higher concentration in the upstream samples compared to the downstream samples. The maximum downstream turbidity was 3.8 NTU which was well below the MOE upper limit of 80 FTU (NTU=FTU) above the upstream ambient concentration (the units NTU and FTU are equivalent). The concentrations of six parameters (TP, Cu, Ni, Pb, Zn, and Fe) exceeded the PWQO at the upstream location, compared to the concentrations of three parameters (TP, Cu and Pb) inside and downstream from the silt curtain. Exceedances within the silt curtain and at the downstream location frequently corresponded to exceedances at the upstream location.

Turbidity and suspended solids were monitored outside the silt curtain as part of the MOE/DFO/MNR approval for the project, with a shutdown limit established at 80 FTU for turbidity, and the greater of 10% above background or 25 mg/L for total suspended solids (TSS). Downstream TSS levels were substantially less than the regulatory limit, ranging from 0.3 to 5.2 mg/L during the demonstration. In addition, turbidity was monitored at the dredge head by means of a head mounted electronic sensor, and measured in conjunction with TSS sampling 10 m upstream of the dredge, immediately behind the dredge head and 10 m downstream of the dredge. Turbidity and TSS monitoring within the silt curtain indicated that TSS concentrations at a distance of 10 m away from the dredge were well below the Environment Canada criteria of 25 mg/L at a distance of 25 m. The maximum TSS concentration measured at a distance of 10 m away from the dredge was 21 mg/L. The maximum recorded TSS concentration at the dredge head was 356 mg/L. Considering the limited local impact of the dredging on river water quality, it is believed that the downstream impact of full-scale dredging would be negligible even without a silt curtain. The results of these programs are presented in detail in Appendix C (Tables C1.2 and C1.3).

The 1995 cleanup project is proposed during September and October when river flows are near their yearly minimum and water level fluctuations are moderate (refer to Figures 4.1 and 4.2). During the reef cleanup project, a water quality (turbidity, suspended solids) monitoring program will be implemented to ensure compliance with regulatory criteria. This program will utilize field measured turbidity to obtain a quick evaluation of any effects resulting from dredging operations.

Data from the pilot-scale project was used to develop a relationship between turbidity and total suspended solids. Regulatory limits from Environment Canada, Ministry of Environment and Energy, and Ministry of Natural Resources were then examined and plotted against background conditions. Those limits, expressed as TSS, were transformed to equivalent Forzamin turbidity units (FTU) using the developed relationship. The ability to express that set of criteria as a readily, understood set of specifications was examined and modified to develop the proposed shutdown criteria present in Figure 7.1. Equivalent regulatory limits are also presented for purposes of comparison. The relationship presented by the line can be expressed as follows:

- at background turbidity levels from 0 to 22 FTU, the allowable increase above background ranged from 12 to 0 FTU, decreasing by 2 FTU for every 4 FTU increase in background. The pattern is presented in the following table.

Background Turbidity	**Operation Limit (FTU)**
0	12
4	14
8	16
12	18
16	20
20	22

- at a background of 22 FTU and above, the allowable increase would be 5% above background.

As previously noted (Section 5.1), the Contractor may be required to make additional dredge head modifications or alter dredging procedures in order to ensure that operations can be undertaken without the need for enclosure of the dredging area with a silt curtain. If, however, the Contractor is still not able to meet the stated criteria, a silt curtain may be required.

An oil absorbent boom will also be deployed upstream and downstream of the dredging operation to collect any oils/grease released from the sediments during the cleanup.

7.1.4 Resource Use

The project will require the installation of heavy cables along each riverbank to act as anchor and traverse points for the dredge, while the dredge itself will deploy a cable across the river to allow it to work in a cross-river fashion. The anchoring system proposed will be similar to that employed during the previous demonstration project, using large trees along both shores as anchor points for the along-river cables. Public safety will be ensured by proper marking and isolation (snow fence) of the anchor lines along both the Merritt Island shoreline and the River Road shoreline.

In addition, the cross-river cable may interfere with any potential navigation on this section of the river. Given the isolated nature of this section of the river between the two canal syphons, usage is extremely limited, consisting of the occasional canoe or other small craft. Warning signs will be posted on the shoreline upstream and downstream of the dredging site warning of the cable crossing, and appropriate lighting of the dredge will be undertaken during the night. The cable will also be dropped to the river bottom at night. The oil booms will each be two pieces, to allow the movement of small boats (canoes, etc) through this section of the river during the cleanup project.

7.1.5 Noise and Aesthetics

The undertaking of the project will create some disturbance to the aesthetics of the Merritt Island park and the River Road shoreline, and will also cause some disturbance to local residents as a result of increased activity and noise levels associated with the initial equipment setup, the dredging and transfer process, and the final decommissioning and cleanup of the work sites. The removal process is expected to extend over approximately 2 months, hence impacts related to both of the above will be temporary.

Noise monitoring was undertaken for the previous demonstration as part of the MOE Certificate of Approval for the project. Noise emission data was collected over a 10-d period prior to the start of the 1992 demonstration project to establish baseline conditions. Subsequent monitoring occurred over a 10-d period during the demonstration project with the dredge and treatment facility operational. The results are summarized in Table 7.1. Results indicate that the noise readings during the demonstration project are noticeably increased over the existing ambient. However,

Table 7.1

Demonstration Noise Emission Data

Date (1991)		Average Decibel Reading (L_{ex})*		
		Location 1 (dBA)	Location 2 (dBA)	Location 3 (dBA)
Background Survey				
September	12	-	57.0	-
	16	-	-	65.4
	18	-	-	60.3
	27	-	-	65.2
October	1	-	55.9	54.0
	2	-	-	69.6
	3	55.8	56.0	-
	9	62.0	58.6	-
	9	64.5	-	-
	23	57.1	57.7	-
Demonstration Survey				
October	25	60.4	58.9	67.2
	28	57.4	68.1	68.0
	29	63.5	62.3	66.0
	30	68.6	62.8	65.6
	31	66.9	60.7	64.7
November	1	67.1	69.1	68.4
	4	67.7	68.2	-
	5	66.3	69.1	60.5
	6	71.3	63.9	72.0
	7	65.2	58.2	63.0

Notes:
Monitored Locations:
Location 1 - Atlas Pumphouse fence
Location 2 - Hydro pole at Down's Drive and River Road
Location 3 - Atlas' North Filtration Plant (inside fence)

*L_{ex} - equivalent exposure level is obtained from entire day readings from noise dosimeter.

no complaints were received from neighboring residents during the demonstration project.

To address short-term increases in noise related to construction aspects of the project, the following measures will be implemented:

- All equipment used at the site will comply with MOEE regulation NPC 115, (MOEE, 1978) 'Construction Equipment' as per Section 9 of the Environmental Protection Act

- Construction equipment shall be limited to the hours 0700 to 1900, Monday to Saturday. No construction equipment shall be used on Sundays or statutory holidays.

7.1.6 Fisheries

Fish abundance in this section of the river is relatively low, given that it is relatively isolated from upper and lower reaches of the river by the canal syphons. Only white crappie and unspecified minnows were found during a hoop net/minnow trap survey of the river conducted during the summer of 1990 (Tarandus, 1992).

The reef areas proposed for removal are comprised of primarily metallic, mill scale sediments. Previous investigations of the biological community of these reef deposits (Dickman et al, 1990) have found them to be completely to partially devoid of benthic organisms and aquatic macrophytes, depending on the distance downstream from the sewer outfall. The removal of these materials should be considered as a net gain in fisheries habitat as it is envisioned that relatively healthy biological communities will become established over time within the remediated areas. The speed of that recovery cannot be commented upon at this time. Thus the project should be considered consistent with the DFO policy of no net loss of fisheries habitat.

7.1.7 Wetlands

The area adjacent to the dredging operations is part of the Welland River wetland complex, which is a Provincially Significant Class 1 wetland, and as such any removal would be contrary to the Provincial Wetland Policy Statement, which states that there be no loss of wetland area or function. As that area is also considered to be fish habitat, its removal would come under the authority of the federal Fisheries Act which has a "no net loss" policy. The federal act does however make provision for, and will allow for the destruction of fish habitat, provided it is compensated for by the replacement of "like for like" habitat. The use of the sheet pile wall at the reef wetland interface will minimize the amount of wetland to be lost. The Ministry of Natural Resources has agreed to adopt the federal fisheries policy approach for the anticipated loss of wetland and fish habitat (MNR, 1995b).

The final goals for the remediation of the wetland portion of this section of the Welland River have not as yet been decided upon, however, they are to be developed by a subgroup of the WRCC (Wetland Working Group) in consultation with MNR, DFO and NPCA, as part of a long-term planning process to determine uses and objectives for the Welland River watershed ecosystem. Final restoration/rehabilitation of this section of the river is expected to take place as part of a subsequent project, and would take into account watershed characteristics and public views on desired uses. The goal of the current removal process, to be undertaken as part of this project, is to ensure that contaminated floodplain sediments are retained in place, while providing as much flexibility to pursue future planning options as possible.

7.1.8 Wildlife

Some disturbance to wildlife and wildlife habitat along the floodplain will occur during the initial placement of anchor cables and during their repositioning. These will however, be short-term events which are not expected to have lasting effects on habitat or wildlife.

The establishment of the slurry pipeline, the installation of the sheetpiling and the dredging operation itself will have some short term, temporary impact on wildlife (waterfowl, muskrats, mink, raccoons) as they will be frightened from the area during these periods. The section of the Welland River in which the project resides (immediately downstream of Old welland Canal siphon) is considered to have 'local or no significance' with respect to waterfowl staging, and 'no significance' with respect to migratory passerine and/or shorebird stopover area (MNR Wetland Evaluation Record, 1985). The most limiting factor for wildlife habitat in this area is the water level fluctuations caused by Ontario Hydro's downstream operations (MNR, 1995b).

7.2 Floodplain Removal

Some removal of floodplain material will be required as part of this project, however, the full-scale remediation of the entire floodplain area is **not** part of the proposed project. The interface between the mill scale and the floodplain sediments will be established in more detail through a small additional site study in order to more clearly define the extent of dredging and hence, the amount of floodplain to be removed.

7.3 Dredgeate Transport

The removal of the contaminated reef material and sediment by 'wet' methods was selected over 'dry' methods to avoid diverting the river through the west bank. This diversion would require extensive excavation and restoration of the west bank and would severely disrupt river flow conditions and the existing aquatic community.

The dredged material will be removed as a slurry, and transported by pipeline to the treatment site in the same manner as utilized during the previous demonstration project. Improvements to be incorporated into the full-scale cleanup include

- installation of one-way valves at the start of the shore-based pipeline to eliminate potential for backflow should the offshore line rupture

- the provision of line coupling mechanisms based on safety latches or bolted style clamps at the junction between all rigid and flexible sections of the river-based pipeline. Two of the pipeline ruptures during the demonstration project were as a result of accidental release of the load-binder style clamps utilized during that project.

- control over feed quantity to the treatment process will be provided by the dredge operator as directed by the treatment process operator. Direct communication between the dredge and treatment facility operators will ensure that pipeline overpressurizations, which lead to rupture of the river-based pipeline on one occasion during the demonstration project, cannot occur.

7.4 Treatment Facility

The sediment treatment facility for the pilot-scale demonstration was constructed at the site of Atlas' NFP and received dredged slurry from the McMaster Avenue dredging site through a 1500-m long pipeline. The treatment technology was a combination of physical and chemical processes. The objectives of the treatment facility were to remove solids and associated contaminants from the dredged slurry, to separate the solids into various size, density and magnetic fractions and to treat the liquid effluent to an acceptable level prior to its discharge into the river (Acres, 1993).

The main components of the treatment facility consisted of a coarse screen, screw classifier, fine vibrating screens, sludge thickener/clarifier and dewatering centrifuges. Larger solids were separated from the liquid fraction by the coarse screen, screw classifier and fine screens. The removal of fine suspended solids and soluble metals from the water fraction of the sediment slurry was achieved with the addition of a coagulant and polymer. The resulting chemical flocs were removed in the thickener. The thickened chemical sludge was dewatered by the use of a high-speed centrifuge.

In general, the treatment facility operated successfully and achieved its objectives without any major problems. The evaluation of its mechanical performance during the demonstration was based on observations of its ability to handle the slurry and solids loadings which it received from the dredge site. The efficiency of each of the process units was evaluated on the basis of the results of the extensive slurry and solids sampling and analytical programs which were implemented.

The concentrations of metals of concern and conventional parameters in the influent slurry to the treatment facility were variable, due largely to the nature of the dredging (i.e., start and stop operation of the dredge, variable flow and solids content of the slurry) and the variation in the properties of the dredged materials. Except for Cr, the average concentrations of all metals of concern in the thickener overflow, which was discharged into the Atlas NFP for further treatment, were higher than the PWQO. Conventional parameters were below the PWQO.

The operation of Atlas' existing NFP was such that additional flow capacity was available to allow the effluent from the treatment facility to be further treated with the normal North Plant process water in the NFP. Blending the effluent from the sediment treatment facility with the Atlas wastewater had no adverse impact on the quality of the NFP effluent. Except for volatile and suspended solids, the concentrations of conventional parameters and metals of concern in the effluent of the sediment treatment facility were below the concentrations in Atlas' wastewater under normal plant operations. The suspended solids concentrations were within the Atlas NFP design criteria.

All solids generated by the treatment facility passed the Regulation 347 slump test and can be classified as 'solid waste'. The results from the Regulation 347 leachate tests on the solids removed by the individual units indicate that they can be further classified as nonregisterable, nonhazardous solid waste. A comparison of the chemistry of the solids to existing MOE decommissioning guidelines indicates that without any further treatment the only acceptable disposal option for the separated solids is municipal or industrial landfilling.

Solids separated by the fine vibrating screens and the thickener in the sediment treatment facility had high nutrient contents but also had Ni, Mo and Cr concentrations exceeding the sewage sludge for agricultural use guidelines. If combined with other sediment sludges these solids may qualify for spreading on agricultural land provided that the application rates are within the permissible heavy metal concentrations recommended in the applicable guidelines.

A few operational difficulties were experienced at the treatment facility during the demonstration. The following recommendations for modifications to the facility are presented with a view to improving its overall performance under the conditions anticipated during full-scale cleanup and treatment. The full-scale cleanup treatment process will be designed for a 2000 USgpm flow-through rate.

The demonstration treatment facility was designed to receive a maximum flow of 1500 USgpm. The dredge produced a variable flow with an average of 1000 USgpm and occasional peaks in the range of 1500 to 4200 USgpm. During dredging, some overflow occurred from the scalping screen sump, the screw classifier flare tank and the vibrating screens. Slurry pumps with a maximum capacity of 1500 USgpm were used at the treatment facility. To prevent overflow problems replacement of the 1500 USgpm pumps with larger slurry pumps throughout the facility is recommended. To prevent slurry build up in the screw classifier flare tank, a larger diameter outlet pipe is recommended for the screw classifier.

The fine vibrating screens were occasionally blinded due to high concentrations of oil and grease, which resulted in some minor runoff of slurry from the screen surfaces. Fine screens will be replaced by 'Hi-G Dryer' units, which combine hydro-cyclone and fine vibrating screen technologies, and will result in a more efficient removal of fine materials.

The thickener operation was very successful, despite its less than optimum size for the desired flow-through operation. However, some turbulence did exist in the thickener tank during the periods of high flow which reduced the thickener efficiency. Installation of an additional baffle at the thickener inlet would dissipate this turbulence.

Generally, the centrifuge operation was successful but was more susceptible to process upsets than the other unit processes. The dewatering of the thickener sludge by the centrifuge was assisted by the use of a polymer. The centrifuge operation was very sensitive to the feed sludge solids content and polymer dosage. The operation of the centrifuge did not always produce a good quality overflow due to poor flocculation of the thickened sludge. Different polymers (Jayfloc 806 and 925) reported to be particularly effective at flocculation of fine sedimentary material, are being bench tested for usage in the full-scale cleanup. Appropriate dosage points will be identified during field operations. One centrifuge was found to adequately handle the sludge generated during the demonstration, however, an additional unit may be required to handle the higher flow rate and percent solids expected for the full-scale cleanup.

The sampling and analytical program was very successful. It generated data for the entire duration of the demonstration project. These data allowed evaluation of the treatment facility performance and efficiency. Large and dense solids (e.g., coarse sand, gravel, mill scale and various debris) in the slurry influent to the treatment facility settled out very rapidly and made it difficult to take representative subsamples for chemical analysis. Sufficiently large samples should be taken from the end of the pipe as slurry is being discharged into the first unit process (scalping screen) to ensure that samples are representative and that coarse materials are included.

The effluent from the sediment treatment facility (thickener overflow) was blended with Atlas' wastewater in a ratio of 1:10 and further treated in Atlas' settling basin and NFP. To asses the effect that dilution of Atlas' wastewater with treated slurry had on the quality of effluent from the Atlas NFP, samples were taken from the final effluent of the Atlas NFP treatment facility on November 2, 4, and 5. The average concentration of TSS, oil and grease and metals in the effluent of the NFP are presented in Table 7.2. For comparison, Table 7.2 also includes the average concentrations of the parameters in the effluent of the NFP from the Atlas NFP Performance Evaluation report (19/06/91). Except for oil and grease, the concentration of the parameters in the NFP effluent during the dredging demonstration were below the historic values reported in the performance evaluation report. The better NFP effluent quality during the dredging demonstration is related to the use of coagulant and polymer in the treatment facility. The high concentration of oil and grease in the NFP effluent during the demonstration project must have been the result of a high concentration in Atlas' process water since the concentration of oil and grease in the sediment treatment facility effluent (thickener overflow) was only 1 mg/L. During the demonstration project, Atlas, in their North Plant, adopted the use of the same coagulant and polymer that was used in the sediment treatment facility. This was done

Table 7.2

North Filtration Plant (NFP) Effluent

NFP Effluent	TSS (mg/L)	Oil & Grease (mg/L)	Cu (mg/L)	Mn (mg/L)	Ni (mg/L)	Pb (mg/L)	Zn (mg/L)	Cr (mg/L)	Fe (mg/L)
During Demonstration [1]	<1	24.5	0.04	0.07	0.06	<0.01	0.03	0.006	0.02
During NFP Normal Operation [2]	2.8	5.8	NA	NA	0.066	NA	NA	0.03	0.29

Notes:

[1] Average for November 2, 4 and 5
[2] From the Atlas North Filtration Plant Performance Evaluation (19/06/91)
NA = Data not available

to maintain compatibility between the North Plant and sediment treatment facility chemical additives during the demonstration project.

The new chemicals were not as efficient in the North Plant as in the sediment treatment facility and may have been responsible for the higher oil and grease concentration observed during the demonstration project.

When the flow to the treatment facility exceeded 1500 USgpm, excess flow was diverted to the TSB. The diverted flow was dosed with the coagulant and the polymer used in the chemical process. On November 1 and 5, not enough solids were accumulated in the bottom of the thickener to operate the centrifuge efficiently and the contents of the thickener were diverted to the TSB. Except for TOC, the concentrations of the metals of concern and the conventional parameters in the underflow drainage water were below Ontario Drinking Water Objectives (MOEE, 1994). Except for Pb the concentrations of metals of concern were below PWQO. The underflow drainage water and the overflow from the TSB did not require further treatment.

7.4.1 Other Treatment Alternatives

A variety of other treatment options, such as soil washing, physical, chemical, and biological treatments, metal extraction and recovery, and thermal destruction of organic contaminants, were investigated for the demonstration project and were found not to be cost effective. No evaluation of additional alternatives is planned for this project.

7.5 Disposal

At the end of the demonstration project a composite sample was collected from the piles of solids that were removed by the scalping (coarse) screen, screw classifier and vibrating screens, as well as the thickener solids dewatered by the centrifuge. The solid samples were analyzed for metals, conventional parameters and leachate toxicity (Regulation 347 leachate test) to provide data for the consideration of solids disposal options. These results are presented in Table 7.3 along with Regulation 347 Schedule 4 Criteria (formerly Regulation 309). Except for the concentration of Cd and Pb in the leachate from the centrifuge solids, the concentration of parameters in the leachate from the treatment facility solids were less than the Regulation 347 Schedule 4 Criteria. All parameters were at concentrations less than 10 times the Schedule 4 Criteria indicating the solids to be nonleachate toxic, therefore, nonregisterable.

The concentrations of contaminants in solids recovered by the sediment treatment facility were compared to three criteria in Table 7.3. Regarding the Decommissioning and Cleanup of Sites in Ontario criteria (MOEE, 1992), the measured concentrations of most of the metals in the solids exceed the limits for commercial/industrial land and, therefore, cannot be placed as fill at such sites. The concentrations of contaminants in the separated solids were also compared to Fill Quality Guidelines for Lakefilling in Ontario (Hayton et al, 1992). Under these guidelines, only material classified as inert fill may be used in lakefilling projects (shoreline stabilization, construction of piers, dams, etc). These guidelines are more stringent than the decommissioning guidelines and, therefore, the solids from the treatment facility would not qualify as confined lakefill material.

The Ontario Guidelines for Sewage Sludge Utilization on Agricultural Lands (OGSSUAL) (MOEE, 1986) are also included in Table 7.3. It is noted that the fine vibrating screen and centrifuge solids contain high nutrient concentrations (TP and TKN) and that the vibrating screen solids have a high organic content. Also, that the concentrations of Ni and Mo in the solids removed by both the vibrating screens, and the centrifuge, as well as the Cr concentration in solids removed by the vibrating screens were above the OGSSUAL maximum permissible concentrations. Apart from their possible use on agricultural land, the solids separated in the sediment treatment facility are presently only acceptable for municipal or industrial landfilling. The metals in the solids may, however, be recovered through a series of steps mainly involving solubilization and leaching and/or magnetic separation of the heavy metals, however, cannot be undertaken in a cost-effective manner.

Slump testing was performed on solids removed by the screw classifier, vibrating screens, and solids dewatered by the centrifuge, once a day, in duplicate. The maximum reduced height, or slump, recorded for all the solids tested was 120 mm (for screw classifier solids). These results indicate that solids generated during sediment treatment passed the Regulation 347 slump test and can be classified as solid waste. It should be noted that the high slumps recorded for screw classifier solids was due to a lack of cohesion in the solids rather than excessive water content.

Atlas owns a landfill site on River Road close to the dredging project which is certified to receive solid nonhazardous industrial waste which is where the material (solids) from the demonstration project were placed.

Table 7.3

Solids Composite Sample Data

Conventional Parameters

Sample	Oil&Grease (mg/kg)	LOI (%)	Mois. (%)	TP (mg/kg)	TKN (mg/kg)	TOC (mg/kg)
Coarse Screen	5700	11.5	19.2	NA	NA	NA
Classifier	1200	1.5	8.6	1600	870	25000
Vibrating Screen	11200	18.9	45.7	6600	12100	250000
Centrifuge	7200	8.4	44.2	6200	6950	80000
Cleanup Guideline for Soils[1]	–	–	–	–	5,600	10,000

Metals of Concern

Sample	Cu (mg/kg)	Mn (mg/kg)	Ni (mg/kg)	Pb (mg/kg)	Zn (mg/kg)	Cr (mg/kg)	Fe (mg/kg)	Cd (mg/kg)	Co (mg/kg)	Mo (mg/kg)
Coarse Screen	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Classifier	460	2100	916	121	306	1130	203000	1	79	527
Vibrating Screen	594	1760	1460	294	811	2930	158000	2	114	1020
Centrifuge	743	2280	1400	267	519	2140	183000	2	163	1350
OGSSUAL [2]	1700	–	420	1100	4200	2800	–	34	340	94
Cleanup Guideline for Soils[1]	225	–	150	750	600	750	–	6	80	40
Confined Lakefill Guideline[3]	41	–	38	45	120	58	–	0.7	16	1

MOE Reg 309 Leach Test

Sample	PCB [4] (mg/L)	As (mg/L)	B (mg/L)	Ba (mg/L)	Cd (mg/L)	Cr (mg/L)	Pb (mg/L)	Se (mg/L)
Coarse Screen	<0.003	<0.005	<0.2	<0.5	<0.005	<0.05	<0.05	<0.002
Classifier	<0.003	0.007	<0.2	<0.5	<0.005	<0.05	<0.05	<0.002
Vibrating Screen	<0.003	0.006	0.3	<0.5	<0.005	<0.05	<0.05	<0.002
Centrifuge	<0.003	0.019	0.2	0.6	0.022	<0.05	0.1	0.005
Reg. 309 [5]	0.003	0.05	5	1	0.005	0.05	0.05	0.01

Notes:

[1] Criteria for Commercial/Industrial Land Use in Coarse–Textured Soils (MOE, 1989)

[2] Ontario's Guidelines for Sewage Sludge Utilization on Agricultural Lands, 1986.

[3] Fill Quality Guidelines for Lakefilling in Ontario (MOE, 1992)

[4] Values were converted from mg/kg to mg/L considering 20 times dilution factor.

[5] MOE Regulation 309 Schedule 4 Criteria, 1989 (Regulation 347, November 1993).

NA = Data not available

During the full-scale reef cleanup, material from the screw classifier (primarily coarse mill scale) will be added to existing mill scale stockpiles on Atlas' property, while the remainder of the material (scalping and fine screen units, and centrifuge solids) will be placed in Welland's municipal landfill (subject to Regulation 347 testing). Temporary storage basins will be cleaned out when the solids become sufficiently dewatered. Solids will be taken to either the municipal landfill or Atlas' industrial landfill, dependent on Regulation 347 test results.

7.6 Contingency Plans

The cleanup operation has been designed to minimize contamination of the environment. Contingency plans will be developed, however, to ensure appropriate action is taken in response to unforeseen circumstances or accidents with the potential to cause environmental contamination or risk to public health.

Contingency plans are required to address the following types of occurrences:

- monitoring results indicating that a criteria limit has been exceeded or is about to be exceeded

- accidental releases of contaminated material into the environment.

In the event of criteria limit exceedance, the first effort will be to determine whether a temporary cutback or cessation of dredging operations will result in compliance with the criteria limit. This may be a workable approach when the threshold exceedance is related to unfavorable environmental conditions, such as floods, storm surges, or to extremely high levels of contamination in the material being processed. An alternative possibility, however, is that criteria limit exceedance might be related to a deficiency in the dredging method or treatment designed into the cleanup operation. In this case, it will be necessary to suspend the cleanup operation until appropriate mitigation for the criteria limit exceedance has been developed and implemented.

In the event of accidental release, immediate response is necessary to limit the quantity of material released and the movement of the material through the environment. This response consists of containment of the released material, followed by recovery, treatment and disposal of the material.

The following sections outline the contingency measures proposed for each area of environmental concern during dredging, transport, and treatment. A formal, approved contingency plan will be put in place by the site manager prior to any dredging activity.

7.6.1 Dredging Operations

The primary concern during dredging operations will be the release of sediments and associated contaminants. The demonstration project indicated that the hydraulic suction dredge is extremely efficient at capturing suspended materials in the dredged slurry. No silt curtain will be used during the full-scale cleanup. However, a movable oil boom will be positioned downstream of the dredge to collect any solvent extractables that escape the dredge suction. In addition, oil absorbing materials will be available at the dredge site to recover oils contained by the boom.

A water quality monitoring program will be implemented for the dredging program, which will be used to assess daily operations. TSS and turbidity will be measured on a regular basis and the site manager will be alerted immediately in the event of a criteria limit exceedance. The site manager will then be required to curtail dredging operations until appropriate modifications or repairs to the dredging procedures are made which result in compliance with water quality criteria limits.

The contract documents will specify that the cleanup of any spill during dredging operations are the responsibility of the contractor, and that the contractor shall have adequate manpower and equipment on site to implement any clean up of spills or other accidental discharges.

7.6.2 Pipeline Transport

The pipeline from the shore to the treatment plant will be constructed with fused joints and sufficient one-way check valves to minimize potential for pipeline breakage and subsequent leakage. The pipeline will be pressure tested to 1.5 times the maximum working pressure before use. The entire length of the dredgeate discharge pipeline shall be regularly monitored by a pipeline inspection team. In addition the site manager shall provide a 6-way communication system to ensure radio contact is maintained between the dredge operator, booster pump operator, pipeline inspection crew, site inspector, site manager's office, and the treatment site to ensure that any release from an accidental pipeline rupture will be shut off immediately.

In the event of a pipeline spill, the contractor shall remove, treat, and dispose of the materials as described in an approved contingency plan that will be put in place prior to any construction activity. As with dredging operations, the contractor shall be responsible for the cleanup operations during pipeline transport including the manpower and equipment to implement any cleanup as specified in the contract documents.

7.6.3 Treatment Site

The treatment site receiving the dredgeate shall be provided with a nonabsorbent surface which drains to an existing setting basin. The 6-way communication system will ensure that the dredge operator is made aware of the required flow for the treatment facility, and that no discharges to the environment will occur at the treatment site in the case of a process equipment breakdown. A temporary storage basin will be provided to handle excess flows (if any). The cleanup of materials from any process equipment spill will be handled by existing Atlas staff and resources as an extension of the contingency plans for Atlas' existing NFP.

7.6.4 Odor and Noise

Odor and noise contingency plans were developed for the demonstration project. Odor was not found to be a problem, hence no contingency plan is proposed for the full-scale cleanup. A noise contingency plan will be implemented during the full-scale cleanup if complaints are received from local residents. The plan is as follows.

Noise Contingency Plan

The noise contingency plan will ensure that noise-related concerns are properly dealt with to the satisfaction of the area residents. The plan will consist of six steps that are listed below.

1 - A letter describing the project at the various operations will be delivered to local households. The letter will provide residents with a 24-h phone number which they can call should they have any complaints regarding the project. The hotline number will be Atlas Security at 905-735-5661.

2 - When a noise complaint is received, the Site Construction Engineer, Mr. T. Paul, or his designated appointee, will interview the caller to determine if the noise is sensed intermittently or continuously, then he shall determine the origin of the noise. Noise sources related to the project will be located at the dredge site, booster pump site and the treatment facility.

3 - Noise monitoring will be initiated as soon as possible at the point of reception to determine existing noise levels. Weather conditions and wind speed and direction will be assessed.

4 - If a genuine noise concern exists based on measured background and time of complaint monitoring, then the operation generating the noise will be shut down and measures taken to mitigate the noise to acceptable levels.

5 - If no agreement can be reached between a single resident and project personnel regarding the existence of an objectionable noise, then the MOE will be contacted to assess the noise situation and data and the need for corrective measures.

6 - The noise complaints, monitoring procedures and noise mitigation measures will all be documented.

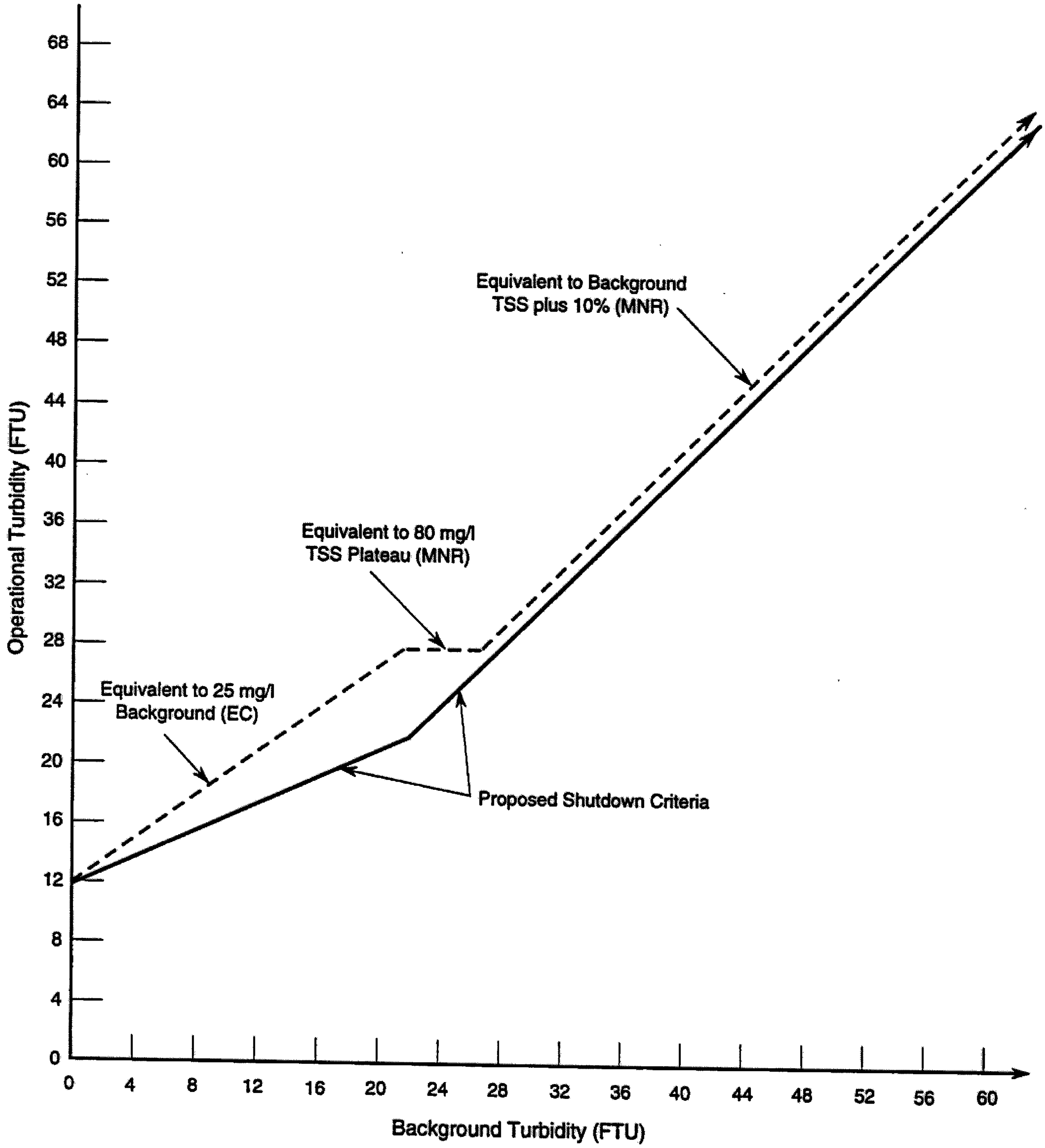


Fig. 7.1

Atlas Specialty Steels - Environment Canada

Welland River Reef Cleanup Project

Proposed Water Quality Shutdown Criteria

ACRES

P11201.00 MR

8 Approvals and Permits

After project screening and approval under the new Canadian Environmental Assessment Act (January 1995), several other approvals and permits will be required from various departments of the federal and provincial governments and property owners affected by the project.

8.1 Federal Government

Fisheries and Oceans Canada

(a) Fisheries Act Authorization (under harmful alteration, disruption or destruction of fish habitat).

8.2 Provincial Government

Ministry of Natural Resources

(a) Work Permit under the Public Lands Act and Lakes and Rivers Improvement Act

(b) Approval for "Works Within a Waterbody" under Lakes and Rivers Improvement Act.

These permits are now part of a streamlined permitting process adopted by MNR/NPCA.

Ministry of the Environment and Energy

(a) Permit to Take Water under Section 34 of Ontario Water Resources Act for taking more than 50 000 L of water per day from existing water body.

(b) Certificate of Approval under Section 53 of Ontario Water Resources Act (RSO 1990, Chapter 0.40) for Industrial Sewage Works (or amendment to existing Certificate of Approval).

(c) Compliance with "Generator Registration Report" (under Regulation 347) in the event that new sediment is disposed.

(d) Certificate of Approval for a Waste Management System (Section 39, EPA).

(e) Notification to the Environmental Registry plus additional public notice (if required) under the Environmental Bills of Rights.

Niagara Peninsula Conservation Authority

(a) Permit for Fill, Construction, and Alteration to Waterways, (under Ontario Regulation 82/86).

Part of consolidated MNR/NPCA permit application process.

8.3 Municipal Governments and Other Interest Groups

No specific approvals are required but the following will be provided with information for comments:

- Canadian Coast Guard, Department of Transport[1]
- Regional Municipality of Niagara (Public Works, Health Services Department)
- City of Welland, Engineering Department
- Niagara River RAP-PAC
- Welland River Cleanup Committee.

8.4 Affected Property Owners

A number of property owners will be directly affected by the project. Permission to work on their land will have to be obtained from the following:

- City of Welland
- Mr. S. Infantino
- Mrs. M. Gilbert
- Mr. R. Beatty

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1 Approval to "Dredge in a Navigable Waterway under Section 5(2) of the Navigable Waters Protection Act, RSC 1985, Chapter N-22". In recent discussions with the Canadian Coast Guard (K. Brant, January 1995 personal communication with L. King, Acres International) approval under this Act is not required as no permanent structures will be installed. CCG is interested and will be consulted on in the safety aspects of the project (across river cables) even though the river is relatively isolated with respect to boating.

- Mr. F. Scarpino
- Mrs. E. Hagar
- Welland Lion's Club
- Mrs. M. Wehlann
- Public Works and Government Services Canada with respect to Merritt Island.

