

Delisting Criteria for the Canadian Portion of the Detroit River Area of Concern

In 1987 the governments of Canada and the United States signed a protocol amending the Great Lakes Water Quality Agreement of 1978 by the addition of Annex 2, "Remedial Action Plans and Lakewide Management Plans". Under this annex, the two governments identified 43 environmentally degraded hot spots, or Areas of Concern ("AOC"), throughout the Great Lakes where changes had occurred in the chemical, physical, or biological integrity of the ecosystem sufficient to impair one or more of fourteen enumerated beneficial uses. The two federal governments undertook to cooperate with state and provincial governments to prepare a three-stage Remedial Action Plan ("RAP") for each AOC. Under the terms of the Agreement, the International Joint Commission reviews and comments on RAPs as each stage is completed and submitted for approval.

The Detroit River and its watershed is one of these designated AOCs, and it is one of only five binational AOCs. The Detroit River is a connecting channel in the centre of the international Great Lakes system, and links Lake St. Clair to Lake Erie. Its watershed, more than 2000 square kilometres (1242 square miles) in size, contains two large metropolises: Detroit, Michigan and its suburbs (with a population over three million) and Windsor, Ontario and its suburbs (with a population of 280,000). The river is about 51 kilometres (32 miles) long, with a width that varies from 600 metres (1969 feet) at the Ambassador Bridge to over six kilometres (3.7 miles) where it empties into Lake Erie. The depth ranges from 16 metres (50 feet) in the upper stretches to just 0.9 metres (three feet) in parts of the lower river, and the flow rate is roughly 453 billion litres (120 billion US gallons) per day.

The Detroit River's Canadian tributaries include the Little River, Turkey Creek, and the Canard River. Parts of Turkey Creek and the lower Little River flow through urban areas, while the southern part of Turkey Creek's watershed, the upper Little River and the Canard River drain farmland. About a quarter of the Canadian shore of the Detroit River is occupied by industry, another quarter by residential areas, and half is undeveloped. The U.S. tributaries to the Detroit River include the Rouge River (itself an AOC), and the Ecorse and Monguagon Creeks. The Detroit River AOC is unique in that it has another AOC as a tributary to it. In contrast to the Canadian watershed, all of the U.S. tributaries drain primarily urban areas, much of which is heavily industrialized. Most of the U.S. shore of the Detroit River is developed.

The River is important both for commerce - 8,000 ships a year traverse it, and for recreation - boaters, anglers and bird watchers enjoy it in large numbers. Its importance to both groups is reflected in its unique dual designation as both a Canadian and American Heritage River. These designations highlight the importance of preserving the fish and wildlife habitat in the river: 65 species of fish currently reside in it while perhaps 40 more have been lost as a result of human activity. Various species of birds and other wildlife also inhabit the river and its wetlands.

In the original Stage One RAP, only eight of the fourteen Beneficial Use Impairments (BUIs) were thought to be impacted in the Detroit River AOC. However, additional research has now demonstrated that eleven of the fourteen BUIs are likely impaired in the AOC, another BUI has been added which is also impaired, one BUI is likely not impaired, and knowledge of the remaining two impairments is insufficient to reach a definitive conclusion. The impairments are a result of a number of factors, including urban and industrial development in the watershed and inputs of bacteria, PCBs, PAHs, metals, oils, and greases, as well as the loss of fish and wildlife habitat. Combined sewer overflows and industrial and municipal discharges are major contaminant sources in the river. Further, in Michigan, stormwater runoff and tributaries such as the Rouge River are also major sources of contamination. Invasive species, changes in the fish community structure, and reductions in wildlife populations are additional concerns.

The process of developing delisting criteria for the Detroit River AOC has been lengthy. In December 2000, Jennifer Read of the Great Lakes Institute at the University of Windsor, on behalf of the Detroit River Canadian Cleanup Committee (DRCCC), prepared a draft document entitled *Criteria for Determining Delisting Eligibility for Impaired Beneficial Uses in the Detroit River Area of Concern*. That document summarized the efforts of a group of scientists, resource managers, and concerned citizens from both the US and Canada to begin the process of developing delisting criteria with scientifically determined targets specific to the Detroit River AOC. That report was analysed and considered at three binational public meetings hosted by the Citizens Environment Alliance in February and March of 2001. A summary of the conclusions reached at those meetings was presented by the organizers in *A Report to the Detroit River Canadian Cleanup Committee on the Restoration of the Detroit River Area of Concern*. In April 2002, a workshop was facilitated by Dave Dolan, Professor at the University of Wisconsin at Green Bay, with experts in the field and other interested parties to further define the proposed delisting criteria. The workshop conclusions were compiled by Dave Dolan and Pat Murray into a July 2002 document entitled *Workshop on Delisting Criteria for the Detroit River Area of Concern*. This report relies on and draws from all of the above preparatory work, with particular emphasis on the latter document. Throughout the delisting process, efforts have been supported by funding from Environment Canada.

