Contaminated Sediment Remediation in the Canadian Portion of the Detroit River

Claire Sanders, Detroit River Canadian Cleanup, sanders@detroitriver.ca
Ken Drouillard, Great Lakes Institute for Environmental Research (GLIER), University of Windsor, kgd@uwindsor.ca
Jacqueline Serran, Detroit River Canadian Cleanup, serran@detroitriver.ca

Background

The Detroit River is a 51 km-long connecting channel that links Lake St. Clair to the western basin of Lake Erie. The river runs through two major urban areas (i.e., Detroit, MI and Windsor, ON) and has long been used for industrial and recreational purposes. Over the past 100 years, the shoreline and watershed of the river has experienced a large amount of urban, industrial, and agricultural development. As industry became more intensive, and the watershed more developed, water pollution, loss of habitat, and point and non-point source pollution became large issues, which led to the Detroit River being designated as a binational Great Lakes Area of Concern (AOC) through the Great Lakes Water Quality Board of the International Joint Commission in 1985 (Green et al., 2010).

Eight beneficial uses that were identified as impaired on the Canadian side of the Detroit River. The status of a number of them, such as *Degradation of Benthos, Fish Tumours and Other Deformities,* and *Fish and Wildlife Consumption,* depend on the quality of the sediment in the river. Contaminants such as heavy metals, polychlorinated biphenyls (PCBs), and polycyclic aromatic hydrocarbons (PAHs), which were released from factories or entered the river via runoff, have a negative effect on wildlife, benthos, and fish living within the system (e.g., by increasing tumour prevalence in fish) and in humans through the bioaccumulation of toxic substances through the food web. Over the past several decades, legislation has been introduced on both sides of the border to reduce the amount of contaminants entering the Detroit River; however, these legacy contaminants still exist in the sediment.

Sediment Contamination on the Canadian side of the Detroit River

Elevated levels of contaminants have been found in sediments on both the Canadian and U.S. sides of the Detroit River. In 1993, the Ontario Ministry of the Environment established Provincial Sediment Quality Guidelines (Fletcher et al., 2008), which determined the thresholds above which adverse effects will be experienced by various sediment-dwelling organisms. The Lowest Effect Level (LEL) of contaminants of potential concern (COPCs) is the threshold of contaminants above which the most sensitive species may experience adverse effects and the Severe Effect Level (SEL) is the threshold above which ecological detriment to the majority species will begin to be observed.

Sediment samples were analyzed from the Detroit River AOC in 1999, 2001, 2009, and 2013 to determine whether contaminant levels exceeded SELs (Drouillard et al., 2010; 2014; 2015). There has been a general decline in SEL exceedances on both sides of the river and since 1999, only one SEL exceedance has been recorded in 2013 on the Canadian side of the river (Drouillard et al., 2014; McDougall, 2019; Table 1). The hot spots of contaminant accumulation were located along the American shoreline upstream of Belle Isle and downstream in the Trenton

Table 1: A summary of Severe Effect Level exceedances recorded in Canadian and American waters of the Detroit River, 1990-2013. Note: Excd. = exceedances.

Country	**1999**		**2001**		**2009**		**2013**	
	SEL Excd.	Survey Sites	SEL Excd.	Survey Sites	SEL Excd.	Survey Sites	SEL Excd.	Survey Sites
Canada	9	74	0	10	0	34	1	37
USA	14	73	2	6	6	39	3	37

Channel, which is consistent with previous studies (i.e., Thornley and Hamady, 1984). The one Canadian site that had SEL exceedances in 2013 for chromium, lead, and copper was located near the Ambassador Bridge, just inside of the Canadian border (Drouillard et al., 2014; 2015).

Though sediment COPCs continue to be above Great Lakes background levels on the Canadian site of the Detroit River, it is not expected that these contaminant levels will cause noticeable biological impairment (McDougall, 2019). The existing research indicates that sediment contamination on the Canadian side is localized, with the vast majority of sites sampled having concentrations below provincial SELs. As a result, no sediment remediation activities have been conducted in the Canadian waters of the Detroit River or are planned in the future, but continued monitoring of sediment contamination levels is recommended. With the increasing quality of the sediment in the Detroit River, two of the beneficial use impairments (BUIs) whose status is dependent on sediment quality (*Fish Tumours and Other Deformities* and *Degradation of Benthos*) have recently been recommended for a status change to not impaired for Canadian waters of the AOC.