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List of References

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Appendix A

Consultation Process Information

Appendix A1

Welland River Cleanup
Project Planning Committee Members
1991-1993

Welland River Cleanup Project Planning Committee Members

Affiliation	Name	Address	Phone No.	Facsimile No.
Acres International Limited	Mr. P. Miles	Acres International Limited 5259 Dorchester Road, P.O. Box 1001 Niagara Falls, Ontario L2E 6W1	(905) 374-5200	(905) 374-1157
Atlas Specialty Steels	Mr. D. Marr	Atlas Specialty Steels One Centre Street, P.O. Box 1000 Welland, Ontario L3B 5R7	(905) 734-5088	(905) 735-1044
	Ms. K. Watt		(905) 734-5017	
Brock University Biological Sciences Dept.	Prof. M. Dickman	Brock University Dept. of Biological Sciences 500 Glenridge Ave. St. Catharines, Ontario L2S 3A1	(905) 688-5550	(905) 682-9020
	Ms. G. Rygiel			
Canadian Wildlife Service	Mr. G. McCullough	Canadian Wildlife Service Regional Habitat Biologist, Ontario Region 152 Newbold Court London, Ontario N6E 1Z7	(519) 681-0486	(519) 686-9348
City of Welland	Mr. D. Cook	City of Welland, Engineering Dept. City Hall, 411 East Main St. Welland, Ontario L3B 3X4	(905) 735-1700 Ext. 228	(905) 732-1919
Environment Canada	Mr. I. Orchard	Environment Canada Environmental Protection Ontario Region 25 St. Clair Ave. East, 7th Floor Toronto, Ontario M4T 1M2	(416) 973-1089 (CP)	(416) 954-8174
	Mr. R. Santiago		(416) 954-5940 (416) 460-8945 (CP)	
	Ms. C. Buchberger		(416) 954-0807	
Environment Canada	Mr. S. Painter	Environment Canada P.O. Box 5050 Burlington, Ontario L7R 4A6	(905) 336-4789	(905) 336-6430
Environment Canada Canada Centre for Inland Waters	Mr. Rob Dobos Env. Assessment Coordinating Committee	Environment Canada Canada Centre for Inland Waters 867 Lakeshore Road Burlington, Ontario L7R 4A6		
Fisheries and Oceans Canada	Ms. K. McCabe	Fisheries and Oceans Canada National Water Research Institute P.O. Box 5050 Burlington, Ontario L7R 4A6	(905) 336-6235	(905) 336-4819
Gencorp Automotive	Mr. J. Wheeler	Gencorp Automotive 100 Kennedy St. P.O. Box 1002 Welland, Ontario L3B 5R9	(905) 735-5631	(905) 735-5564
Ministry of Natural Resources	Ms. A. Yagi	Ministry of Natural Resources P.O. Box 1070, Hwy. #20 Fonthill, Ontario L0S 1E0	(905) 892-2656	(905) 892-3134

Welland River Cleanup Project Planning Committee Members - 2

Affiliation	Name	Address	Phone No.	Facsimile No.
Retired from Ministry of Natural Resources	Mr. R. Lewies	12 Dundalk Court St. Catharines, Ontario L2M 3M8	(905) 937-3328	-
Ministry of the Environment	Mr. A. McLarty	Ministry of the Environment - Niagara River Team Ellen Fairclough Building 119 King St. W. 12th Floor Hamilton, Ontario L8N 3Z9	(905) 521-7704	(905) 521-7820
	Ms. B. Koblik Berger		(905) 521-7834	
	Mr. R. Slattery	Ministry of the Environment 637 Niagara Street Welland, Ontario L3C 1L9	(905) 732-0816 Ext. 234	(905) 685-2658
Niagara Peninsula Conservation Authority	Mr. A. Damario	Niagara Peninsula Conservation Authority 2358 Centre Street Allanburg, Ontario L0S 1A0	(905) 227-1013	(905) 227-2998
Niagara River PAC	Ms. D. Ralph	4-103 Albert St. St. Catharines, Ontario L2R 2H4	(905) 684-7667	-
	Ms. V. Cromie	Niagara River Remedial Action Plan Public Advisory Committee 3747 Portage Road Niagara Falls, Ontario L2J 2L1	(905) 374-8113	(905) 374-5064
Public Works Canada	Mr. A. Khan	Public Works Canada 4900 Yonge Street North York, Ontario M2N 6A6	(416) 512-5500	(416) 512-5712
Regional Municipality of Niagara	Mr. J. Furgal	Regional Municipality of Niagara 2201 St. Davids Road P.O. Box 1042 St. Catharines, Ontario L2V 4T7	(905) 685-1571	(905) 685-5205
Regional Niagara Health Department	Mr. J. Luszkacs	Regional Niagara Health Dept. 573 Glenridge Ave., P.O. Box 3040 St. Catharines, Ontario L2R 7E3	(905) 384-9750 or (905) 735-5697	(905) 735-4895
Wastewater Technology Centre	Mr. C. Wardlaw	Wastewater Technology Centre 867 Lakeshore Road, P.O. Box 5068 Burlington, Ontario L7R 4L7	(905) 336-4691	(905) 336-8913
	Mr. W. Randle			
Welland resident	Ms. R. Beatty	225 River Road Welland, Ontario L3B 2S2	(905) 732-6445	-
Welland resident	Ms. M. Wehlann	R.R.#1, 477 River Road Welland, Ontario L3B 5N4	(905) 734-9665	-

Appendix A2

Workshop
June 26, 1993

Information Package

Welland River Cleanup Project

Workshop - June 26, 1993

Rivers

"They run through the land and through our lives. We depend on them. We live along their banks, fish for food and drink from their waters.

When our rivers are healthy and clean, we are rich as a nation. But toxic chemicals and debris have dangerously polluted our waters.

Today, although the danger is not as visible, neglect and abuse are still killing our rivers, destroying fish and wildlife and putting human health at risk"

....from American Rivers

WORKSHOP AGENDA

8:30 a.m. - 9:00 a.m.	Registration and Coffee
9:00 a.m. - 9:15 a.m.	**Welcome and Introduction** *Mr. P. Miles, P.Eng., Coordinator, Welland River Cleanup Project*

(A question and answer period will follow each presentation)

9:15 a.m.- 10:00 a.m.	**State of the River** • Review of RAP/PAC Workshops on Sediment Quality, Water Quality and Habitat *Ms. D. Ralph, Vice Chair, Niagara River Remedial Action Plan Public Advisory Committee* • Review of Welland River Studies *Mr. P. Miles*
10:00 a.m. - 10:30 a.m.	**Benefits of a Welland River Cleanup** *The Honourable Mr. J. Bradley, M.P.P.*
10:30 a.m. - 11:15 a.m.	**The Welland Area Sewage System** • Regional Municipality of Niagara *Mr. J. Furgal, P.Eng., Manager, Industrial Waste and Laboratory Services* • City of Welland *Mr. D. Cook, P.Eng., Environmental Services Engineer, City of Welland*
11:15 a.m. - 11:30 a.m.	**Break** *(Coffee and Doughnuts)*
11:30 a.m. - 12:00 p.m.	**Possible Sources of Remediation Funding Assistance** *Mr. H. St.Rose, P.Eng., Acting Head, Waste Management & Transportation of Dangerous Goods Act*
12:00 p.m. - 12:45 p.m.	**Site Remediation Alternatives** • Overview *Mr. C. Wardlaw, P.Eng., Head, Contaminated Sediment Treatment Technology Program, Wastewater Technology Centre* • Welland Dredging and Treatment Demonstration *Mr. P. Miles* • Other Alternatives *Mr. C. Wardlaw; Mr. I. Orchard, Head, Contaminated Sediment Removal Technology Demonstration Program, Environment Canada* • Floodplain Alternatives *Mr. P. Miles*
12:45 p.m. - 1:15 p.m.	**General Question and Answer Period**
1:15 p.m. - 1:30 p.m.	**Informal Open Discussion**

Representatives from Municipal, Provincial and Federal governments will be present to assist the committee in presenting information and answering your questions. We look forward to meeting many of the community members at the workshop. We also value your input to the project and encourage your participation in the planning.

What are Those Committees that I Hear About?

Welland River Cleanup Project Planning Committee

This committee is an offshoot of the Planning Committee which was formed in March of 1991 for the purpose of reviewing and assisting with the planning for the Welland River Dredging and Sediment Treatment Demonstration which was carried out in October/November of 1991 under the sponsorship of Atlas Specialty Steels with funding assistance from Environment Canada's Great Lakes Cleanup Fund. The committee was inactive through much of 1992 pending evaluation of the technologies demonstrated in 1991 but was reactivated in February of 1993 with its objective to develop a plan for the full-scale cleanup of contaminated sediments in an 8-km section of the Welland River from Lincoln Street (Webber Road) in Welland to the Seaway Canal in Port Robinson. The Planning Committee is distinct from the Niagara River RAP-PAC but operates in cooperation with them. The present Planning Committee membership includes:

Ms. R. Beatty	*Welland Resident*
Ms. C. Buchberger	*Environment Canada*
Mr. D. Cook	*City of Welland*
Prof. M. Dickman	*Brock University*
Mr. J. Furgal	*Regional Municipality of Niagara*
Mr. A. Khan	*Public Works Canada*
Ms. B. Koblik Berger	*Ministry of Environment and Energy*
Mr. R. Lewies	*Ministry of Natural Resources (Retired)*
Mr. J. Luszkacs	*Regional Niagara Health Dept.*
Mr. D. Marr	*Atlas Specialty Steels*
Ms. K. McCabe	*Fisheries and Oceans Canada*
Mr. G. McCullough	*Canadian Wildlife Service*
Mr. A. McLarty	*Ministry of Environment and Energy*
Ms. K. Menyes	*Niagara Peninsula Conservation Auth.*
Mr. P. Miles	*Acres International Limited*
Mr. I. Orchard	*Environment Canada*
Mr. S. Painter	*Environment Canada*
Ms. D. Ralph	*Niagara River RAP-PAC*
Mr. W. Randle	*Wastewater Technology Centre*
Ms. G. Rygiel	*Niagara Ecosystems Task Force*
Mr. R. Santiago	*Environment Canada*
Mr. T. Simonen	*Niagara River RAP-PAC*
Mr. R. Slattery	*Ministry of Environment and Energy*
Mr. C. Wardlaw	*Wastewater Technology Centre*
Ms. K. Watt	*Atlas Specialty Steels*
Ms. M. Wehlann	*Welland Resident*
Ms. A. Yagi	*Ministry of Natural Resources*

Niagara River Remedial Action Plan Public Advisory Committee

The Niagara River area of concern is addressed by two Remedial Action Plans (RAPs). One involves the U.S. side of the river and is being conducted by New York State. The Canadian Niagara River RAP is being done by a RAP team composed of scientific and technical staff from the Canadian Federal and Provincial governments. The Canadian RAP has relied heavily on obtaining advice from the general public. The prime means of public input has been and continues to be the Niagara River Public Advisory Committee (PAC). The PAC comprises several dozen committed individuals representing academia, industry, environmental groups, local agencies, municipal government and most importantly, the general public. The PAC meets regularly each month to coordinate public activities associated with the Niagara River Remedial Action Plan.

About the Speakers...

Mr. Phil Miles, P.Eng., is a Senior Geotechnical Engineer with Acres International Limited in Niagara Falls functioning in the capacity of Project Manger/Project Engineer in the Environmental and Waste Management Services Department. He is currently Coordinator of the Welland River Cleanup Project Planning Committee. Mr. Miles became involved with the Welland River project in 1989 working on behalf of Atlas Specialty Steels. With over 20 years experience in geotechnical engineering, Mr. Miles has gained considerable experience in many levels of project work including site investigations, project coordination, design studies, preparation of contract documents and construction supervision. Most recently, Mr. Miles took part in developing a site remediation plan for the Northern Wood Preservers site in Thunder Bay, Ontario. His responsibilities included an evaluation of land and harbour-bottom contamination, design and implementation of a soil and sediment sampling and analytical program and identification of a technology for the harbour cleanup. He has recently functioned as project engineer on the Welland River Reef Project with responsibility for coordinating site investigations, data evaluation, recommendations for site remediation, project reporting and liaison with various government agencies and the public. He was also project engineer on the Welland River Dredging and Treatment Demonstration project which included the development of clean up criteria, the estimation of contaminant volumes, the design and supervision of a demonstration dredging program to evaluate technologies for the final clean up. The project also involved treatment processes for dewatering and separating the sediments.

Ms. Dawn Ralph is Vice Chair of the Niagara River Public Advisory Committee (PAC) which works in conjunction with the Remedial Action Plan Team (RAP Team) to achieve the remediation of the Niagara River Area of Concern (AOC). She has been involved with the PAC since its beginning in November 1989. As a PAC representative, she has also been a part of the Atlas Specialty Steels liaison and project planning committees and has attended conferences on water conservation and the sun setting of hazardous chemicals (specifically chlorine). On another environment side, she volunteers with Niagara Ecosystem Task Force, where she holds the position of secretary. As a student of Brock University, she is in the fourth year of an Honours B.Sc. (Biology).

About the Speakers...

The Honourable Mr. Jim Bradley is an MPP for the Provincial Constituency of St. Catharines and is currently the Official Opposition Deputy House Leader. His past positions of prominence in the Liberal Government from 1985 to 1990 have included the Minister of the Environment, Chairman of the Emergency Planning Committee of Cabinet and membership on a variety of Cabinet boards and committees such as the Management Board, the Economic Policies Committee, the Northern Development Committee, and the Premier's Health Strategy Council. Prior to 1985 his legislative service included Liberal Caucus spokesperson for Education and Consumer Affairs, Vice Chairman of the Legislative Public Accounts Committee, Co-Chairman of the Liberal Caucus Task Force on school and work, and membership on numerous other committees including the Justice Committee, the Resources Development Committee and the Serial Development Committee. Before his election to provincial government in 1977, Mr. Bradley was very active on St. Catharines City Council and a host of service boards and commissions. His long career of service to the local community in St. Catharines and the province, especially as the Minister of the Environment has given him a special insight to the environmental problems which face the Niagara Region.

Mr. Joe Furgal, P.Eng., is employed by the Regional Municipality of Niagara and is currently Manager of Industrial Waste and Laboratory Services. He supervises five industrial waste inspectors, two laboratory technicians and a lab assistant. His industrial waste team inspects and samples regional industrial discharges as well as influent and effluent from the region's Pollution Control plants. Lab analysis of samples services to monitor the compliance with local sewer-use bylaws and the quality of effluent water being discharged back into the regions river and lake systems. Mr. Furgal has first-hand knowledge of what Welland puts into the Welland River.

Mr. Don Cook, P.Eng., has been employed by the City of Welland for the last four years and is currently the City's Environmental Services Engineer. His previous 17 years were with the Regional Municipality of Niagara as a Technical Services Engineer responsible for long range servicing planning related to water and sewer projects. Mr. Cook has also been involved with the region's waste management planning and was responsible for the Region's waste management master plan from 1982 to 1988. He was the author of the Region's water and sewer servicing review in 1981. His long employment in the Niagara Region has provided him an excellent background for discussing in a knowledgeable and realistic manner the environmental problems facing the local community.

About the Speakers...

Mr. Hamish St.Rose, P.Eng., is a graduate in Geotechnical Engineering and has spent 3 years with the Ontario Ministry of Environment and Energy and 2-1/2 years with Environment Canada. He is presently Acting Head of the Waste Management section of the Environmental Contaminants & Nuclear Programs Division within Environmental Protection's Ontario Region office. Program areas in which he has been involved include the Orphan and Technology Demonstration components of the National Contaminated Sites Remediation Program, the Federal PCB Destruction Program, PCB and Export/Import of Hazardous Waste Regulations and miscellaneous hazardous and 3R issues.

Mr. Craig Wardlaw, P.Eng., is a Senior Project Engineer with the Wastewater Technology Centre (WTC) in Burlington, Ontario. His primary duty at WTC is to manage the Contaminated Sediment Treatment Technology Program which is funded by the Great Lakes Cleanup Fund (Environment Canada). Mr. Wardlaw has previous experience in waste management, environmental regulations enforcement, water survey, and agricultural erosion control. He holds Bachelors degrees in both Water Resources Engineering and Zoology and is currently working towards a Masters degree in Environmental Engineering.

Mr. Ian Orchard holds a BA degree in Geography/Urban Studies and a Masters in Environmental Studies and is currently Head of the Contaminated Sediment Removal Program at Environment Canada, Environmental Protection. This is a multi-year program aimed at the demonstration and evaluation of state-of-the-art removal, handling and pretreatment options for contaminated sediments. Mr. Orchard has 17 years experience in the area of dredging and contaminated sediments and has been involved in the development of criteria and polices relating to the evaluation of dredging projects, confined disposal of dredge material, the assessment of contaminants in sediment and their ecosystem effects as well as the development of remedial options for the management of contaminated sediments in Areas of Concern in the Great Lakes. He is Chairman of the IJC Remedial Options Work Group and Co-Chairman of the Canada - Ontario Agreement, Polluted Sediment Committee responsible for Canada's commitments to dredging and contaminated sediment under the Great Lakes Water Quality Agreement. Mr. Orchard also serves on the Work Group of the USEPA's Assessment and Remediation of Contaminated Sediments Program.

Summary of Presentations

Welland River Cleanup Project

Workshop Summary

July 1993

Introduction

This brief report is intended to provide a summary of the presentations made at the Welland River Cleanup Project Workshop which was held at Niagara College in Welland on June 26, 1993. The summary is being sent to all participants and attendees for their information.

The workshop was sponsored and organized by the Welland River Cleanup Project Planning Committee. It was funded by Environmental Protection, Environment Canada who are very active on the Planning Committee.

The purpose of the workshop was to inform interested people, representing the general public and local industry, about the conditions in the Welland River. The Planning Committee is trying to generate some coordinated interest in initiating a river cleanup.

A river cleanup will involve a significant cost. With a community driven process, and if the cleanup is initiated in the near future, it may be possible to take advantage of various sources of funding assistance.

The Planning Committee has focused its attention on an 8 km section of the river from Lincoln Street, in Welland, to the new canal in Port Robinson. This section contains numerous outfalls known to be sources of contamination. A river outfall and sediment sampling program within this section of the river is presently being carried out by a group of Brock University students under the direction of Professor Mike Dickman. The goal of the program is to identify other areas in the river which may be in need of remediation.

The workshop was not organized to point fingers at polluters, whoever they might be. Rather, it was meant to identify the conditions in the river to individuals and local industry who might be interested in participating in the planning for a cleanup. We need to look seriously at how beneficial uses can be restored to the river.

The Niagara River Public Advisory Committee (PAC) is a group of public representatives from citizens groups, academia, industry and others. This group advises members of the Niagara River Remedial Action Plan (RAP Team) with respect to the views, ideas, desires and demands of the public with respect to the clean up of the Niagara River and its tributaries.

The RAP is made up of three stages: identification of problems, options for remediating those problems, and implementation of the remediation. The RAP and the PAC are currently involved in stage two: the choosing of preferred remedial options. To this end, the PAC recently held 3 information sessions and 3 workshops, one each on Water Quality, Sediment Quality and Biota & Habitat Quality. The public was encouraged to attend these meetings through an advertising campaign directed to residents throughout the Peninsula. On June 12, a summary workshop was held to tie up any loose ends from the previous 6 sessions, to clarify the wording on some of the options and to try to decide 'Where do we go from here, and How?'.

The remedial options which were drafted at these 7 meetings were very general, with the idea that each would be followed with specific Action Items. The Action Items will be developed by small sub-committees within the PAC. As always, the general public will be/is encouraged to participate.

In all 3 sections (Water, Sediment, and Biota & Habitat Quality), one of the major options was the involvement of the PAC on existing Community Liaison or Remediation groups. Where none exists in a problem area, the option became that of assisting, facilitating, or directing the creation of such a group in which concerned citizens can act together to clean up their local area, or stretch of waterway.

Since the Welland is the major Canadian tributary to the Niagara River, it is of special importance to the PAC and RAP team. PAC representation, on the committees concerned with this section of the Welland River, has been ongoing since 1990(?). Some of our members were involved in the liaison committee and the demonstration project planning committee, and are now involved in the Welland River Clean Up Committee.

This is all part of our (PAC's) desire to work with Liaison groups throughout the area of concern (the Niagara River and its Canadian Tributaries) to promote, facilitate, and implement remediation of the Niagara River and its tributaries.

Review of Welland River Studies

Many studies have been carried out on the lower Welland River. Some of this past information has been summarized in a 1992 report by Tarandus Associates who carried out a 1990 field study on the river sponsored by the Ministry of the Environment and Energy (MOEE). Studies have included:

- sediment and water quality studies
- fisheries studies
- benthic invertebrate studies
- aquatic macrophyte studies.

The studies go back to about 1964 when M. Johnson from the Ontario Water Resources Commission carried out a comprehensive study. Johnson concluded that domestic sewage and industrial wastes led to serious water quality impairment in the lower Welland River (see Figure 1). More recently, sources of contaminants in the river have been identified and investigated. Industrial sources include:

- Atlas Specialty Steels
- B. F. Goodrich
- Ford Glass Plant
- other smaller Welland industry.

Municipal sources include:

- Welland Water Pollution Control Plant (WPCP)
- numerous combined sewer outfalls and overflows.

Industrial and municipal discharges are common in Section B shown in Figure 1.

The Tarandus report concludes that in terms of water quality, iron, copper, aluminum and total phosphorus frequently exceed the MOEE Provincial Water Quality Objectives (PWQO) in the study area. Elevated mercury concentrations were found at sampling stations 1 and 2. Other parameters such as most metals, phenolics, total cyanide, polychlorinated biphenyls (PCBs), polyaromatic hydrocarbons (PAHs) and pesticides were generally undetected.

The MOEE, in monitoring river water quality from 1979 to 1987, found that concentrations of zinc, copper, mercury, chromium and lead in the water has decreased and that aluminum has increased slightly from 1981 to 1987.

With regard to sediment quality, elevated concentrations of several elements or compounds such as lead, chromium, mercury, cadmium, zinc, iron, nickel, copper, arsenic, nitrogen, total organic carbon, total phosphorus and PCBs were sometimes found.

The MOEE Provincial Sediment Quality Guidelines (PSQG) severe effect levels, which are a measure of the level of contamination that is harmful to the majority of benthic organisms that would normally live in the sediments, were consistently exceeded from Station 10 to 19a for chromium, iron, nickel, and copper. Elevated levels of total cyanide and oil and grease were also found at some locations.

Similar findings were documented by Acres International Limited in a detailed sediment study in 1989 and 1990 in the areas of the McMaster Avenue and the Atlas-Gencorp outfalls south of the WPCP. This study reported approximately 30 000 m^3 of sediment with contaminant levels exceeding the ambient levels of contamination in the area upstream of the outfalls. Contaminants are chromium, nickel, iron, copper, lead, zinc and manganese which have been deposited into the river by Atlas Specialty Steels and other local industry.

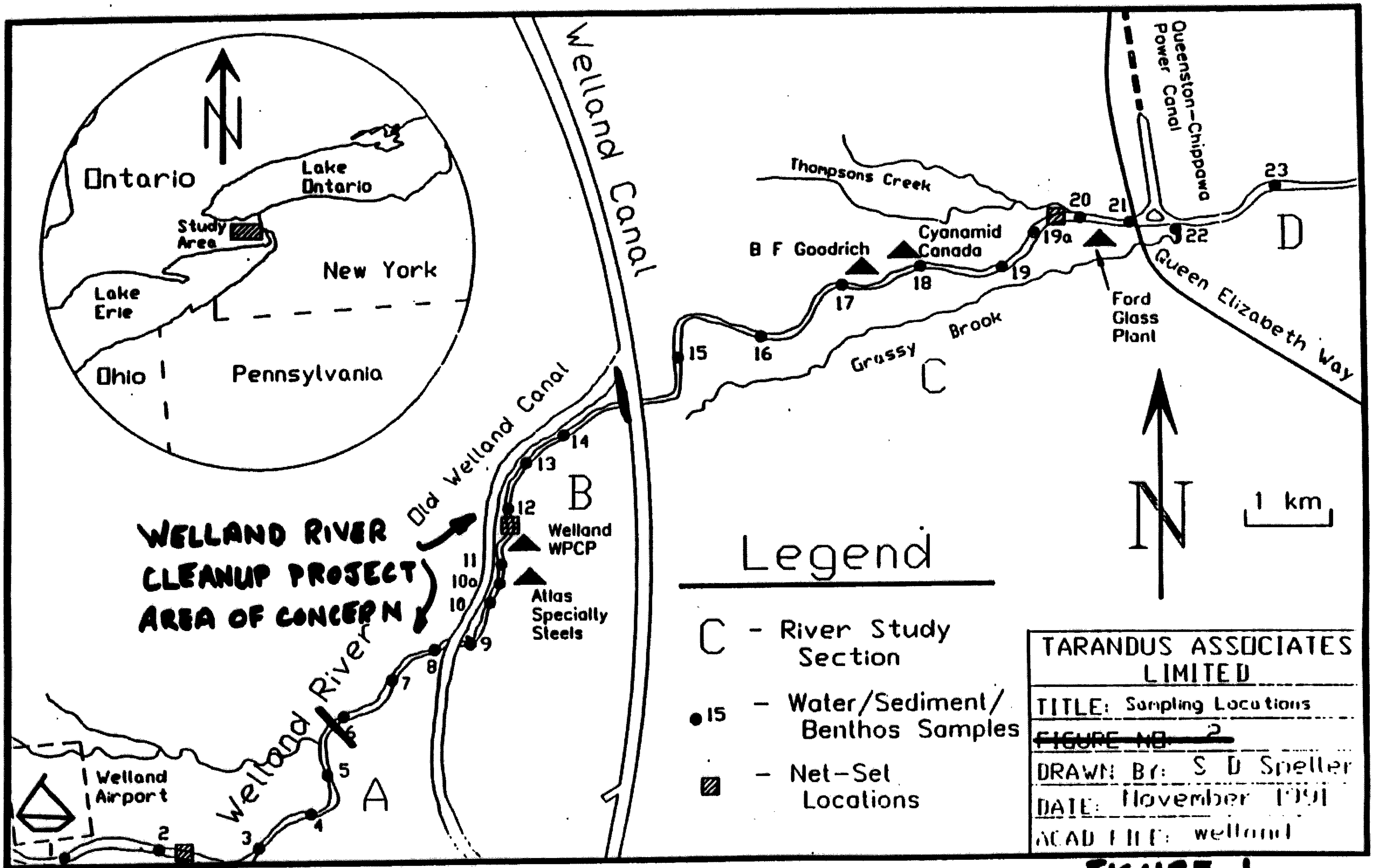
Tarandus also reported finding elevated concentration of PAHs at station 9 which is the location of a major stormwater discharge.

Regarding the sediment benthic community, pollution tolerant species of benthic invertebrates were found in relatively high numbers in Sections B, C and D, indicating somewhat degraded sediment in these areas. Studies by Professors Brindle and Dickman in the mid- to late 1980s showed a severe impact to the benthic communities in the area around the Atlas-Gencorp outfall at station 10a or 11.

In terms of Fisheries, the fish community in the Welland River is dominated by warm water species. A higher number of fish were netted in the survey in Section A than in Sections B and C.

Both the east and west floodplains of the Welland River between the McMaster Avenue outfall and the WPCP were studied by Acres in 1990 and 1991. The silty clay type floodplain sediments were sometimes found to contain the same high levels of contamination as found in the river sediment in the area. It has been estimated that a total of approximately 29 000 m^3 of floodplain sediment have contaminant levels higher than upstream river sediment levels.

Water quality, sediment quality and the benthic community in the Welland River in the area of concern all suffer some impairment, sometimes severe impairment.



Ontario
Lake Ontario
Study Area
New York
Lake Erie
Ohio
Pennsylvania
N
Welland Canal
Old Welland Canal
Welland River
WELLAND RIVER CLEANUP PROJECT AREA OF CONCERN
Welland Airport
Welland WPCP
Atlas Specialty Steels
Thompsons Creek
B F Goodrich
Cyanamid Canada
Grassy Brook
Ford Glass Plant
Queenston-Chippawa Power Canal
Queen Elizabeth Way
A
B
C
D
1 km
N
Legend
C - River Study Section
15 - Water/Sediment/ Benthos Samples
- Net-Set Locations
TARANDUS ASSOCIATES LIMITED
TITLE: Sampling Locations
FIGURE NO. 2
DRAWN BY: S D Speller
DATE: November 1991
ACAD FILE: welland

FIGURE 1

SIGNIFICANT EVENTS IN CITY OF WELLAND

1824	St. Andrew's Day - sod turning for first Welland Canal
1829	Wooden aqueduct built to carry canal over Welland River - settlement called Aqueduct
1842	Wooden aqueduct replaced with stone - name of settlement changed to Merrittsville
1878	Village incorporated in 1878
1917	July 1, 1917 - City of Welland was born

SIGNIFICANT SEWAGE SYSTEM CONSTRUCTION

1932	Sewage Treatment Plant - southeast section of City - primary treatment, raw sludge drying beds - plant effluent to Lyons Creek
1956	Plant taken out of service - replaced with P. Station and Forcemain (Bradley Street) - permitted discharge to Welland River by gravity system
1947	Discussions between then City, Township of Thorold and Township of Crowland took place with view to regional system of plants and trunk sewers
1961	City Annex urban area of Crowland Township - commenced study to report on storm, sanitary and combined sewerage facilities
1963	96" Wellington Trunk Completed - City began ten year program to sewer community as a whole as outlined in 1963 consultant report, treat all sanitary sewage and eliminate some 35 direct discharge points to Welland River
1965	Federal government announced plan for Welland Canal By-pass - some plans as outlined in 1963 report were altered to accommodate by-pass construction
1968	Opening of River Road S.T.P. - primary plant
1972	Flows from Town of Pelham added to system
1974	Completion of South Bank Interceptor by Region of Niagara - Majority of 35 direct discharge points have access to treatment facility

SIGNIFICANT EVENTS

1963	Completion of Wellington Street Trunk
1963	Completion of R.V. Anderson Report on Sewerage Works
1968	Completion of River Road Trunk Sewer
1969-70	Completion of Aqueduct Trunk and connection to River Road Trunk - June 1970
1971	Completion of North Bank Interceptor to Endicott Terrace and Colbeck Drive
1970	Completion Woodlawn Trunk to Rice Road
1971	Woodlawn Trunk to Fonthill
1972	Lyons Creek System comes on stream
1973	Dain City area added
1974	Secondary to plant
1975	South Bank Interceptor
1975	Mill Street Interceptor
1988	McMaster Sewer Interceptor Connection completed

Funding Assistance

Why are you here - Mtg to solicit interest + options

1. Support in kind (ie. goods & services). Participants to be involved in planning of demo + provision of support (in kind contributions, land, facilities, personnel or goods and services including donations, events and borrowing on future earnings). **Creation of Core Group.**

2. Options to be developed & generally discussed at Planning Committee mtg - options to be further refined and provided to group.

3. Community based and generated project. At least half of the funding/resources should come from local agencies, businesses, community funding programs. Agencies to be involved are: City of Welland; NPCA; Welland River Reef Cleanup Committee; MOEE; MNR; Atlas Specialty Steels; DOE; Niagara River PAC; Niagara Ecosystem Task Force; Brock University; local businesses; National Contaminated Sites Remediation Program; Public Works Canada and DeSRT.

4. Outside funding assistance includes: NCSRP; MOEE; ETP/DeSRT; Cleanup Fund and private trusts.

REMOVAL

No decision on technology, but we do have an inventory. Prepare an RFP. Mudcat MC90E, Submerged pump (TOYO); Matchbox fluidizer or Shuttered Clam/backhoe.

TIMING/SEQUENCE

Not before Summer '94 - Remove handle/transport/store + Treat in Spring '95.

What next? **One on One Mtgs** with those present so as to: identify level of interest & extent of involvement. Need for key participants.

Mtg of Core Group July to discuss and formulate a plan which would focus on contaminated sediment options and develop a proposal to the Cleanup Fund. The Core Group will have before them: environmental screening documents & public consultation schedule, a list of preferred technologies, locations and costs, an outline of the presentation to the CuF in August/September. Core Group **meets monthly or as determined at next mtg.**

IAN ORCHARD
JUNE 26/93

INTRODUCTION TO
THE NATIONAL CONTAMINATED SITES REMEDIATION PROGRAM,
THE CONTAMINATED SEDIMENT REMOVAL PROGRAM
AND
THE CONTAMINATED SEDIMENT TREATMENT PROGRAM

ENVIRONMENT CANADA
CONSERVATION AND PROTECTION

FEBRUARY 11, 1993

ABSTRACT

Awareness of potential impacts related to contaminated soil and sediment have increased over the past few years. Concern has been raised on the possible health risks to humans and the environment. Environment Canada has taken the initiative to respond to these concerns by implementing programs which deal with remediation of contaminated soil and sediment in high risk areas. Working with the various jurisdictions nationwide and with the private sector, a team effort is being made to increase our knowledge, encourage the development of innovative remedial technologies, and to expedite the actual cleanup of site specific areas.

The National Contaminated Sites Remediation Program, the Contaminated Sediment Removal Program, and the Contaminated Sediment Treatment Program are the focus of this paper. Goals and objectives are outlined with a summary of projects undertaken to date.

INTRODUCTION

Contamination in soil and sediment is a growing concern. Practices across Canada have generally overlooked the effects of toxins in land and water. Recent concerns over the last few years have brought about a whole new awareness of potential impacts to humans and the environment.

Leachate from contaminated soil can enter groundwater, lakes, rivers and other water bodies. Humans and wildlife can be directly affected if this water is consumed. Vegetation in contact with the contaminated soil can also be impaired through transpiration. Accumulation of contaminants can occur in fruits and vegetables which may be eaten by humans and wildlife.

Ingestion of pollutants may also occur with aquatic benthic organisms living in and/or near contaminated sediment. This could affect reproductivity, cause disease and may affect higher trophic levels of the food chain, including humans. Even though the discharge of pollutants into water bodies have become stricter, historical contaminated sediment is still a significant problem to the impairment of the water column.

In response to these concerns, a number of programs have been implemented. This paper introduces the following programs to the reader: the National Contaminated Sites Remediation Program; the Contaminated Sediment Removal Program; and the Contaminated Sediment Treatment Program.

NATIONAL CONTAMINATED SITES REMEDIATION PROGRAM

A contaminated site is defined as being a "location at which soil, sediment, waste, groundwater or surface water are contaminated by hazardous substances at levels which pose an existing or imminent threat to human health or the environment." Generally, these sites are a result of industrial development and are located in residential, commercial, industrial, rural and wilderness areas.

Recognizing a nationwide need for remediation of high risk contaminated sites, the Canadian Council of Ministers of the Environment created the National Contaminated Sites Remediation Program (NCSRP) as a means to accomplish the goal of cleaning up such high risk areas.

Taking on this joint federal-provincial-territorial responsibility, $275 million were committed on an equal cost-shared basis to the NCSRP over the period of 1990 - 1995. Bilateral agreements have been signed with British Columbia, Yukon, Northwest Territories, Alberta, Ontario, Quebec, New Brunswick, Nova Scotia, Prince Edward Island and Newfoundland. Administered through mutual agreements between these jurisdictions, three objectives were defined:

* To identify, assess and remediate all contaminated sites in Canada which affect or could potentially affect human or environmental health. All activities should be undertaken in a nationally uniform and effective manner based on the "polluter-pays" principle.

* Where the owner or responsible individual(s) for the contamination cannot be identified or where they are incapable of funding the remediation work, the financial role will be taken on by the government in order to carry out the necessary remediation work.

* To encourage and assist the private sector with the development of new remediation technologies and to demonstrate innovative equipment capabilities.

From these objectives, two nationwide components were implemented: (1) the high risk "orphan" contaminated sites component, allocating $200 million for the cleanup of abandoned areas; and (2) the Development and Demonstration of Site Remediation Technology (DESRT) program, allocating $50 million for development, demonstration and implementation of innovative remediation technologies.

ORPHAN CONTAMINATED SITES

The "orphan" contaminated sites component of NCSRP is used as a safeguard in cases where responsible parties cannot be identified or cannot be held financially accountable. To classify an area as an orphan site, the following eligibility criteria is used:

* The site must be a high risk contaminated area, thus having an existing or imminent threat to human or environmental health.

* The responsible individual(s) for the site cannot be legally identified or can be identified but are financially insolvent.

* The responsible individual(s) are not cooperating with the set time-frame established by the regulatory agency.

Legal action will be sought, where possible, against responsible individual(s) in those cases where remediation costs are incurred by the government.

Presently, there have been 22 remediation projects for high risk orphan contaminated sites. Some of these projects are still ongoing, while other are complete. The following is a summary of the projects to date:

ALBERTA

1. Canada Creosote Site adjacent to Bow River, Calgary
2. Peerless Wood Preserver Site in Cayley
3. Purity 99 Oil Refinery Site in Hartell

ONTARIO

4. Tyre King Site in Hagersville
5. Waste Oil Transfer Site in Smithsville
6. Blackbird Holdings Site in Rednersville
7. Mine Site in Deloro

QUÉBEC

8. Lead Contaminated Site in St-Jean-Sur-Richelieu
9. Tire Fire Site in St-Amable
10. Industrial Waste Contaminated Site at Le Vidangeur de Montréal Ltee. in Montréal
11. The Ruisseaux Bouchard et Bertrand Industrial Waste Contaminated Site in Dorval
12. Hazardous Waste Disposal Site in Ville Mercier
13. Weedon Copper Mine Site in Fontainebleau
14. Industrial Waste Dumping Site in Sainte-Marie-Salome

NEW BRUNSWICK

Petroleum Contaminated Sites in:

16. Weldon
17. Drummond
18. Harvey
19. Haute-Aboujagane
20. Trois Ruisseau
21. Rogersville

NOVA SCOTIA

15. Scrap Yard Site at Five Island Lake near Halifax

NEWFOUNDLAND

22. Scrap Yard Site in Makinsons

Where applicable, existing laws are being reviewed and revised to adhere to the polluter pays principle. By clearly defining the liabilities associated with contaminating an area, revised laws will serve as a preventative measure to reduce future sources of contamination. It is anticipated that with the acknowledgement of this program and its accomplishments, a distinct message will be sent to the public reinstating the fact that pollution prevention costs less than pollution remediation.

DEVELOPMENT AND DEMONSTRATION OF SITE REMEDIATION TECHNOLOGY

Under the Development and Demonstration of Site Remediation Technology (DESRT) program, new technologies are developed for site characterization, assessment, remediation and compliance monitoring involved in the cleanup activities of contaminated sites.

The first priority of the program is given to those technologies which have been developed to a pilot plant stage and can be evaluated through a field demonstration to verify performance and cost efficiency. The second priority of the program is given to those projects which are in the laboratory stage of designing advance technologies.

Proposals are accepted from the private and public sectors, universities, trade and research organizations and consulting firms. Given that the proponent has proven in-field environmental technology capability, eligibility criteria is based on:

* Applicants' involvement in remedial work at contaminated sites
* Goals of the project related to improving technological capabilities for reducing and/or potentially eliminating health threats to humans and the environment, given the priorities of the DESRT program
* The degree of technological uniqueness, ability to be used within restricted site specific areas, and its applicability across Canada
* The degree of risk involved in commercializing the technology
* Participation with the private sector and its Canadian content
* Potential impact of cleaning contaminated sites
* Foreseeable time schedule to undergo a full-scale cleanup with use of the technology

The following is a list of technology development and demonstration projects undertaken to date:

1. Bench scale feasibility study and a field demonstration of a gravel washing technology in a creosote contaminated riverbed at the Canada Creosote Site, Calgary, Alberta.
2. Bench scale bioremediation study and hydraulic containment studies at the Peerless Wood Preservers Site, Cayley, Alberta.
3. Field demonstration of a soil washing/solvent extraction and bioslurry treatment of PCB and heavy metal contaminated soil

at the New Brunswick Department of Transportation Former Scrap Yard Site, Saint John, New Brunswick.

4. Six contaminated soil treatability studies involving innovative technologies for stabilization of organics and inorganics, bioremediation, and thermal extraction at the Pacific Place Site, Vancouver, British Columbia. These technologies include: stabilization of untreated soils using DCR/VOEST Alpine Montage (VAM) Process; bioremediation of organics using Slurry Reactor and Landfarming; thermal extraction of organics using X*TRAX Process and the Taciuk Processor; and stabilization of ash and untreated high metal content soils.

With the scientific and technical knowledge base created by this program, it is anticipated that the Canadian environmental industry will be strengthen in such a way as to lead it toward an international market of technology expertise.

TWO COMPONENTS OF THE GREAT LAKES CLEANUP FUND

In 1989, the federal government launched the Great Lakes Action Plan (GLAP). This five year, $125 million program was implemented to focus on promoting restoration and remediation projects in Areas of Concern (AOC) which demonstrated the need for federal participation through legislative mandate, federal ownership or involved existing federal policy of declared federal interest. To assist in the development of remedial programs and to demonstrate technologies which meet federal responsibility in Canada's 17 AOC, the Cleanup Fund was introduced, contributing $55 million between 1990 and 1996.

Under the Cleanup Fund, approximately one-third of the budget has been allocated toward sediment remediation. Environmental Protection is the lead agency in the Department of the Environment for the formulation and implementation of federal programs associated with the assessment and remediation of contaminated sediment in AOC. Three distinct programs have been implemented: the Contaminated Sediment Assessment Program; the Contaminated Sediment Removal Program; and the Contaminated Sediment Treatment Program. Both the Contaminated Sediment Removal and Treatment Programs will be discussed in this paper.

CONTAMINATED SEDIMENT REMOVAL PROGRAM

The Contaminated Sediment Removal Program (CSRP) was created to provide leadership in the identification and demonstration of removal technologies and procedures for contaminated sediment in the Great Lakes. Through this program, scientific and technical advise, and state-of-the-art removal and handling options will be provided to Remedial Action Plan (RAP) teams for their use in developing strategies for remediation in specific AOC.