Although clearly all beneficial use impairments should be addressed before an AOC can be considered for delisting, it has become evident that some of the impairments are ‘primary’, and restoration of these impairments is requisite for achieving progress on any of the ‘secondary’ impairments. Until the primary impairments are restored, resources should be focused on the restoration of primary impairments. A table detailing the designation and status of the impairments in the Detroit River AOC is below, followed by a detailed discussion of each BUI in turn.

These criteria are the current Canadian targets for the Detroit River RAP. As such, they will provide guidance for efforts and work plans on the Canadian side of the river. These criteria are not set in stone; rather, as new information is learned, they will be subject to correction, amendments or updates. Efforts will continue to work with the United States to develop binational delisting criteria for

the Detroit River RAP.

	Beneficial Use Impairment	Status in Detroit River AOC	Designation - Primary or Secondary
1.	Restrictions on fish and wildlife consumption	Impaired for fish	Primary
2.	Tainting of fish and wildlife flavour	Impaired for fish	Secondary
3.	Degradation of fish and wildlife populations	Impaired	Primary
4.	Fish tumours and other deformities	Impaired	Primary
5.	Bird or animal deformities or other reproductive problems	Impaired	Primary
6.	Degradation of benthos	Impaired	Primary
7.	Restrictions on dredging activities	Impaired	Secondary
8.	Eutrophication or undesirable algae	Likely not impaired (requires research)	Secondary
9.	Restrictions on drinking water consumption or taste and odour problems	Impaired (taste and odour)	Secondary
10.	Beach closings	Impaired	Secondary
11.	Degradation of aesthetics	Impaired	Secondary
12.	Added costs to agriculture or industry	Not impaired	Secondary
13.	Degradation of phytoplankton and zooplankton	Insufficient evidence (requires research)	Primary
14.	Loss of fish and wildlife habitat	Impaired	Primary
15.	Exceedance of water quality standards/objectives	Impaired	Primary

It should be borne in mind when assessing these delisting criteria that the attainment of these goals would not mean that the Detroit River has returned to a pristine, natural state. Indeed, such a goal is utopian given the current state of the Great Lakes as a whole, as well as the realities of the

planet's environment. However, the achievement of these goals would mean that the Detroit River is no longer the seriously polluted body of water it once was, and is well on its way to becoming even healthier. It is understood that ongoing monitoring, enforcement, and action will be required to ensure that progress is continuing, and that new issues are not becoming a concern.

Beneficial Use Impairment #1 - Restrictions on Fish and Wildlife Consumption

Delisting criteria:

- 1) Contaminant burdens in sport fish species decline below the strictest action level for all jurisdictions issuing fish consumption advisories for a minimum of three years, with levels demonstrating a downward trend. Contaminant levels in fish which are a result of pollutants originating outside the AOC - and which therefore cannot be addressed within the watershed - should not be a barrier to delisting.
- 2) Contaminant burdens in relatively non-migratory fish species (even though such species are seldom preferred sport fish species) decline below action levels for all jurisdictions that issue fish consumption advisories for a minimum of three years, with levels demonstrating a downward trend. Contaminant levels in fish which are a result of pollutants originating outside the AOC - and which therefore cannot be addressed within the watershed - should not be a barrier to delisting.
- 3) No public health advisories are in effect for human consumption of wildlife for a minimum of three years.

Consumption advisory programs were developed primarily to inform recreational anglers of the quality of the sports fish population. The validity and utility of these advisories depend on the scope and structure of the monitoring program. Monitoring programs should be established to regularly assess levels of mercury, PCBs, dioxin/furans and dioxin-like PCBs in the Detroit River fish population, with monitoring for other chemicals incorporated if warranted by scientific research. Monitoring should continue even after delisting to confirm that downward trends persist and that human health remains protected. When assessing safe contaminant levels, it is necessary not only to compare results with current advisories (which are periodically updated), but also with current scientific research. Recent evidence suggests that a cumulative response to a mixture of contaminant concentrations needs to be assessed when developing maximum allowable contaminant intake levels and setting consumption limits. Contaminant data needs to be augmented with biological data to enable valid comparisons of datasets from different sources. Consumption advice should be based on a common maximum allowable daily intake of a contaminant. The principle of multiple-contaminant impact assessments related to consumption advice should be promoted, utilizing the principle of Toxic Equivalencies.

The current number and type of fish consumption advisories in the Detroit River AOC indicate a serious problem. In Ontario, fish consumption advisories are in place for ten species of sport fish, while the most severe type of advisory ('no fish consumption whatsoever') is in place for eight species. In Michigan, fish consumption advisories are in place for six species of fish, while the most severe type

of advisory is in place for only one fish species. A 2000 survey of anglers on the Canadian shoreline of the Detroit River identified the ten most frequently consumed species of fish. There are consumption advisories currently in place for six of the ten most frequently consumed species, demonstrating a serious issue from a public health perspective.