There has been one sediment remediation project in a subwatershed of the Detroit River called Turkey Creek. From 2001 to 2008, a series of studies were undertaken to determine the extent of historical and ongoing sources of PCB contamination within the watershed. During the 2001 sampling campaign, PCB concentrations exceeded provincial water quality objectives in each water sample collected during a 28-day time-integrated period. Trace metals also exceeded provincial objectives, with both trace metal and PCB concentrations increasing in the upstream reaches of Turkey Creek, indicating a potential contaminant source upstream. In 2005, the upstream reaches of the Turkey Creek and the Grand Marais Drain were targeted to delineate areas of contamination and determine the bioavailability of PCBs. Water, sediment, soil, and young-of-year fish sampling was performed and semi-permeable membrane devices were deployed from Walker Road to Central Avenue to track contaminants. Results showed that ongoing sediment transport and resuspension processes were maintaining an increased bioavailability of PCBs to organisms within the creek, that there were elevated PCB concentrations within the banks of the creek, and that just over 200 m of creek bed and banks were the likely contributors to the overall contamination in the Turkey Creek-Grand Marais drain. In 2008, 975 m^3 of sediments, contaminated with heavy metals and PCBs, were excavated to a target PCB concentration of less than 1ug/g in the Grand Marais Drain upstream of Walker Road. Reductions in PCB concentrations were observed in the Turkey Creek Grand Marais Drain in 2012 when a study was conducted to determine the success of the sediment remediation. Overall, contamination within the Turkey Creek watershed and at the mouth of the creek into the

Detroit River have improved, although it is unclear as to whether this is a direct result of the remediation work.

Dredging for Navigational Purposes

While no locations have been identified for remedial dredging, dredging of sediments does take place in one area of the lower Canadian Detroit River for navigational purposes. The Canadian Coast Guard division of Fisheries and Oceans Canada currently assumes responsibility for these dredging projects. Today, routine maintenance dredging is conducted at least once every ten years to remove accumulated sediment to ensure that navigational channels are maintained at design depths (DFO, 2019). In the Detroit River, the *Restrictions on Dredging Activities* BUI was designated 'impaired' in the 1991 Stage 1 Remedial Action Plan Report because disposal of sediment on the Michigan side of the Detroit River and in the lower section of the Canadian side were not suitable for open water disposal because of heavy metals, PCBs, and contaminants.

The Ontario Provincial Sediment Quality Guidelines came into effect in the early 1990s after this BUI was identified in most AOCs and, as a result, the regulations and practices for management of dredged material have evolved and improved significantly. Sediment analyses of dredge spoils from 2002 and 2007 shows that the sediment quality of the dredged material from the Canadian side of the Detroit River has remained consistent from year to year, with minor exceedances of Provincial Sediment Quality Guidelines Lowest Effect Levels (LEL) for arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, zinc, total organic carbon, total Kjeldahl nitrogen, and total phosphorus. In 2002, six samples showed LEL exceedances for several PAHs, as well as trace amounts of PCBs. Due to these exceedances and the high silt content which limits upland beneficial reuse, the dredged sediment is disposed of in a conveniently located confined disposal facility. No contaminants approached the Severe Effect Levels.

Regulatory oversight in navigational dredging projects is achieved through the federal and/or provincial environmental protection legislation and approval process. Many jurisdictions now recognize that open water disposal is not without adverse environmental impacts, regardless of the contaminant level of the dredged material. In 2013, draft guidance from the Canada-Ontario Agreement federal and provincial remedial action plan management was produced. This guidance says:

> *"Restrictions on Dredging Activities" BUI may be considered "not impaired" in AOCs where dredging for commercial navigation may be undertaken and the agency responsible for the dredging activities requires that the dredged material be disposed of in an existing, regulated management facility in accordance with provincial and/or federal guidelines and regulations."*

Based on this guidance, the status of the *Restrictions on Dredging Activities* BUI on the Canadian side of the Detroit River was officially changed to unimpaired in April 2019.

Conclusions and Recommendations

Over the past several decades, legislation has been enacted on both the Canadian and American side of the Detroit River to reduce the amount of contaminants entering the Detroit River. As a result, on the Canadian side of the Detroit River, we are seeing an improvement in sediment quality. Where SEL contamination exists, it is localized in nature, indicating that severe biological impairment due to contaminated sediment on the Canadian side of the river is unlikely. Therefore, there have been no sediment remediation projects in the Detroit River itself to remove contaminated sediment. The only dredging of sediment that occurs in the Detroit River is to ensure that navigational channels are maintained at the required depth. The sediment quality of the dredged material remains consistent from year to year, with some exceedances of LEL and no exceedances of SEL.

There has been a concerted effort by both Canadian and American authorities and industries to reduce the amount of contaminants entering the Detroit River from both point and nonpoint sources. Further, infrastructure improvements at wastewater treatment plants and to sewer systems (i.e., the replacement of combined sewer systems) provide opportunity to further decrease contaminants entering the system. In addition, the continued regulation and education to ensure proper disposal of waste containing contaminants will help to ensure these chemicals do not inadvertently end up in river sediment.

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