The principal objectives of the CSRP are:

* To identify and develop an inventory of existing sediment removal technologies.

* To assist in the development and demonstration of new and innovative sediment removal technologies.

* To demonstrate to RAP teams and others involved with sediment remediation that sediment removal is a viable remedial option.

Criteria for selecting a suitable technology to be demonstrated is based on the following:

* Type of removal technology

* Operation controls

* Measures to limit turbidity and suspended solids

* Transportation of dredge material

* Pre-treatment of material

* Treatment of dredged material

* Physical characteristics of material to be removed

* Quantities of material to be removed

* Dredging depth

* Distance to disposal area

* Physical environment of and between dredge and disposal areas

* Contamination in material to be removed

* Method of disposal

* Production required (cost)

* Environmental and regulatory approvals

The CSRP focus is primarily on technologies that offer the means of removing sediment with minimal disturbance and adverse environmental impact. The program encourages the demonstration of promising new technologies that can be developed to a pilot plant stage, and can be subjected to on-site field evaluation to verify performance and cost information. All removal equipment must meet certain operational requirements such as minimizing resuspended particles, maximizing solids content, manoeuvrability, positioning accuracy, mobility and suitability to hydrodynamic conditions.

Demonstrations of innovative removal technologies to date have been:

1. Pilot scale demonstration of the Mud Cat 915 ENV, a modified horizontal auger suction dredge, in Welland River

2. Pilot scale demonstration of the Cable Arm 100E clamshell bucket in Parliament Street Slip, Toronto Harbour

3. Pilot scale demonstration of the Cable Arm 100E in Hamilton Harbour (Revisions to the bucket were based on results from the Toronto Demonstration)

4. Pilot scale demonstration of the Pneuma Pump, an airlift suction dredge, in Collingwood Harbour. This Demonstration lead to a full scale removal demonstration.

It is anticipated that these innovative technologies will have wide application across the entire Great Lakes Basin for carrying out routine navigational dredging projects involving contaminated sediment.

CONTAMINATED SEDIMENT TREATMENT TECHNOLOGY PROGRAM

The principle objective of the Contaminated Sediment Treatment Technology Program is to fund selected technologies at bench, pilot and full scale demonstrations as a means to encourage and evaluate the development of remediation technologies for the treatment of contaminated sediment. The focus initially was on demonstrating technologies at laboratory and bench-scale levels. This focus has shifted to pilot and full scale demonstrations. A full scale demonstration would not necessarily clean up an entire sediment "hot-spot", but would process enough sediment to prove if the technology is technically and economically viable.

For a technology to be considered for funding, it must meet the following criteria:

* The technology must either remove, segregate or destroy contaminants in sediment or the pore water associated with wet sediment

* The technology must have at least one innovative feature

* The technology must be developed to the bench scale phase (i.e. the program will not fund research leading to technology

creation)

* The technology should, in principal, be economically feasible

* The technology must be rated superior to other technologies in the same category (chemical treatment, biological treatment, solidification/stabilization, extraction, incineration, alternate thermal treatment, physical pre-treatment and other treatment types)

Preference is given to technologies which are mobile and to technologies which are Canadian owned or have a high level of commitment to becoming established in Canada. Each technology evaluation is based on technical merit, innovative nature, cost/value, company reputation, laboratory capabilities, environmental benefit, applicability to AOC, and scale-up potential.

To date, there have been 21 bench and pilot scale treatment technology demonstrations:

1. EcoLogic Thermal Destructor using Hamilton, Thunder Bay and Sheboygan sediment

2. Dearborn Bioremediation using Thunder Bay sediment

3. AOSTRA Taciuk Processor using Hamilton and Thunder Bay sediment

4. Siallon Stabilization using Hamilton and Thunder Bay sediment

5. Acres/Derrick Pre-treatment using Welland River sediment

6. Altech Sediment Washing using Welland River sediment

7. Beak Sequential Leaching using Welland River sediment

8. Institute of Gas Technology Bio-treatment using Hamilton sediment

9. ARC/EPRI Coal Agglomeration using Hamilton sediment

10. Ensotech Stabilization using Welland sediment

11. Bergmann Soil Washing using Toronto sediment

12. Triton/Sonofloc Sediment Floccuation using Welland River sediment

13. Tallon Metals Extraction using Hamilton sediment

14. BioGenesis Soil Washing using Thunder Bay sediment

15. Waste Stream/EIMCO Bioremediation using Hamilton sediment

16. Cognis Metals Extraction using St. Marys River sediment

17. Chemical Waste Management X*TRAX using Thunder Bay sediment

18. EcoLogic Thermal Processor using Hamilton sediment

19. Acres/Derrick Pretreatment using Welland sediment

20. Toronto Harbour Commissioners Soil Washing Plant using Toronto sediment

21. Dearborn Bioremediation using Hamilton sediment

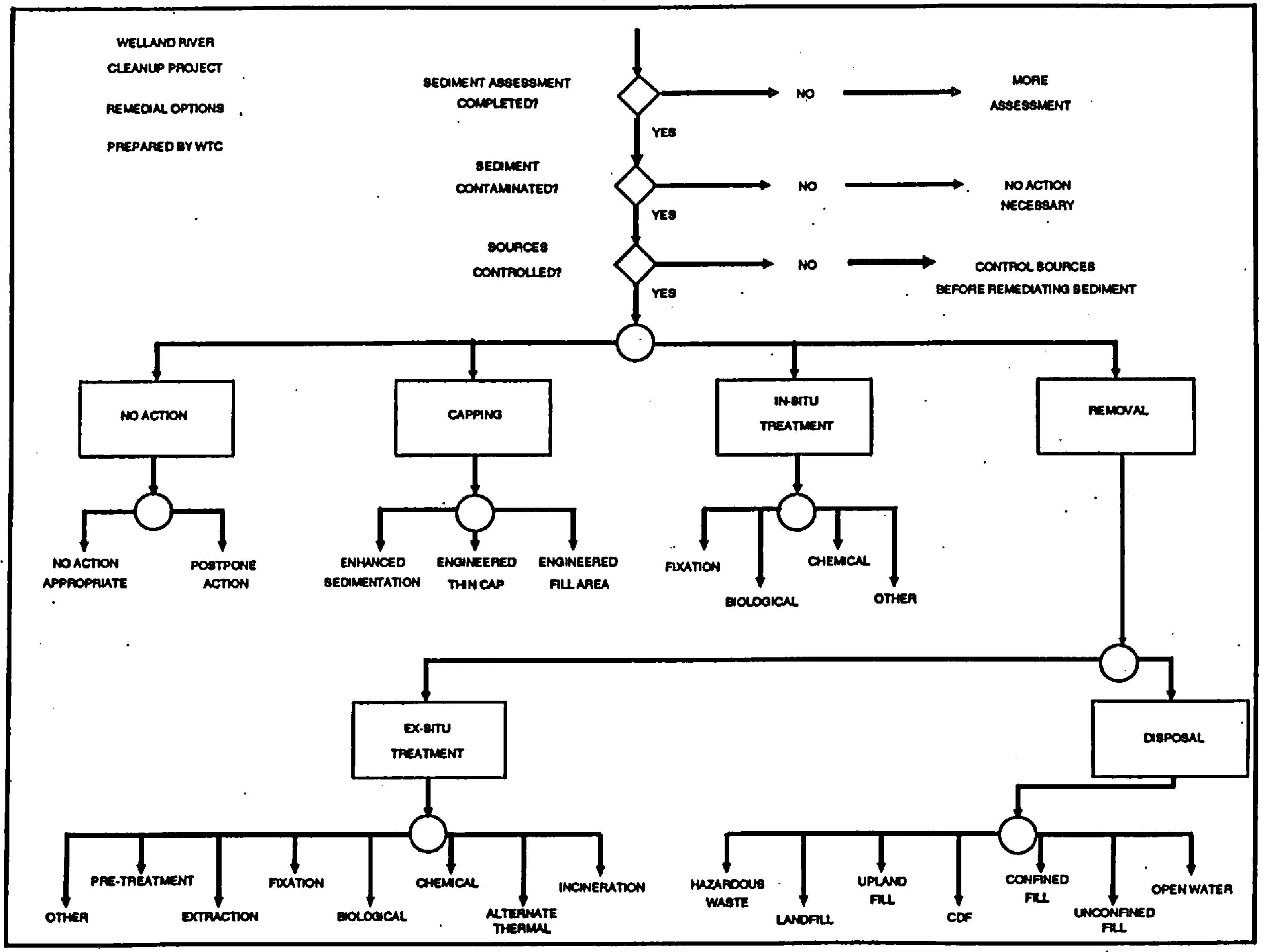
Results of these demonstrations have been entered into a computerized sediment treatment technologies database (SEDTEC); the only database in North America of its kind. A hard copy of SEDTEC will be distributed to Remedial Action Plan teams, Public Advisory Committees and selected Canadian Government officials as a way of communicating the knowledge achieved by the program. Through this gained experience, treatment of contaminated sediment is expected to be more readily considered as a viable remedial option when dealing with the problems associated with the Great Lake's AOC.

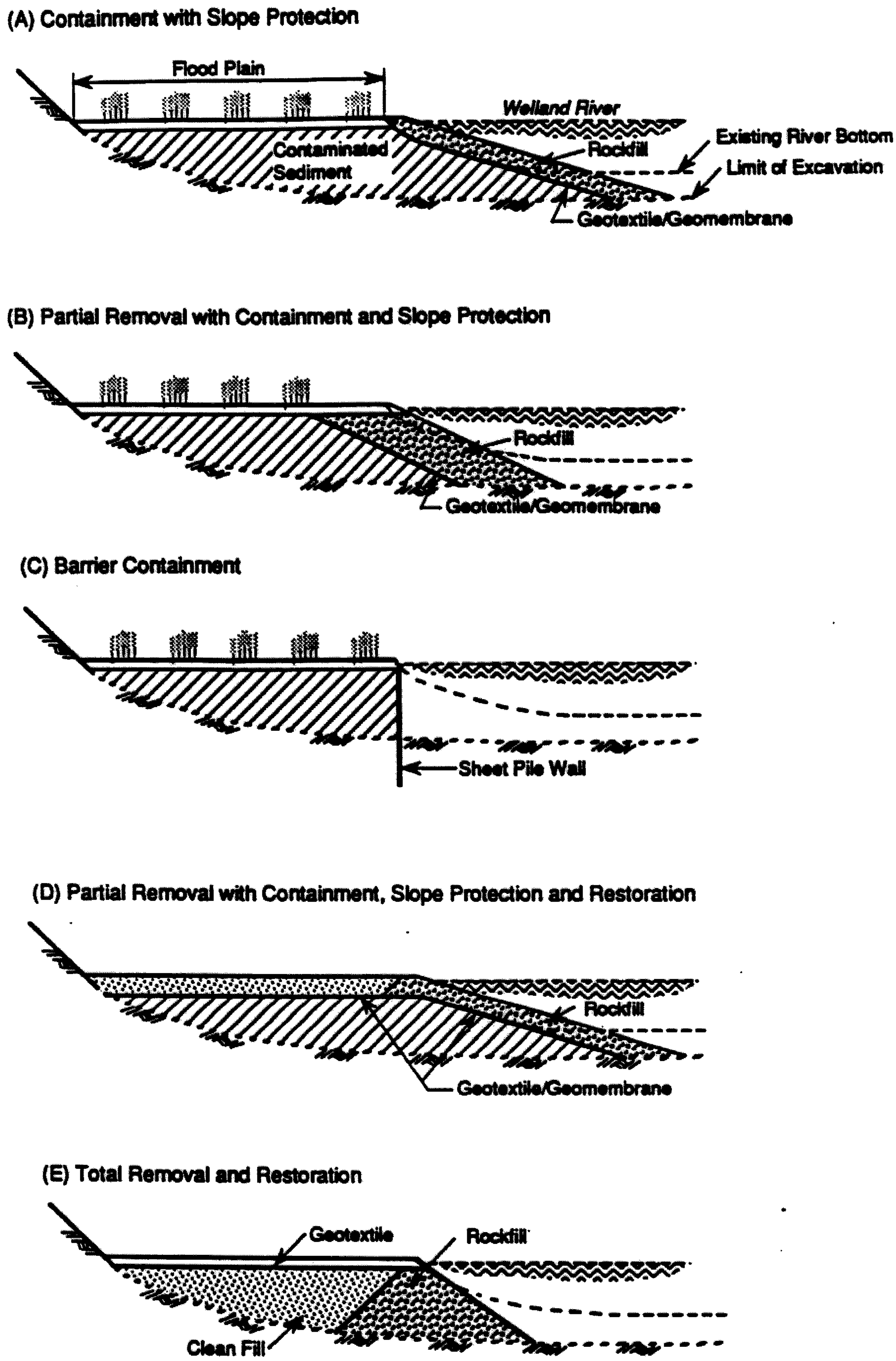
CONCLUSION

The National Contaminated Sites Remediation Program, the Contaminated Sediment Removal Program and the Contaminated Sediment Treatment Program have a familiar goal; the goal to remediate high risk contaminated areas, whether they be land or water based.

Through a team effort with various government jurisdictions and the private sector accomplishments have been made to improve our knowledge base, increase our technological abilities, and demonstrate that innovative technologies exist and can be developed for full scale remediation. Using the "polluter pays" principle, these programs are making a significant impact on changing public attitudes about pollution prevention.

Successful remediation at specific areas have been accomplished through these programs. With further research, development, planning and implementation these programs will become a leading force toward cleaner and healthier environments.


WELLAND RIVER
CLEANUP PROJECT
REMEDIAL OPTIONS
PREPARED BY WTC
SEDIMENT ASSESSMENT COMPLETED?
NO
MORE ASSESSMENT
YES
SEDIMENT CONTAMINATED?
NO
NO ACTION NECESSARY
YES
SOURCES CONTROLLED?
NO
CONTROL SOURCES BEFORE REMEDIATING SEDIMENT
YES
NO ACTION
CAPPING
IN-SITU TREATMENT
REMOVAL
NO ACTION APPROPRIATE
POSTPONE ACTION
ENHANCED SEDIMENTATION
ENGINEERED THIN CAP
ENGINEERED FILL AREA
FIXATION
BIOLOGICAL
CHEMICAL
OTHER
EX-SITU TREATMENT
DISPOSAL
OTHER
PRE-TREATMENT
EXTRACTION
FIXATION
BIOLOGICAL
CHEMICAL
ALTERNATE THERMAL
INCINERATION
HAZARDOUS WASTE
LANDFILL
UPLAND FILL
CDF
CONFINED FILL
UNCONFINED FILL
OPEN WATER



Atlas Specialty Steels
Welland River Flood Plain
Possible Remediation Options

ACRES

P08880.03 MR

Atlas Specialty Steels
Welland River Flood Plain
Comparison of Possible Remediation Options

Remedial Option	Advantages	Disadvantages
(A) Containment with slope protection	- least environmental disruption - no removal of flood plain - no restoration of flood plain - least cost	- flood plain contamination remains - some river contamination remains - long-term monitoring
(B) Partial removal with containment and slope protection	- total removal of river contamination	- partial removal of flood plain - partial restoration of flood plain - some flood plain contamination remains - long-term monitoring - higher relative cost
(C) Barrier containment	- total removal of river contamination - no removal of flood plain - no restoration of flood plain	- flood plain contamination remains - long-term monitoring - higher relative costs
(D) Partial removal with containment, slope protection and restoration	- flood plain contamination isolated from biota	- total removal of flood plain - total restoration of flood plain - some flood plain contamination remains - high relative cost - long-term monitoring
(E) Total removal and restoration	- total removal of river contamination - total removal of flood plain contamination - no long-term monitoring	- greatest environmental disruption - total removal of flood plain - total restoration of flood plain - highest cost

Preliminary Cost Comparison of Floodplain Remediation Options

(Costs for materials and construction only)

Option	Cost per Meter Width of Floodplain
(a) Containment with slope protection	$300
(b) Partial removal with containment and slope protection	$950
(c) Barrier containment	$1,500
(d) Partial removal with containment, slope protection and restoration	$950
(e) Total removal and restoration	$2,000

Welland River Cleanup Project Workshop - June 26, 1993

Questions & Concerns Voiced at the Workshop

State of the River (D.Ralph)

1. Out of the 17 Ontario areas of concern, what are the areas of concern in our region?

2. What were the final results of the Welland River dredging project?

3. Are Ontario Hydro and the St. Lawrence Seaway represented on the PAC?

4. Is there a committee representing boating enthusiasts? The river is unsafe for boating (i.e., unseen hazards below water's surface); who is responsible for boating safety?

   R. Slattery suggests Transport Canada; I. Orchard suggests Aids & Waterways Branch in Toronto

5. Interest is expressed in a 1-day cleanup day for concerned residents, committee members, etc, interested in pitching in to clean up the river's shores.

   A sign-up sheet is passed out during the workshop for all those interested in participating.

Sediment and Water Quality (P.Miles)

1. How may samples are taken to determine a mean result?

2. How much sediment in each sample? What is the depth of sampling in spring? In autumn?

3. Why are spring and fall samples taken? How does the time of year affect the sampling results?

4. How safe is it to eat the Welland River fish? Fish that have been caught recently taste like tin.

5. Is the contamination limited to a certain depth? If so, what depth?

6. Are the siphons under the canal ever cleaned?

7. Does the canal water come into the river? The St. Lawrence Seaway and Ontario Hydro both drain and flood the river.

Benefits of a Welland River Cleanup (J.Bradley)

1. Lack of interest from the general public because of the lack of severe fines and penalties give to polluters.

   Companies, as well as governments, should be held liable and responsible for cleaning their own "mess".

2. Unenforceable bylaws in place in regard to raw sewage outfalls; how does the public get action?

3. How do we (the public) go about getting government funding? Are there loop holes or weaknesses in the government structure that we can use to our advantage?

Welland Area Sewage Systems (J.Furgal & D.Cook)

1. What about forcing residents to hook up to the sewer system?

2. Government agencies and city hall are not listening to resident and their problems with the sewage system.

3. Ontario Hydro is major cause of problems along Welland River. Since Sir Adam Beck II (1955) there have been problems. Have these impacts on the Welland River been studied?

   (i.e., 8:00 pm - flow upstream
   7:00 am - flow switched to downstream
   9:00 am - flow upstream
   11:00 am - flow downstream
   1:00 pm - flow upstream
   4:30 pm - flow downstream)

4. Sewage treatment plants have only been in use since 1968. When people say " I remember when we used to swim in the Welland River years ago" they do not realize that they swam in water in which untreated raw sewage was pumped directly into the river.

Site Remediation Option & Alternatives, Funding Assistance (H.St.Rose, I.Orchard)

1. Can Ontario Hydro not make sediment removal easier by simply draining the river?

2. Concern of a potential 'hot spot' along Drapers Creek after years of industrial dumping. Trees are dying.

3. Would like to see the 1-day proposed cleanup put onto the next meeting's agenda.

4. How can cleaning the Welland River do any good while other bodies of water are still being polluted?

Press Announcements

Press Announcements

Sample letter and press release sent to newspapers:

- St. Catharines Standard
- Welland Tribune
- Niagara Falls Review
- Fort Erie Times Review
- Port Colborne News

and to the following radio/TV stations:

- CJRN, Niagara Falls
- CHRE FM, St. Catharines
- CBC radio
- CHOW, Welland
- CHSC/CHRE, St. Catharines
- Maclean Hunter, Channel 10.

Welland River Cleanup Project

June 9, 1993

The Tribune
(Canadian Newspapers Co.)
Community Calendar
228 East Main Street
P.O. Box 278
Welland, Ontario
L3B 5P5

Attention: Ms. Olgo Porcyk

Dear Ms. Porcyk: **Welland River Cleanup Project Workshop**

As per your conversation with Ms. Dawn Ralph, the Welland River Cleanup Project Planning Committee would like to submit our community bulletin for our workshop being held on Saturday, June 26, 1993, at Niagara College in Welland to be published free of charge in the Community Calendar section of the Tribune.

The goal of the workshop is to bring members of the community together with those of local industry and government agencies to work collectively in planning the future cleanup of the Welland River.

It would be greatly appreciated if the attached announcement were to appear within your newspaper before June 26, 1993. If you have any questions, please do not hesitate to call me at (416) 374-5200, Ext. 5362. Thank you in advance for your cooperation.

Yours very truly,

P. C. Miles

Philip C. Miles, P.Eng.
Coordinator, Welland River Cleanup Project

PCM:ss

Attach

Proposed News Release June 14, 1993

"Community Involvement" Key Issue at Upcoming Welland River Cleanup Workshop

The environmental state and the future of the Welland River is in the hands of the local community. This is a key point which will be emphasized at an upcoming workshop to be held at Niagara College, Welland Campus on Saturday, June 26, 1993, from 8:30 a.m to 1:30 p.m. The workshop is being sponsored by Environment Canada but is being planned by a small group of dedicated individuals who make up the Planning Committee of the Welland River Cleanup Project. The committee comprises representatives of the general public, Welland industry, Brock University and various government agencies.

In October of 1991, the Planning Committee, under the leadership of Atlas Specialty Steels, Welland, and in conjunction with Environment Canada carried at a demonstration of remediation technologies which proved that a positive change to the river is possible.

The Committee has recently identified an area of concern in the river and has received endorsement, in principle, for the Niagara River Remedial Action Plan Public Advisory Committee to develop a plan of action to remediate contaminated sediments in an 8-km section of the Welland River stretching from Lincoln Street (Webber Road), Welland, to the Seaway Canal at Port Robinson.

The purpose of the workshop is to inform the general public and local industry representatives as to the present condition of the river, as well as what has been and what can be done to clean it up. Those who have used the river or merely enjoyed its beauty are considered 'stakeholders' and are encouraged to take an active role in planning for a cleanup.

In order to restore the Welland River to a healthier state, area residents, local industry, government agencies, and any other concerned citizens are invited to attend and participate in deciding the future of the Welland River. The cleanup of the river will not happen without the active participation of concerned local citizens. A community partnership is essential for a successful Welland River cleanup.

More information on the workshop can be obtained from Mr. Philip C. Miles, Planning Committee Coordinator at (416) 374-5200.

Welland River Cleanup Project

To	News Department	**Date**	June 15, 1993
		File No.	P08960.11
		Del	S. Stokes
At	CKTB/HTZ-FM 97.7 Radio	**No. of Pages**	5
No.	(416) 684-2949		
From	Philip C. Miles, P.Eng.		

Subject: Welland River Cleanup Project Workshop

The Welland River Cleanup Project Planning Committee would like to inform you of our workshop being held on Saturday, June 26, 1993, at Niagara College in Welland. The Planning Committee comprises environmentally concerned representatives of the Welland community, local industry, and government agencies dedicated to restoring the Welland River to a healthier state.

Since the goal of the workshop is to bring members of the community together with those of local industry and government agencies to work collectively in planning the future cleanup of the river, your participation in announcing our workshop and its purpose will serve the community well.

The enclosed information package explains the workshop and its objectives. This same package is presently being distributed to the Welland residents living along the Welland River, representatives of local industries as well as government agency representatives. The workshop will be advertised locally on cable television and in various newspapers.

In addition to our community announcements, the Planning Committee has prepared a news release that will serve to inform the public about the Project as well the nature and objectives of our workshop. We would greatly appreciate the opportunity of having this news release, or modification of it, read on the air before June 26. Should you have any questions regarding the workshop or the Welland River Cleanup Project in general, please do not hesitate to call me at (416) 374-5200, Ext. 5362. I would appreciate the opportunity of speaking with you at your earliest convenience regarding the news release. Thank you in advance for you timely consideration of this matter.

Yours very truly,

P.C. Miles

Philip C. Miles, P.Eng.
Coordinator, Welland River Cleanup Project

PCM:ss

Encl

Community Announcement

Welland River Cleanup Workshop
A community partnership needed
to plan future of Welland River.
Niagara College, Secord Rm., Welland
Saturday, June 26, 8:30 am - 1:30 pm
For more information, call 416-374-5200
Ask for Susan Stokes to register
Free admission - Everyone welcome

Welland River Cleanup Project

Years of neglect and misuse have left this city's river in its present contaminated condition. Local industry, government agencies and the community must work together to restore the river to its naturally beautiful and productive state.

All are invited to learn more about the river and participate in planning its future.

Workshop

Organized by WRCP Planning Committee

Saturday, June 26, 1993 / 8:30 a.m. to 1:30 p.m.

Secord Room, Niagara College of Applied Arts & Technology
300 Woodlawn Road, Welland, Ontario

Free registration!
Phone Susan Stokes (416) 374-5200 Ext. 5329 to register your intention to come.

Workshop Registration

Workshop Registration - June 26, 1993

NAME & AFFILIATION (Please print)	ADDRESS	PHONE NO.	Do you wish to recieve followup information?	
			YES	NO
PAT QUINN	89 WHITE AVE.	7349213	✓	
BLAKE GOULET AQUATIC SCIENCES INC	45 HANNOVER, #1 ST. CATHARINES L2M 6P6	641-0941	✓	
MIKE DICKMAN	BOTANY DEPT POKFULAM Rd UNIV. of HONG KONG, H.K.	6885550	✓	
Vohn & Cathie LASOVICH	272 River Rd. Welland	732-5040	✓	
Tom McClellan	40 Chapel Hill Cr.	735-8286	✓	
JAMES [illegible] General Automotive	100 Kennedy St.	735-5531 X302	✓	
Billie Atkinson	50 Riverside	7350895 735-2211 X7757	✓	
[illegible] Whelan	46 Riverside	735-2468	✓	
Eva Hagan	387 River Rd	734.3358	✓	
Margaret Wehlann	477 River Rd.	734-8665	✓	
Anthony Whelan	98 Riverside Drive	735-3949	✓	
[redacted]	[redacted]	[redacted]	[redacted]	
John Christie	7277 Casey St N. Falls	357-7997	✓	

NAME & AFFILIATION (Please print)	ADDRESS	PHONE NO.	Do you wish to recieve followup information?	
			YES	NO
Bijan Danesh Environmental Ecological Ent.	5803 Depew Ave., N.F., Onto. L2G5M2	(416) 374-9000	✓	
Jane Aaviku Live on River ☺	67 Fitch	7352906	✓	
Anne Yagi MNR & friend of MNR	11 Berkwood Pl Fonthill But send info to office Box 1070 Fonthill L0S1E0	892-2654(W) 892-4964(H)	✓	
Frank Reid	18 Wychwood Rd Welland Ont. L3C5V3	734-7009	✓	
Stuart Reid	18 Wychwood Rd Welland Ont L3C5V3	734-7009		✓
David MacLeod	152 River Rd. Welland. L3B 2C9	788-1575	✓	
Don Mack	Atlas	734-5085	✓	
Ian Orchard	Environment Canada	416-973-1089	✓	
Karen Watt	Atlas	734-5117	✓	
Maurice Beaudoin	428 McAlpine N Welland Ont. L3B 1T3	416 735 1157.		
Hamish St. Rose	25 St. Clair Ave E, 7th Flr Toronto, M4T 1M2	416-973-1809	✓	
Craig Wardlaw	867 Lakeshore Rd. Burlington, Ont L7R 4L7	416-336-4691	✓	
Bob Lawies	12 Dundalk Court St. Catharines L2M 3M8	416-937-3328	✓	
Bill Elsie Lawrason	28 Colbeck Dr Welland Ont	416 732-6794	✓	

L3C 5B5

NAME & AFFILIATION (Please print)	ADDRESS	PHONE NO.	Do you wish to recieve followup information? YES	NO
C. SFERRAZZA AQUATIC SCIENCES	Box 2205 (B) 45 Hannover Dr (1) ST. Cath. [illegible]	641-0941	X	
Bob Slattery MOEE	WELLAND	384-9890	✓	
Anthony Crocco Brock U	3541 Varsity Ave Niagara Falls, ONT. L2J 3B7	354-7554	✓	
Mike Scapillato Brock U.	117 Rolling Acres Dr. Welland, Ontario L3C6K5	735-8575	✓	
Francis van Amelsvoort D. van Amelsvoort	C/O 109 Bradford St Barrie, ON, L4N 3A9.	705-726 3511	✓	
Archie McLARTY MOEE	119 King St. W. PO Box 2112 HAMILTON L8N3Z9	416-521 -7704	✓	
Maria Orlando	R.R#3 Welland.	416 732 3711	✓	
Lucy Orlando	R.R.3 Welland	416 732-3711	✓	
Raymonde Vocal	50, mill St. Welland	735-4764	✓	
Pat [illegible]	180 River Rd	734-1884	✓	
JANET MULLIN	188 River Rd,	732-0418	✓	
Joe [illegible]	88 RIVERSIDE DR	734-6158	✓	
Samuel Wells Jr.	344 alberta St. Welland	735 3615	✓	

Letters of Invitation to Workshop

ACRES

May 27, 1993
P08960.11

City of Welland
411 East Main Street
Welland, Ontario
L3B 3X4

Attention: Mr. Craig Stirtzinger
City Clerk

Dear Mr. Stirtzinger:

Planned Workshop for the Welland River Cleanup Project

The Planning Committee for the Welland River Cleanup Project has recently received endorsement, in principle, from the Niagara River Remedial Action Plan Public Advisory Committee to develop a plan for remediating contaminated sediments in an 8-kilometre section of the Welland River from Lincoln Street (Webber Road), Welland, to the Seaway Canal in Port Robinson. To help achieve this goal the Planning Committee is sponsoring an open workshop to encourage local and area stakeholders to become more involved in the planning for the river cleanup, to provide them with information regarding existing river and floodplain conditions as they are presently known and to examine possible methods of cleaning up the river and floodplain sediments.

The workshop organizing committee believes that a city representative would make a valuable contribution to the workshop and you are hereby invited to participate in the program. The workshop will be held from 8:30 a.m. to 1:30 p.m. on Saturday, June 26, 1993, at the Niagara College, Woodlawn Campus, in Welland. The attached tentative workshop agenda provides an outline of the topics to be addressed. Invitations to the workshop will be sent to Welland industries and residents and we hope that many will express their concern for the health of the river by their participation. Individuals from various government agencies, which represent possible sources of funding assistance, will also be in attendance.

Your representative is requested to make a presentation approximately 15 minutes in length addressing the past, present and future impact of the City's sewer system on the river environment. A short question and answer session would follow the talk. We hope also to have a representative from the Regional Municipality of Niagara present to speak on the impacts of the Region's sewage treatment system.

The Planning Committee comprises many of the same individuals who were involved with the Welland River Dredging and Sediment Treatment Demonstration project which was carried out at the McMaster Avenue outfall by Atlas Specialty Steels in the fall of 1991. I have attached a list of Planning Committee members for your information.

I believe the value of the City's presence and participation at the workshop cannot be overstated and hope your response to our request is favorable. Because of the need to finalize the workshop arrangements as soon as possible, I am intending to contact you within the next few days to discuss our request. In the meantime, if I can provide any further information or answer any questions which you might have about the workshop or the project, please do not hesitate to contact me at 374-5200, Ext. 5362. I look forward to speaking with you.

Yours very truly,

P. C. Miles

PCM:ss

Philip C. Miles, P.Eng.
Planning Committee Coordinator

Attach

Welland River Cleanup Project - Tentative Workshop Mailing List

Affiliation	Address	Contact Name & Title
Acres International Limited	5259 Dorchester Road P.O. Box 1001 Niagara Falls, Ontario L2E 6W1	Mr. P. Miles
Anton's Industries	17 Vaughan Road Welland, Ontario L3B 5X1	Mr. Anton Swampillai
Ashby Dental Laboratory	83 West Main Street Welland, Ontario L3C 4Z8	Mr. Brian Ashby
Atlas Specialty Steels	One Centre Street P.O. Box 1000 Welland, Ontario L3B 5R7	Mr. D. Marr/Ms. K. Watt
Barca's Bakery (Hometown Bakery and The Bunery)	298 Crowland Avenue Welland, Ontario L3B 1X6	Mr. Richard Burgess President
Basic Technologies Corp.	490 West Side Road P.O. Box 1006 Welland, Ontario L3B 5R6	Mr. E. J. de Waard President
Brock University Department of Chemistry	500 Glenridge Ave. St. Catharines, Ontario L2S 3A1	Prof. Ian Brindle
Brock University Dept. of Biological Sciences	500 Glenridge Ave. St. Catharines, Ontario L2S 3A1	Prof. M. Dickman
Burger Electric Motor Service Ltd.	80 Clark Street Welland, Ontario L3B 5W6	Mr. David Burger
Canada Forgings Inc.	130 Hagar Street P.O. Box 308 Welland, Ontario L3B 5P8	Mr. N. Carpentier President
Canadian Modern Language Review	237 Hellems Avenue Welland, Ontario L3B 3B8	Mr. Frank Adderio Managing Editor
Canadian Wildlife Service Regional Habitat Biologist, Ontario Region	152 Newbold Court London, Ontario N6E 1Z7	Mr. G. McCullough
Canadians for a Clean Environment	4083 Front St. Niagara Falls, Ontario L2G 6G5	Mr. Al Oleksuik
City of Welland Engineering Dept.	City Hall, 411 East Main St. Welland, Ontario L3B 3X4	Mr. D. Cook
City of Welland	411 East Main St. Welland, Ontario L3B 3X4	Mr. Dick Reuter Mayor
Clem's Ready Mix	4240 Bartlett Road Beamsville, Ontario L0R 1B0	Mr. Robert Murray General Manager

Welland River Cleanup Project - Tentative Workshop Mailing List - 2

Affiliation	Address	Contact Name & Title
Compliment Enterprises Ltd.	967 Niagara Street Welland, Ontario L3C 1M5	Mr. David Luska President
Copyman Print Shop	572 Niagara Street N. Welland, Ontario L3C 1L8	Mr. Andrew Quellette President
Crowland Sash & Frame Ltd.	65 Shaw Street Welland, Ontario L3B 5W9	Mr. A. J. Rizzo President
D'Angelo Printing Co.	87 West Main Street Welland, Ontario L3C 4Z8	Mr. G. D'Angelo General Manager
Deere, John Welland Works of John Deere Ltd.	Canal Bank Road Welland, Ontario L3B 3N3	Mr. John S. Gault General Manager
Desco Coating (of Niagara)	167 Riverside Drive P.O. Box 362 Welland, Ontario L3B 5P7	Mr. Mario Ventresca President
Dietrad Marine Products Ltd.	54 Clark Street Welland, Ontario L3B 5W6	Mr. Peter Stevens General Manager
Drason Industries Inc.	120 Shaw Street Welland, Ontario L3B 5X8	Mr. Bob Draper
E.S. Fox Limited Corporate Division	81 Thorold Road P.O. Box 10 Welland, Ontario L3B 5P1	Mr. E. S. Fox Jr. President and General Manager
Environment Canada National Contaminated Sites Remediation Program	12th Floor, Place Vincent Massey 351 St. Joseph Blvd. Hull, Quebec K1A 0H3	Mr. Ned Lynch Manager
Environment Canada	P.O. Box 5050 Burlington, Ontario L7R 4A6	Mr. S. Painter
Environment Canada Environmental Protection Ontario Region	25 St. Clair Ave. East, 7th Floor Toronto, Ontario M4T 1M2	Mr. I. Orchard/ Mr. R. Santiago/ Ms. C. Buchberger
Environment Canada, Environmental Partners Fund	25 St. Clair Ave. East, 3rd Floor Toronto, Ontario M4T 1M2	Mr. Paul Bubells Project Officer
Erie Brake & Clutch	120 Shaw Street Welland, Ontario L3B 5X8	Mr. Jim Donald
Fisheries and Oceans Canada National Water Research Institute	P.O. Box 5050 Burlington, Ontario L7R 4A6	Mr. S. Metikosh
Four Seasons Bakery	631 East Main Street Welland, Ontario L3B 3Y3	Mr. Dominic Vescio

Welland River Cleanup Project - Tentative Workshop Mailing List - 3

Affiliation	Address	Contact Name & Title
Friends of Fort George	P.O. Box 1323 Niagara-on-the-Lake, Ontario L0S 1J0	Dr. Ed Lemon
Frontier Refractories Inc.	60 Udline Street P.O. Box 427 Welland, Ontario L3M 4H8	Ms. Kathy Ulicny President
Gencorp Automotive (Gencorp Canada Inc.)	Ross and Kennedy Streets P.O. Box 1002 Welland, Ontario L3B 5R9	Mr. D. S. Thompson General Manager
General Drop Forge Inc.	500 Major Street E. P.O. Box 455 Welland, Ontario L3B 5R2	Mr. Keith Smith General Manager
Genesse Foods Inc.	77 Foss Road P.O. Box 670 Welland, Ontario L3B 5R4	Mr. Victor Genesse President
Goodman-Brown Machine & Marine Ltd.	924 Southworth Street S. Welland, Ontario L3B 2A5	Mr. G. Brown President
Great Lakes Environment Office	25 St. Clair Ave. East 6th Floor Toronto, Ontario M4T 1M2	Ms. Janette Anderson
Great Lakes Environment Office	25 St. Clair Ave. East 6th Floor Toronto, Ontario M4T 1M2	Mr. Griff Sherbin Chief, Technical Issues
Haun Drop Forge Co. Ltd.	Major & Scholfield Streets P.O. Box 98 Welland, Ontario L3B 5P2	Mr. Kevin Smith General Manager
Hopkins Steel Works Limited (Ennisteel Corp.)	2 Broadway Avenue P.O. Box 491 Welland, Ontario L3B 5R2	Mr. A. Hopkins Jr. President
Hydel Engineering Ltd.	566 Ridge Road P.O. Box 662 Welland, Ontario L3B 5R4	Mr. Eric Best President
IA Printing	32 Cross Street Welland, Ontario L3B 3G1	Mr. Dennis Etienne
Imperial Optical Co. Ltd	20 Division Street Welland, Ontario L3B 3Z6	Mr. A. Sattin Branch Manager
Indexable Cutting Tools of Canada Ltd.	66 Clark Street Welland, Ontario L3B 5W6	Mr. John W. Precious President
Interlake Casket & Urn Inc.	55 Mill Street Welland, Ontario L3C 4Y4	Mr. B. G. Church President

Welland River Cleanup Project - Tentative Workshop Mailing List - 4

Affiliation	Address	Contact Name & Title
International Baking company	192 Burgar Street Welland, Ontario L3B 2T4	Dr. D. Goswami
Ions Appliances Inc.	1110 Hansler Road P.O. Box 1004 Welland, Ontario L3B 5S1	Mr. A. D. Millman President
Liberal Party (Provincial)	2 Second Drive, Unit #2 St. Catharines, Ontario L2N 1K8	Mr. Jim Bradley, MPP
Lift-Line Machinery Ltd. (Waterloo)	495 Westside Road Welland, Ontario L3B 5X1	Mr. Tim Morgan President
Micro-Port International Ltd	632A South Pelham Street Welland, Ontario L3C 3C8	Mr. Roy Bishop President
Ministry of Agriculture and Food	726 Canboro Road Fenwick, Ontario L0S 1C0	Mr. Dan Carlow Agriculture Representative
Ministry of Natural Resources	P.O. Box 1070, Hwy. #20 Fonthill, Ontario L0S 1E0	Mr. R. Lewies
Ministry of the Environment and Energy Niagara River Action Plan Team	Ellen Fairclough Building 119 King St. W. 12th Floor Hamilton, Ontario L8N 3Z9	Mr. A. McLarty/ Ms. B. Koblik Berger
Ministry of the Environment and Energy - WCR	119 King Street P.O. Box 2112 Hamilton, Ontario L2N 2V8	Mr. Stan Irwin Project Coordinator
Ministry of the Environment and Energy	637 Niagara Street Welland, Ontario L3C 1L9	Mr. R. Slattery
Ministry of the Environment and Energy Research and Technology Branch	135 St. Clair Avenue West, 5th Floor Toronto, Ontario M4V 1P5	Mr. Doug Valley
Mitech Plastics Corporation	129 Hagar Street Welland, Ontario L3B 5V9	Mr. Richard Limogas C.O.O.
Mr. Joe Caruso	54 Park St. Welland, Ontario L3B 4M5	Mr. Joe Caruso
New Democratic Party (Provincial)	60 King St., Unit 103 Welland, Ontario L3B 6A4	Mr. Peter Kormos, MPP
Niagara College of Applied Arts & Technology	Woodlawn Road P.O. Box 1005 Welland, Ontario L3B 5S2	Mrs. Lyn Russo Director, Marketing and Communications
Niagara Falls Angler's Club	42 Almond St. St. Catharines, Ontario L2T 1E9	Mr. Mike Behunin