Despite the need for, and importance of, fish consumption advisories, they may be inadequate for indicating the status of local, point source, bioavailable contaminants. Sedentary, bottom-feeding fish species, or those with limited migration patterns (carp and freshwater drum) can provide reliable data on the bioavailability of contaminants from local point sources. On the other hand, data from migratory fish species such as top predators (walleye and northern pike) will not provide data on specific, local environmental conditions, as these species tend to integrate environmental conditions throughout their range of movement. As such, delisting criteria need to involve more than a simple requirement that there be no current consumption advisories for fish and wildlife. Some consumption advisories are set at levels so low that no amount of remedial activity in the Detroit River would reduce chemical concentrations to levels not requiring advice restricting consumption. In addition, a portion of the contamination burden of some fish is a result of chemicals originating outside the AOC. Some fish species not currently consumed by humans may be more accurate indicators of the health of the Detroit River than the more commonly consumed and studied top predator fish, and should therefore be included in toxicity research and in delisting criteria.

In the Detroit River, PCBs are responsible for 51 percent of the Ontario advisories, elevated mercury levels for 32 percent, and dioxin for seventeen percent. PCBs and mercury are also responsible for virtually all of Michigan's advisories (dioxin is responsible for one Michigan carp advisory). Dioxin should be monitored as an emerging issue. With respect to mercury and PCBs, fish contaminant levels have declined little, if at all, in the past two decades.

Beneficial Use Impairment #2 - Tainting of Fish and Wildlife Flavour

Delisting criteria:

- 1) Survey results confirm no tainting of fish or wildlife flavour.

As a secondary BUI, efforts should not be directed towards addressing this impairment until the more serious primary impairments have been addressed. In particular, it is anticipated that as consumption advisories are addressed, fish and wildlife flavour issues will also be impacted. There is currently no evidence of tainting of flavour of local wildlife.

Beneficial Use Impairment #3 - Degradation of Fish and Wildlife Populations

Delisting criteria:

- 1) Environmental conditions should support self-sustaining, healthy, and genetically diverse communities of most sensitive indicator species at levels of abundance and biodiversity that

would be expected from the amount and quality of suitable physical, chemical, and biological habitat present. The objectives for this AOC should be consistent with Great Lakes ecosystem objectives, the Great Lakes Fishery Commission's fish community goals for adjoining waters, and the conservation vision for the lower Detroit River.

- 2) Scientifically defensible fish and wildlife bioassays confirm that there is no significant toxicity from water column or sediment contaminants.
- 3) As much as is possible in a connecting channel, programs should be in place to discourage further proliferation of existing non-native species, and the prevention of future introductions.

There is ample scientific proof that the water and sediments of the Detroit River are contaminated and that exposure to these contaminants has degraded local populations of fish and wildlife, including amphibians, zooplankton, benthic invertebrates, birds, and numerous fish species. Contaminants have also caused physiological impairments such as decreased reproduction, embryonic deformities, immune system suppression, reduced recruitment, tumours and lesions. Ample evidence also supports the position that other important factors in population degradation are the loss of nearly all the coastal wetlands found along the river banks, and the destruction of the river bottom by blasting, dredging, and filling.

The causes of this impairment are systemic. Consequentially, delisting of this impairment should not be considered until the other seven primary BUIs have been found to meet their delisting criteria. This does not mean, however, that efforts at addressing this impairment should not be made. In fact, any efforts will be especially valuable because of the direct positive impact they will have on other beneficial uses. Ongoing assessments using published methods should be undertaken to monitor the recovery and abundance, as well as the contaminant body burden, of indicator species such as amphibians, bald eagles, canvasback ducks, mink, and snapping turtles. Ongoing monitoring should also evaluate the abundance of larval fish, the incidence of fish tumours, and the genetic diversity of brown bullheads. Index stations, including both reference sites and worst-case sites - preferably those for which current or historic data are already available - should be evaluated regularly to assess progress.

The ongoing monitoring of keystone species must be expanded. Bald eagles are commonly cited as an indicator species, but even at its peak, the number of bald eagles supported by the Detroit River was low. As such, assessments of the population health and breeding success of additional keystone species are necessary. Both lake sturgeon and river otters are returning to the area and could serve as sensitive indicators of the health of the river. Species that are especially sensitive to change should also be monitored to assess the ongoing impact of non-native invasive species.

Beneficial Use Impairment #4 - Fish Tumours and Other Deformities

Delisting criteria:

- 1) Incidence rates of fish tumours or other deformities do not exceed rates at unimpacted control

sites for a minimum of three sampling periods spaced two to three years apart, and should demonstrate a downward trend.

- 2) At a minimum, three year old Detroit River brown bullhead should not exceed liver tumour incidences of five percent, external tumour incidences of twelve percent, and barbel lesion incidences of twelve percent. These criteria should be met at the ten percent significance level in all areas of the Detroit River.

Elevated levels of both internal and external tumours in fish have been associated with carcinogens in sediment and water at a variety of locations in North America. Over the years numerous field and laboratory investigations have demonstrated a cause and effect relationship between carcinogens (in particular polynuclear aromatic hydrocarbons, or PAHs) and liver cancer in fish. One of these studies linked high PAH metabolite levels in bile with elevated levels of DNA adducts in the livers of Detroit River brown bullhead and walleye. Despite this link, there are difficulties with absolutely correlating specific levels of contamination and cancer prevalence because cancer research deals with statistical probability, as opposed to acute toxicity.

