Summary of Water Quality Information

Summer 1994

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INTRODUCTION

The Northeast Ohio Regional Sewer District (the District) was created in 1972 by the Cuyahoga County Common Pleas Court to assume the operation and management of wastewater collection, treatment, and disposal facilities serving the Cleveland metropolitan area. The District is an independent political subdivision of the State of Ohio governed by a seven-member Board of Trustees. Three members are appointed by the City of Cleveland, three by the Suburban Council of Governments, and one by the Cuyahoga County Board of Commissioners.

The District provides service for the City of Cleveland and 52 suburban communities. The service area encompasses 295 square miles occupied by more than one million people. This area will continue to expand as the District completes construction of its Southwest and Heights/Hilltop intercepting sewers.

Three major wastewater treatment plants are operated by the District: Easterly and Westerly, which discharge their effluents to Lake Erie, and Southerly, which discharges its effluent to the Cuyahoga River. The total average daily flow treated by the plants is 310 million gallons with a full treatment capacity during rainfall of 465 million gallons. The District also maintains approximately 200 miles of interceptor sewers and operates a computerized combined sewer overflow control system.

From 1972 through 1993, the District had invested more than $987 million in system improvements and facility construction. These investments have contributed substantially to the improvements in the quality of the Greater Cleveland area's waterways. Additionally, they have been part of national and international efforts to protect and enhance the Great Lakes. During the May 1994 deliberations over reauthorization of the Clean Water Act, Senator Max Baucus (D-Montana), Chairman of the Senate Environment & Public Works Committee, singled out the Cuyahoga River and Lake Erie as outstanding examples of this nation's success at improving water quality.

As stewards of water quality in Northeast Ohio, the District actively monitors area waterways. The District also participates in tracking regional and national trends. The following summary is a brief compilation of some of the highlights from the District's water quality information. While certainly not comprehensive, it provides a few graphic examples of the dramatic improvements which have occurred during the District's existence. It also provides a few indications of where efforts to further improve water quality will need to be directed in the future. To best understand where we should go, we need the perspective of knowing where we have been and how far we have come.

Please address any comments or questions you may have concerning the following information to:

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PHOSPHORUS IN LAKE ERIE

In the early 1970's, Lake Erie was commonly described as a "dying" lake. The reason for this description was that Lake Erie had been becoming choked with algae. The algae, when it died, would fall to the lake bottom and decay, depleting the bottom waters of oxygen. The loss of oxygen wiped out many of the organisms upon which desirable game fish depended for food. In addition to the disappearance of these fish, the excessive algae growth was causing unsightly conditions along the shoreline and foul-tasting drinking water.

The situation was primarily attributable to elevated loadings to the lake of nutrients, especially phosphorus, which spurred algae growth. Major sources of phosphorus included fertilizer running off from farms and phosphate from detergents passing through municipal sewage treatment plants. Prior to 1972, sewage treatment plants did not typically remove phosphorus.

After phosphorus was recognized as the nutrient of concern in Lake Erie in 1970, several initiatives produced dramatic declines in phosphorus loadings to Lake Erie and the other Great Lakes. High-phosphate detergents were replaced in the marketplace and were eventually banned. Farmers began to implement conservation tillage practices to reduce farmland runoff. Municipal wastewater treatment plants applied technologies to remove phosphorus from sewage. The resulting decreases in phosphorus loadings from municipal sources are presented in **Figures 1 and 2.**

Because of the lower phosphorus loadings, blooms of algae are now rare and areas of oxygen depletion in Lake Erie have been reduced. The benefits are evident in an improved fishery, better-tasting drinking water, and more attractive beaches. Lake Erie can no longer be described as "dying."