Welland River Cleanup Project - Tentative Workshop Mailing List - 5

Affiliation	Address	Contact Name & Title
Niagara Falls Nature Club	3647 Rolling Acres Niagara Falls, Ontario L2J 3B8	Mr. Alan Veall Public Advisory Committee
Niagara Metal Industries (775457 Ontario Inc.)	129 Hagar Street Welland, Ontario L3B 4V9	Mr. Fred J. Davies President
Niagara Peninsula Conservation Authority	Centre St. Allanburg, Ontario L0S 1A0	Mr. A. Damario
Niagara River Remedial Action Plan Public Advisory Committee	3747 Portage Road Niagara Falls, Ontario L2J 2L1	Mr. T. Simonen (c/o Ms. V. Cromie)
Niagara Sausage & Meat Products Ltd.	Ridge Road, R.R.#4 Welland, Ontario L3B 5N7	Mr. Johnson Lee
Niagara Wood Products	454 McAlpine Avenue N. Welland, Ontario L3B 1T3	Mr. Fred Minor
Northside Dairy (Ault Foods)	871 Niagara Street Welland, Ontario L3C 6Y1	Mr. Joe Malon Manager
Orlando Lumber Limited	Colbeck Drive, R.R.#3 Welland, Ontario L3B 5N6	Mr. Mike Orlando President
Panabrasive Inc.	650 Rusholme Road P.O. Box 634 Welland, Ontario L3B 5R4	Mr. L. J. Milot President
Peninsula Die & Tool Ltd.	59 Southworth Street P.O. Box 86 Welland, Ontario L3B 5N9	Mr. C. B. White President
Peninsula Saw Co. Ltd.	370 Netherby Road P.O. Box 334 Welland, Ontario L3B 5P7	Mr. Daniel Sardella
Perfect Portion Holdings Co. Inc.	15 Burgar Street, 2nd Floor Welland, Ontario L3B 2S6	Mr. Andre Champagne President
Premier Refractories Canada, Ltd.	Prince Charles Drive P.O. Box 220 Welland, Ontario L3B 5P4	Mr. F. W. Lutes President
Public Works Canada	4900 Yonge Street North York, Ontario M2N 6A6	Mr. A. Khan
Pyrolysis Systems Inc.	61 Thorold Road P.O. Box 10 Welland, Ontario L3B 5P1	Mr. E. S. Fox Jr., P.Eng. President & General Manager
Rainbow Printing	73 Ontario Road Welland, Ontario L3B 5C2	Mr. Andrew Potulicki Manager

Welland River Cleanup Project - Tentative Workshop Mailing List - 6

Affiliation	Address	Contact Name & Title
Red-D-Mix	73 Ontario Road Welland, Ontario L3B 5H9	Mr. Paul Lugg Plant Superintendent
Regional Municipality of Health	130 Lockhart Drive St. Catharines, Ontario L2T 1W4	Medical Officer of Health
Regional Municipality of Niagara	P.O. Box 1042 Thorold, Ontario L2V 4T7	Mr. Simon Tam Env. Services, P.W.D.
Regional Municipality of Niagara	2201 St. Davids Road St. Catharines, Ontario L2V 4T7	Mr. J. Furgal
Regional Niagara Health Dept.	573 Glenridge Ave., P.O. Box 3040 St. Catharines, Ontario L2R 7E3	Mr. J. Luszkacs
Royce Yorke Designers & Manufacturers (R & Y Tool & Die Company Ltd.)	River Road, R.R.#1 Welland, Ontario L3B 5N4	Mr. Ted Liske President
Rustic Designs	138 Federal Road Welland, Ontario L3B 3P2	Mr. Robert Bogdan
Ryan Whirlpools Inc.	28 Vaughan Road Welland, Ontario L3B 5Y1	Messrs. David Wright and Jamie Wright
Sandrin Bros. Ltd. - Canal Division	660 Forkes Road W. Welland, Ontario L3B 3N0	Mr. Lucio Sandrin President
Sandstrom Trade & Technology Inc.	30 Griffith Street P.O. Box 850 Welland, Ontario L3B 6Y5	Ms. Monica Sandstrom President
Shaw Pipe Protection (A Division of Shaw Industries Ltd.)	Ridge Road & Hwy. 140 P.O. Box 518 Welland, Ontario L3B 5R3	Mr. B. McKinnon Plant Superintendent
St. Catharines Resident	4-103 Albert St. St. Catharines, Ontario L2R 2H4	Ms. D. Ralph Vice Chair, Public Advisory Committee
Stelpipe, A Unit of Stelco Inc. (Page Hersey & Welland Tube Works)	200 Dain Avenue - General Office P.O. Box 1010 Welland, Ontario L3B 5Y6	Mr. G. W. Rich Vice President & General Manager
The Guardian Express	147 East Main Street Welland, Ontario L3B 3W5	Mr. Rorry Bradnam Publisher & General Manager
The Standard Newspaper	17 Queen St. St. Catharines, Ontario L2R 5G5	Mr. D. Draper Reporter
The Tribune (Canadian Newspapers Co.)	228 East Main Street P.O. Box 278 Welland, Ontario L3B 5P5	Ms. Sue Dickens

Welland River Cleanup Project - Tentative Workshop Mailing List - 7

Affiliation	Address	Contact Name & Title
The Wood Shop	14 Clark Street Welland, Ontario L3B 5W6	Mr. Mike Arnell President
UCAR Carbon Canada Inc.	Canal Bank Road P.O. Box 1001 Welland, Ontario L3B 5R8	Mr. Cassilly Managing Directory
W. D. Marr Industries Inc.	129 Hagar Street Welland, Ontario L3B 5V8	Mr. Wayne Marr President
Ward Ironworks Limited	123 Victoria Street P.O. Box 511 Welland, Ontario L3B 5R3	Mr. M. S. Ward President
Wastewater Technology Centre	867 Lakeshore Road, P.O. Box 5068 Burlington, Ontario L7R 4L7	Mr. C. Wardlaw
Welbridge Engineering Co. Ltd.	Market Square Welland, Ontario L3B 3GB	Mr. R. Elliott Manager
Welland Auto/Marine Repairs and Salvage	771 Reaker Road, R.R.#4 Welland, Ontario L3B 5N7	Mr. Jim Levare
Welland Forge	139 Centre Street P.O. Box 216 Welland, Ontario L3B 5P4	Mr. J. V. Custode Vice President & General Manager
Welland Lumber & Builders Supplies Ltd.	918 Southworth Street S. Welland, Ontario L3B 2A5	Mr. Craig Hebert Industrial Manager
Welland Meat Packers Ltd.	310 Riverside Drive Welland, Ontario L3C 5E5	Mr. Peter Hogeterp Manager
Welland Metal Supplies Limited	208 Burgar Street P.O. Box 206 Welland, Ontario L3B 5P4	Mr. G. Nigh President
Welland Paving Co. Ltd.	75 Udine Avenue P.O. Box 875 Welland, Ontario L3B 5Y5	Mr. Vincent Pate President
Welland Printing Co Ltd. Inhouse Design	115 Division Street Welland, Ontario L3B 3Z8	Mrs. E. Stanley-Reynolds Vice President
Welland Resident	R.R.#1, 477 River Road Welland, Ontario L3B 5N4	Ms. M. Wehlann
Welland Resident	39 Shotwell Street Welland, Ontario L3C 1N9	Ms. Diana Harris
Welland Resident	436 East Main Street Welland, Ontario L3B 3X5	Mr. Brian Beauchesne

Welland River Cleanup Project - Tentative Workshop Mailing List - 8

Affiliation	Address	Contact Name & Title
Welland Resident	225 River Road Welland, Ontario L3B 2S2	Ms. R. Beatty
Weston Bakeries	236 Burgar Street Welland, Ontario L3B 2T4	Mr. Ken Lane Manager
Whiting Equipment Canada Inc.	Alexander Street P.O. Box 217 Welland, Ontario L3B 5P4	Mr. H. Lee President & General Manager
Zar Graphics	10 Wellington Street Welland, Ontario L3B 1A9	Mr. Ziggy Gingras

June 2, 1993

Welland River Cleanup Project

Dear Welland Resident:

Restoration of the Welland River

In recent years a small number of dedicated individuals has been working to improve the future of the Welland River, a prominent, once beautiful and productive river which perhaps flows through your backyard or neighbourhood. Local people of all ages have enjoyed the Welland River and have fond memories of time spent there. Few people realize, however, how contaminated the river has become through misuse and neglect.

The **Niagara River Remedial Action Plan Public Advisory Committee** comprising representatives from the general public, local industry, university and various government agencies is concerned mostly with the Niagara River but has come to realize that the Welland River has a major impact on the quality of the water and sediment which enters the lower Niagara River and Lake Ontario.

A similar group is the **Welland River Cleanup Project Planning Committee**. This committee works in cooperation with the Public Advisory Committee but has been dealing more specifically with the Welland River within the confines of the City of Welland. In October of 1991, the Planning Committee planned and carried out a demonstration of sediment cleanup and treatment technologies under the sponsorship of Atlas Specialty Steels, Welland, and in conjunction with Environment Canada, which showed that it is possible to make a positive change to the river. The Planning Committee has recently identified an area of concern in the Welland River and has received endorsement, in principle, from the Public Advisory Committee to develop a plan for remediating contaminated sediments in an 8-km section of the river from Lincoln Street (Webber Road), Welland, to the Seaway Canal at Port Robinson.

The cleanup of the river will not happen without the active participation of concerned citizens like you. If you have used the river or perhaps just appreciated its presence, you are a 'stakeholder', and I encourage you to become involved in the planning of a river cleanup. We have all played some part in the river becoming what it is, and we must all play a part in its restoration.

To provide you with information regarding existing river and adjacent floodplain conditions and options for cleaning up the river, the Planning Committee is organizing an **open workshop on Saturday, June 26, 1993, at Niagara College in Welland**. Details of the workshop and an agenda have been enclosed for your information. Please accept this as your invitation to learn more about the Welland River, discuss its future and ask whatever questions you have. Many knowledgeable speakers will be present including The Honourable Mr. Jim Bradley, MPP and former Minister of the Ontario Ministry of the Environment, as well as Regional and City of Welland representatives.

In order to restore the Welland River to a healthy state, a participatory approach must be taken. Community interest in remediating the river must exist in order to proceed with the planning for the cleanup. Other cleanups such as Frenchman's Creek are being successfully spearheaded by community groups in the Niagara Region at the present time. A community partnership, involving people like you, is essential for a successful Welland River cleanup project. Please mark the date of the workshop on your calendar and plan to attend.

Yours very truly,

P. C. Miles

Philip C. Miles, P.Eng.
Coordinator, Welland River Cleanup Project

PCM:ss
Encl

Welland River Cleanup Project

OPEN WORKSHOP

The Planning Committee for the Welland River Cleanup Project has recently expanded its area of concern and has received endorsement from the Niagara River Remedial Action Plan Public Advisory Committee to develop a plan for remediating contaminated sediments in an 8-km section of the river extending from Lincoln Street (Webber Road), Welland, to the Seaway Canal at Port Robinson.

To progress toward this goal the Planning Committee is holding an open workshop designed to

- to encourage more stakeholders to become involved in the planning for the river cleanup
- to provide stakeholders and interested participants with general information on existing river and floodplain conditions as they are presently known
- to examine possible methods of cleaning up the contaminated river and floodplain sediments.

The Place:	*Secord Room Niagara College of Applied Arts & Technology, Woodlawn Campus*
Location:	*300 Woodlawn Road, Welland, Ontario*
Date:	*Saturday, June 26, 1993*
Time:	*8:30 a.m. - 1:30 p.m.*

A COMMUNITY PARTNERSHIP IS ESSENTIAL FOR A SUCCESSFUL PROJECT

Pre-registration by Friday, June 18, 1993, is appreciated.

Pre-registration is not necessary but would be greatly appreciated for organizing purposes. Please indicate your intention to attend the above workshop by contacting Ms. Susan Stokes at Acres International Limited either by

- phone: (416) 374-5200, Ext. 5329
- fax: (416) 374-1157
- or to pre-register in writing, fill out the form below, detach and mail to

Acres International Limited
(Attention: Ms. Susan Stokes)
5259 Dorchester Road, P.O. Box 1001
Niagara Falls, Ontario L2E 6W1

FREE REGISTRATION!

Yes, I am planning on attending the above-mentioned workshop on June 26, 1993 at 8:30 a.m.

Name/Phone: ______________________________

WORKSHOP AGENDA

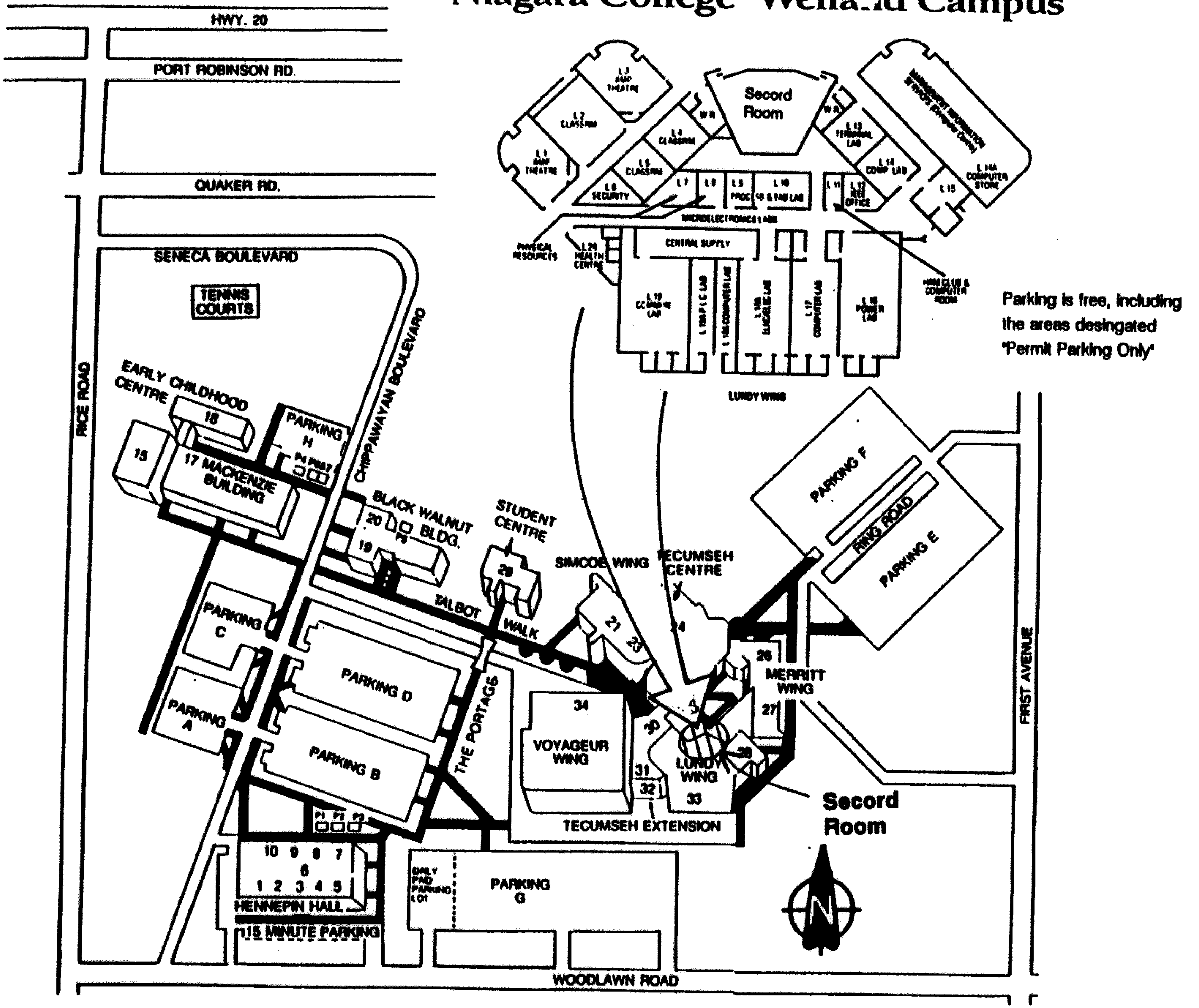
8:30 a.m. - 9:00 a.m.	Registration and Coffee
9:00 a.m. - 9:15 a.m.	**Welcome and Introduction** *Mr. P. Miles, P.Eng., Coordinator, Welland River Cleanup Project*

(A question and answer period will follow each presentation)

9:15 a.m.- 10:00 a.m.	**State of the River** • Review of RAP/PAC Workshops on Sediment Quality, Water Quality and Habitat *Ms. D. Ralph, Vice Chair, Niagara River Remedial Action Plan Public Advisory Committee* • Review of Welland River Studies *Mr. P. Miles*
10:00 a.m. - 10:30 a.m.	**Benefits of a Welland River Cleanup** *The Honourable Mr. J. Bradley, M.P.P.*
10:30 a.m. - 11:15 a.m.	**The Welland Area Sewage System** • Regional Municipality of Niagara *Mr. J. Furgal, P.Eng., Manager, Industrial Waste and Laboratory Services* • City of Welland *City Representative*
11:15 a.m. - 11:30 a.m.	**Break** *(Coffee and Doughnuts)*
11:30 a.m. - 12:00 p.m.	**Possible Sources of Remediation Funding Assistance** *Mr. H. St.Rose, P.Eng., Acting Head, Waste Management & Transportation of Dangerous Goods Act*
12:00 p.m. - 12:45 p.m.	**Site Remediation Alternatives** • Overview *Mr. C. Wardlaw, P.Eng., Head, Contaminated Sediment Treatment Technology Program, Wastewater Technology Centre* • Welland Dredging and Treatment Demonstration *Mr. P. Miles* • Other Alternatives *Mr. C. Wardlaw; Mr. I. Orchard, Head, Contaminated Sediment Removal Technology Demonstration Program, Environment Canada* • Floodplain Alternatives *Mr. P. Miles*
12:45 p.m. - 1:15 p.m.	**General Question and Answer Period**
1:15 p.m. - 1:30 p.m.	**Informal Open Discussion**

Representatives from Municipal, Provincial and Federal governments will be present to assist the committee in presenting information and answering your questions. We look forward to meeting many of the community members at the workshop. We also value your input to the project and encourage your participation in the planning.

N..gara College Wella..d Campus



Parking is free, including the areas desingated "Permit Parking Only"

Appendix A3

Meetings of the Welland River Cleanup Project

Meetings of Welland River Cleanup Project Planning Committee

February 25, 1993
May 18, 1993
June 11, 1993
July 22, 1993
November 16, 1993
December 16, 1993
January 10, 1994
March 24, 1994
April 28, 1994
June 2, 1994
September 27, 1994
January 19, 1995

Members of Welland River Reef Cleanup Project Planning Committee - 1993*

R. Beatty	Welland Resident
D. Cook	City of Welland
M. Dickman	Welland River Reef Cleanup Committee
J. Furgal	Regional Municipality of Niagara
A. Khan/M. Hartley	Public Works Canada
A. Zimic	Niagara Peninsula Conservation Authority
R. Lewies	Ministry of Natural Resources
J. Luszkacs	Regional Niagara Health Department
D. Marr/K. Watt	Atlas Specialty Steels
G. McCullough	Canadian Wildlife Service
S. Metikosh/D. Myles	Fisheries and Oceans
P. Miles/G. Haymes	Acres International
A. McLarty/B. Koblic Berger	Ministry of Environment
I. Orchard/R. Santiago/ C. Buchberger	Environment Canada
S. Painter	Environment Canada
D. Ralph	Niagara River PAC
T. Simonen/V. Cromie	Niagara River PAC
R. Slattery/R. Shannon	Ministry of Environment
C. Wardlaw/P. Bucens	Wastewater Technology Centre
M. Wehlann	Welland Resident

* This is a general listing. Attendance/Membership did vary slightly with each meeting.

Members of Welland River Reef Cleanup Project Planning Committee - 1994*

Doug Elliott	Chairman
Tony D'Amario	Niagara Peninsula Conservation Authority
Don Marr	Atlas Specialty Steels
K. Watt	Atlas Specialty Steels
Ian Orchard	DOE - Remediation Technologies
Ben Vacca	Niagara Health Services Department
Valerie Cromie	Niagara River PAC - Community Liaison Coord.
Joe Furgal	Regional Municipality of Niagara
Phil Miles	Acres International
A. L. Erzinclioglu	Acres International
Margaret Wehlann	Welland Resident
John Markarion	MOEE
Don Cook	City of Welland
Ron Oliver	Geon Canada
Anne Yagi	Ministry of Natural Resources
Chris Attema	Niagara Peninsula Conservation Authority
David Brendon	Wastewater Technology Centre
Archie McLarty	MOEE - Hamilton

* This is a general listing. Attendance/Membership did vary slightly with each meeting.

List of Core Planning Committee Meetings

February 25, 1993

April 1, 1993

April 23, 1993

Core Planning Committee Members
Welland River Cleanup Project

M. Dickman	Welland River Reef Cleanup Committee
B. Koblik Berger	Ministry of Environment
R. Lewies	Ministry of Natural Resources
D. Marr/K. Watt	Atlas Specialty Steels
P. Miles	Acres International
I. Orchard/R. Santiago	Environment Canada
D. Ralph	Niagara River PAC
R. Slattery	Ministry of Environment
C. Wardlaw	Wastewater Technology Centre
M. Wehlann	Welland Resident
A. Zimic	Niagara Peninsula Conservation Authority

Letter of Invitation to Noncommittee Members to Attend Planning Committee Meeting

July 16, 1993

address~

Dear name~:

Notice of Meeting & Tenative Agenda

This is to advise you of the next meeting of the General Planning Committee for the Welland River Cleanup Project. The meeting has been scheduled for Thursday, July 22, 1993, at 9:30 a.m. The location will be the Environmental Center meeting room at the offices of the Regional Municipality of Niagara. A tentative agenda is attached.

Directions to the Regional offices are as follows:

- Highway 406 to St. Davids Road West
- west on St. Davids Road to Schmon Parkway
- south on Schmon Parkway to first right turn
- first building (with green windows) on the left

Non-committee members, such as yourselves, who attended the workshop on June 26, 1993, or who expressed an interest in receiving more information about the cleanup project are invited to attend the above-noted meeting.

Please advise of your attendance by contacting Ms. Susan Stokes at Acres at (416) 374-5200, Ext. 5329.

Yours very truly,

Philip C. Miles, P.Eng.
Coordinator, Welland River Cleanup Project

PCM:ss

Attach

Welland River Cleanup Project

Date of Meeting: JULY 22, 1993

Please sign in.

Those in Attendance:

Name	Affiliation
✓ P. Miles	Acres.
✓ DON MARR	ATLAS
✓ JOE FURGAL	REGION OF Niagara
✓ Dawn Ralph	PAC
✓ John Christie P.Eng	Private.
✓ Bijan Danesh	Environmental Ecological Enterprises (
✓ [illegible]	MNR
✓ T. DAMARIO	Niagara Peninsula Conservation Authori
✓ [illegible]	citizen
✓ [illegible]	citizen.
✓ Karen Watt	Atlas Specialty Steels
✓ Belinda Koblik-Berger	MOEE - Niagara River
✓ [illegible]	W. R
✓ CARMEN SFERRAZZA	AQUATIC SCIENCES INC
✓ VALERIE CROMIE	NIAGARA RIVER RAP/PAC
✓ Anthony Crocco	Brock University.
✓ MIKE DICKMAN, PRES.	NIAGARA ECOSYSTEMS TASKFORCE
✓ Lynanne Brousseau	citizen.
✓ Geoffrey Cloutier	Brock University
✓ Grazyna Rygiel	Brock University Biol Dept.

name	Affiliation
Jane AAVIKU	CITIZEN Along the river.

Appendix A4

Newsletter

Welland River Cleanup Project

March 1995

Key Dates/Events

•

Public Meeting
March 21, 1995

•

Project Mobilization
July 4, 1995

•

Start of Dredging
July 10, 1995

•

Complete Dredging
late August, 1995

•

Demobilization and Cleanup
early September , 1995

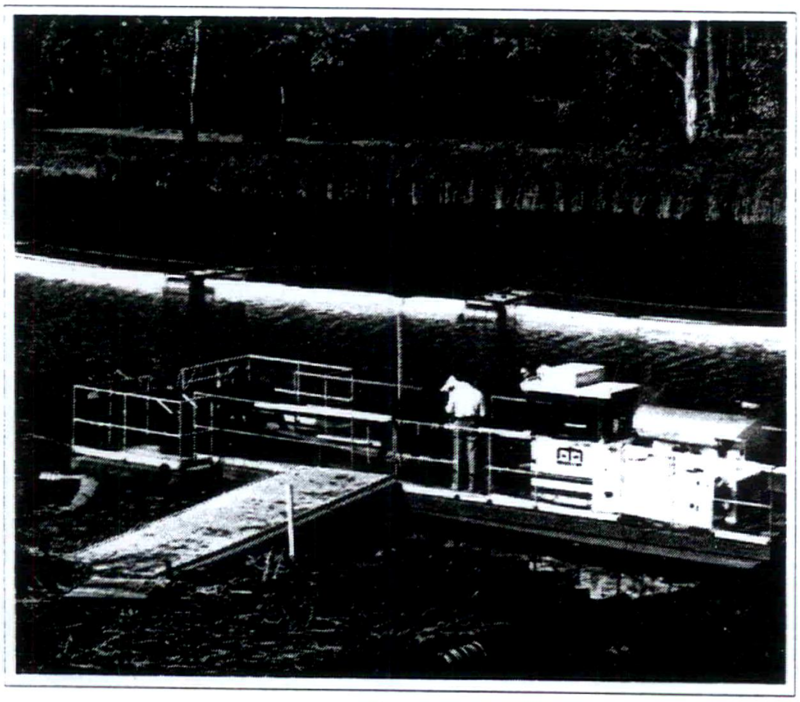
History of Contamination in the Welland River

There have been many studies carried out on the lower Welland River. As early as the 1960's, it was determined that domestic sewage and industrial wastes had led to serious water quality impairment of the river. The sediments in the river bed were also found to contain elevated concentrations of several elements including lead, chromium, mercury, cadmium, zinc, iron, nickel, copper, arsenic, nitrogen, total organic carbon, and total phosphorus . Brock University researchers identified that there were severe impacts on the benthic communities (the bottom dwelling organisms) especially around certain outfalls into the river. Subsequent studies identified other areas where deposits of industrial contaminants had accumulated (reefs). These areas are shown in the map on the reverse side.

▲ *Welland River*

The Welland River Cleanup Committee was formed in 1990 with the aim of clearly identifying the problems within the river and developing methods to restore the water and sediment quality to acceptable levels. The objective is to utilize an "ecosystem approach" to resolution of water and resource management issues. We have assembled a committee comprised of municipal, regional, provincial and federal representatives as well as environmental researchers, local industries, consultants and concerned public citizens.

The cleanup is being planned as a remediation project within the Niagara River Area of Concern and has received the endorsement of the Niagara River Remedial Action Plan (RAP) Public Advisory Committee and the RAP Team. The Project is one of the remedial activities recommended by the RAP Stage 2 report (Recommendation No. 16), and as well addresses the Canada-Ontario Agreement regarding the cleanup of severely contaminated sediments.



◀ **Dredge**

Previous Dredging Demonstration

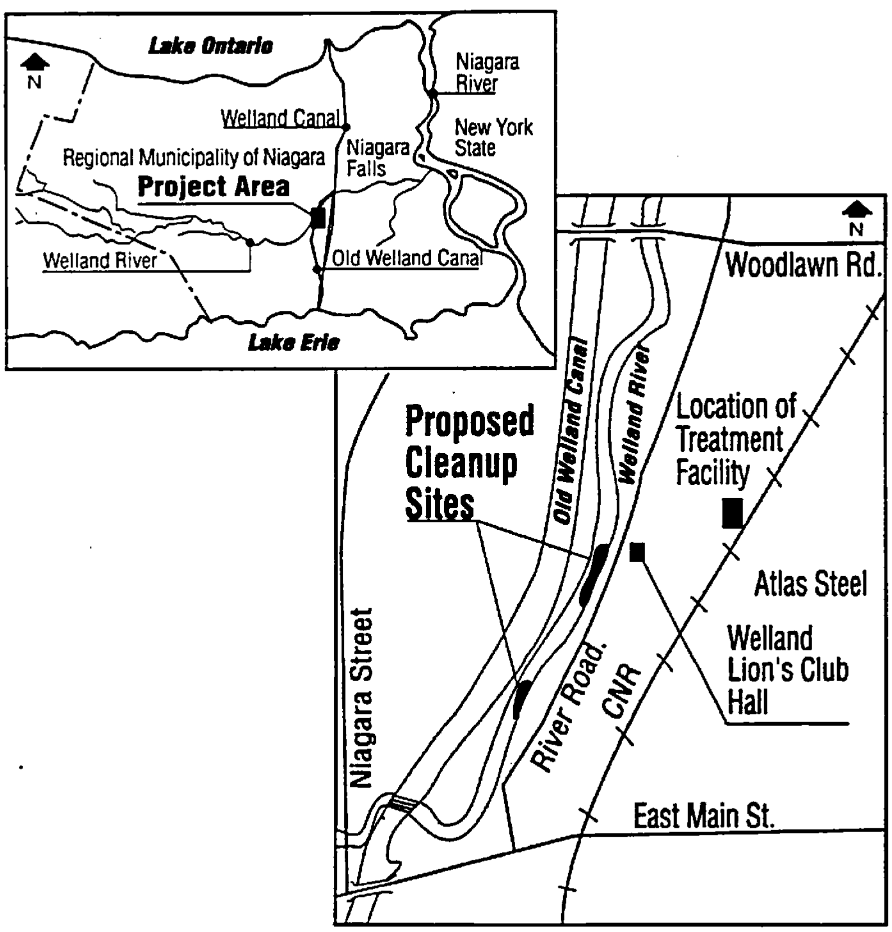
Atlas Specialty Steels acknowledged in the late 1980's that some of the contamination in the river had resulted from release of mill scale from their rolling operations into outfalls adjacent to their property. They undertook a commitment to clearly identify the problem and assist in the cleanup.

Under partial assistance from Environment Canada's Great Lakes Cleanup Fund, approval was granted in 1991 to undertake a dredging demonstration. Contaminated sediment was removed from the river bed and pumped by pipeline to Atlas property for treatment. The demonstration took place over a 3 - week period in October/November 1991 and removed approximately 130 cubic metres of contaminated sediment from a reef located near the McMaster Avenue outfall. The demonstration showed that the contaminated sediment could be successfully removed and treated with little negative impact on the river environment.

Present Proposal

The aim of the Welland River Cleanup Committee is the restoration of productive aquatic habitat in the affected stretch of the river. With the success of the previous dredging operation, it is now proposed to remove the remainder of the contaminated reef materials at the McMaster Avenue sewer outfall and also the reef associated with the Atlas-Gencorp Outfall (see figure below) - approximately 6200 cubic metres of material. Similar dredging and treatment technologies as utilized during the demonstration will be employed, taking into account improvements/refinements resulting from the demonstration.

The project is to be funded by Atlas Specialty Steels with assistance from the Great Lakes Cleanup Fund and potentially other provincial, municipal and corporate partners. The project is supported by the Friends of the Welland River, a community based group of volunteers involved in the aesthetic cleanup of the river. It is proposed that the work be carried out during the summer of 1995.



Public Participation

A public meeting is planned for the following date:

Welland Lion's Club Hall
414 River Road, Welland
March 21, 1995, 7:30pm

The purpose of the meeting will be to more fully explain the nature of the contamination within the river and describe the proposed dredging and treatment activities, and slope stabilization. The meetings will take the format of a short formal presentation followed by a question and answer session.

For further information, please contact one of the following:

Cate Mee
Acres International, Niagara Falls
905-374-5200

Val Cromie,
Niagara River Remedial Action Plan,
Public Advisory Committee
905-374-8113

Dan Monteith
Atlas Specialty Steels
905-734-5017

◀ *Location Map*

Appendix A5

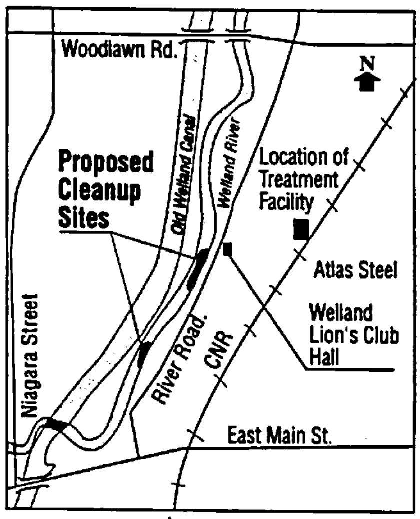
Public Meeting
March 21, 1995

Newspaper Advertisement for the Public Meeting as Placed in the Following Papers

Niagara Regional Shopping News - March 15, 1995
The Tribune - March 17, 1995
Cover Story - March 18, 1995

Welland River Cleanup Committee
Notice of Public Meeting

With the ongoing commitment to clean up the Welland River, it is proposed to remove contaminated sediments from two stretches of the river this summer. The material would be dredged from the river and then pumped by pipeline to a treatment facility located on Atlas Steel's property.



A successful demonstration project was undertaken on the river in 1991. Similar dredging and treatment technologies as utilized previously will be employed this time, taking into account improvements that were developed from the demonstration.

A public meeting to more fully explain the nature of the contamination within the river, describe the proposed dredging, treatment and remediation technologies, discuss any environmental concerns and solicit public input on the project will be held as follows:

Location: **Welland Lion's Club Hall**
414 River Road, Welland.
Date: **21st March, 1995, 7:30 pm**

The meeting will take the format of a short presentation followed by a question and answer session. All those interested are encouraged to attend. For more information, please contact:

Cate Mee, Acres International Limited
Telephone 905-374-5200 (call collect)

Public Meeting

Agenda

1) Introduction — Cate Mee - 5 minutes
   Welcome
   Purpose of meeting
   Introduction of all partners
2) History of Project
   Don Marr - 5 minutes
   Ian Orchard - 10 minutes
3) Present Proposal
   • Technical Information
     Phil Miles - 15 mins
   • Environmental Conditions
     Larry King - 5 mins.
4) Formal Question/Answer Session
   Coordinated by Cate Mee
5) Informal Discussion Period
   Coffee and Donuts
6) Pilot Scale Demonstration Project Video
7) Questionnaire
   Ask to fill out prior to leaving

ACRES

Please Sign In

Welland River Reef Cleanup Project - Public Meeting, 21st March 1995

Name	Address	Phone
[illegible]	7135 BRIAN CRESC.	356-0298
Joe [illegible]	3501 Schmon Pkwy (Niag. Region	357-5972
Larry Beland	306 Cooper Rd	732-1736
D. McCulloch	301 Cooper Rd	732-4355
B.T. [illegible]	20 YORK ST	732-5239
Roland Larouche		732-41[illegible]
Pizzacalla Peter	84 Almond St	735-5769
Jessie Armstrong	90 Margery Rd.	734-3687
Wm. Armstrong	90 Margery Rd	734-3687
[illegible]	20 FOREST RD.	7355631
Tony D'Amario	NPCA - Allanburg	227-1013
Jim Wheeler	100 Kennedy St. (Gencap)	735-5631
John & Irene Sernasie	246 River Rd	732-3202
Margaret Wellman	477 River Rd Welland	734-9665

Please Sign In

Welland River Reef Cleanup Project - Public Meeting, 21st March 1995

Name	Address	Phone
A Larabie	329 St George St Welland	734-6732
Pat O'Hara	3-1616 Pelham St. Fonthill ON L0S 1E5	892-8756
Jane Vello Aauwen	Friends of the Welland R.	☺
Barbara Miron	Friends of the Welland R.	
Carole + Len Eghel	Cole Almond St	735-2797
Roger Elliott	264 Kingsway.	735-6957
Bernie Dehate	49 Duncan	No phone
Anh McLarty	MOEE PO Box 2112 Hamilton L8N 3Z9	905-521-7704
Henry Miron	26 Colbeck Drive Welland	735 4999
Helen Skay	108 River Rd Welland	—
Pat Hodgshire	180 River Rd. Welland	
Eva Hagan	387 River Rd Welland	734-3358
Bob Shannon	MOEE	732-0816
Anne Yagi	OMNR	892-2656

Valerie Cromie — Niagara River RAP Program — 374-8113.

Welland River Cleanup Committee
Public Meeting
21st March 1995
7.30 pm at Welland Lions Club Hall

Attendance:

~25 members of the public (including The Friends of the Welland River)
10 Agency Representatives (2 Environment Canada, 1 MNR, 3 MOEE, 2 NPCA, 1 Regional Niagara, 1 NRRAP/PAC)
3 Industry Representatives (2 Atlas and 1 Gencorp)
3 Consultants (Acres)

Meeting called to order ~7.40 pm

Agenda as attached

Formal presentations to 8.45 pm

Question and Answer Session

Question: ***(Jane Aaviku - Friends of the Welland River) When the silt curtain is in place there is no flow past the dredge - isn't it preferable to have the curtain? The Welland residents would feel more comfortable with the curtain in place.***

Answer: (Phil Miles) Admittedly there will be flow across the dredge, however results from the previous demonstration showed that the dredge worked adequately, there was little resuspension and the minimum requirements could be met. Silt curtains are expensive. Monitoring and shut down procedures will be in place - the operation will still have to meet the strict limits imposed in the permit conditions. The dredge is very sensitive to operator control and a good operator can minimize the amount of sediment released.

(Ian Orchard) Representatives of Environment Canada and MOEE will be on site at all times, ensuring that acceptable standards are met otherwise the operation will be closed down. Environment Canada also wants to show that innovative technologies work such as the hydraulic suction dredge can work in a riverine situation without the need for a silt curtain. GM in Macena New York has been dredging contaminated sediments and there has been considerable resuspension - Environment Canada would like to prove that with the correct techniques this need not occur and wants to use the Welland River as a test site. There are other areas still to be remediated where it is not feasible to use a silt curtain and therefore it is useful to have a proven technique available.

Question: ***(Jane Aaviku) The Welland River has a flow reversal and the dredging will be across the flow - have considerations been given to trying to coincide with Ontario Hydro operating conditions and only dredging when the flow is downstream?***

Answer: (Phil Miles) It would not be practical to consider Ontario Hydro's operations as they would be very restrictive in terms of time available for dredging. The reason that it is planned to dredge perpendicular to the flow for this project, is that there was very low solid concentrations when working parallel to the shore as only one corner of the dredge head fully engaged the sediment. The cross river dredging will allow the full face of the dredge to come in contact with the sediment and hence be more efficient from a production perspective.