It is important when quantifying tumour numbers that data is standardized, and that incidences are counted in the same manner in each study. Certain factors should also be controlled to increase reliability. Brown bullheads and white suckers are good indicator species in the Detroit River, as they have relatively small home ranges and are therefore differentially exposed to contaminants based on the area of the river in which they live. Only those fish aged three and over should be studied, because tumour frequency increases with age. Finally, the season in which data is collected should be considered, as it can appear to influence tumour prevalence. Canadian and US researchers should collaborate in combining both their historical and recent data into a single database, with uniform treatment of variables and similar collection methodologies. This will not only aid in defining areas for future study, but will also allow ongoing assessment of remediation efforts.

Currently in the Detroit River, internal cancer and liver neoplasms are found in about seven percent of brown bullheads aged three years and older. While research suggests that for the health of the river to be considered improved this percentage should be reduced to five, it must also be borne in mind that these percentages are not statistically distinguishable without testing a very large number of fish. As such, remediation efforts with respect to this type of tumour are very close to the delisting goal and increased efforts should be focused on other types of tumours. About 23 percent of brown bullhead aged three years or older exhibit external tumours and raised lesions, in contrast to a recovering river in which the rate would be roughly twelve percent. Barbel (sensory receptor) lesions have been noted in about 50 percent of the same fish, while preliminary research suggests that this rate should be closer to twelve percent as well. Scientific research should be undertaken to investigate background rates of barbel lesions and unaffected blood parameters, both of which can be obtained without killing the fish.

Periodic monitoring should continue after delisting to detect any upswings in tumour rates early,

and to ensure the ongoing health of fish populations. It should be borne in mind that the delisting criteria are to be applied to fish throughout the river, but should also be met individually by populations of fish in the more contaminated sections, such as the Trenton Channel.

Beneficial Use Impairment #5 - Bird or Animal Deformities or Reproductive Problems

Delisting criteria:

- 1) Incidence rates of bird and animal deformities or reproductive problems in sentinel wildlife species do not exceed background levels at suitable reference sites elsewhere in the Great Lakes basin or in suitable inland control populations for a minimum of three years.

During the late 1960s and early 1970s, reproductive problems and population declines were observed in fish-eating birds throughout the Great Lakes. Herring gulls, double-crested cormorants, black-crowned night herons, bald eagles, and a variety of terns were among the species affected. Heightened embryonic mortality, reduced survival of offspring, and altered reproductive behaviour of adults contributed to reproductive failures. All were associated with exposure to various organochlorine contaminants. The pesticide DDT caused eggshell thinning in some species. Developmental abnormalities such as crossed bills, clubbed feet, and edema (swelling) in the head, neck, and abdomen were associated with exposure to PCBs. This suite of effects is referred to as Great Lakes Embryo Mortality, Deformities, and Edema Syndrome (GLEMEDS). Other physiological effects such as immunosuppression, reduced vitamin A, and altered thyroid status have also been documented in Great Lakes birds.

Reproductive problems have also been noted in wildlife other than birds in polluted areas of the Great Lakes, including snapping turtles, amphibians, and mink. Concentrations of many organochlorines steeply declined following restrictions in the 1970s, but rates of decline have slowed dramatically in the last decade. While reproductive outcomes and the general health of many Great Lakes species improved throughout the remainder of the 1970s and during the 1980s, effects continue today in many fish-eating species in the more contaminated areas. Severe eggshell thinning and consistent reproductive failure are now uncommon, but elevated embryonic mortality and occasional reproductive failures still occur. Current levels of contamination are associated with biologically significant health impacts, many of which have been revealed in recent years as new methods have been applied to field studies. These types of reproductive impairments and deformities have been and continue to be observed in the Detroit River AOC.

The Canadian Wildlife Service has instituted a comprehensive Wildlife Health Effects Project to study various wildlife species (mink, snapping turtles, colonial waterbirds, and bald eagles) in Canadian Areas of Concern. Although the Detroit River assessment is not complete, preliminary results indicate continued reproductive impairments in several species. This type of assessment and additional comprehensive monitoring studies should be repeated every three to five years to ensure adequate data for measuring improvement. Small scale and ongoing studies, such as those researching contaminants in

herring gull eggs, mudpuppy deformities, and the reproductive success of snapping turtles, should continue. All research should utilize new measures of reproductive health as well as recent advances in genomics and molecular and cell biology. Future research efforts should ensure that both traditional contaminants and newly emerging contaminants, such as polybrominated biphenyl ethers, are studied.

Although bald eagles are frequently cited as an indicator species, their small population in the Detroit River area is insufficient to provide statistically significant samples in any single year. However, the examination of data collected over a period of five to ten years may provide valuable information, especially for nest occupation, hatching success, fledging success, and contaminant concentrations. Although it would be almost impossible to calculate actual rates, the presence alone of specific deformities related to certain contaminants may indicate ongoing serious environmental problems in the AOC.

Beneficial Use Impairment #6 - Degradation of Benthos

Delisting criteria:

- 1) At a minimum, benthic community composition must contain none of the attributes that would characterize a degraded community for at least four years. Attributes of a degraded community include:
 - a) An indicator species characteristic of degraded environmental conditions is dominant;
 - b) A keystone species expected in a specific habitat is absent or has been replaced by an invading species;
 - c) Taxa designated as ecosystem objectives for a specific zone have not attained the recommended density, biomass, or productivity;
 - d) The composite (multimetric) biotic score determined for the area does not fall within a range previously designated as indicative of unimpaired quality;
 - e) A suite of species (multivariate assemblage) collected from the area is very different (statistically significant different, $p < 0.01$) from the assemblage of species expected to be found in reference areas with the same physical environmental characteristics; or
 - f) The taxa richness per unit of benthic density is below that expected of a particular environment.
- 2) Toxicity of sediment associated contaminants at appropriate sites should not be significantly higher than controls. The benthic community should be considered impaired by toxicity if:
 - a) The community is degraded;
 - b) Bioassays using sediment from a particular area indicate toxicity to benthic organisms;
 - c) Zoobenthos collected from the sediments have significantly elevated incidences of deformities or other abnormalities; or
 - d) The contaminant burden of benthic animals is great enough that the predators are at risk of bioaccumulating concentrations of the contaminants that would trigger human consumption advisories.

The benthic community refers to the assemblage of invertebrate animals that spend all or part of their life cycle on or in wetted substrates. The composition of the community depends heavily on the physical environment in which the benthos live. River benthos can be characterized as typically residing in either erosional or depositional habitats. The fauna of erosional habitats typically dwell on hard substrates and require specific flow conditions to provide adequate oxygen and food. The fauna of depositional habitats burrow into the fine sediments where they live and feed. Both types may be severely impacted by hypoxia (low oxygen), thermal extremes, and water and sediment toxicity. As such, zoobenthos communities, and the variety of species therein, have closely tracked the water quality, sediment characteristics, and trophic status of aquatic systems. This relationship makes an evaluation of the impairment status of zoobenthos particularly useful in assessing the ecological health of a body of water. Degraded benthic communities have been documented in the Detroit River, especially along the Michigan shoreline.

There are many different types of benthic invertebrates that can be used to assess the state of the Detroit River, including mayflies, caddisflies, midges, and worms. In order to provide specific targets, some scientifically-established levels for benthic organisms are outlined below. However, these criteria only indicate a community that would not be considered degraded, and that would contribute to delisting. Efforts would still be required to return Detroit River benthos to a level that would be considered healthy. In depositional sediments, elevated densities of worms (*Tubificidae*) point to anoxic (oxygen depleted) sediments, and are broadly recognized indicators of organic pollution. Therefore for the Detroit River to be considered non-degraded, no more than 3,000 worms should be found per square metre. *Gammarus* and *Echinogammarus* are moderately tolerant of pollution, and as a result, their absence from depositional habitats indicated degradation. Mayflies (genus *Hexagenia*) are indicators of clean water, and studies suggest that in a non-degraded Detroit River they should be present at densities of greater than twenty per square metre in soft sediments. Midges (*Chironomidae*) can live and feed on either depositional or erosional sediments. Studies demonstrate that at least four different types of midges should be found in an unbiased sample of fifty individuals from non-degraded sediment. In erosional sediments, sites with good environmental quality should include Turbellaria (*Dugesia* flatworms), snails (*Elimia* and *Amnicola*), net-spinning caddisflies (*Cheumatopsyche* and *Hydropsyche*: *Hydropsychidae*), amphipoda (*Gammarus* and/or *Echinogammarus*), and hydrozoans (*Cnidaria*). *Hydropsychids*, or net-spinning caddisflies should be present in erosional sediments at densities of at least 100 per square metre in a non-degraded river.

All benthos provide an important source of food for fish; therefore, benthos contaminant levels are important. Even if the contaminants do not affect the benthos themselves, their body loads of contaminants are biomagnified as they pass up the food chain, and have the potential to seriously impact fish contaminant levels as a result. Consequently, the levels of both PCBs and mercury in benthos should be below 150 parts per billion, which is equivalent to the amount that would make benthos safe to eat if they were fish rather than invertebrates. Because they feed on sediments, midge mouthpart deformities can result from contaminated sediments. An incidence of mouthpart deformities (extra or missing teeth of the mentum) in genera of susceptible chironomids/midges (*Chironomus*, *Tribelos*,

Procladius, and *Coelotanypus*) significantly greater than 2.5 ± 1.5 percent ($p < 0.05$; $n = 150$) indicates degraded conditions. As such, the area should not be considered for delisting if a sample of 150 or more individuals displays an incidence of five percent among sensitive taxa.

Most benthic species only live for one year, and therefore represent the state of the community for that year. As such, ongoing monitoring is valuable, as it provides an annual snapshot of the state of the community. In order to be eligible for delisting, samples from the Detroit River should not identify any characteristics of a degraded community for at least four years.