(Larry King) Also, for this demonstration in July and August, the river flows will be at their lowest. With the previous demonstration there were higher flows and the potential for significant flows related to storm events in October.

Comment (General Public) It should be understood that the dredge works like a big vacuum cleaner - sucking in material and lessening the possibility of suspension.

Question: ***Are the Forge Shops accepting any responsibility for any of the contaminated sediments?***

Answer: (Don Marr) Atlas is looking to ask other industries to assist with the cleanup.

Question: ***What does Atlas do with the materials in the slurry?***

Answer: (Don Marr) Atlas will re-use the heavy metals
(Phil Miles) Materials will be subjected to testing to determine disposal options. Some of the river sediments which are not leachate toxic materials will be disposed at the City of Welland landfill site. [Where they will be used for landfill cover - Don Marr] Other materials that are non-hazardous but leachate toxic, will be taken to a registered site.

Question: ***After the cleanup, will recreational swimming be possible in the river?***

Answer (Bob Slattery) The end uses of the river are still to be identified. It is organizations like The Friends of the Welland River who determine what is wanted, boating, swimming?? They are presently undertaking an education process to inform the public about the Welland River.

Question: ***What is the present fecal count in the river***

Answer: (Doug Elliot) I can't give you a definitive answer - the CA is working at Binbrook reservoir cleaning up the operation of sewage systems there - the aim is to work downstream cleaning up the problems.

Question: ***What makes it safe for swimming and fishing?***

Answer: (Doug Elliot) Cleanup and reduce all the excessive inputs into the river - every sewer and farm operation. Then an educational support program is required to change people's attitudes.
(Bob Slattery) MOEE is addressing direct dischargers into the river.

Question: ***What is to discourage Atlas discharging oil into the river?***

Answer: (Don Marr) Atlas is not discharging oil into the river - they are under the MISA program and there are very heavy fines for any violation. They have not discharged any untreated wastewaters directly into the river since 1979.

Question: ***Where is the oil coming from then? It is horrible to look at.***

Answer: Other sources, or it could be that the mill scale on the reef gives the appearance of oil. The water coming out of the outfall is clear, allowing one to see the black bottom sediments, giving the impression of material coming out the outfall.

Question: ***Are there any discharges from Gencorp?***

Answer: (Jim Wheeler - Gencorp rep.) Gencorp does have some discharges - they are addressing the problem at the source. They are discussing the situation with Atlas re Gencorp support (in-kind or financial) of the project but they are directing their efforts to their own problems.

Question: ***While dredging can boats use the river? There is a small jetty on Merritt Island used for canoes and small motor boats.***

Answer: (Phil Miles) There will be a cable traversing system for the dredge which will be anchored on both sides of the river. Traffic will not be kept off the river. The cables will be flagged - when in use the cables will be ~1m above the surface. When not in use the cable would be dropped 1-2m below the surface. It is planned to dredge 6 days/wk 0800-19.00 hrs but not Sundays or public holidays.

Question: ***Will the hole dug for the water, be filled in? [the temporary settling basin] It will provide a mosquito breeding ground.***

Answer: (Don Marr) The area will be kept drained but the berm walls will stay in place so that it can be used for interim storm water storage.

Question: ***What is kept in the big tank? [the white tank on Atlas' property]***

Answer: (Don Marr) Fuel oil. In winter when there is a gas curtailment to Atlas (the gas is diverted to home consumers for home heating) and Atlas has to use fuel oil.

Question: ***Which reef will be dredged first?***

Answer: (Phil Miles) The larger one (Atlas Mansfield). This is tied into Atlas' scheduled shut down for the last 2 weeks in July. Atlas' 42" sewer discharges 4, 000 - 5, 000 gal/min and it is planned to dredge when this is shut down - the operation will still have to contend with the project water discharge of 2 000 gal/min.

Question: ***Are there other areas of contaminated sediment?***

Answer: (Phil Miles) There have been investigations from Welland Iron Brass to the Water Pollution Plant and other hot spot areas do exist. [The public was directed to look at a map on the wall that showed areas where contaminated sediments were identified.]

Question: ***Are these areas to be dealt with?***

Answer: (Phil Miles) These are not the responsibility of Environment Canada and Atlas. The Welland River Cleanup Committee is looking at an 8 km stretch of river from Weber Road to Port Robinson and developing options. Brock University students found a number of hot spots.

Bioassays have been carried out on sediment from a number of areas to determine its effect on organisms in the river bottom. Despite the fact that there have been high levels of contaminant found, they are not having significant adverse effects on the organisms. It is difficult to know how to interpret this information.

Question: ***Will the river ever be clean?***

Answer: (Doug Elliot) It is and has always been known as a muddy river, it drains the Caistor Soils (fine grained clays) prone to soil erosion. It can, however, be useable.

Question: ***Where the water comes from the drilled holes in the aqueduct and it provides circulation, conditions seem better. Can more holes be drilled?***

Answer: (Ann Yagi) This water actually creates problems because it reduces flows from further upstream and the river's ability to transport bedload.
(Joe Furgal) The purpose is to maintain circulation and fresh water from the Welland Canal for drinking water purposes to the filtration plant.

End of formal question and answer session.

A number of information boards had been placed around the room that the public were encouraged to look at, also a video was played showing the activities of the previous demonstration. Refreshments were served.

Comments during Informal Discussions

The following questions/comments were asked during the informal discussion session

1) A gentleman who lives on Almond Street near Ross Street expressed concern over the danger from air borne contaminants originating from the separation and treatment process. He was concerned that contaminants originating in the sediment would become entrained in the air evaporating from the temporary storage basin (TSB) being developed by Atlas immediately to the north of the large oil tank, and impinge on his property.

Larry King explained the separation and treatment process - that it was in the wet, not the dry, and that there would be no drift of contaminated water spray from the process. The liquid effluent going to the temporary storage basin would not contain high levels of volatile organics, which could be a reason for a health concern. Metals are the contaminant of primary concern, and they are primarily present as separate particles or attached to particulate matter (clays and organics) in the effluent. The temporary storage basin is the last step in the removal of fine sediments from the dredge slurry, and most remaining attached metals would be precipitated out at this point, before the effluent is directed to Atlas' settling pond and NFP for final treatment. Chemicals added to the TSB would increase the coagulation and settling rate, and would not result in air quality concerns.

2) A couple indicated that Downs Drive and Melville Avenue, as shown on our site maps and drawings, was now Ross Street.

3) An attendee requested more information on the impacts to the wetland.

P. Miles explained that removing 1 to 2 m of contaminated river material at the river/wetland interface would require that some of the wetland would also be removed in order to leave a stable side slope ranging from about 3H:1V to 6H:1V. The remaining wetland slope would be protected from erosion by a cover of granular fill.

Welland River Cleanup
QUESTIONNAIRE
Public Meeting
March 21, 1995

1. Do you have any concerns regarding the dredging activities? Yes ☐ No ☐

____
____
____
____
____

2. Do you have any concerns regarding the pipeline? Yes ☐ No ☐

____
____
____
____
____

3. Do you have any concerns regarding the sediment treatment system? Yes ☐ No ☐

____
____
____
____
____

4. Are there any other aspects of the project that concern you?

____
____
____
____
____

5. How did learn about this meeting?
   Newsletter ___ Newspaper Advertisement ___ Word of Mouth ___ Other____________
   TV Announcement___Community Calender___

   Please provide your name, address and telephone number, if you wish to be kept informed of this project

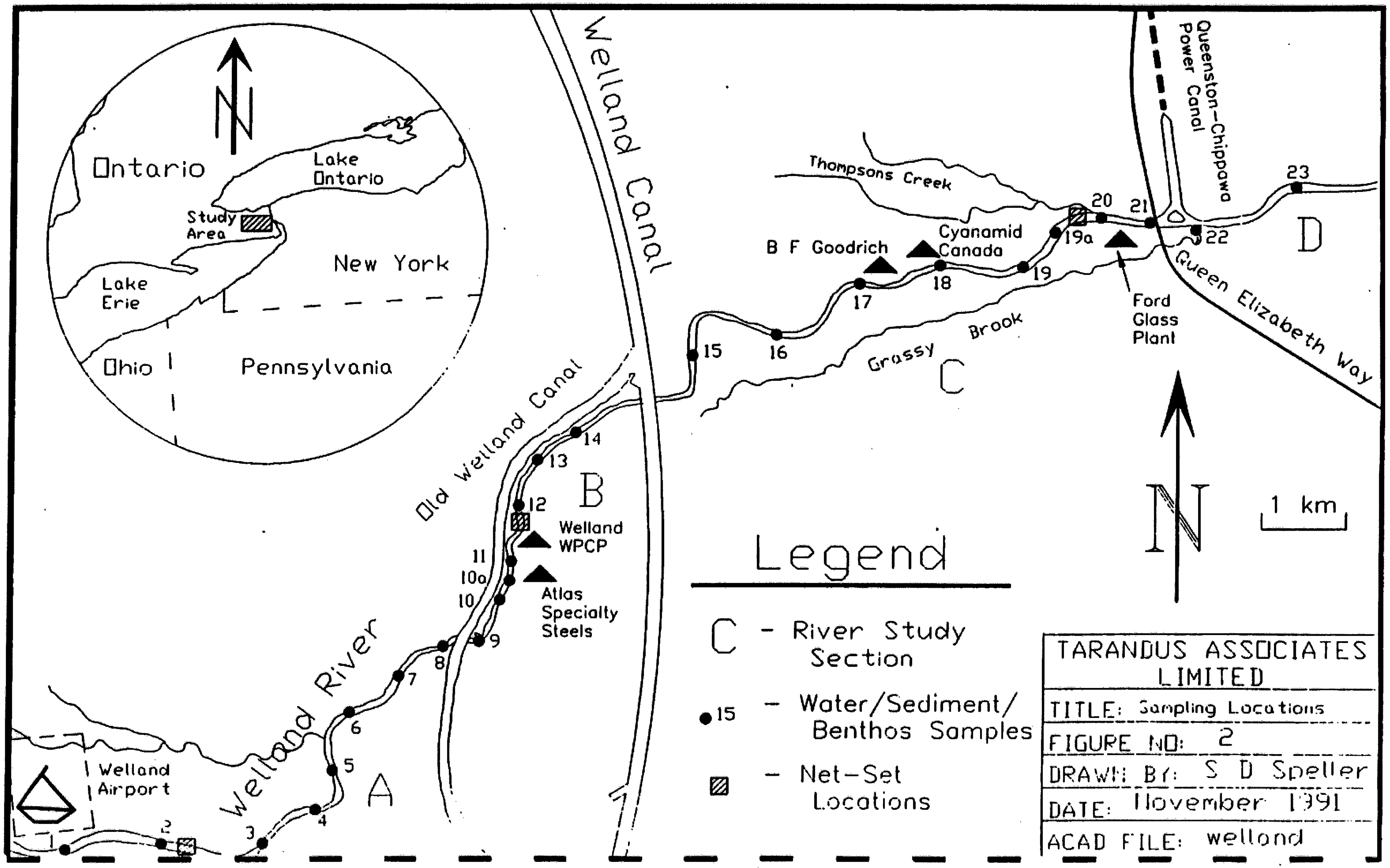
____
____
____
____

IF YOU HAVE ADDITIONAL COMMENTS, PLEASE USE REVERSE SIDE

Thank you for your time and suggestions

Appendix B

Physical Data
(Tarandus Report, 1992)



TARANDUS ASSOCIATES LIMITED
TITLE: Sampling Locations
FIGURE NO: 2
DRAWN BY: S D Speller
DATE: November 1991
ACAD FILE: welland

Water and Sediment Parameter Abbreviations:

Abbreviation	Parameter
Pb	Lead
Zn	Zinc
Cd	Cadmium
Cr	Chromium
Fe	Iron
Se	Selenium
As	Arsenic
Sb	Antimony
Ba	Barium
Be	Beryllium
Co	Cobalt
Cu	Copper
Mo	Molybdenum
Ni	Nickel
V	Vanadium
Ag	Silver
Hg	Mercury
CN	Cyanide
Mn	Manganese
Mg	Magnesium
Al	Aluminum
PCB	Polychlorinated biphenyls
OC	Organochlorine
PAH	Polycyclic Aromatic Hydrocarbons
NH_4	Ammonia
TP	Total Phosphorus
TKN	Total Kjeldahl Nitrogen
NO_2	Nitrite
NO_3	Nitrate
TOC[1]	Total Organic Carbon
LOI[1]	Loss on Ignition
SAR[1]	Sodium Adsorption Ratio

Water Quality Data

Water - Summer Survey

SITE	Zn	Cd	Mn	Co	Cu	Fe	Pb	Cr
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
1	<0.01	<0.002	0.18	<0.005	0.03	2.1	<0.01	<0.005
2	<0.01	<0.002			0.015		<0.01	<0.005
3	<0.01	<0.002			0.005		<0.01	<0.005
4	<0.01	<0.002			0.03		<0.01	<0.005
5	<0.01	<0.002			0.04		<0.01	<0.005
6	<0.01	<0.002			0.05		<0.01	<0.005
7	<0.01	<0.002			0.03		<0.01	<0.005
8	<0.01	<0.002			0.02		<0.01	<0.005
9	<0.01	<0.002	0.01	<0.005	0.02	0.095	<0.01	<0.005
10	<0.01	<0.002			0.01		<0.01	<0.005
10a	0.02	<0.002			0.005		<0.01	<0.005
11	<0.01	<0.002			0.015		<0.01	<0.005
12	<0.01	<0.002			0.015		<0.01	<0.005
13	<0.01	<0.002			0.02		<0.01	<0.005
14	<0.01	<0.002			0.01		<0.01	<0.005
15	<0.01	<0.002	0.02	<0.005	0.005	0.43	<0.01	<0.005
16	<0.01	<0.002			0.035		<0.01	<0.005
17	<0.01	<0.002			0.025		<0.01	<0.005
18	<0.01	<0.002			0.01		<0.01	0.0075
19	<0.01	<0.002			0.03		<0.01	<0.005
19a	<0.01	<0.002			0.005		<0.01	<0.005
20	<0.01	<0.002			0.01		<0.01	<0.005
21	<0.01	<0.002	0.01	<0.005	0.015	0.4	<0.01	<0.005
22	<0.01	<0.002			0.0125		<0.01	<0.005
23	<0.01	<0.002	0.01	<0.005	0.005	0.06	<0.01	<0.005

Water - Summer Survey (Continued)

SITE	Ni mg/L	Be mg/L	Mo mg/L	V mg/L	Al mg/L	Ba mg/L	Hg µg/L	As µg/L
1	<0.005	<0.005	<0.005	<0.005	1.74	0.04	0.3	<5
2					1.42		0.25	<5
3					1.155		0.125	<5
4					0.97		0.1	<5
5					0.81		<0.05	<5
6					0.82		<0.05	<5
7					0.75		<0.05	<5
8					0.28		<0.05	<5
9	<0.005	<0.005	<0.005	<0.005	0.12	0.02	<0.05	<5
10					0.12		<0.05	<5
10a					0.13		<0.05	<5
11					0.11		<0.05	<5
12					0.1		<0.05	<5
13					0.3		<0.05	<5
14					0.28		<0.05	<5
15	<0.005	<0.005	<0.005	<0.005	0.36	0.02	<0.05	<5
16					0.24		<0.05	<5
17					0.31		<0.05	<5
18					0.295		<0.05	<5
19					0.34		<0.05	<5
19a					0.32		<0.05	<5
20					0.3		<0.05	<5
21	<0.005	<0.005	<0.005	<0.005	0.32	0.02	<0.05	<5
22					0.16		<0.05	<5
23	<0.005	<0.005	<0.005	<0.005	0.16	0.02	<0.05	<5

Water - Summer Survey (Continued)

SITE	Se	Ag	CN	Colour	Cond	Ammnia-N	Sb	Nitrite
	μg/L	mg/L	mg/L	TCU	uS/cm	mg/L	μg/L	mg/l
1	<1	<0.005	0.002	48	440	0.008	<2	0.003
2			0.002		440			
3			0.002		415			
4			0.002		420			
5			0.002		360			
6			0.002		350			
7			0.002		310			
8			0.002		290			
9	<1	<0.005	0.002	3	290	0.008	<2	0.005
10			0.002		290			
10a			0.002		290			
11			0.002		310			
12			0.002		310			
13			0.002		300			
14			0.002		300			
15	<1	<0.005	0.002	4	290	0.008	<2	0.023
16			0.002		290			
17			0.002		290			
18			0.002		300			
19			0.002		300			
19a			0.002		300			
20			0.002		310			
21	<1	<0.005	0.002	4	300	0.33	<2	0.04
22			0.002		280			
23	<1	<0.005	0.002	2	290	0.23	<2	0.003

Water - Summer Survey (Continued)

SITE	Mg mg/L	Nitrate mg/L	pH -log[H+]	Phenolics mg/L	TKN mg/L	SS mg/L	Turb NTU	TP mg/L
1	14.1	0.35	8	0.01	1	48	6.5	0.2
2			7.9	0.012	1.01		5.5	0.25
3			7.95	0.0025	0.955		7.3	0.1515
4			7.95	0.029	0.81		6.8	0.149
5			8.05	<0.001	0.62		4.3	0.098
6			8	0.004	0.56		4.2	0.083
7			8.15	0.004	0.43		1.8	0.053
8			8.1	<0.001	0.33		0.5	0.024
9	8.5	0.16	8.125	0.012	0.42	7	0.3	0.016
10			8.1	0.012	0.28		0.3	0.016
10a			8.2	0.001	0.3		0.3	0.013
11			8.25	0.002	0.33		0.8	0.066
12			8.15	0.001	0.4		1.1	0.064
13			8.15	0.022	0.38		0.7	0.044
14			8.1	0.03	0.4		0.8	0.045
15	8.9	0.31	8.1	0.024	0.39	14	0.5	0.041
16			8.05	0.016	0.37		0.5	0.042
17			8.1	0.031	0.34		0.4	0.042
18			8.45	0.008	0.33		0.55	0.048
19			8.15	0.002	0.39		0.6	0.053
19a			8.15	0.004	0.46		0.6	0.053
20			8.1	0.022	0.4		0.6	0.052
21	9.2	0.55	8.15	0.016	2.6	14	0.5	0.06
22			8.4	0.0015	0.315		0.3	0.0135
23	8.4	0.16	8.25	0.005	0.39	4	0.3	0.013

Water - Fall Survey

SITE	Cu	Al	Hg	Phenols
	mg/L	mg/L	μg/L	mg/L
1	0.005	1.85	<0.05	<0.001
2	0.01	2.7	<0.05	<0.001
3	0.005	3.4	<0.05	<0.001
4	0.01	1.03	<0.05	<0.001
5	0.005	0.86	<0.05	<0.001
6	0.005	1.9		<0.001
7	0.005	1.91		<0.001
8	0.005	1.14		<0.001
9	<0.005	1.49		<0.001
10	0.01	0.54	<0.05	<0.001
10a				<0.001
11				<0.001
12				<0.001
13				<0.001
14				<0.001
15	0.01	1.3	<0.05	<0.001
16				<0.001
17				<0.001
18				<0.001
19				<0.001
19a				<0.001
20				<0.001
21	<0.005	1.07	<0.05	<0.001
22				<0.001
23	0.035	0.34	<0.05	<0.001

Sediment Quality Data

Sediments - Summer Survey

SITE	CN	LOI	O&G	phenolics	pH	Zn	Cd	TOC
	µg/g	%	µg/g	µg/g	-log[H⁺]	µg/g	µg/g	%
1	0.13	14	2900	0.01	6.8	116	0.6	7.4
2	<0.05	11	1040	0.01	7	97	0.5	
3	<0.05	12	980	0.01	6.9	116	0.45	
4	0.075	10.5	845	0.01	6.95	104	0.425	
5	<0.05	12	1070	0.02	7	108	0.55	
6	<0.05	7.2	870	0.01	7.3	112	0.4	
7	<0.05	7	1800	0.01	6.9	135	0.55	
8	<0.05	7	2500	0.01	7	112	0.4	
9	<0.05	7	4550	0.01	7	335	0.8	3.55
10	<0.05	7	2000	0.01	7	550	0.975	
10a	<0.05	5	1990	0.01	7	270	0.4	
11	<0.05	2	250	0.01	7.3	98	0.15	
12	<0.05	6	3200	0.01	7.1	620	1.4	
13	<0.05	2	195	0.01	7.5	75	0.25	
14	<0.05	2	320	0.01	7.5	76	0.1	
15	<0.05	2	410	0.01	7.3	83	0.15	0.92
16	<0.05	4	1110	0.01	7.1	116	0.2	
17	<0.05	5	1670	0.01	7.2	163	0.35	
18	0.09	5	3100	0.01	7.1	191	0.5	
19	<0.05	5	2500	0.01	7.1	330	0.9	
19a	<0.05	5	750	0.01	7.2	127	0.25	
20	0.18	5	1280	0.01	7.2	69.5	0.1	
21	0.1	3	860	0.01	7.2	95	0.2	1.13
22	<0.05	5	1240	0.025	7	75.5	0.675	
23	<0.05	6	1670	0.01	7	55	0.3	2.5

Sediments - Summer Survey (Continued)

SITE	SAR	TKN µg/g	Mn µg/g	Co µg/g	Cu µg/g	Fe µg/g	Pb µg/g	Cr µg/g	Ni µg/g	Be µg/g
1	1.14	2800	580	14.5	35	32000	49	40	33	1.5
2					24		26	40		
3					33		37	49		
4					29		31	43.5		
5					31		34	43		
6					30		34	40		
7					35		85	45		
8					51		40	44		
9	0.76	1910	430	10.75	93.5	30000	74.5	55.5	54	1
10					77		86	95		
10a					50		38	91		
11					28		25	53		
12					85		62	260		
13					34		21	162		
14					26		22	79		
15	0.83	290	960	19	47	58000	26	300	178	1
16					31		23	43		
17					58		50	300		
18					64		45.5	265		
19					115		41	107		
19a					33		24	59		
20					54.5		40.5	53		
21	0.8	800	650	13	94	35000	29	97	75	1
22					19		20.5	22.5		
23	0.9	1340	330	6.5	15	16400	16	19	19.5	0.5

Sediments - Summer Survey (Continued)

SITE	Mo µg/g	V µg/g	Al µg/g	Mg µg/g	Ba µg/g	Hg µg/g	Ag µg/g	Sb µg/g	TP µg/g	As µg/g
1	0.5	58	34000	9400	139	0.08	0.5	1	1020	5
2			33000			0.04				5
3			38000			0.12				7
4			34000			0.07				5
5			32000			0.06				5
6			31000			0.06				5
7			31000			0.1				6
8			26000			0.4				5
9	1.75	34.5	17750	15900	102.5	2.22	0.5	1	1005	5
10			34000			0.18				11
10a			35000			1.4				8
11			35000			0.02				6
12			38000			0.68				17
13			29000			0.02				6
14			29000			0.02				6
15	24	42	23000	13900	118	0.06	0.5	1	1060	6
16			32000			0.28				6
17			31000			0.1				6
18			22000			0.28				6.5
19			38000			0.26				10
19a			28000			0.08				6
20			25000			0.04				5.5
21	3.5	43	26000	14000	127	0.1	0.5	1	1300	6
22			15750			0.07				4
23	0.5	27	12400	17200	51	0.06	0.5	1	620	3

Sediments - Fall Survey

SITE	PCBs	Hg	Zn	Cd	CN	O&G
	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g
1	<0.05				<0.05	960
2					0.15	670
3	<0.05					1570
4						540
5	<0.05		130	0.4		720
6			112	0.6		970
7	0.13	0.36	177	0.9		2700
8	0.074	1.64	125	0.6		1660
9	0.11	3.11	309	0.7		4850
10	0.045	1.3	310	0.7		3600
10a		0.14	142	0.3		780
11		2	280	0.8		3400
12		0.92	570	1.5		11800
13		0.04	.99	0.2		450
14			137	0.25		515
15	0.051		192	0.5		2000
16			187	0.6		1320
17			210	0.7	0.13	2600
18			210	0.6	0.15	2600
19			220	0.7	0.1	2700
19a	<0.05					6600
20			179	0.6	1.67	1560
21	0.142				0.12	3550
22					<0.05	1120
23	<0.05					1080

Sediments - Fall Survey (Continued)

SITE	Mn µg/g	Co µg/g	Cu µg/g	Fe µg/g	Pb µg/g	Cr µg/g	Ni µg/g	As µg/g
5	850	15	31	38000	38	50	38	
6	680	12.5	34	32000	36	43	34	
7	570	12	72	29000	73	46	37	5
8	630	12	94	28000	47	49	41	5
9	615	13.3	109.5	35000	93.5	188.5	131	5
10	1210	38	168	118000	87	670	390	11
10a	810	16.5	43	52000	38	149	98	
11	740	18.5	73	53000	63	250	166	4
12	730	23	105	70000	91	460	270	10
13	980	17	52	60000	23	300	179	6
14	995	19	53.5	59000	28.5	385	230	6.5
15	940	18	66	54000	48	340	177	8
16	990	19.5	71	63000	44	420	240	5
17	960	20	71	59000	49	440	230	7
18	840	19	74	53000	49	380	210	5
19	840	19	116	54000	53	350	192	7
20	820	22	138	47000	80	260	192	8

Appendix C

Pilot-Scale Demonstration Data

Table C1.1

Altas Specialty Steels/Environment Canada
Welland River Dredging and Treatment Demonstration
Summary of Contaminant Loading Monitoring Results

100 m upstream of the silt curtain

Date (1991)		pH	Cond	BOD	COD	TOC	DOC	TSS	VSS	TP	Turb[1]	NH3	NO3+ NO2	TKN	TDS (ev)	FOG	Ag	Be	Cd	Bi
		s.u.	µS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	NTU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Oct	[illegible]	8.1	280	3	< 1	11	na	< 1	0.8	< .01	1.7	0.05	0.10	0.42	157	1.8	< .01	< .002	< .003	< .04
	[illegible]	7.9	288	< 1	43	na	11	2.2	< 2.0	< .01	1.7	0.05	0.25	0.40	110	0.5	< .01	0.004	0.007	< .04
	[illegible]	8.0	215	5	27	10	9	3	< 1	< .01	2.1	0.05	0.22	0.62	196	6	< .01	< .002	< .003	< .04
	[illegible]	7.9	256	3	6	11	5	7	< 1	< .01	2.0	0.04	0.22	0.28	186	3	< .01	< .002	< .003	< .04
Nov	1	8.0	286	2	6	12	11	< 1	<	[redacted]	1.8	0.01	0.23	0.40	175	3	< .01	< .002	< .003	< .04
	2	7.8	225	30	156	42	na	3	< 1	< .01	1.4	0.03	0.22	0.40	6	2	< .01	< .002	< .003	< .04
	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	4	7.7	na	< 1	15	na	na	3	<	[redacted]	1.3	0.08	0.10	0.36	136	< 1	< .01	< .002	< .003	< .04
	5	na	230	< 1	12	10	na	3	< 1	< .01	1.4	< .01	0.18	0.27	118	4	< .01	< .002	< .003	< .04
	6	8.0	265	1	17	11	11	3	< 1	< .01	2.1	0.10	0.19	0.33	110	2	< .01	< .002	< .003	< .04
	7	8.0	258	1	16	11	13	3	< 1	< .01	1.6	0.06	1.1	0.16	130	4	< .01	< .002	< .003	< .04
	8	7.9	250	< 1	< 3	13	11	3	1	< .01	1.4	0.06	0.24	0.46	146	2	< .01	< .002	< .003	< .04
	9	7.7	260	< 1	21	12	11	2	1	< .01	1.7	0.07	0.29	0.36	150	< 1	< .01	< .002	< .003	< .04
	[illegible]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	[illegible]	8.0	275	< 1	6	12	11	7	< 1	< .01	1.6	0.02	0.13	0.57	145	4	< .01	< .002	< .003	< .04
	[illegible]	8.1	325	1	< 3	13	13	4	3	< .01	2.0	0.04	0.13	0.88	215	2	< .01	< .002	0.004	< .04
	[illegible]	7.7	275	< 1	36	11	11	6	2	< .01	2.2	0.04	0.19	0.46	180	1	< .01	< .002	< .003	< .04
	[illegible]	8.0	230	< 1	18	11	11	1	< 1	< .01	1.9	0.05	0.18	0.54	150	< 1	< .01	< .002	< .003	< .04
Max		8.1	325	30	156	42	13	7	3	0.44	2.2	0.61	1.1	0.88	215	6	na	na	0.007	na
Min		7.7	215	< 1	< 1	10	5	< 1	0.8	< .01	1.3	< .01	0.13	0.15	6	0.5	< .01	< .002	< .003	< .04
Average *		7.9	257	3	24	14	11	3	1	0.09	1.7	0.08	0.29	0.44	140	2	0.01	0.003	0.003	0.04
Count *		16	15	16	16	14	12	16	16	16	16	16	16	16	16	16	16	16	16	16
STD *		0.1	26	9	36	8	2	2	0.6	0.02	0.3	0.14	0.22	0.13	43	1	na	na	0.002	na
PWQO		6.5–8.5	–	–	–	–	–	–	–	0.01	–	0.02*	–	–	–	–	.0001	0.011	.0002	–

Date (1991)		Co	Cu	Mn	Mo	Ni	Pb	Sr	W	Zn	V	P	Tl	Ba	Cr	Na	K	Fe	Al	Ca	Mg
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Oct	[illegible]	< .005	< .005	0.006	< .006	< .0	[redacted]	0.193	< .003	0.014	< .02	< .4	< .003	0.024	< .005	10.6	1.33	0.113	0.228	28.3	7.02
	[illegible]	0.146	[redacted]	2.43	1.51	[redacted]	[redacted]	0.542	0.411	[redacted]	0.886	0.17	1.01	0.701	2.73	18.1	30	[redacted]	87.2	139	80.5
	[illegible]	< .005	0.004	0.009	0.006	< .0	[redacted]	0.200	< .003	0.005	0.030	< .4	< .003	0.022	< .005	11.2	1.44	< .005	0.118	30.1	8.40
	[illegible]	< .005	< .005	0.006	< .006	< .01	< .01	0.280	< .003	0.004	< .02	< .4	< .003	0.025	< .005	12.7	1.80	0.040	0.079	30.0	10.2
Nov	1	< .005	< .005	0.004	< .006	< .01	< .01	0.220	< .003	< .002	< .02	< .4	< .003	0.023	< .005	12.0	1.54	0.040	0.090	30.9	8.60
	2	< .005	< .005	0.006	< .006	< .01	< .01	0.219	< .003	< .002	< .02	< .4	< .003	0.023	< .005	12.4	1.22	0.088	0.084	28.6	8.37
	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	4	< .005	< .005	0.003	< .006	< .01	< .01	0.290	< .003	< .002	< .02	< .4	< .003	0.023	< .005	12.6	1.79	0.033	0.081	30.2	8.47
	5	< .005	< .005	0.003	< .006	< .0	[redacted]	0.212	< .003	< .002	< .02	< .4	< .003	0.023	< .005	12.5	1.47	0.042	0.077	28.5	8.27
	6	< .005	< .005	0.005	< .006	< .01	< .01	0.220	< .003	< .002	< .02	< .4	< .003	0.027	< .005	12.7	1.70	0.038	0.090	37.0	9.40
	7	< .005	[redacted]	0.009	0.009	< .01	< .01	0.250	< .003	0.004	< .02	< .4	< .003	0.031	0.014	16.7	1.80	0.118	0.108	41.1	10.3
	8	< .005	< .005	0.002	< .006	< .01	< .01	0.280	< .003	< .002	< .02	< .4	< .003	0.027	< .005	12.2	1.62	0.016	0.087	29.9	9.09
	9	< .005	< .005	0.003	< .006	< .01	< .01	0.221	< .003	< .002	< .02	< .4	< .003	0.029	< .005	12.7	1.69	0.024	0.082	28.2	9.14
	[illegible]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	[illegible]	< .00	[redacted]	0.008	< .006	< .0	[redacted]	0.243	< .003	< .002	< .02	< .4	< .003	0.029	< .005	16.6	2.96	0.090	0.120	30.7	8.48
	[illegible]	< .005	< .005	0.004	< .006	< .01	< .01	0.301	< .003	< .002	< .02	< .4	< .003	0.031	< .005	18.3	2.20	0.082	0.088	40.8	11.8
	[illegible]	< .005	< .005	0.005	< .006	< .01	< .01	0.287	< .003	< .002	< .02	< .4	< .003	0.029	< .005	13.2	1.59	0.053	0.088	37.3	9.83
	[illegible]	< .005	0.004	0.003	< .006	< .0	[redacted]	0.218	< .003	< .002	< .02	< .4	< .003	0.026	< .005	12.0	1.28	0.046	0.080	28.1	8.88
Max		0.146	0.985	2.43	1.51	2.14	0.729	0.542	0.411	1.59	0.886	0.17	1.01	0.701	2.73	18.3	30	113	87.2	139	80.5
Min		< .005	< .005	0.002	< .006	< .01	< .01	0.193	< .003	< .002	< .02	< .4	< .003	0.022	< .005	10.6	1.23	< .005	0.061	28.3	7.02
Average *		0.014	0.085	0.158	0.100	0.14	0.06	0.26	0.029	0.103	0.07	0.5	0.080	0.07	0.2	13.4	3.45	7.11	5.94	42.7	12.04
Count *		16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
STD *		na	0.30	0.60	0.71	na	0.27	0.09	na	0.65	0.43	na	na	0.19	1.30	2.1	6.66	28.17	21.06	28.1	8.67
PWQO		–	0.005	–	–	0.025	0.01	–	–	0.03	–	–	–	–	–	–	–	0.3	–	–	–

Notes:

[1] Field measurements
* Less than values are included in average. All observations are included in the count. Only real whole numbers have been used to calculate the STD.
* Un-ionized concentration at 10°C and pH 8

na – Not available
PWQO – Provincial Water Quality Objectives (MOE, January 1986)
– Values exceeding the PWQO are shown shaded.