Beneficial Use Impairment #7 - Restrictions on Dredging Activities

Delisting criteria:

- 1) Contaminants in sediments do not exceed applicable standards, criteria, or guidelines. As such, there are no restrictions on dredging or disposal activities.

The issue of dredging is closely related to benthic degradation. For both uses to be unimpaired, sediment quality must be uncontaminated. Due to this interconnection, as well as to the fact that dredging does not ordinarily provide direct benefits to the ecosystem, it is considered a secondary use impairment. In some cases dredging can negatively impact other beneficial uses, especially if contaminated sediments that are otherwise not bioavailable are disturbed and released into the waterway. Efforts focusing on this impairment should not be put forth until the more critical primary impairments have been addressed. In the interim, dredging of the riverbed continues, with some restrictions imposed regarding the disposal of removed materials.

Beneficial Use Impairment #8 - Eutrophication or Undesirable Algae

Delisting criteria:

- 1) There are no persistent water quality problems (e.g. dissolved oxygen depletion of bottom waters, nuisance algal blooms or accumulations, decreased water clarity, etc) attributed to cultural eutrophication. Algal blooms in Lake Erie should not be attributable to Detroit River water quality impairments.

Although algal blooms have not been a large concern in the Detroit River (partially as a result of its high rate of flow), they have seriously impacted Lake Erie. Given that the Detroit River feeds water into Lake Erie, it is important that phosphorus target loadings are not increased or exceeded for the river. In order to determine whether this use is impaired in any way in the Detroit River, scientific research should be undertaken to clearly establish that concentrations of phosphorus are not higher in the lower areas of the river than in the upper areas. If it is determined that this is the case, this use would not be considered impaired in the AOC. In any respect, this impairment is considered secondary, and therefore should not be focused on until more serious primary impairments have been redressed.

Beneficial Use Impairment #9 - Restrictions on Drinking Water
Consumption or Taste and Odour Problems

Delisting criteria:

- 1) Densities of disease-causing organisms, or concentrations of hazardous or toxic chemicals or radioactive substances in treated drinking water supplies do not exceed applicable human health objectives, standards, or guidelines.
- 2) Surveys confirm that taste and odour problems are absent.
- 3) Treatment needed to make raw water suitable for drinking does not exceed the standard treatment used in comparable portions of the Great Lakes which are not degraded (i.e. settling, coagulation, disinfection).

A large percentage of the drinking water consumed by the millions of residents of the Detroit River watershed comes from the river itself. As such, the quality of the water drawn from the river is important to their quality of life. Although there are not currently any restrictions on treated drinking water consumption, taste and odour problems have been noted in the past, necessitating additional water treatment. However, it is anticipated that as other use impairments are addressed, overall water quality will improve and therefore this use is considered a secondary impairment.

Beneficial Use Impairment #10 - Beach Closings

Delisting criteria:

- 1) When waters, which are commonly used for total body contact or partial body contact recreation, do not exceed applicable standards, objectives, or guidelines for such use.
- 2) There are no closures of Detroit River or tributary beaches as a result of water quality impairment for a minimum of two years.

Beach closings in the AOC are relatively frequent occurrences in the summer months as a result of bacteriological concerns. Monitoring on the Detroit side of the river is done by the Wayne County Health Department, while monitoring of Canadian beaches is done by the Windsor-Essex County Health Unit. Bacteria levels set by Michigan's Department of Environmental Quality are 130 E.coli counts per 100 millilitres of water and 200 fecal coliform per 100 millilitres of water over a 30 day/five sample average. Ontario's bacterial limits are 100 E.coli per 100 millilitres of water over a one month/five sample average. Despite the importance of this issue and the ongoing concerns it causes to residents of the AOC, it is considered a secondary impairment. This is not to minimize the importance of the issue, but rather to acknowledge that this impairment is interconnected with other primary impairments and will be addressed indirectly as those impairments are tackled.

Beneficial Use Impairment #11 - Degradation of Aesthetics

Delisting criteria:

- 1) The waters are devoid of any substance which produces a persistent objectionable deposit, unnatural colour or turbidity, or unnatural odour. Oil and petrochemicals should not be present in concentrations that can be detected as a visible film, sheen or discolouration on the water surface, detected by odour, or form deposits along shorelines and bottom sediment. Water should be free from substances attributable to municipal, industrial, agricultural, and other discharges, such as raw sewage, dredge spoils, and spills that will settle to form putrescent or otherwise objectionable sludge deposits.

As with the previous impairment, degraded aesthetics have been a problem in the AOC in the past. Problems have included debris and objectionable deposits from combined sewer overflows (CSOs) and numerous spills of various materials. However, it is considered a secondary impairment because it is anticipated that as other primary impairments are addressed, this impairment will also improve. Monitoring of this impairment could involve not only concentrating on specific spills or complaints, but also compiling a historical visual record of the appearance of the river to document improvement.

Beneficial Use Impairment #12 - Added Costs to Agriculture or Industry

Delisting criteria:

- 1) There are no additional costs required to treat the water prior to use for agricultural purposes - including but not limited to livestock watering, irrigation, and crop spraying - and industrial purposes - including commercial or industrial applications and non-contact food processing.