Table C1.1

Altas Specialty Steels/Environment Canada
Welland River Dredging and Treatment Demonstration
Summary of Contaminant Loading Monitoring Results

Inside the silt curtain

Date (1991)	pH	Cond	BOD	COD	TOC	DOC	TSS	VSS	TP	Turb[1]	NH3	NO3+ NO2	TKN	TDS (ev)	FOG	Ag
	S.U.	µS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	NTU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Oct 28	8.0	223	2	< 1	11	na	< 1	0.6	< .01	1.8	< .01	0.19	0.38	192	< 1	na
29	7.9	270	< 1	33	na	11	12	< 1	< .01	1.9	0.04	0.23	0.42	140	0.8	< .01
30	7.9	230	8	78	21	26	3	< 1	< .01	1.8	< .01	0.22	0.38	156	6	< .01
31	7.9	260	7	26	13	10	2	< 1	< .01	2.3	< .01	0.22	0.36	170	3	< .01
Nov 1	8.0	265	< 1	5	12	8	< 1	< 1	[illegible]	1.9	< .01	0.23	0.38	130	4	< .01
2	7.7	275	30	920	186	na	< 1	< 1	< .01	1.6	< .01	0.21	0.42	4	< 1	< .01
3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
4	7.7	na	< 1	6	na	na	2	< 1	[illegible]	1.6	0.04	0.21	0.29	140	1	< .01
5	na	255	< 1	< 3	21	na	2	< 1	< .01	1.8	< .01	0.21	0.23	120	1	< .01
6	8.0	255	1	13	13	11	3	1	< .01	3.1	0.04	0.18	0.27	115	< 1	< .01
7	8.1	235	1	18	12	12	4	< 1	< .01	3.0	0.03	0.22	0.27	130	3	< .01
8	7.7	255	< 1	< 3	12	11	6	< 1	< .01	4.2	0.05	0.28	0.54	135	3	< .01
9	7.8	260	< 1	12	5	6	5	< 1	< .01	4.2	0.08	0.29	0.40	156	< 1	< .01
10	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
11	8.1	260	< 1	7	14	na	6	2	< .01	4.2	0.04	0.20	0.50	140	2	< .01
12	8.1	290	1	< 3	13	12	6	4	< .01	3.3	0.04	0.19	0.54	186	2	< .01
13	8.0	260	< 1	13	11	11	10	2	< .01	3.3	0.02	0.21	0.38	180	3	< .01
14	8.1	250	< 1	24	12	7	3	< 1	< .01	2.0	0.02	0.23	0.46	140	< 1	< .01
Max	8.1	290	30	920	186	26	10	4	0.47	4.2	0.08	0.29	0.54	186	6	na
Min	7.7	215	< 1	< 1	10	5	< 1	0.8	< .01	1.6	< .01	0.16	0.15	6	0.5	< .01
Average [2]	7.9	256.9	3.7	72.8	25.8	11.6	3.5	1.3	0.1	2.8	0.0	0.2	0.4	137.6	2.1	0.010
Count [2]	15	15	16	16	14	11	16	16	16	16	16	16	16	16	16	15
STD [2]	0.2	18.4	8.7	240.1	45.2	5.5	2.3	1.2	0.0	1.0	0.0	0.0	0.1	38.8	1.5	na
PWQO	6.5–8.5		–	–	–	–	–	–	0.01	–	0.02[3]	–	–	–	–	.0001

Date (1991)	Be	Cd	Bi	Co	Cu	Mn	Mo	Ni	Pb	Sr	W	Zn
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Oct 28	na	na	na	na	na	na	na	na	na	na	na	na
29	< .003	< .003	< .04	< .005	0.004	0.008	< .006	< .01	< .01	0.243	< .003	0.008
30	< .003	< .003	< .04	< .005	[illegible]	0.012	< .006	< .01	< .01	0.224	< .003	0.008
31	< .003	< .003	< .04	< .005	< .003	0.008	< .006	< .01	< .01	0.250	< .003	0.004
Nov 1	< .003	< .003	< .04	< .005	< .003	0.007	< .006	< .01	< .01	0.246	< .003	< .003
2	< .003	< .003	< .04	< .005	< .003	0.008	< .006	< .01	< .01	0.247	< .003	0.007
3	–	–	–	–	–	–	–	–	–	–	–	–
4	< .003	< .003	< .04	< .005	< .003	0.007	< .006	< .01	< .01	0.226	< .003	< .003
5	< .003	< .003	< .04	< .005	< .003	0.007	< .006	< .01	< .01	0.220	< .003	0.004
6	< .003	< .003	< .04	< .005	< .003	0.008	0.007	< .01	< .01	0.224	< .003	0.005
7	< .003	< .003	< .04	< .005	< .003	0.008	< .006	< .01	< .01	0.221	< .003	< .003
8	< .003	< .003	< .04	< .005	< .003	0.010	< .006	< .01	< .01	0.217	< .003	0.004
9	< .003	< .003	< .04	< .005	< .003	0.014	< .006	< .01	< .01	0.222	< .003	0.007
10	–	–	–	–	–	–	–	–	–	–	–	–
11	< .003	< .003	< .04	< .005	[illegible]	0.010	< .006	< .01	< .01	0.227	< .003	< .003
12	< .003	< .003	< .04	< .005	< .003	0.012	< .006	0.010	[illegible]	0.254	< .003	< .003
13	< .003	< .003	< .04	< .005	< .003	0.008	< .006	< .01	< .01	0.284	< .003	< .003
14	< .003	< .003	< .04	< .005	[illegible]	0.003	< .006	< .01	[illegible]	0.211	< .003	< .003
Max	na	na	na	na	0.045	0.014	0.007	0.010	0.020	0.284	na	0.008
Min	< .003	< .003	< .04	< .005	< .003	0.003	< .006	< .01	< .01	0.211	< .003	< .003
Average [2]	0.003	0.003	0.040	0.005	0.007	0.008	0.006	0.010	0.011	0.234	0.003	0.004
Count [2]	15	15	15	15	15	15	15	15	15	15	15	15
STD [2]	na	na	na	na	0.016	0.003	na	na	0.002	0.019	na	0.001
PWQO	0.011	.0002	–	–	0.005	–	–	0.025	0.01	–	–	0.03

Date (1991)	V	P	Ti	Ba	Cr	Na	K	Fe	Al	Ca	Mg
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Oct 28	na	na	na	na	na	na	na	na	na	na	na
29	< .02	< .4	< .003	0.024	< .005	11.0	1.40	< .005	0.112	32.8	9.12
30	0.021	< .4	0.015	0.025	0.020	11.6	1.37	< .005	0.282	31.0	8.79
31	< .02	< .4	< .003	0.025	< .005	12.7	1.59	0.046	0.070	38.0	10.2
Nov 1	< .02	< .4	< .003	0.023	< .005	12.5	2.06	0.048	0.083	37.2	8.86
2	< .02	< .4	< .003	0.025	< .005	12.8	1.46	0.072	0.088	37.8	8.88
3	–	–	–	–	–	–	–	–	–	–	–
4	< .02	< .4	< .003	0.023	< .005	12.4	1.87	0.068	0.071	38.8	9.83
5	< .02	< .4	< .003	0.024	< .005	12.5	1.51	0.064	0.076	36.8	9.28
6	< .02	< .4	< .003	0.029	< .005	12.7	1.87	0.086	0.070	37.1	9.29
7	< .02	< .4	< .003	0.028	< .005	12.6	1.14	0.080	0.102	37.4	9.30
8	< .02	< .4	< .003	0.026	< .005	12.8	1.30	0.088	0.103	36.7	8.80
9	< .02	< .4	< .003	0.026	< .005	13.2	< 1	0.184	0.128	38.8	9.10
10	–	–	–	–	–	–	–	–	–	–	–
11	< .02	< .4	< .003	0.026	< .005	13.2	< 1	0.184	0.128	38.8	9.10
12	< .02	< .4	< .003	0.026	< .005	13.3	1.81	0.180	0.128	38.4	8.57
13	< .02	< .4	< .003	0.028	< .005	12.7	1.63	0.124	0.130	38.4	9.28
14	< .02	< .4	< .003	0.025	< .005	11.7	1.26	0.083	0.101	34.7	8.79
Max	0.021	na	0.015	0.029	0.020	13.3	2.06	0.180	0.282	38.0	10.2
Min	< .02	< .4	< .003	0.023	< .005	11.0	< 1	< .005	0.070	31.0	8.79
Average [2]	0.020	0.4	0.004	0.026	0.006	12.5	1.46	0.080	0.112	36.1	9.36
Count [2]	15	15	15	15	15	15	15	15	15	15	15
STD [2]	na	na	na	0.002	na	0.6	0.26	0.041	0.081	1.9	0.40
PWQO	–	–	–	–	–	–	–	0.3	–	–	–

Table C1.1

Altas Specialty Steels/Environment Canada
Welland River Dredging and Treatment Demonstration
Summary of Contaminant Loading Monitoring Results

100 m downstream from the silt curtain

Date (1991)		pH	Cond	BOD	COD	TOC	DOC	TSS	VSS	TP	Turb¹	NH3	NO3+NO2	TKN	TDS (ev)	FOG	Ag	Be	Cd
		S.U.	µS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	NTU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Oct	28	8.1	223	2	< 1	11	na	1.8	0.6	< .01	1.8	< .01	0.19	0.55	155	< 1	na	na	na
	29	8.6	298	< 1	35	na	10	1.7	< 2	< .01	1.9	0.03	0.32	0.40	145	0.2	< .01	< .003	< .003
	30	8.0	280	8	31	13	13	3	< 1	< .01	1.9	0.02	0.24	0.36	185	6	< .01	< .003	< .003
	31	8.1	na	30	815	185	260	3	< 1	< .01	2.0	0.02	0.36	0.29	170	3	< .01	< .003	< .003
Nov	1	8.1	295	< 1	10	14	11	< 1	< 1	[illegible]	1.5	< .01	0.15	0.29	145	4	< .01	< .003	< .003
	2	8.1	281	< 1	85	12	na	< 1	< 1	< .01	1.5	< .01	0.25	0.29	< 1	< 1	< .01	< .003	< .003
	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	4	8.0	na	< 1	10	na	na	1	< 1	< .01	1.5	0.03	0.19	0.29	130	1	< .01	< .003	< .003
	5	na	245	< 1	6	12	na	2	< 1	< .01	1.4	< .01	0.18	0.23	115	1	< .01	< .003	< .003
	6	8.1	280	< 1	8	10	11	3	< 1	< .01	2.4	0.02	0.19	0.20	125	< 1	< .01	< .003	< .003
	7	8.1	298	< 1	8	12	13	na	na	< .01	3.8	0.03	0.19	0.27	na	3	< .01	< .003	< .003
	8	8.0	280	< 1	< 3	14	12	2	< 1	< .01	1.2	0.02	0.28	< .01	120	1	< .01	< .003	< .003
	9	7.7	270	< 1	17	12	11	1	< 1	< .01	1.7	0.04	0.29	0.50	155	< 1	< .01	< .003	< .003
	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	11	8.0	280	< 1	9	13	11	3	< 1	< .01	2.1	0.02	0.21	0.48	180	1	< .01	< .003	< .003
	12	8.2	340	1	< 3	14	11	3	2	< .01	1.8	0.02	0.15	0.61	220	3	< .01	< .003	< .003
	13	8.1	285	< 1	26	12	11	6	2	< .01	2.3	0.01	0.20	0.48	170	< 1	< .01	< .003	< .003
	14	8.1	295	< 1	12	11	10	4	< 1	< .01	2.0	0.01	0.22	0.38	145	< 1	< .01	< .003	< .003
Max		8.2	340	30	815	185	260	6	2	0.40	3.8	0.04	0.36	0.81	220	6	na	na	na
Min		7.7	223	< 1	< 1	10	10	< 1	0.6	< .01	1.2	< .01	0.15	< .01	< 1	0.2	< .01	< .003	< .003
Average *		8.0	288	3	67	28	31	2.4	1.2	0.03	1.9	0.02	0.22	0.36	141	1.6	0.01	0.003	0.003
Count *		15	14	16	16	14	12	15	15	16	16	16	16	16	15	16	15	15	15
STD *		0.1	28	12	212	44	86	1.3	0.7	na	0.6	0.01	0.06	0.12	28	1.7	na	na	na
PWQO		6.5-8.5		-	-	-	-	-	-	0.01	-	0.02ª	-	-	-	-	.0001	0.011	.0002

Date (1991)		Bi	Co	Cu	Mn	Mo	Ni	Pb	Sr	W	Zn	V	P	Tl	Ba	Cr	Na	K	Fe	Al	Ca	Mg
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Oct	28	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
	29	< .04	< .005	[illegible]	0.016	0.005	< .01	[illegible]	0.287	< .003	0.026	< .02	< .4	< .003	0.029	0.006	13.8	1.66	< .005	0.183	33.9	9.80
	30	< .04	< .005	0.005	0.011	< .008	< .01	[illegible]	0.231	< .003	0.008	< .02	< .4	0.004	0.024	< .005	11.7	1.40	< .005	0.302	31.3	8.83
	31	< .04	< .005	[illegible]	0.004	< .008	< .01	< .01	0.225	< .003	< .003	< .02	< .4	< .003	0.024	< .005	11.8	1.62	0.054	0.065	36.9	9.91
Nov	1	< .04	< .005	< .003	0.005	< .008	< .01	< .01	0.273	< .003	< .003	< .02	< .4	< .003	0.025	< .005	13.8	1.75	0.070	0.072	37.9	10.5
	2	< .04	< .005	< .003	0.004	< .008	< .01	< .01	0.228	< .003	< .003	< .02	< .4	< .003	0.024	< .005	12.7	1.98	0.046	0.089	37.0	9.64
	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	4	< .04	< .005	< .003	0.003	< .008	< .01	< .01	0.219	< .003	< .003	< .02	< .4	< .003	0.023	< .005	12.2	1.03	0.033	0.089	38.1	9.44
	5	< .04	< .005	< .003	0.003	< .008	< .01	< .01	0.210	< .003	< .003	< .02	< .4	< .003	0.023	< .005	11.8	1.38	0.041	0.084	38.1	9.16
	6	< .04	< .005	< .003	0.003	< .008	< .01	< .01	0.214	< .003	< .003	< .02	< .4	< .003	0.027	< .005	11.5	1.30	0.022	0.082	36.7	9.00
	7	< .04	< .005	< .003	0.003	< .008	< .01	< .01	0.220	< .003	< .003	< .02	< .4	< .003	0.029	< .005	12.8	1.74	0.019	0.065	38.8	9.17
	8	< .04	< .005	< .003	0.003	< .008	< .01	< .01	0.214	< .003	< .003	< .02	< .4	< .003	0.030	< .005	12.1	1.80	0.007	0.076	38.7	9.86
	9	< .04	< .005	< .003	0.003	< .008	< .01	< .01	0.221	< .003	< .003	< .02	< .4	< .003	0.036	< .005	12.5	1.98	0.017	0.083	38.2	9.16
	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	11	< .04	< .005	< .003	0.003	< .008	< .01	[illegible]	0.236	< .003	< .003	< .02	< .4	< .003	0.027	< .005	13.4	< 1	0.050	0.078	38.6	9.61
	12	< .04	< .005	< .003	0.003	< .008	< .01	< .01	0.309	< .003	< .003	< .02	< .4	< .003	0.026	< .005	17.0	2.14	0.047	0.061	41.3	12.2
	13	< .04	< .005	< .003	0.004	< .008	< .01	0.01	0.272	< .003	< .003	< .02	< .4	< .003	0.027	< .005	13.7	1.80	0.087	0.111	37.2	9.88
	14	< .04	< .005	0.004	0.003	< .008	< .01	[illegible]	0.210	0.005	< .003	< .02	< .4	< .003	0.025	< .005	11.8	1.61	0.087	0.121	34.6	8.74
Max		na	na	0.013	0.016	0.008	na	0.018	0.309	0.005	0.026	na	na	0.004	0.039	0.006	17.0	2.14	0.087	0.302	41.3	12.2
Min		< .04	< .005	< .003	0.003	< .008	< .01	< .01	0.210	< .003	< .003	< .02	< .4	< .003	0.023	< .005	11.5	< 1	< .005	0.065	31.3	8.74
Average *		0.04	0.005	0.004	0.005	0.008	0.01	0.011	0.243	0.003	0.006	0.02	0.4	0.003	0.030	0.005	12.6	1.54	0.030	0.108	38.1	9.6
Count *		15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
STD *		na	na	0.003	0.004	0.000	na	0.003	0.047	na	0.009	na	na	na	0.002	na	1.4	0.27	0.084	0.080	2.1	0.83
PWQO		-	-	0.005	-	-	0.025	0.01	-	-	0.03	-	-	-	-	-	-	-	0.3	-	-	-

Table C1.2

Altas Specialty Steels/Environment Canada
Welland River Dredging and Treatment Demonstration
Summary of Suspended Solids Monitoring Results

Station Depth (m), Secchi disk (m), Turbidity composite[1] (NTU), Turbidity average[2] (NTU) and TSS (mg/L)

Date (1991)	Time	Parameter	Upstream East	Upstream Mid-River	Upstream West	Downstream East	Downstream Mid-River	Downstream West
Oct 17	AM	Depth	2.7	3.1	2.9	2.9	3.5	2.3
		Secchi	2.7	3.1	2.9	2.9	3.5	2.3
		Turbidity comp	–	–	–	–	–	–
		Turbidity avg	1.2	1.1	1.2	1.2	1.1	1.1
		TSS	0.7	0.8	0.9	0.8	0.9	0.3
	PM	Depth	2.8	3.1	2.5	2.8	3.2	1.9
		Secchi	2.6	3.1	2.5	2.8	3.2	1.9
		Turbidity comp	–	–	–	–	–	–
		Turbidity avg	1.3	1.3	1.2	1.2	1.2	1.2
		TSS	0.8	0.6	1.1	0.6	1.0	0.7
Oct 18	AM	Depth	2.8	3.2	2.9	2.9	3.3	2.5
		Secchi	2.6	3.2	2.9	2.9	3.3	2.5
		Turbidity comp	–	–	–	–	–	–
		Turbidity avg	1.2	1.2	1.2	1.1	1.1	1.2
		TSS	0.8	0.7	0.7	0.5	0.8	0.6
	PM	Depth	2.7	3.1	2.4	2.7	3.3	2.7
		Secchi	2.7	3.1	2.4	2.7	3.3	2.7
		Turbidity comp	–	–	–	–	–	–
		Turbidity avg	1.2	1.2	1.2	1.2	1.1	1.1
		TSS	–	–	–	–	–	–
Oct 21	AM	Depth	2.8	3.3	3.0	2.9	3.5	2.3
		Secchi	2.6	2.9	2.9	2.9	2.9	2.3
		Turbidity comp	–	–	–	–	–	–
		Turbidity avg	1.9	2.0	1.6	1.5	1.7	1.5
		TSS	1.4	1.2	1.3	1.3	0.8	0.7
	PM	Depth	2.5	3.3	2.8	2.6	3.5	2.6
		Secchi	2.5	2.9	2.8	2.6	2.9	2.6
		Turbidity comp	–	–	–	–	–	–
		Turbidity avg	1.6	1.5	1.4	1.5	1.5	1.5
		TSS	1.4	1.2	1.0	1.2	1.0	1.2
Oct 23	AM	Depth	2.8	3.3	3.0	2.6	3.2	2.2
		Secchi	2.9	2.9	2.9	2.6	2.9	2.2
		Turbidity comp	–	–	–	–	–	–
		Turbidity avg	1.7	1.5	1.5	1.5	1.5	1.5
		TSS	1.4	1.2	1.8	1.0	0.7	1.3
	PM	Depth	2.9	3.3	2.9	2.8	3.5	2.4
		Secchi	2.9	3.3	2.9	2.8	2.9	2.4
		Turbidity comp	–	–	–	–	–	–
		Turbidity avg	1.5	1.5	1.4	1.7	1.5	1.4
		TSS	0.9	1.3	1.1	1.2	1.9	0.6
Oct 25	AM	Depth	2.8	3.3	2.6	2.8	3.5	2.5
		Secchi	2.8	2.9	2.6	2.8	2.8	2.5
		Turbidity comp	–	–	–	–	–	–
		Turbidity avg	1.5	1.3	1.3	1.7	1.7	1.7
		TSS	1.0	0.9	1.5	1.6	2.2	2.1
	PM	Depth	2.8	3.2	3.0	2.6	3.3	2.4
		Secchi	2.7	2.8	2.8	2.8	2.8	2.4
		Turbidity comp	1.5	1.5	1.3	1.5	1.5	1.5
		Turbidity avg	1.5	1.5	1.3	1.5	1.4	1.6
		TSS	2.0	1.8	2.0	2.3	2.3	2.7
Oct 26	AM	Depth	2.6	3.5	2.8	2.6	3.5	2.5
		Secchi	2.6	3.1	2.8	2.6	3.5	2.5
		Turbidity comp	1.9	1.7	1.6	1.7	1.5	1.5
		Turbidity avg	1.8	1.8	1.6	1.7	1.5	1.4
		TSS	1.5	1.6	1.4	1.6	1.5	1.4
	PM	Depth	2.8	3.5	2.6	2.7	3.5	2.3
		Secchi	2.8	3.0	2.6	2.7	3.1	2.3
		Turbidity comp	1.8	1.9	1.5	1.8	1.6	1.9
		Turbidity avg	1.8	1.7	1.5	1.7	1.5	1.9
		TSS	2.2	2.0	1.9	2.0	2.2	2.6
Oct 28	AM	Depth	2.2	3.5	3.0	2.7	3.7	2.4
		Secchi	2.2	3.5	3.0	2.7	2.5	2.4
		Turbidity comp	1.7	1.8	1.7	1.8	1.7	1.8
		Turbidity avg	1.6	1.7	1.7	1.8	1.7	1.8
		TSS	1.0	1.7	1.2	1.7	1.9	2.0
	PM	Depth	–	–	–	–	–	–
		Secchi	–	–	–	–	–	–
		Turbidity comp	–	–	–	–	–	–
		Turbidity avg	–	–	–	–	–	–
		TSS	–	–	–	–	–	–
Oct 29	AM	Depth	–	–	–	–	–	–
		Secchi	–	–	–	–	–	–
		Turbidity comp	–	–	–	–	–	–
		Turbidity avg	–	–	–	–	–	–
		TSS	–	–	–	–	–	–
	PM	Depth	2.4	3.0	2.9	2.4	3.4	2.3
		Secchi	2.4	3.0	2.9	2.4	2.8	2.3
		Turbidity comp	1.7	1.7	1.5	1.7	1.7	1.8
		Turbidity avg	1.8	1.6	1.4	1.6	1.7	1.7
		TSS	1.9	1.6	1.7	1.9	1.7	1.9

Table C1.2

Summary of Suspended Solids Monitoring Results

Station Depth (m), Secchi disk (m), Turbidity composite[1] (NTU), Turbidity average[2] (NTU) and TSS (mg/L)

Date (1991)	Time	Parameter	Upstream East	Upstream Mid-River	Upstream West	Downstream East	Downstream Mid-River	Downstream West
		Depth	2.5	3.2	2.6	2.7	3.4	2.5
Oct 30	AM	Secchi	2.5	3.2	2.6	2.7	2.9	2.5
		Turbidity comp	–	–	–	–	–	–
		Turbidity avg	2.2	1.7	1.8	2.0	2.1	1.6
		TSS	–	–	–	1.9	1.7	1.9
		Depth	2.4	3.3	2.4	2.8	3.3	3.1
	PM	Secchi	2.4	3.3	2.4	2.8	3.3	3.1
		Turbidity comp	–	–	–	–	–	–
		Turbidity avg	2.1	1.7	2.1	2.5	2.7	2.7
		TSS	–	–	–	–	–	–
		Depth	2.4	3.3	3.0	2.9	3.4	2.6
Oct 31	AM	Secchi	2.4	3.3	3.0	2.3	2.9	2.6
		Turbidity comp	1.9	2.0	1.8	2.2	2.0	1.9
		Turbidity avg	1.9	1.7	1.8	1.9	1.9	1.9
		TSS	1.9	2.0	1.8	1.6	1.7	1.9
		Depth	2.8	3.1	2.7	2.9	3.2	2.3
	PM	Secchi	2.8	3.1	2.7	2.9	3.2	2.3
		Turbidity comp	2.2	1.8	2.0	2.0	1.8	2.0
		Turbidity avg	2.3	2.0	2.0	2.2	1.8	1.8
		TSS	1.8	1.4	1.3	1.6	1.2	1.6
		Depth	2.2	3.0	2.6	2.6	3.2	2.2
Nov 01	AM	Secchi	2.2	3.0	2.6	2.6	3.2	2.2
		Turbidity comp	–	–	–	–	–	–
		Turbidity avg	1.8	1.6	1.8	2.0	1.7	1.7
		TSS	1.8	1.7	1.2	2.2	1.5	1.7
		Depth	2.3	3.0	2.3	2.5	3.2	2.6
	PM	Secchi	2.3	3.0	2.3	2.5	3.2	2.6
		Turbidity comp	–	–	–	–	–	–
		Turbidity avg	1.4	1.4	1.4	1.6	1.5	1.4
		TSS	1.6	1.2	1.1	1.0	1.0	1.0
		Depth	2.5	3.0	2.8	2.9	3.2	2.6
Nov 02	AM	Secchi	–	–	–	–	–	–
		Turbidity comp	1.8	1.7	1.8	1.7	1.8	2.2
		Turbidity avg	1.6	1.7	1.7	1.8	1.7	1.7
		TSS	1.7	2.3	1.0	1.6	1.8	1.7
		Depth	2.7	3.1	2.8	2.8	3.3	2.7
	PM	Secchi	–	–	–	–	–	–
		Turbidity comp	1.9	1.9	1.9	2.0	1.9	2.0
		Turbidity avg	1.4	1.5	1.5	1.6	1.7	1.7
		TSS	1.0	1.3	1.2	1.9	2.0	1.4
		Depth	2.1	3.1	2.5	2.6	3.5	2.7
Nov 04	AM	Secchi	2.1	3.1	2.5	2.8	3.5	2.7
		Turbidity comp	1.9	1.9	1.7	2.0	1.9	1.9
		Turbidity avg	1.5	1.6	1.5	1.8	1.7	1.6
		TSS	1.5	1.5	1.4	1.9	1.8	1.7
		Depth	2.3	2.9	3.1	2.8	3.3	2.9
	PM	Secchi	2.3	2.9	3.2	2.8	3.3	2.9
		Turbidity comp	1.6	1.4	1.3	1.5	1.5	1.4
		Turbidity avg	1.6	1.4	1.3	1.5	1.4	1.3
		TSS	1.2	1.0	1.0	1.2	1.0	1.0
		Depth	2.5	3.2	3.1	2.4	3.3	2.5
Nov 05	AM	Secchi	2.5	3.2	3.1	2.4	3.3	2.5
		Turbidity comp	1.5	2.2	3.0	1.5	1.4	1.3
		Turbidity avg	1.4	2.3	3.0	1.5	1.5	1.4
		TSS	1.3	3.0	4.2	1.4	1.3	1.1
		Depth	2.6	3.2	3.0	2.8	3.3	2.8
	PM	Secchi	2.6	3.2	3.0	2.8	3.3	2.8
		Turbidity comp	1.8	1.3	1.2	1.6	1.7	1.8
		Turbidity avg	1.8	1.2	1.2	1.6	1.7	1.6
		TSS	1.8	1.2	1.1	1.6	1.6	1.4
		Depth	2.6	3.2	3.0	2.9	3.4	2.6
Nov 06	AM	Secchi	2.6	3.2	3.0	2.9	3.4	2.6
		Turbidity comp	2.4	1.7	2.9	1.9	2.5	5.4
		Turbidity avg	2.4	1.7	2.9	1.8	2.6	5.2
		TSS	2.4	1.3	3.3	1.7	2.9	6.4
		Depth	2.3	3.1	2.9	2.7	3.4	3.0
	PM	Secchi	2.3	3.1	2.9	2.7	3.4	3.0
		Turbidity comp	2.2	1.9	1.7	3.6	2.2	4.2
		Turbidity avg	1.9	1.8	1.7	4.2	2.1	3.9
		TSS	2.2	1.3	1.2	3.9	1.8	4.4
		Depth	2.5	3.0	2.7	2.4	3.3	2.4
Nov 07	AM	Secchi	2.5	3.0	2.7	2.4	3.3	2.4
		Turbidity comp	3.1	2.0	1.7	1.9	2.5	2.0
		Turbidity avg	2.9	2.0	1.8	1.9	2.6	1.9
		TSS	5.2	3.4	2.3	2.9	3.9	2.2
		Depth	2.2	3.0	2.4	2.7	3.2	2.6
	PM	Secchi	2.2	3.0	2.4	2.7	3.2	2.6
		Turbidity comp	1.7	1.3	1.2	2.2	3.3	2.1
		Turbidity avg	1.6	1.3	1.2	2.3	3.2	1.8
		TSS	1.9	1.6	1.5	2.9	4.3	2.8

Table C1.2

Summary of Suspended Solids Monitoring Results

Station Depth (m), Secchi disk (m), Turbidity composite[1] (NTU), Turbidity average[2] (NTU) and TSS (mg/L)

Date (1991)	Time	Parameter	Upstream East	Upstream Mid-River	Upstream West	Downstream East	Downstream Mid-River	Downstream West
Nov 08	AM	Depth	2.5	3.0	3.1	2.1	3.3	2.5
		Secchi	2.5	3.0	3.1	2.1	3.3	2.5
		Turbidity comp	1.5	1.4	1.4	1.9	1.4	1.3
		Turbidity avg	1.5	1.4	1.3	1.8	1.4	1.3
		TSS	2.9	1.7	1.5	2.2	1.5	1.3
	PM	Depth	–	–	–	–	–	–
		Secchi	–	–	–	–	–	–
		Turbidity comp	1.6	1.5	1.3	1.4	2.7	1.4
		Turbidity avg	1.6	1.5	1.3	1.3	2.7	1.4
		TSS	1.5	1.2	1.1	1.2	3.0	1.2
Nov 09	AM	Depth	2.4	3.2	2.8	2.6	3.3	2.2
		Secchi	2.4	3.2	2.8	2.6	3.3	2.2
		Turbidity comp	1.9	1.5	1.5	1.5	1.4	1.5
		Turbidity avg	1.9	1.5	1.5	1.5	1.3	1.4
		TSS	1.9	1.6	2.0	1.3	1.5	1.2
	PM	Depth	2.1	3.1	2.5	2.6	3.3	2.2
		Secchi	2.1	3.1	2.5	2.6	3.3	2.2
		Turbidity comp	1.6	1.8	1.7	1.9	1.4	1.7
		Turbidity avg	1.6	1.7	1.7	1.8	1.3	1.6
		TSS	2.0	2.2	1.7	2.0	2.5	2.2
Nov 11	AM	Depth	2.1	3.0	2.7	2.7	3.1	2.4
		Secchi	2.1	3.0	2.7	2.7	3.1	2.4
		Turbidity comp	4.0	2.2	2.0	1.9	2.1	1.9
		Turbidity avg	3.9	2.3	1.9	2.0	2.1	1.9
		TSS	3.8	1.5	1.3	1.9	2.2	1.4
	PM	Depth	2.0	3.1	2.7	2.7	3.0	2.9
		Secchi	2.0	3.1	2.7	2.7	3.0	2.9
		Turbidity comp	1.9	1.8	1.8	2.1	2.2	2.1
		Turbidity avg	2.1	1.9	1.7	2.1	1.8	1.8
		TSS	1.6	1.4	1.1	2.2	1.8	1.4
Nov 12	AM	Depth	1.8	2.9	2.0	1.6	3.0	2.1
		Secchi	1.8	2.9	2.0	1.6	2.8	2.1
		Turbidity comp	3.0	2.4	1.9	2.3	2.1	1.9
		Turbidity avg	2.3	1.8	1.7	2.0	1.9	1.9
		TSS	3.3	2.0	1.9	2.4	1.8	1.7
	PM	Depth	2.3	2.9	2.8	2.1	2.1	2.7
		Secchi	2.3	2.9	2.8	2.1	2.1	2.7
		Turbidity comp	2.2	2.0	1.7	2.3	1.9	1.9
		Turbidity avg	2.1	1.9	1.7	2.1	1.6	1.6
		TSS	1.6	1.6	1.0	1.4	1.5	1.4
Nov 13	AM	Depth	2.1	2.9	2.7	2.5	2.9	2.7
		Secchi	2.1	2.7	2.5	2.5	2.6	2.6
		Turbidity comp	2.2	2.0	1.9	2.3	2.4	2.1
		Turbidity avg	2.2	2.0	1.9	2.3	2.4	2.1
		TSS	2.6	2.1	2.0	2.7	2.9	2.4
	PM	Depth	–	–	–	–	–	–
		Secchi	–	–	–	–	–	–
		Turbidity comp	–	–	–	–	–	–
		Turbidity avg	–	–	–	–	–	–
		TSS	–	–	–	–	–	–
Nov 14	AM	Depth	2.2	3.0	2.5	2.6	3.2	2.6
		Secchi	2.2	2.9	2.4	2.4	2.9	2.5
		Turbidity comp	2.4	2.2	2.3	2.8	2.2	2.1
		Turbidity avg	2.3	2.2	2.2	2.7	2.2	2.1
		TSS	2.0	2.0	2.0	2.0	2.0	2.0
	PM	Depth	2.3	3.1	2.3	2.6	3.2	2.7
		Secchi	2.3	3.1	2.3	2.6	2.9	2.7
		Turbidity comp	2.1	2.1	2.1	2.1	2.0	1.9
		Turbidity avg	2.1	2.0	2.1	2.0	2.0	1.9
		TSS	2.0	2.0	2.0	2.0	2.0	2.0

1) Turbidity composite is defined as the turbidity of a single sample consisting of a composite of three separate grab samples collected from the bottom, mid-depth and surface of the water at any of the three transect sampling locations.

2) Turbidity average is defined as the average of turbidity measured on three separate grab samples collected from the bottom, mid-depth and surface of the water of any of the three transect sampling locations.

Table C1.3

Atlas Specialty Steels/Environment Canada
Welland River Dredging and Treatment Demonstration
Turbidity and TSS Around the Dredge

Site A = 10 m upstream of dredge   Site B = 10 m downstream of dredge   Site C = behind dredge head

Test Run	Date Sampled	Site A		Site B		Site C	
		Field Turb. (FTU)	TSS (mg/L)	Field Turb. (FTU)	TSS (mg/L)	Field Turb. (FTU)	TSS (mg/L)
1A	28–Oct	1.8	1.7	1.6	1.2	–	–
2A	28–Oct	1.7	1.5	1.9	2.2	2.0	2.2
2B	29–Oct	1.7	1.3	1.5	1.1	–	–
2C	29–Oct	1.8	2	1.8	2.4	2.9	3.8
3	29–Oct	1.5	1.6	1.8	2.2	–	–
4	29–Oct	4.2	–	1.7	–	130.0	–
5	30–Oct	3.6	0.9	1.8	1.8	1.4	10.1
6	30–Oct	1.6	2.2	1.9	3.0	3.0	5.0
7	30–Oct	1.8	1.8	1.9	1.8	2.4	4.0
8	30–Oct	2.1	3.0	2.1	2.5	5.1	13.1
8A	30–Oct	2.3	3.2	3.0	2.0	7.8	13.6
9	31–Oct	1.7	1.7	1.6	1.8	2.0	2.9
10	31–Oct	1.5	1.6	2.0	3.8	–	6.8
11	31–Oct	2.7	4.6	1.7	2.0	–	2.3
12	01–Nov	2.1	2.8	1.8	2.2	2.6	4.2
13	01–Nov	2.0	4.3	2.6	4.1	3.8	10.8
13A	01–Nov	2.9	5.8	2.4	3.7	8.9	28
14	01–Nov	1.8	2.2	2.2	3.1	3.4	7.6
15	02–Nov	1.6	1.6	1.8	1.7	6.5	14.8
15A	02–Nov	1.6	2.2	2.0	2.6	4.0	8.8
16	02–Nov	–	17.9	2.0	3.8	5.0	8.2
18	04–Nov	1.6	2.5	1.7	3.5	3.1	5.9
18A	04–Nov	–	–	2.3	3.7	–	–
19	04–Nov	2.2	2.9	2.1	3.1	9.6	20
20	05–Nov	1.6	1.4	1.8	1	5.4	12.9
20A	05–Nov	–	–	–	–	3	7.4
21	05–Nov	2.1	4.1	2.2	3.6	5.5	4.4
22	05–Nov	2.8	3.2	–	–	–	–
23	06–Nov	1.8	1.6	5.4	13.3	8	18.3
24	06–Nov	2.9	7.9	3.5	4.6	24	36.6
25	06–Nov	6.3	9.9	4.8	6.9	–	15.2
26	06–Nov	9.6	14.7	5.9	4.4	5.6	8.5
27	06–Nov	19	9.4	–	–	19	26.5
28	07–Nov	3.5	5.3	4.6	7.1	–	–
29	07–Nov	6	11.6	21	4.8	–	–
31	07–Nov	6.2	9.2	4.5	6.3	16	36.2
32	07–Nov	8	11.4	6	7.4	8	50.4
33	07–Nov	15	20.3	7	8.5	20	36.9
34	07–Nov	–	–	5	5.3	–	–
35	08–Nov	5.3	11.7	5.4	11	8	26.8
36	08–Nov	–	–	–	–	19	49.4
37	08–Nov	14	20.8	9	13.4	15	35.4
38	08–Nov	–	–	–	–	12	25.7
42	09–Nov	–	–	–	–	45	182
44	09–Nov	–	–	–	–	48	242
44A	09–Nov	–	–	–	–	20	38
45	09–Nov	6	19	9	18	47	253
46	09–Nov	–	–	–	–	70	356
47	09–Nov	–	–	–	–	14	25
48	09–Nov	–	–	–	–	16	32
49	11–Nov	6	6.7	6.3	8.7	–	–
51	11–Nov	–	–	–	–	53	222
53A	11–Nov	–	–	–	8.6	5.5	–
53B	11–Nov	–	8	–	–	5.5	–
Turbidity and suspended solids measured during diver–controlled dredging							
S–1	11–Nov	–	–	–	–	7.9	12.9
S–2	11–Nov	–	–	–	–	9.5	14.6
S–3	11–Nov	–	–	–	–	5	6.6
C–1	13–Nov	–	–	–	–	2.9	3.1
C–2	13–Nov	–	–	–	–	2.7	2.9
C–3	13–Nov	–	–	–	–	3.1	4.5
C–4	13–Nov	–	–	–	–	5.1	12.2
C–5	13–Nov	–	–	–	–	2.2	3.3

Appendix D

Alternatives Examined

1 - Extent of Reef Removal
Erosion Protection Materials
Filter Materials

2 - Reef-Wetland Interface
Wetland Evaluation

Welland River Reef Clean-Up Project

Technical Review Committee Meeting

Date: Friday, March 24, 1995

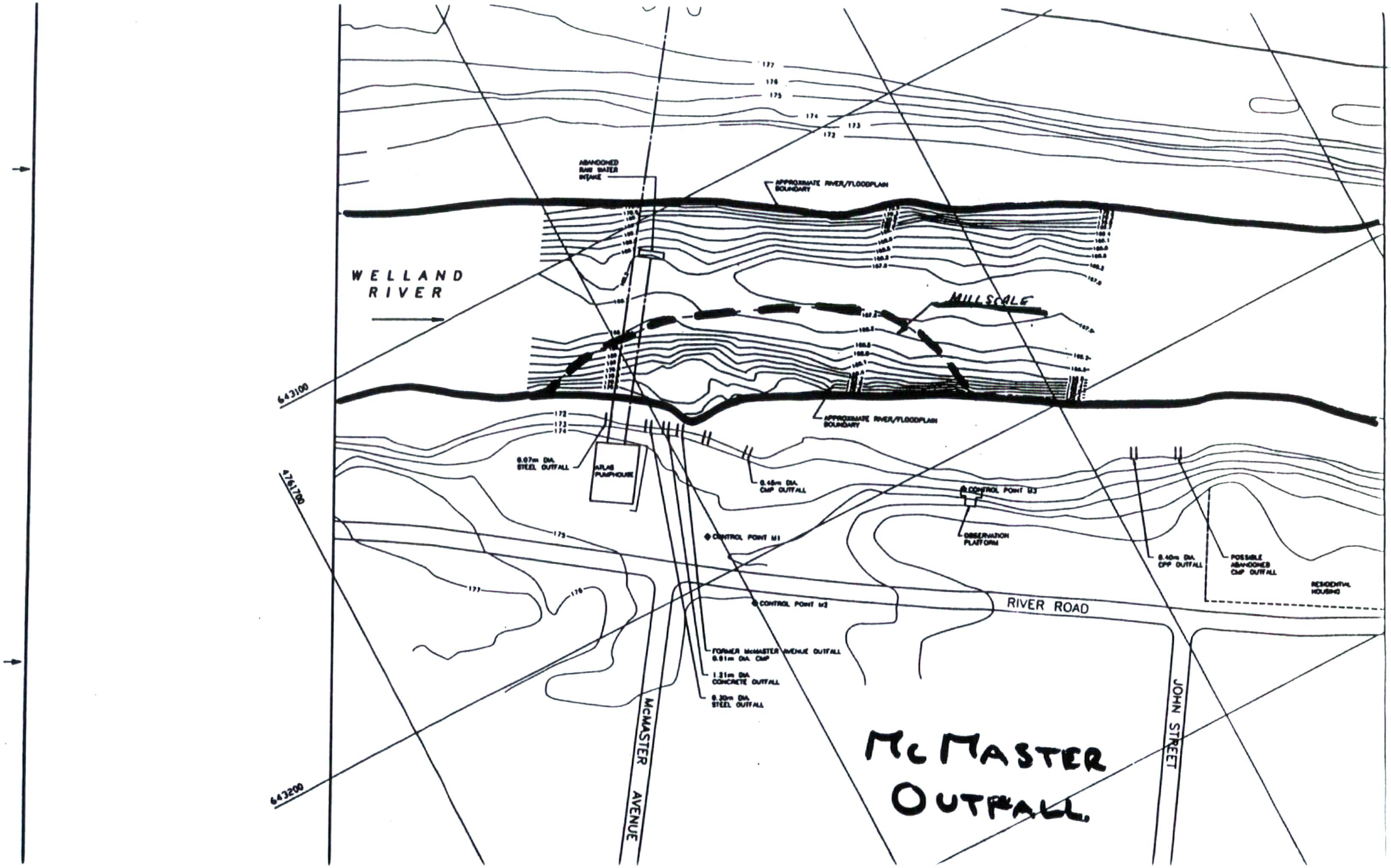
Time: 9:00 a.m.

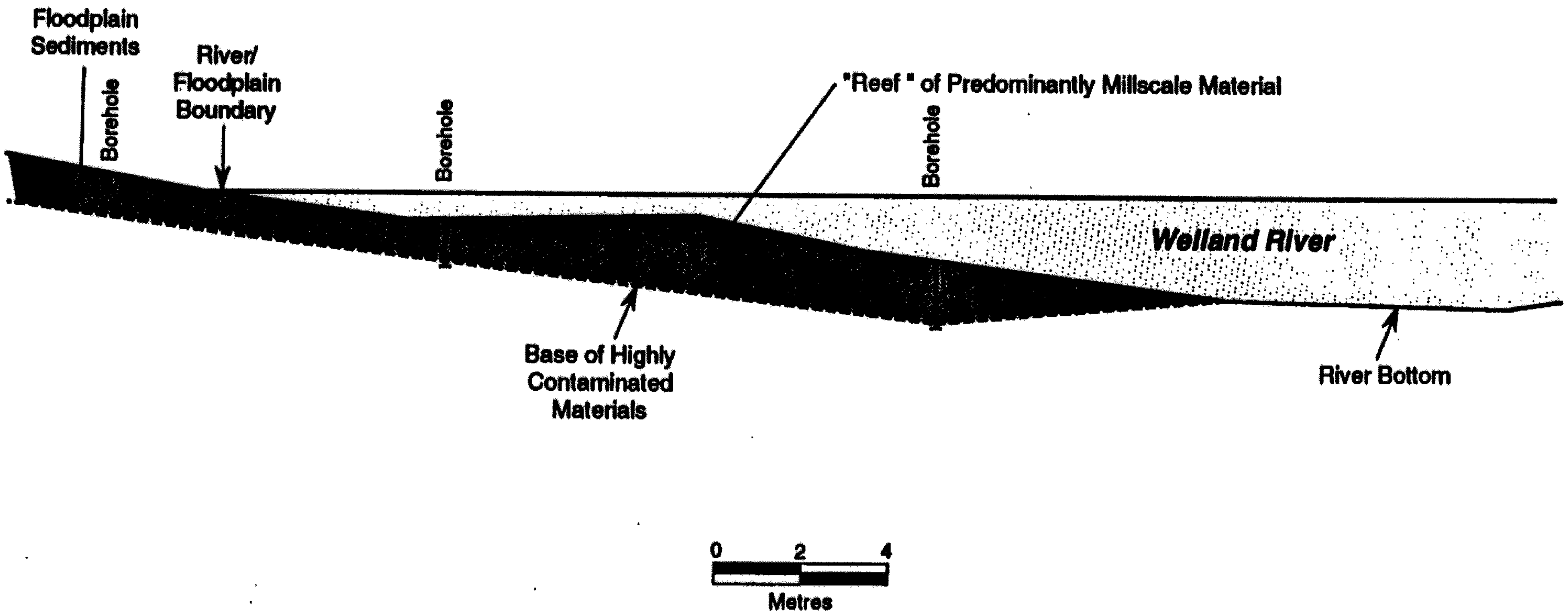
Location: Atlas Specialty Steels
Quality Centre
Welland, Ontario

Tentative Agenda

1. Extent of Clean-Up and Impact on Floodplain
2. Erosion Protection
3. Other Issues

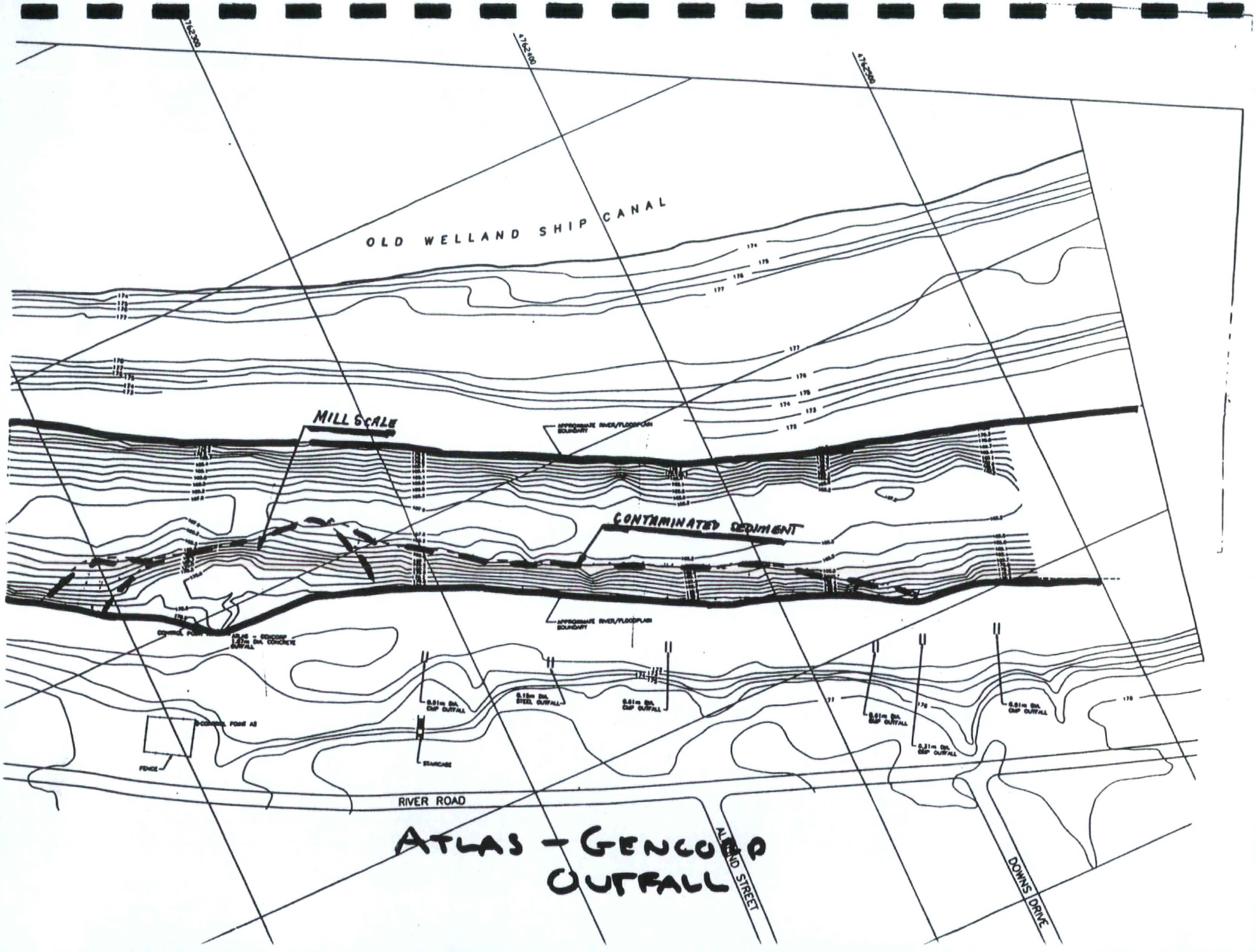
ACRES


WELLAND
RIVER
ABANDONED
RAW WATER
INTAKE
APPROXIMATE RIVER/FLOODPLAIN
BOUNDARY
MILLSCALE
APPROXIMATE RIVER/FLOODPLAIN
BOUNDARY
643100
4761700
643200
ATLAS
PUMPHOUSE
STEEL OUTFALL
CMP OUTFALL
CONTROL POINT M1
CONTROL POINT M2
CONTROL POINT M3
OBSERVATION
PLATFORM
CPP OUTFALL
POSSIBLE
ABANDONED
CMP OUTFALL
RESIDENTIAL
HOUSING
RIVER ROAD
FORMER McMASTER AVENUE OUTFALL
1.21m DIA.
CONCRETE OUTFALL
STEEL OUTFALL
McMASTER AVENUE
JOHN STREET
McMASTER
OUTFALL

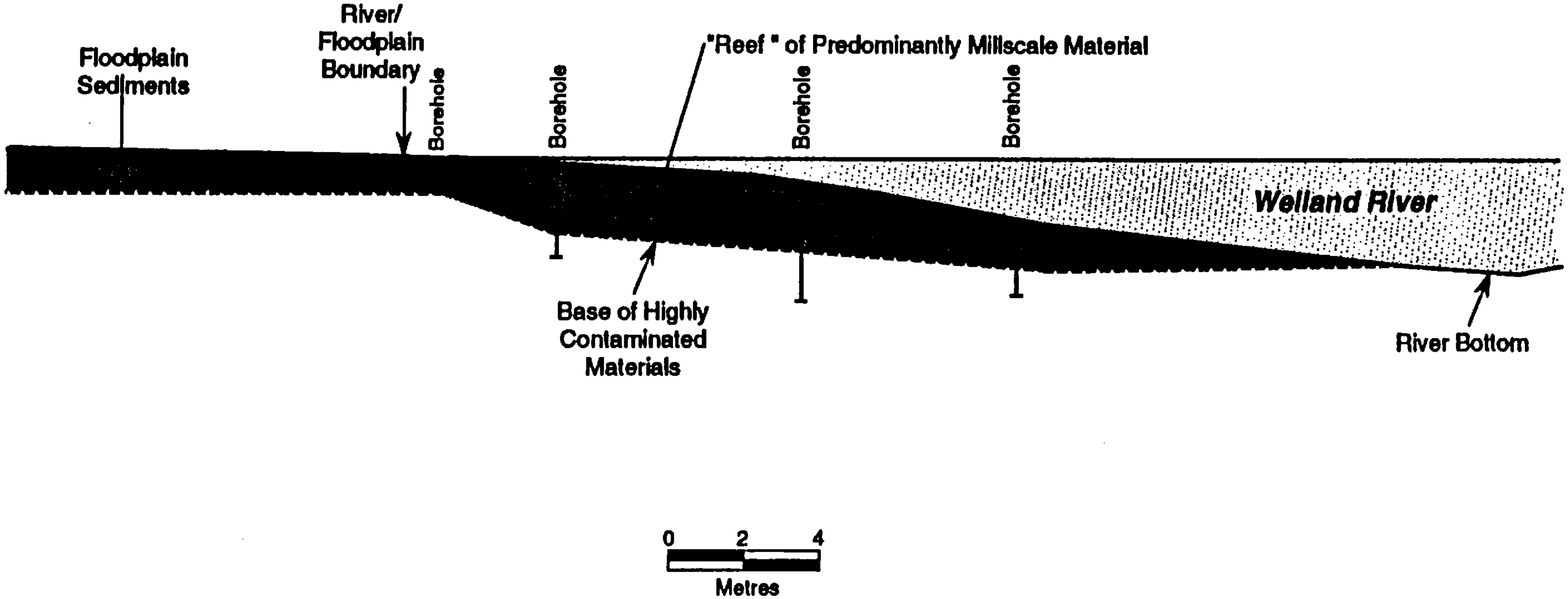


Typical Cross Section
McMaster Avenue Outfall Area
(Chainage -4+90)

P11801.00 MR

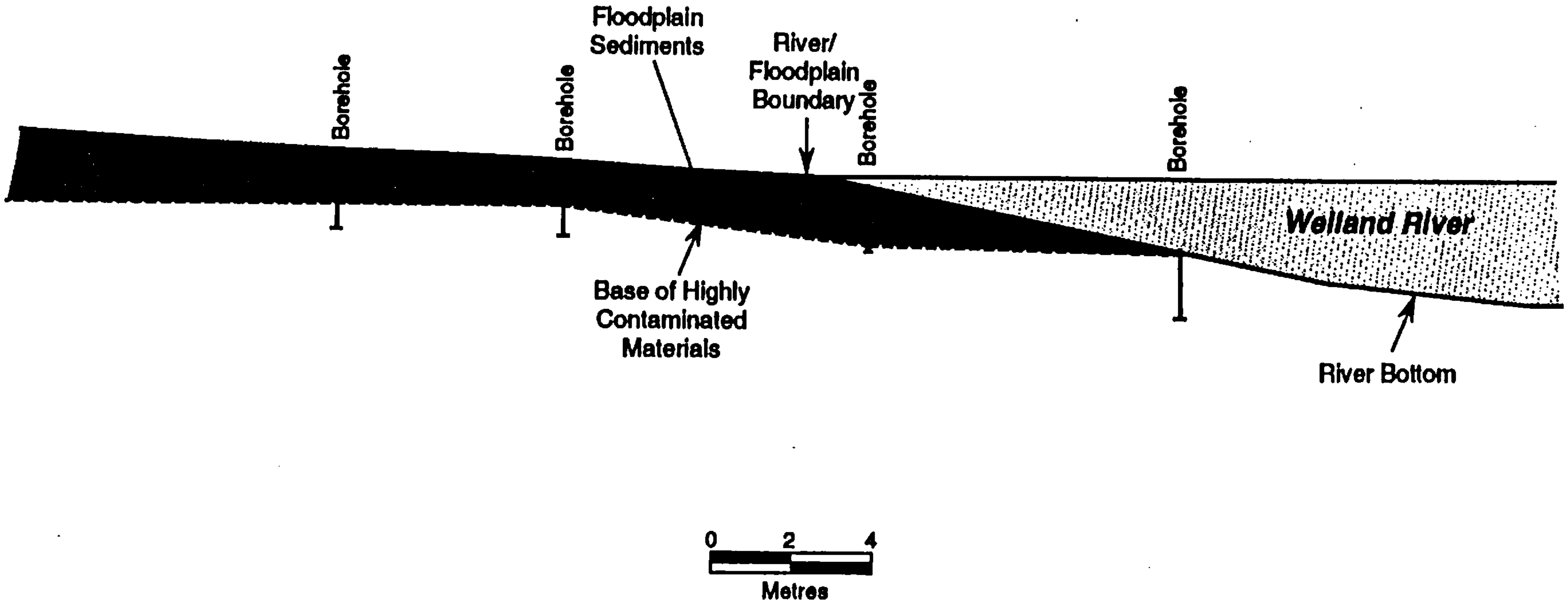


4762300
4762400
4762500
OLD WELLAND SHIP CANAL
MILL SCALE
CONTAMINATED SEDIMENT
APPROXIMATE RIVER/FLOODPLAIN BOUNDARY
APPROXIMATE RIVER/FLOODPLAIN BOUNDARY
STAIRCASE
FENCE
RIVER ROAD
STREET
DOWNS DRIVE
ATLAS - GENCORP
OUTFALL



Typical Cross Section
Atlas-Gencorp Outfall Area
(Chainage 0+20)

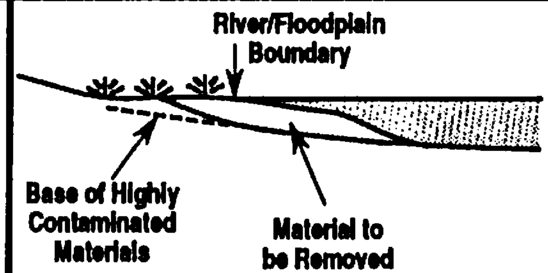
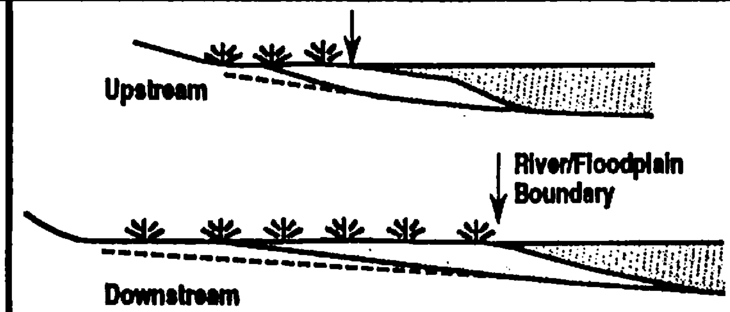
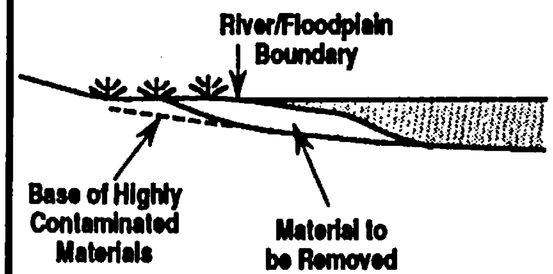
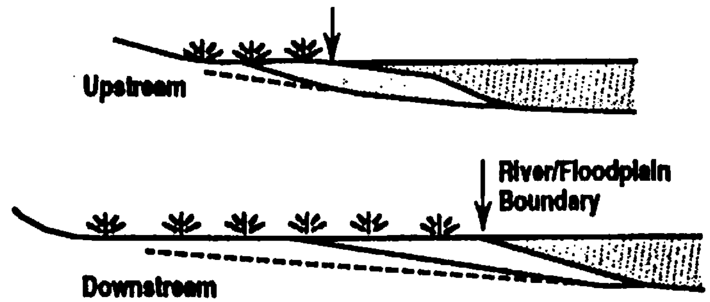
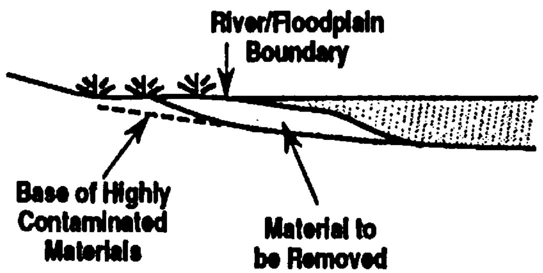
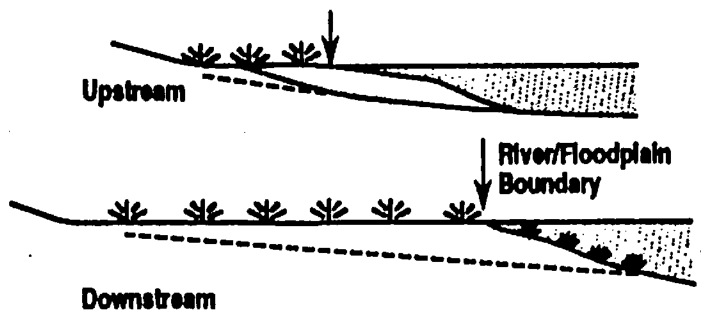
P11201.00 MR



Typical Cross Section
Atlas-Gencorp Outfall Area
(Chainage 1+50)

P11201.00 MR

Clean-up Alternatives

Alternative	Objective	Typical Extent of Dredging: McMaster Outfall Area	Typical Extent of Dredging: Atlas-Gencorp Outfall Area
A	• Removal of Mill-Scale in Outfall Areas (McM and A-G) • Removal of Contaminated Sediment to Edge of River (A-G)		
B	• Removal of Mill-Scale in Outfall Areas (McM and A-G) • Increased Protection of Contaminated Sediment against Erosion (A-G)		
C	• Removal of Mill-Scale in Outfall Areas (McM and A-G) • Contaminated Sediments to Remain in Present Condition (downstream part of A-G)		

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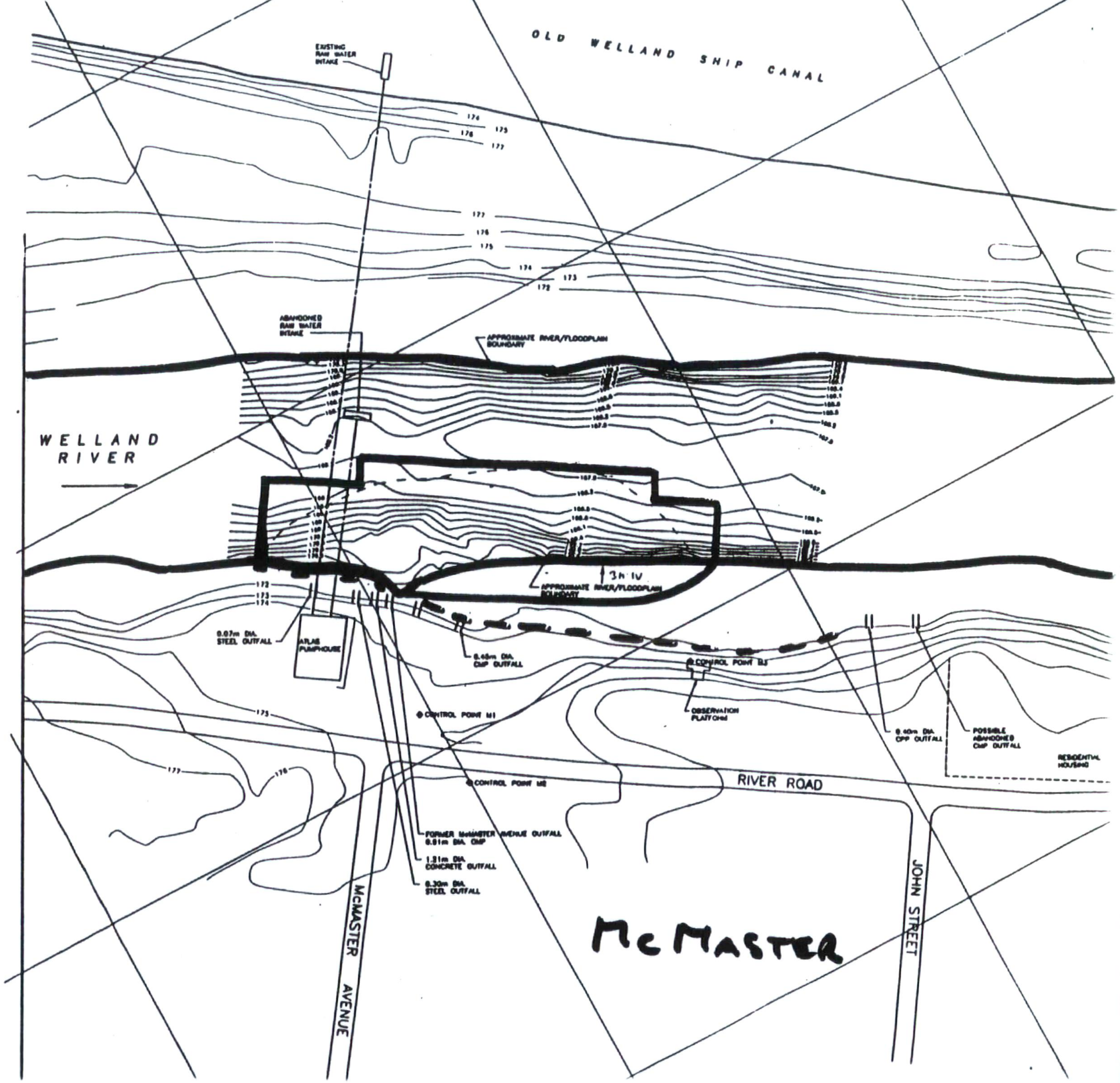
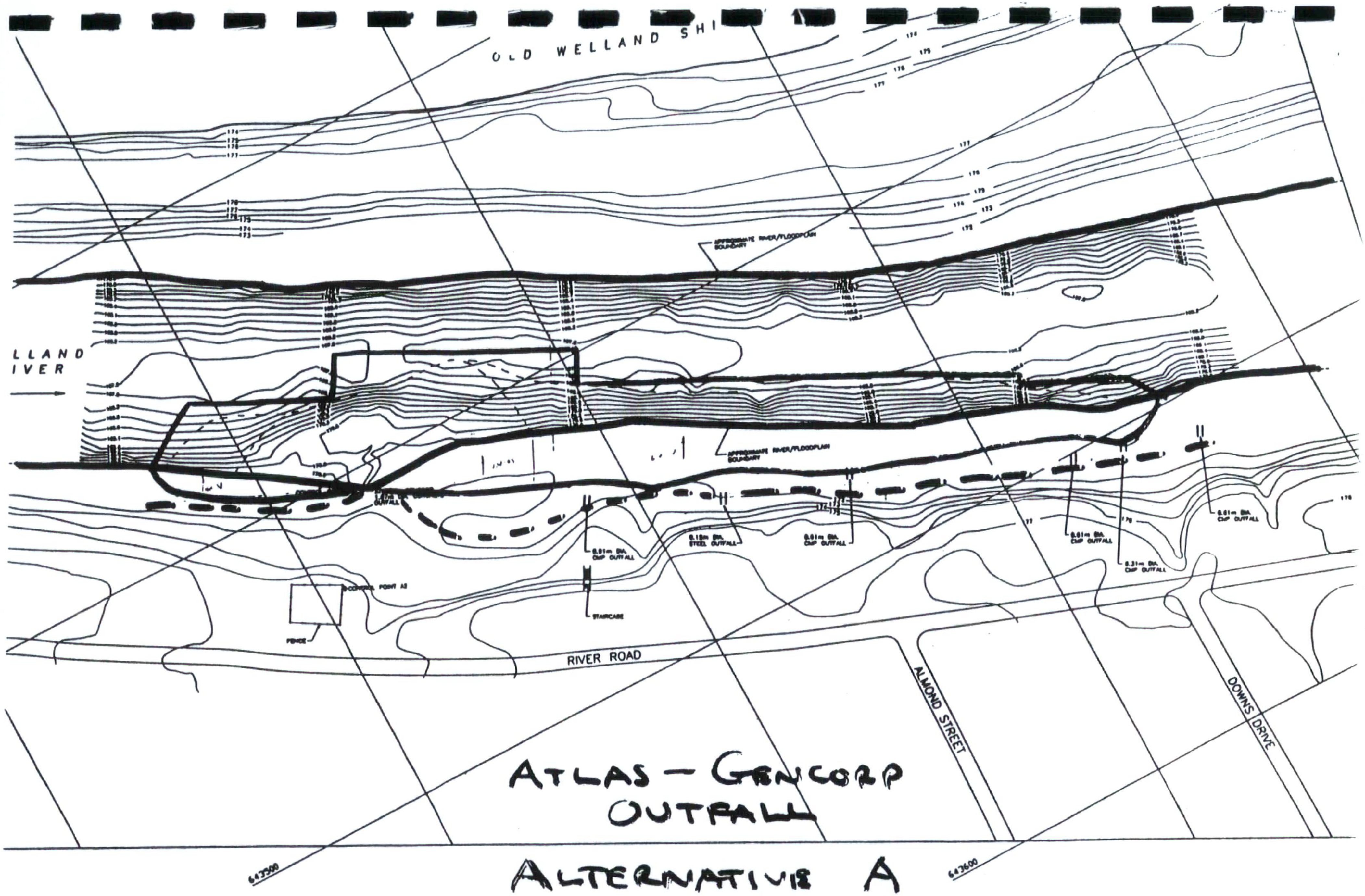
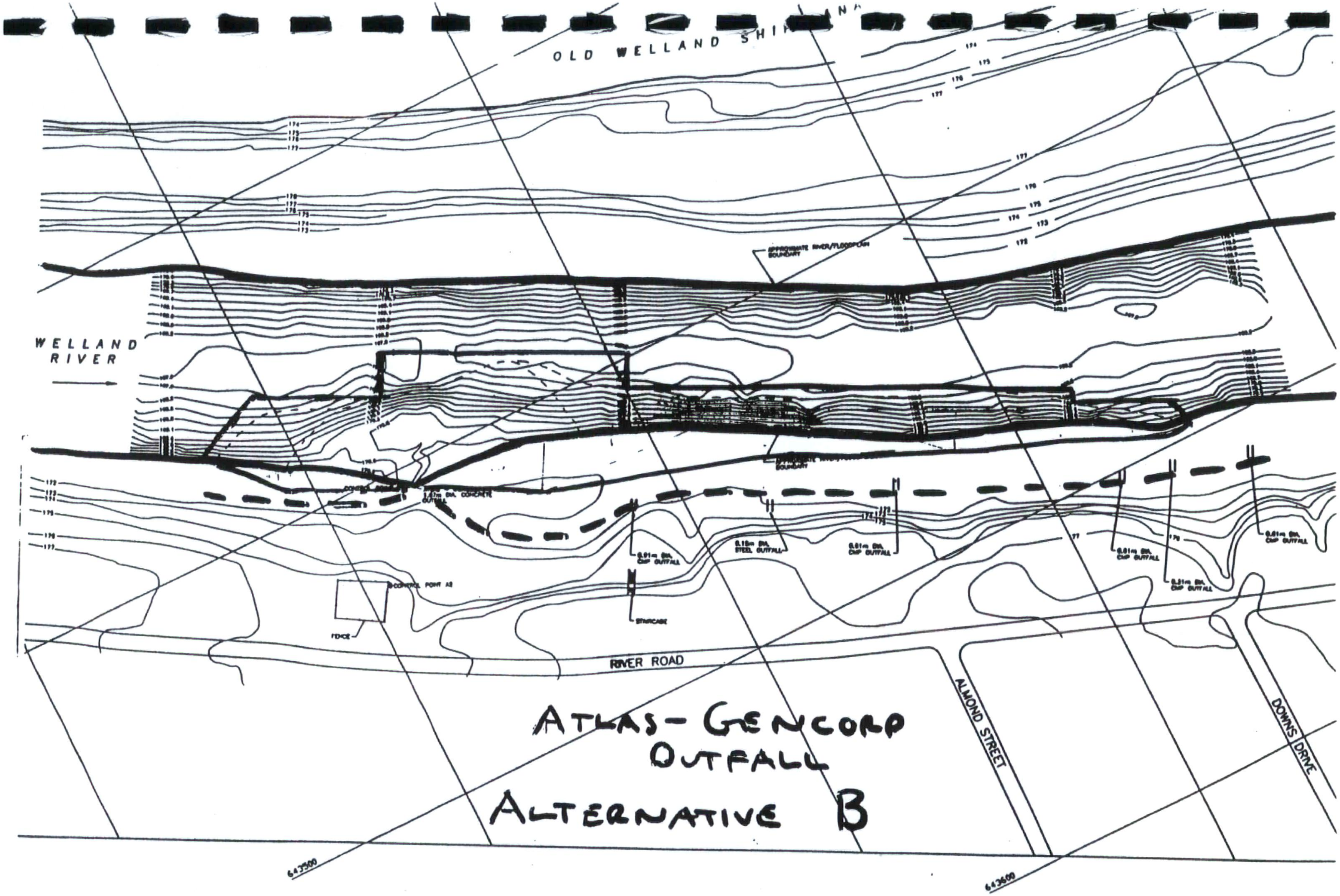

OLD WELLAND SHIP CANAL
EXISTING RAW WATER INTAKE
ABANDONED RAW WATER INTAKE
APPROXIMATE RIVER/FLOODPLAIN BOUNDARY
WELLAND RIVER
3h:1v
APPROXIMATE RIVER/FLOODPLAIN BOUNDARY
ATLAS PUMPHOUSE
CONTROL POINT M3
OBSERVATION PLATFORM
CONTROL POINT M1
CONTROL POINT M2
POSSIBLE ABANDONED CMP OUTFALL
RESIDENTIAL HOUSING
RIVER ROAD
McMASTER AVENUE
JOHN STREET
McMASTER



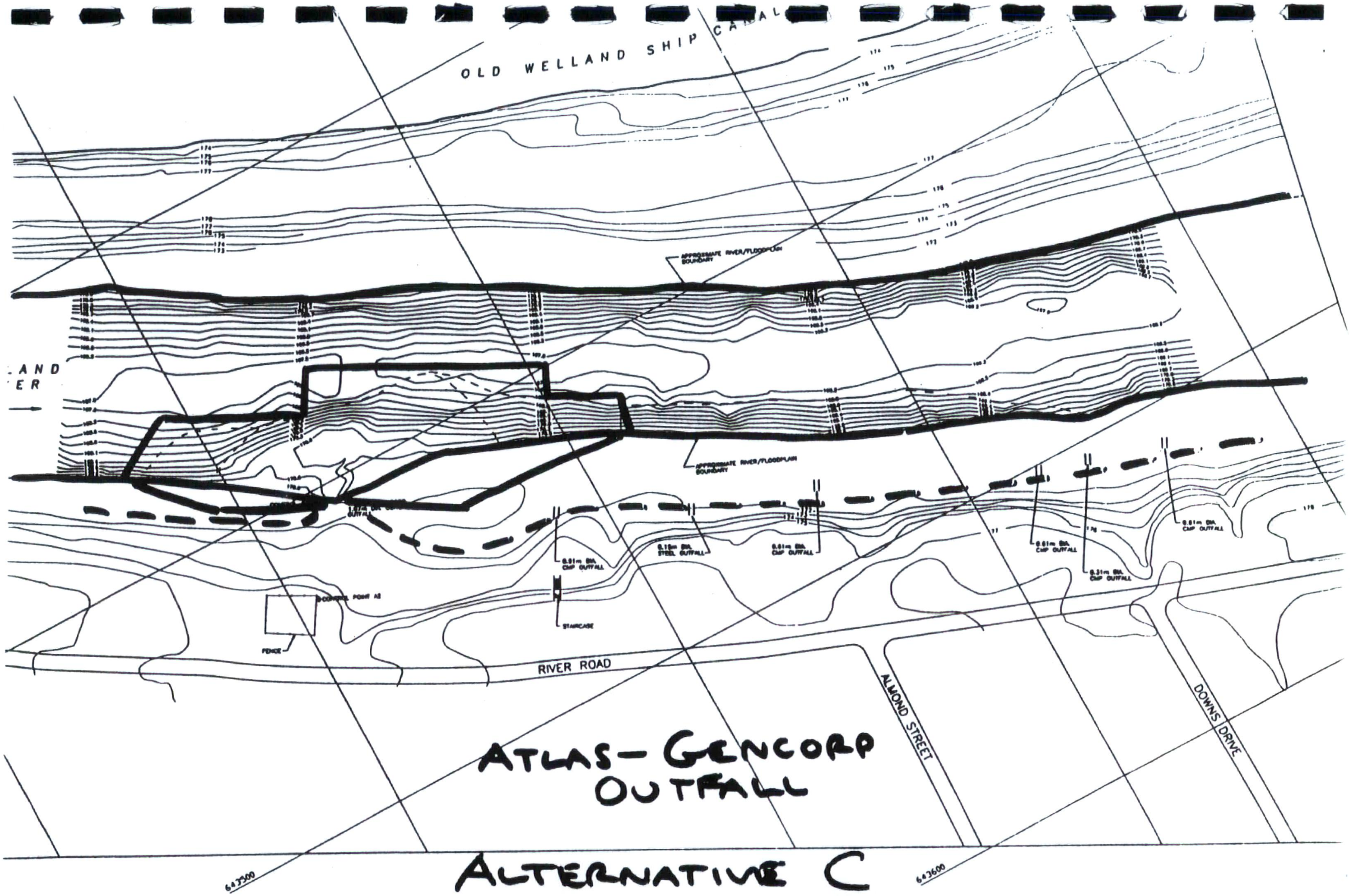
ATLAS – GENCORP OUTFALL

ALTERNATIVE A

CONTROL POINT	DESCRIPTION	NORTHING	EASTING	ELEV
A1	CROSS-CUT ON OUTFALL HEADWALL	4702228.53	643405.74	171.978
A2	RIB ADJACENT TO FENCE	4702207.83	643431.30	170.544



CONTROL POINT	DESCRIPTION	NORTHING	EASTING	ELEV.
A1	CROSS-CUT ON OUTFALL HEADWALL	4762220.53	643408.74	171.920
A2	RIB ADJACENT TO FENCE	4762207.63	643431.30	170.944



CONTROL POINT	DESCRIPTION	NORTHING	EASTING	ELEV.
A1	CROSS-CUT ON OUTFALL HEADWALL	4762226.53	643405.74	171.928
A2	RIB ADJACENT TO FENCE	4762207.63	643431.30	176.944

Alternative A

- OBJECTIVES
  - Removal of mill scale in outfall areas (McMaster Avenue and Atlas-Gencorp)
  - Removal of contaminated sediments to edge of river (Atlas-Gencorp)
- Extensive impact on floodplain
- Large area requires protection from erosion
- Erosion protection may need to be removed in the future (dependent on future decisions with respect to floodplain sediments)
- Increases river cross section (may require further widening in the future, dependent on overall Welland River studies)
- Significant increase in quantities and cost

ACRES

Alternative B

- OBJECTIVES
  - Removal of mill scale in outfall areas (McMaster Avenue and Atlas-Gencorp)
  - Increased protection of contaminated sediment against erosion (Atlas-Gencorp)
- Impact on floodplain less than Alternative A, but significantly greater than Alternative C
- Erosion protection placed over large area
- Erosion protection may need to be removed in the future (dependent on future decisions with respect to floodplain sediments)
- Some contaminated sediments still left in place beneath river
- Removes worst constriction of river
- Increase in quantities and cost

ACRES

Alternative C

- OBJECTIVES
  - Removal of mill scale in outfall areas (McMaster Avenue and Atlas-Gencorp)
  - Contaminated sediments downstream of Atlas-Gencorp outfall to remain in present condition, pending a decision on treatment of the floodplain
- Minimizes impact on the floodplain
- Area requiring erosion protection is reduced. (If the decision is made in the future to excavate the floodplain sediments, the extent of erosion protection requiring removal is minimized.)
- Contaminated sediments left in place beneath river downstream of Atlas-Gencorp outfall
- Removes worst constriction of river
- Quantities and costs within previous estimate
- Most flexible with respect to future floodplain treatment alternatives

ACRES

Comparison of Clean-Up Alternatives

Alternative	Excavation Quantity (m^3)	Floodplain Area Impacted (m^2)	Approximate Cost Difference ($)
Project Definition Estimate (Jan 1995)	6200	3308	0 ("Baseline Cost")
A	9900*	4300	+350,000
B	7300*	2800	+100,000
C	6250*	1800	-100,000

* Includes 600 m^3 of excavation assumed for excavation of mill scale "pockets" within floodplain sediments.

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Erosion Protection

- OBJECTIVES
  - Prevent erosion (scour) of the floodplain sediments during large river flows and consequent mobilization of contaminants into the water column
  - Stabilize the cut slopes resulting from dredging and prevent slumping
  - Prevent movement of contaminated soil particles into the water column, e.g., due to drawdown or wave action
- ALTERNATIVES
  - Revegetation - requires some time for sufficient vegetation to be established
  - Geotechnical fabrics (ECRM's)
    - Act in isolation until vegetation established
    - Difficulties in anchoring in very soft soils and underwater
  - Granular fill
    - Needs to be of adequate size to resist river flows

ACRES

Granular Fill Erosion Protection

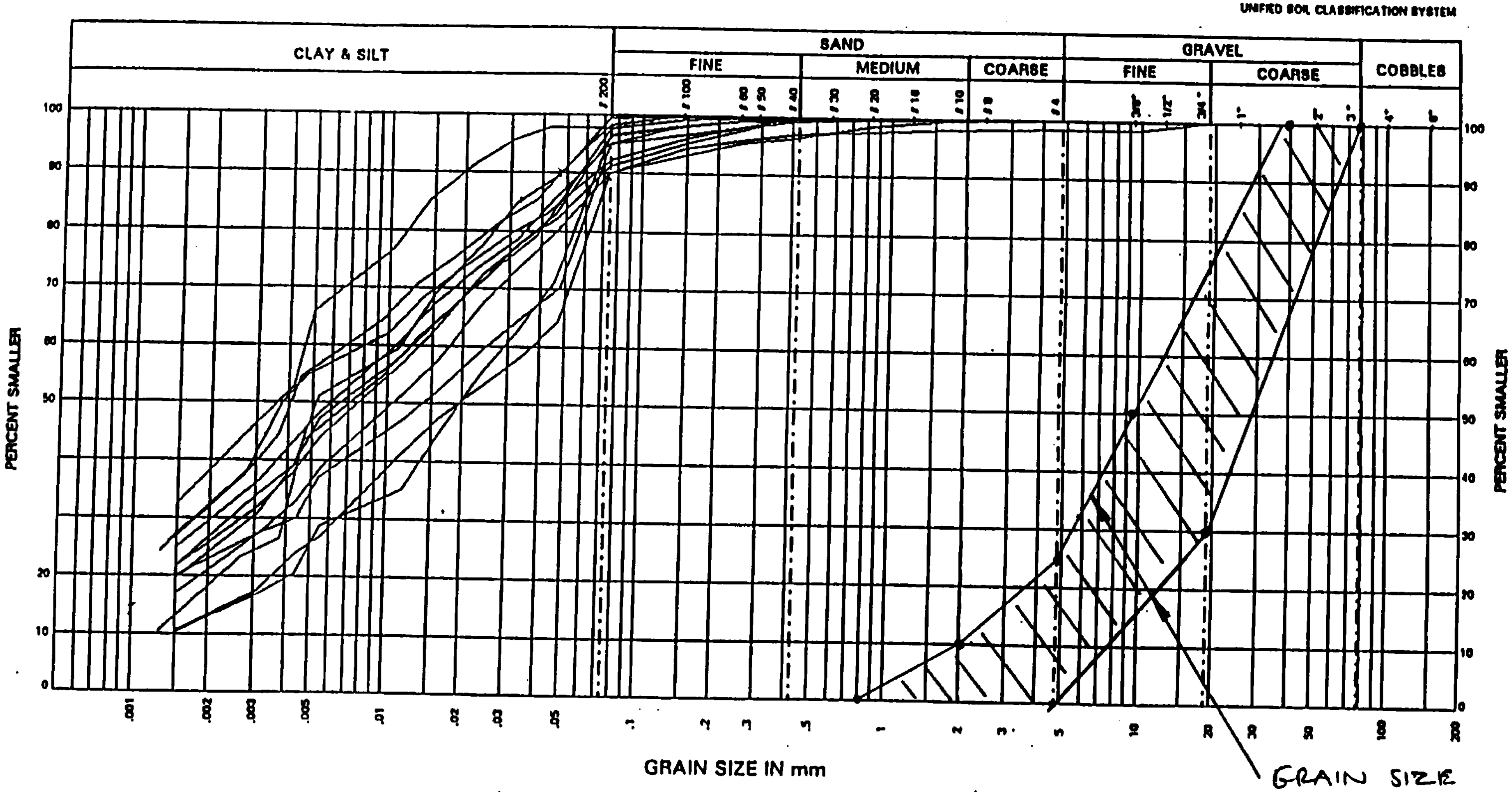
- Requires a d_{50} of 10 mm to resist movement at a water velocity of 1.2 m/s
- Medium sand to coarse gravel (75 mm maximum size)
- To retain fine sediments beneath

$$d_{15\ protection} = 9 \times D_{85\ fines}$$

In this case required $D_{15\ protection} < 0.45\ mm$

- Therefore, intermediate filter layer required

ACRES



GRAIN SIZE ENVELOPE FOR EROSION PROTECTION.