This use has not been identified as impaired in the Detroit River AOC. Treatment of water intakes due to zebra mussels is required in some instances, however, this is a Great Lakes basin-wide issue. Should future monitoring find that this use is impaired, it should be addressed as a secondary impairment which will be ameliorated as other use impairments are remedied.

Beneficial Use Impairment #13 - Degradation of Phytoplankton and Zooplankton

Delisting criteria:

- 1) The phytoplankton and zooplankton community structures are seasonally and spatially identified as high quality based on an objective and quantitative community analysis, an index of biological integrity, and/or a comparison to an appropriate control site over three successive years.
- 2) Results of phytoplankton and zooplankton bioassays appear seasonally and spatially to be within acceptable limits for controls in 95 percent of the samples over three successive years.
- 3) The phytoplankton and zooplankton analysed for persistent, bioaccumulative substances (e.g. PCBs and mercury) appear seasonally and spatially to be below the level of detection for

measured contaminants in 95 percent of the samples over three successive years.

The status and quality of Detroit River phytoplankton and zooplankton have been interpreted in several ways, ranging from impaired, to not impaired, to unknown. This uncertainty results from prior research that used scarce, non-existent, or misinterpreted data, and an almost complete lack of recent studies. As such, the key priority in addressing this impairment is to commission research to adequately assess the level of impairment, if any, of this BUI.

The impairment of phytoplankton and zooplankton populations can be defined in terms of either floristic or faunal characteristics of community structures, water column toxicity to appropriate specimens, and tissue contamination by heavy metals or organic substances. The community structures of Detroit River phytoplankton and zooplankton appear to be healthy according to available research, but they have not been assessed in over a decade and those samples that were assessed represented limited locations. Monitoring of community structures should be done to confirm that phytoplankton and zooplankton community structures are seasonally and spatially identified as high quality in 95 percent of the samples based on an objective and quantitative analysis, an index of biological integrity, and/or a comparison to an appropriate control site over three successive years. The most recent zooplankton toxicity bioassays in 1986 indicated that Detroit River fauna were impaired or degraded. No parallel bioassays have been conducted on phytoplankton and their status is therefore unknown. Research should be conducted to determine water column toxicity to both zooplankton and phytoplankton. If seasonal and spatial bioassay results are not significantly different from acceptable controls in 95 percent of samples over three successive years, plankton in the Detroit River should not be considered impaired in this manner. There is also little research available as to the body burden contaminant levels of Detroit River phytoplankton and zooplankton, and the status of this criteria is therefore unknown. Research should be conducted to determine if such an impairment actually exists. Plankton should be considered unimpaired when phytoplankton and zooplankton analysed for persistent, bioaccumulative substances such as PCBs and mercury are seasonally and spatially below the level of detection for contaminants measured in 95 percent of samples over three successive years.

Beneficial Use Impairment #14 - Loss of Fish and Wildlife Habitat

Delisting criteria:

- 1) The amount and quality of physical, chemical, and biological habitat required to meet fish and wildlife management goals has been achieved and protected.
- 2) Loss of productive fish and wildlife habitat in the Detroit River AOC has ceased, and is protected by local bylaws, ordinances, and/or statutes.
- 3) A net gain of restored and protected habitats has occurred in accordance with local fish and wildlife management plans for the conservation and restoration of Detroit River habitat - in particular, the Biodiversity Conservation Strategy for the Canadian portion of the AOC - and is protected in perpetuity through local bylaws, ordinances, and/or statutes.
- 4) At a minimum, twelve percent of the AOC watershed should be comprised of quality natural

cover, and a buffer of natural riparian vegetation should border 75 percent of all First-to-Third Order streams and virtually all wetlands.

An abundance of quality habitat that sustains a vast number of fish, wildlife, and plant species significantly benefits a natural resource. The loss of such habitats resulting from disturbances in the physical, chemical or biological integrity of a natural resource impairs the beneficial use of that resource. Overwhelming evidence confirms the loss of fish and wildlife habitat in the Detroit River AOC. A comparison of Detroit River maps from 1815 and 1982 shows that industrial and urban development are primarily responsible for the disappearance of over 95 percent of upland forest, 96 percent of Canadian wetlands, and 97 percent of US wetlands. More recent information on the watersheds that drain into the Detroit River shows that urban and agricultural development continue to cause habitat loss. Not only have significant amounts of habitat been lost, but the quality of the remaining habitat has been significantly degraded.

In order to halt this decline, a moratorium on development in critical areas of the watershed is required. If the present rates of habitat loss persist, in fifteen years there may be no wildlife habitat left. Efforts have been made by the US Geological Survey and the Essex Region Conservation Authority, respectively, to identify natural areas that should be considered high priorities for protection and to set restoration targets for the area as a whole. Designated quality natural areas and other existing habitats should be protected through conservation easements, covenants, servitudes, land rezoning, and the acquisition through donation or purchase of parcels of land that will be protected in perpetuity. Special efforts should be made to secure unique habitats. Given the already very low levels of natural cover in the watershed, it is critical that existing habitat be protected. Even the best restoration projects can take years to become established, and often only serve to offset habitat that has been lost to development without any net gains.

Although it can be far more difficult and expensive than protecting and enhancing existing habitats, restoring habitats that have already been lost it is a necessary part of achieving these delisting targets. The realities of the area obviously preclude the restoration of all of the 96 to 97 percent of historic habitat that has been lost in the Detroit River AOC. However, realistic targets for the protection of biodiversity can be achieved. Currently in the AOC only approximately six percent of natural cover/habitat remains. This percentage should be doubled to at least twelve percent at a minimum. This still falls below some of Environment Canada's habitat targets, however, if twelve percent of the AOC were comprised of quality fish and wildlife habitat, then the Detroit River would no longer be considered as seriously degraded as it once was. Efforts should continue to attempt to increase natural cover in order to continue to improve fish and wildlife habitat in the area, but this BUI may be considered for delisting when levels reach twelve percent.

Forested areas should be expanded and connected so that the largest forest patch is at least 100 hectares - currently the largest patch is 62.4 hectares. The amount of overall forest cover currently stands at somewhere between 4.5 and 5.5 percent, which - although well short of Environment

Canada's recommended target of thirty percent - likely meets the minimum recommended forest cover target for the area of 4.8 percent. However, additional forest cover is required in order to achieve the riparian targets set out below. In addition, it is critical to link forest patches with forest corridors at least 100 metres wide - ideally 500 metres wide - to allow species residing in those areas to expand their ranges and maintain genetic diversity.

Riparian habitat, or naturally vegetated areas along First-to-Third Order streams and drains, should be found along a minimum of 75 percent of those streams before delisting occurs, a dramatic increase from the existing eight percent of streams, and that habitat should strive for a width of 30 metres. This minimum is still well short of the ultimate goal for the AOC, which would see riparian vegetation along over 90 percent of First-to-Third Order streams and surrounding all wetlands. Although riparian vegetation can take many forms, efforts should be made to conform to the area's natural vegetation. For example, most of the banks of the Canard River have historically been forested, and therefore rehabilitation efforts along the Canard should focus on forest planting. On the other hand, much of the area bordering Turkey Creek has historically been prairie, and therefore Turkey Creek rehabilitation projects should focus on prairie planting.

Finally, wetland areas must be increased and surrounded by buffer areas. Originally, there was a wetland corridor a kilometre and a half wide along the river which has been lost to infilling. Although that habitat can never be restored, wetlands should be increased where possible from their current levels of one to 1.5 percent, much of which has been negatively impacted by poor water quality, excessive sedimentation, and invasions of exotic species. Although common guidelines suggest six percent wetland cover, that goal may not be realistic in the Detroit River watershed. Instead, wetland cover should be increased to more than 1.5 percent, the ecological functioning of wetlands should be improved where necessary and possible, and virtually all wetland areas should be bordered by a 240 metre wide buffer strip to ensure sustainability and provide high quality wildlife nesting habitat. Wetlands are critical not only because they provide habitat and food for fish and wildlife, but also because they increase water quality by filtering sediments, nutrients, and contaminants from inflowing waters, and provide hydrological benefits such as flood protection by reducing flood peaks and shoreline erosion.

Beneficial Use Impairment #15 - Exceedance of Water Quality Standards/Objectives

(Added by the Detroit River Canadian Cleanup Committee in 1998)

Delisting criteria:

- 1) The geometric mean for problematic historic and emerging RAP-critical pollutants (including, but are not limited to, PCBs, lead, cadmium, zinc, dioxins, copper, and mercury) found at upstream/downstream water quality index stations during the ice-free season complies with the most stringent Canadian and US guidelines for a minimum of two years, and should follow a continuing downward trend.

Water quality assessment is the basis for all monitoring programs. In riverine situations such as the Detroit River, a typical strategy for monitoring water quality is an upstream/downstream index station approach, complemented by compliance monitoring of discharges along the river. This allows accurate assessment of whether or not the source of water contamination is local. If water at upstream and downstream sites exceeds objectives equally, it can be inferred that the source of the problem is outside the AOC and, as such, cannot be addressed within the watershed. Ontario water quality objectives are conservative numerical concentrations established to support and protect designated uses of water for all forms of aquatic life and all aspects of the aquatic life cycle during indefinite exposure to the water. As such, they are often used as simple references for assessing aquatic ecosystem health. By contrast, Michigan employs the principle of 'independent applicability', which holds that if any biological, chemical, or toxicological indicators fail to meet guidelines at a target site, the site is not considered to have attained water quality standards.

Due to the fact that the failure to meet water quality objectives is linked to so many other beneficial use impairments, it is critical that long-term monitoring programs are ongoing. Samples should be taken at least six times annually from sites at both the upper and lower ends of the river. Critical contaminants that have been problematic in the past and therefore should be monitored include, but are not limited to, PCBs, lead, cadmium, zinc, dioxins, copper, and mercury. Results should be made available to governmental bodies, research organizations, and the general public.