LEGEND

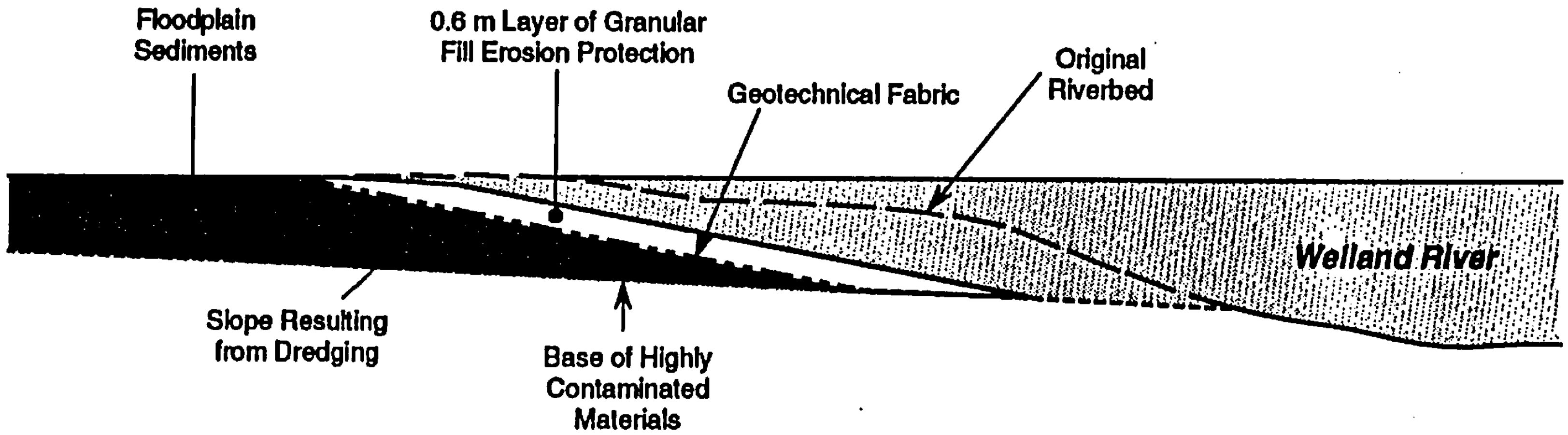
— clayey silt or silt some clay, black or brown

REMARKS: Clayey silt from BH's 210, 221, 225, 226, 228, 236, 238
Silt, some clay from BH's 236, 237, 239

Atlas Specialty Steels	GRAIN SIZE DISTRIBUTION
Welland River Floodplain Study Floodplain Sediments	JOB NO. P08960.07 FIGURE # 5.4 ACRES

Filter Layer Requirements

- Should retain contaminated fine sediments
- Should ideally help to separate granular erosion protection from very soft sediments
- ALTERNATIVES
  - Sand Layer
    - A significant amount will likely be lost into the fine sediments
    - More costly
  - Geotechnical Fabric
    - Will act as a separator between erosion protection and very soft sediments
    - Available as synthetic (geotextile) or degradable (jute, coir, etc)



Typical Section Showing Granular Fill Erosion Protection

P11201.00 MR

Geotechnical Fabric

- Filtration/containment requirement

  Filter opening size (FOS) < 1.5 $D_{85\ fines}$

  In this case required FOS < 0.075 mm

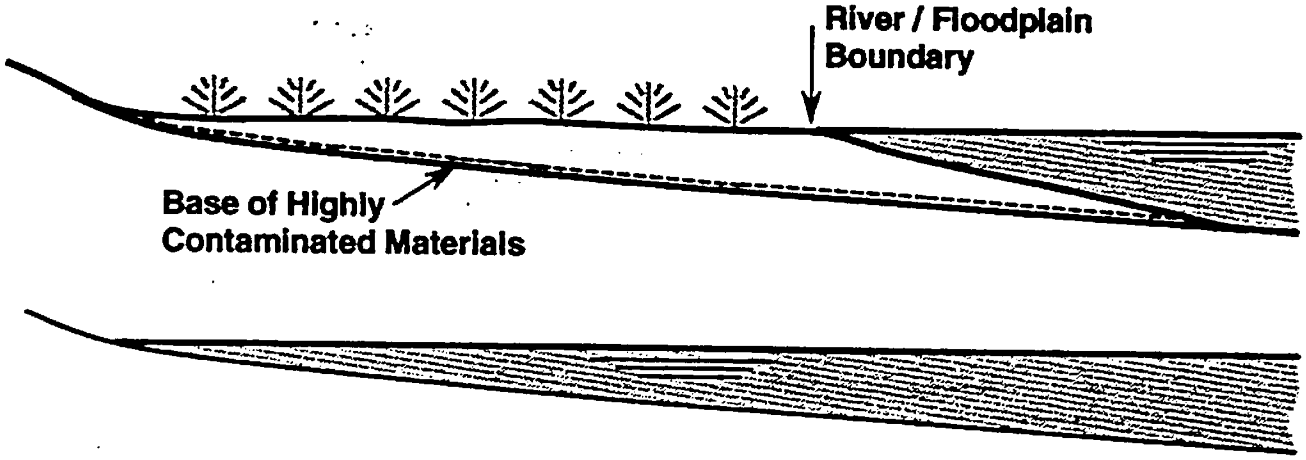
- Geotextile
  - Available with required FOS

- Degradable geotechnical fabrics
  - Smallest openings available in the order of 1 to 2 mm
  - Will not provide any containment after it degrades

ACRES

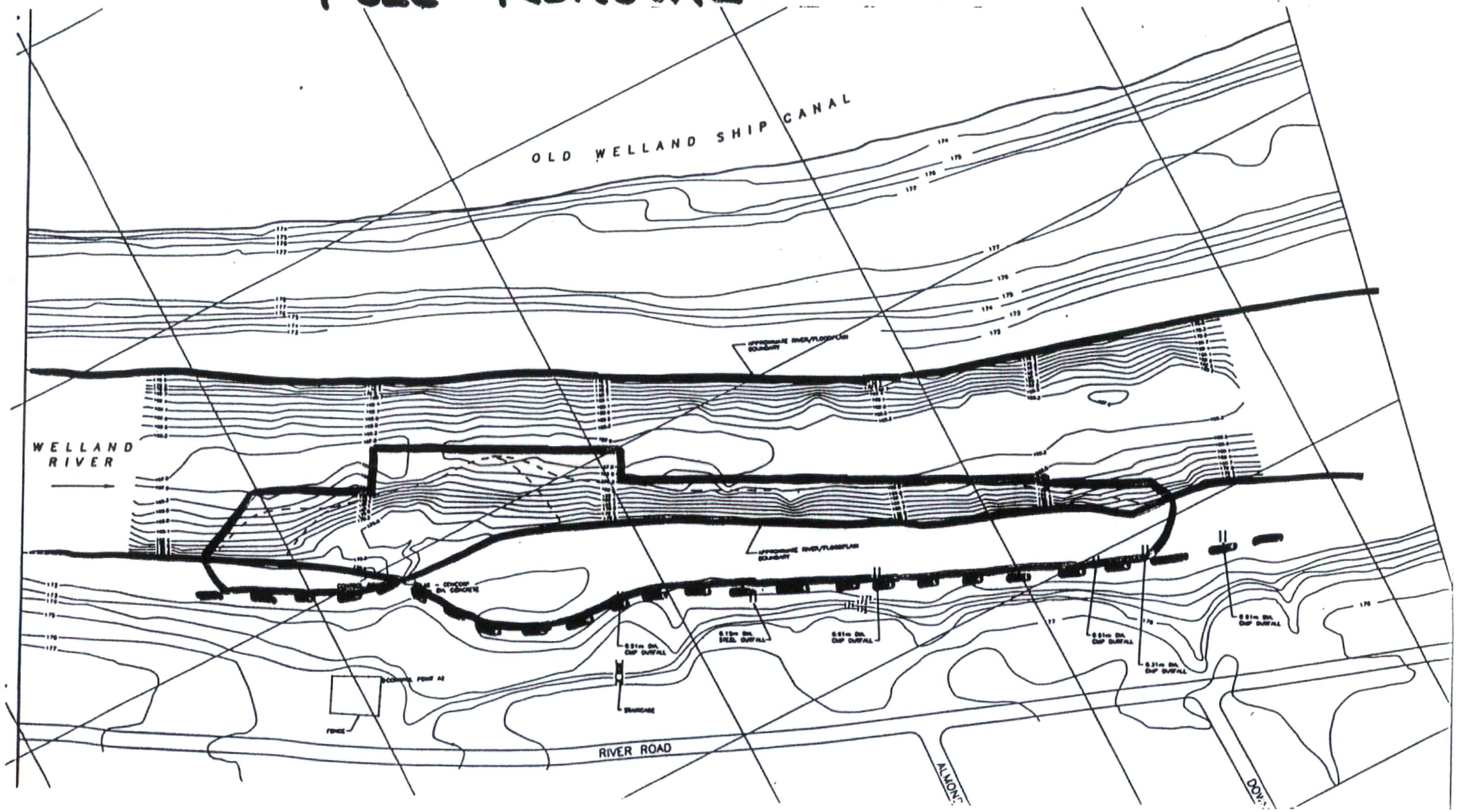
Alternative 1

Full Removal of Floodplain Sediments



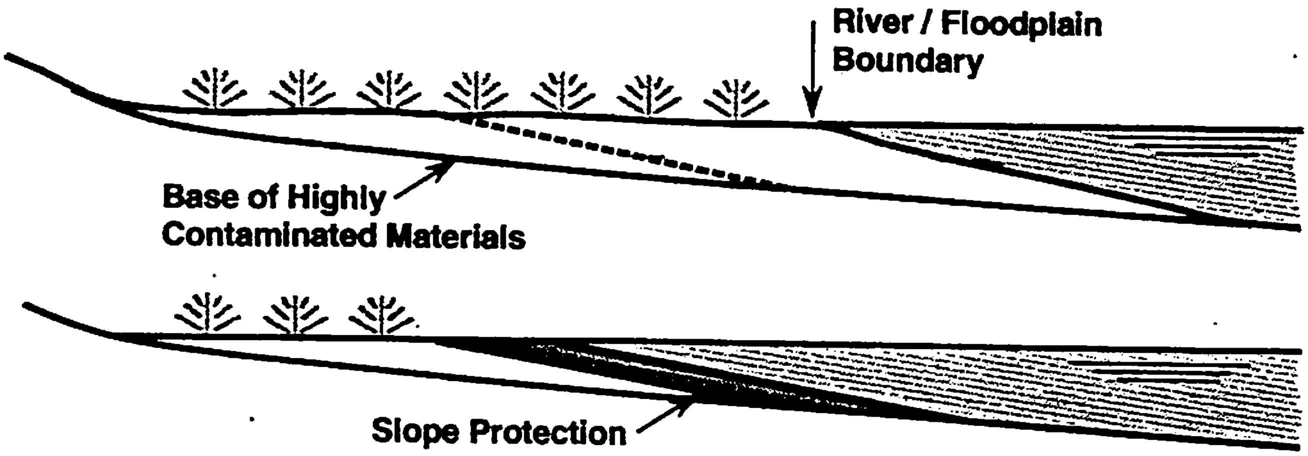
- Total removal of floodplain
- No erosion protection required, as excavated down to "clean" sediments
- Future floodplain decisions likely to require floodplain rehabilitation/restoration

ALTERNATIVE 1
FULL REMOVAL



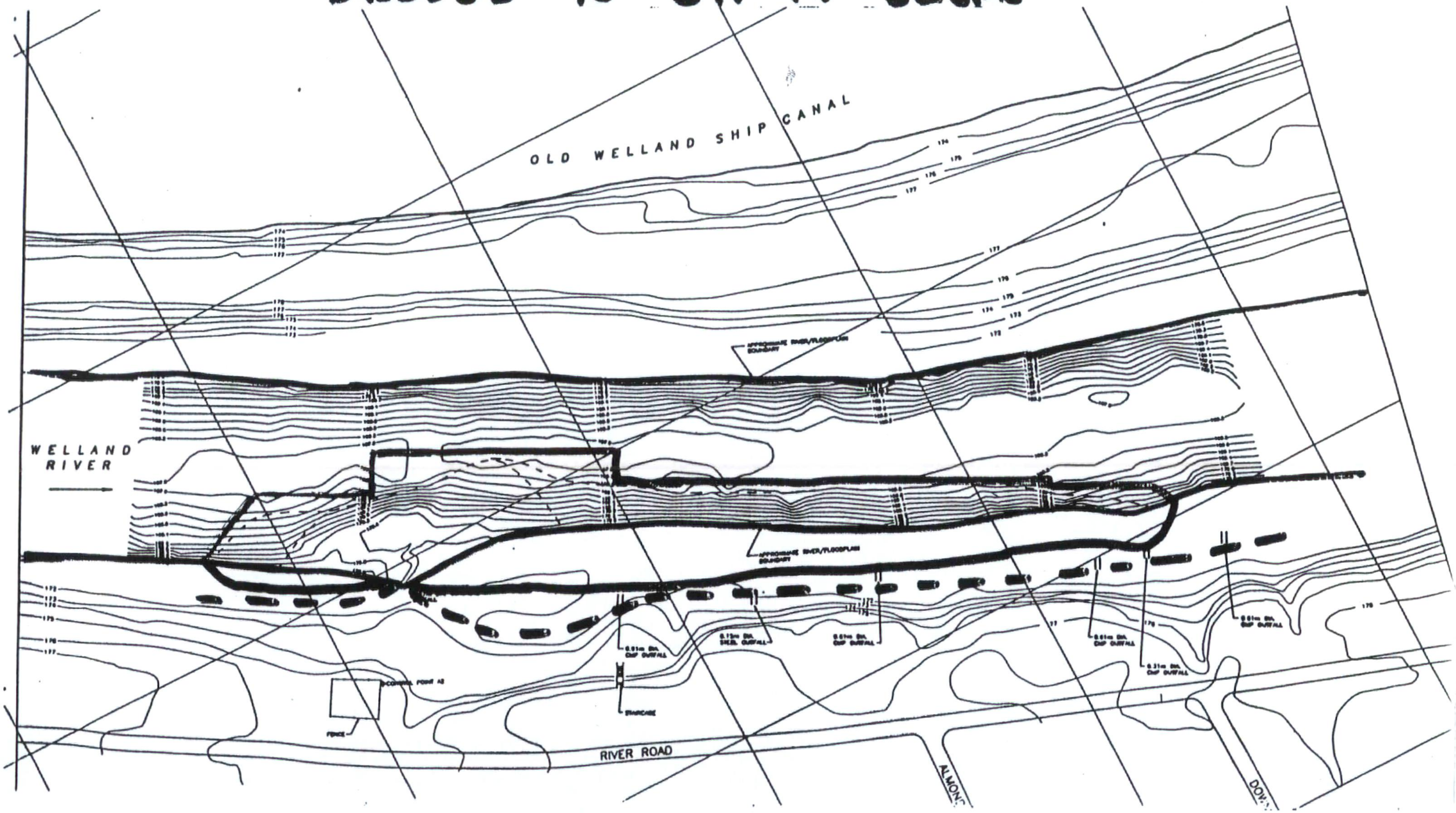
Alternative 2

Excavate Floodplain Sediments to 6H : 1V



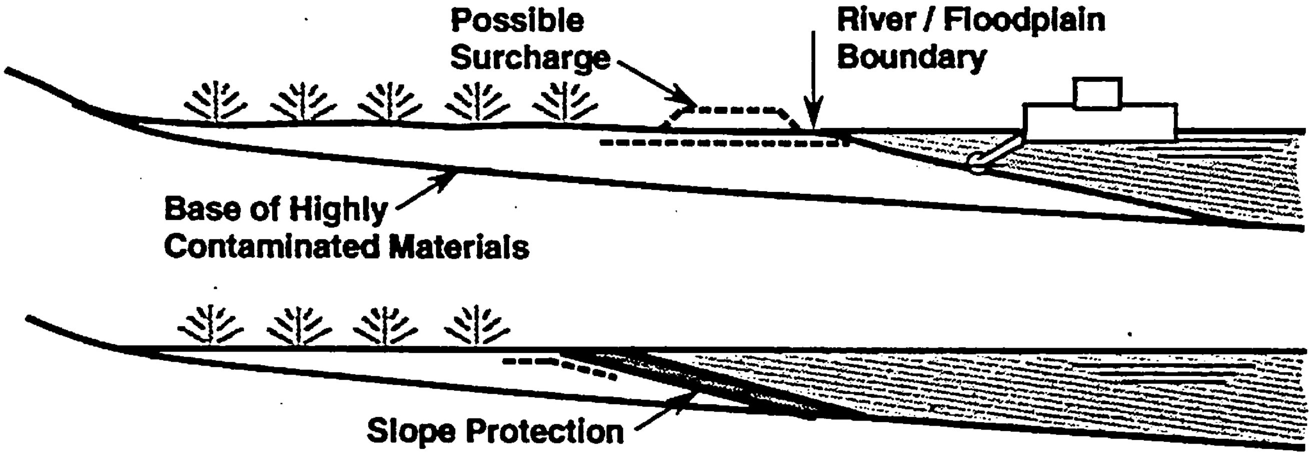
- Extensive impact on floodplain
- Large area requires protection from erosion
- Erosion protection may need to be removed in the future (dependent on future decisions with respect to floodplain)
- Contaminated sediments present below widened section of river, although covered with granular fill

ALTERNATIVE 2
DREDGE TO 6H:1V SLOPE



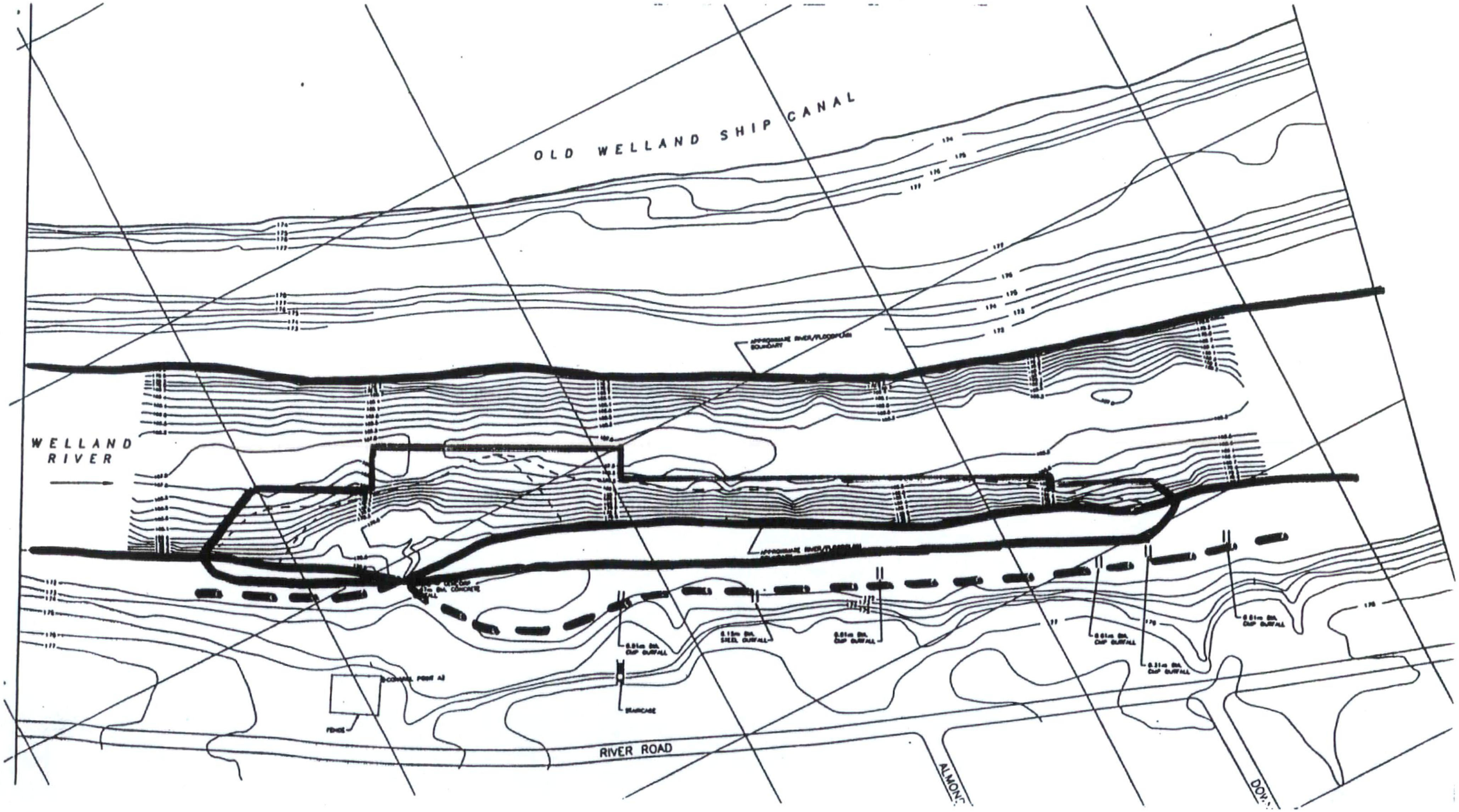
Alternative 3

Undermining of Floodplain Root Mat



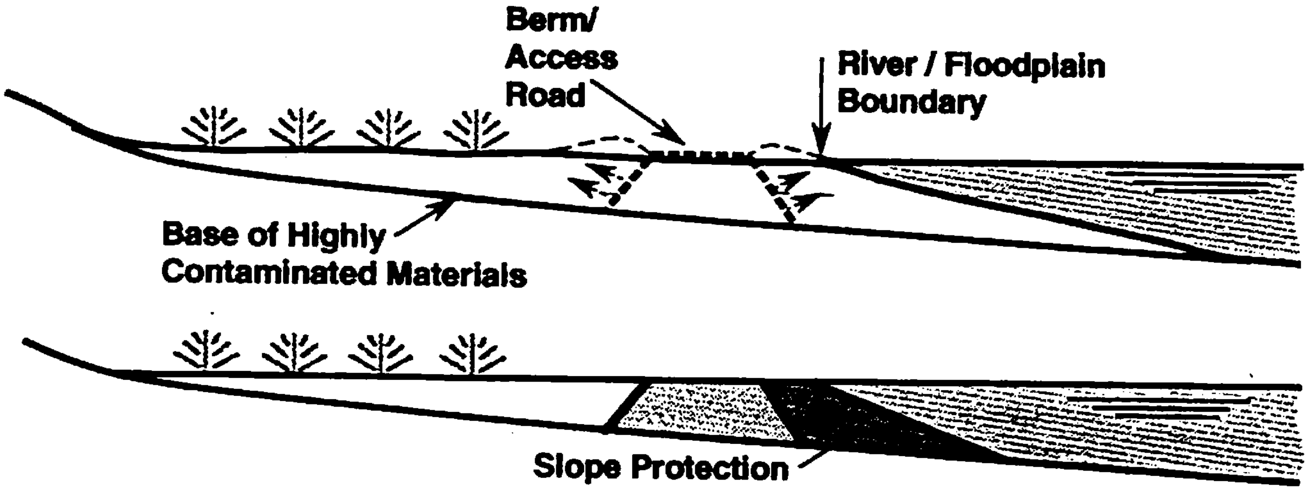
- Extensive impact on floodplain but less than Alternatives 1 and 2
- Surcharging of root mat with granular fill (and geotextile) may be required
- Large area requires protection from erosion
- Erosion protection may need to be removed in the future (dependent on future decision with respect to floodplain)
- Contaminated sediments present below widened section of river, although covered with granular fill and root mat
- Technical concerns regarding practicality and impact on dredging and treatment efficiency

ALTERNATIVE 3 – "UNDERMINING" OF ROOT MAT



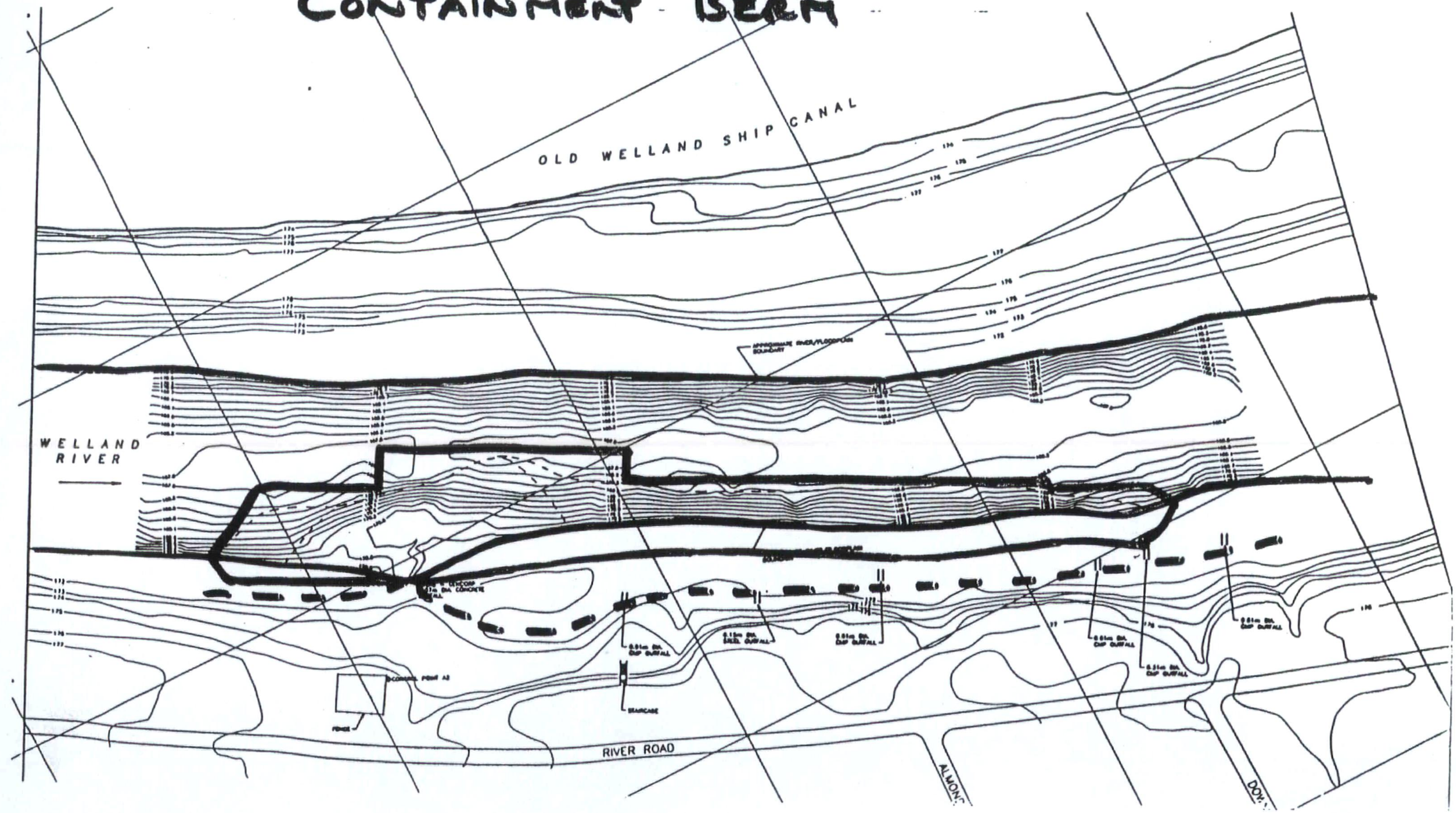
Alternative 4

Containment Berm



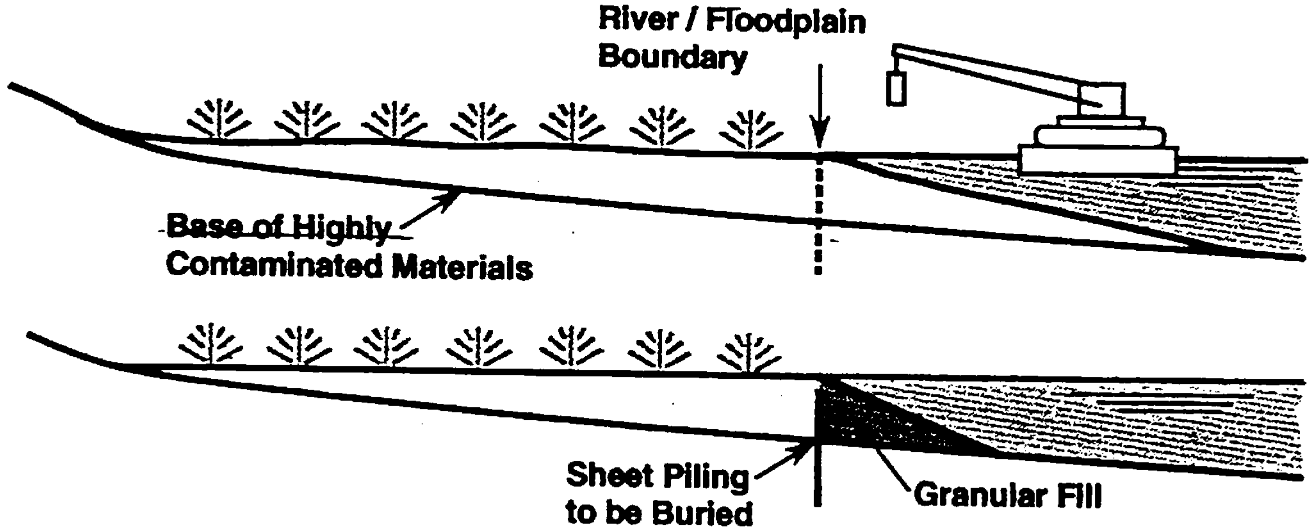
- Extensive impact on floodplain but less than Alternatives 1 and 2
- Contaminated sediments displaced during berm construction will require removal and treatment
- Berm can be utilized during future removal of remaining floodplain sediments (if necessary)
- Possible lowering of stability of sideslope of floodplain
- Increased truck traffic in area
- No contaminated sediments remain below river

Alternative 4
Containment Berm



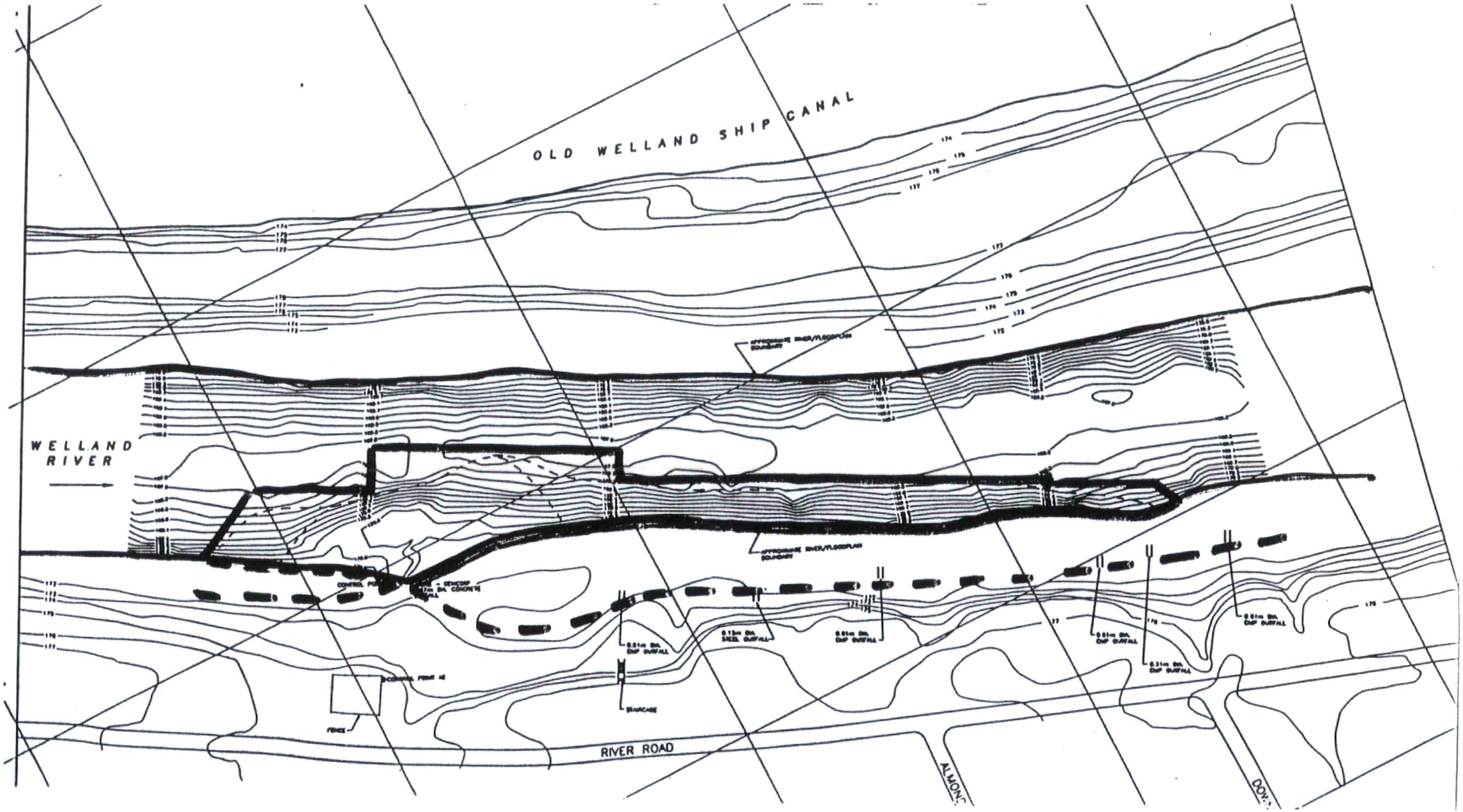
Alternative 5

Sheet Pile Containment



- Minimum impact on floodplain
- Dredging can continue up to the river/ floodplain boundary without affecting the stability of the floodplain
- Vibratory methods can be used to install piles, minimizing noise effects
- Minimizes dredging and treatment quantities
- No contaminated sediments remain below river
- Sheet piling can be utilized for containment during future removal of remaining floodplain sediments (if necessary)
- Sheet piling is a temporary measure and can be removed after remediation of floodplain or as part of the 1995 works

ALTERNATIVE 5
SHEET PILE CONTAINMENT



Project Cost Estimate

	Total Cost ($\$ \times 10^6$)
Alternative 1	
- Full Removal of Floodplain	3.20
Alternative 2	
- Dredging to a 6H:1V Slope	3.30
Alternative 3	
- 'Undermining' of Floodplain Root Mat	3.25
Alternative 4	
- Containment Berm	3.15
Alternative 5	
- Sheet-pile Containment	3.00

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Impact on Floodplain

	Approximate Floodplain Area Impacted (m^2)
Alternative 1	
- Full Removal of Floodplain	4700
Alternative 2	
- Dredging to a 6H:1V Slope	4000
Alternative 3	
- 'Undermining' of Floodplain Root Mat	3200
Alternative 4	
- Containment Berm	2850
Alternative 5	
- Sheet-pile Containment	700

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Wetland Valuation

Wetland benefits and values are variable, depending on the location of the wetland, its extent, the species composition, the actual and potential uses of the wetland (recreational uses such as fishing, hunting, camping, picnicking, hiking, nature viewing, and photography; as well as aesthetic and intrinsic values) and the public services that it provides (flood control, water quality, habitat for fish and wildlife, atmospheric interactions, research and educational values), and the time scale being used for valuation.

Techniques include nonmonetary scaling and weighting approaches, a direct replacement cost approach, a willingness-to-pay approach based on contingent evaluation methods, an opportunity cost approach applied to measurable wetland values and proposed uses, and a multiobjective approach which endeavors to include other societal benefits in the valuation. No universal agreement exists on which is most appropriate.

Welland River Wetland

- Flood Protection/Erosion Control
- Water Quality (Nutrient Uptake/Sediment Removal)
- Spawning, Rearing, Foraging Zones for Various Fish Species
- Habitat and Food Source for Wildlife and Waterfowl Species
- Recreational and Aesthetic Values (Residents of River Road Neighborhood and Intermittent Users of Merritt Island and River)
- Values are incremental, each contributing part to the overall benefits derived from the system

Multiple Objective Analysis

- Most recent and comprehensive
- Attempts to incorporate all aspects of a resource (use, services, often unrecognized or hard to cost values) into its 'economic value'
- For wetlands, includes those benefits referred to as its 'total life support' value, plus those other more readily costed values

Range of Economic Values

1 - Michigan Coastal Wetland - mid 1970's

$490/acre/yr ($0.12/m^2/yr) - hunting, trapping, sport and commercial fishing, as well as nonconsumptive recreation

$3,000/acre/yr ($0.74/m^2/yr) - all of the above plus other values such as nutrient uptake, ecological functions, erosion control, etc

Reference: Jaworski and Raphael, 1978 in Bardecki, 1984

2 - Virginia Tidal Marsh - early 1970's

$108/acre/yr ($0.03/m^2/yr) - fisheries production

$2,500/acre/yr ($0.62/m^2/yr) - waste assimilation

$4,150/acre/yr ($1.03/m^2/yr) - 'total life support'

$7,658/acre/yr ($1.89/m^2/yr) - total annual potential benefit, including those above as well as aquaculture

Reference: Gosselink et al, 1973 in Bardecki, 1984

3 - Louisiana Coastal Wetland (salt marsh) - 1979

$342/acre/yr ($0.08/m^2/yr) - average gross benefits

$3,120/acre/yr ($0.77/m^2) - replacement value, capitalized at annual interest rate of 10%

4 - Lake St. Clair Wetland - 1990

Social Benefits from Preservation vs Conversion to Agriculture

$7,028-7,969/ha ($0.70-0.80/m^2) - net present value (at 4% over 50 years), including consumer surplus, hunting clubs and National Wildlife Area for marshes ranging from 20 ha (diked) to 300 ha (undiked).

Summary

Values reported in the literature range from a few cents to upward to $2/m^2 of wetland. Assuming that the Michigan study is selected as the closest approximation to the current project, removal of hunting and trapping and fishing values results in an estimate of $0.62/m^2/yr.

Given an average rate of inflation of 5%/yr, this results in an overall estimate of approximately $2/m^2/yr in 1995 dollars. If one were to convert this into Canadian funds, that conversion would add another 40% to this amount at the present time.

Thus in the costing of options, those which remove wetland would add an additional amount to their bottom line, to account for the loss of wetland presence and function. This would be added to any existing remediation costs, times the number of years anticipated for the restoration activity to return to full function. For example, an additional $20/m^2 ($2/m^2 X 10 years) would be added to the side slope option cost estimate, to account for the loss of wetland function, over the period of time taken to regain full function (i.e., could take up to 10 years to fully restore functions and uses).

Thus, in comparing the sheet-pile option vs the 6:1 side slope option, the former would retain approximately 3300 m^2 more wetland area than the latter. Thus, a cost penalty of approximately $66,000 would be added to the latter to account for the long-term loss of function associated with that option.