Figure 1

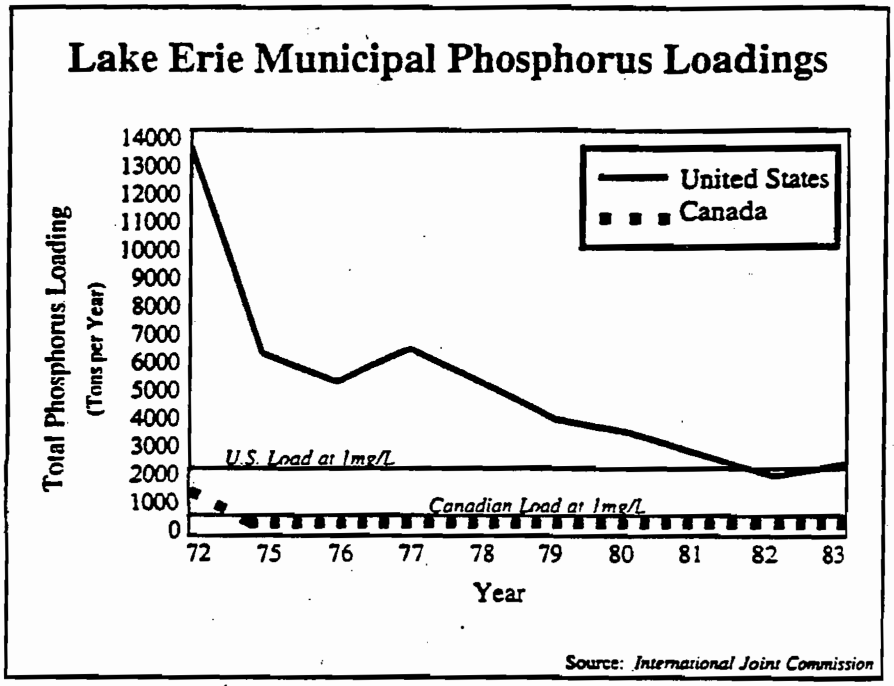
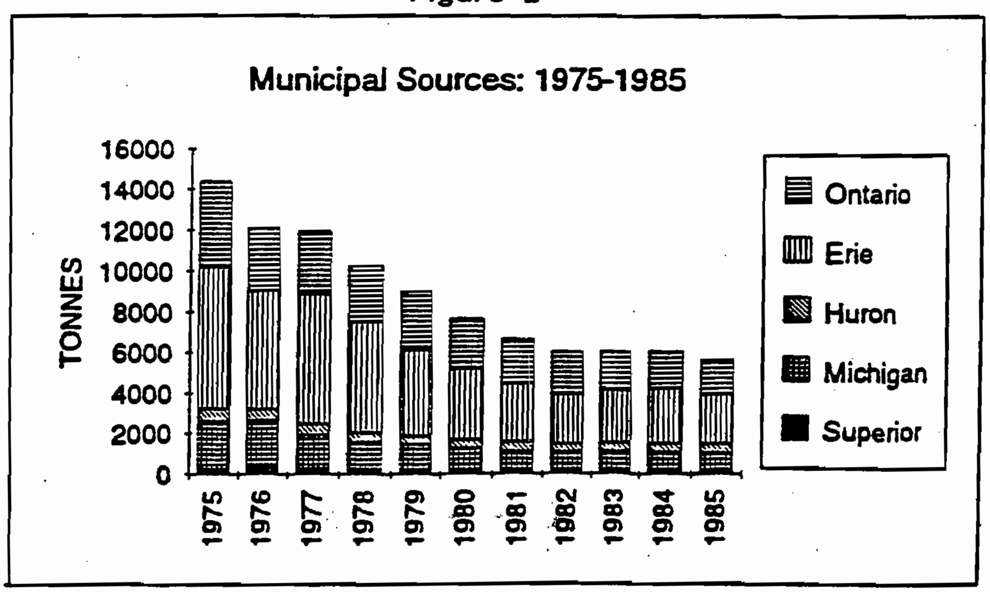


Figure 2



Phosphorus Loadings to the Great Lakes
(Great Lakes Water Quality Board, 1987).

METALS CONCENTRATIONS AT EASTERLY

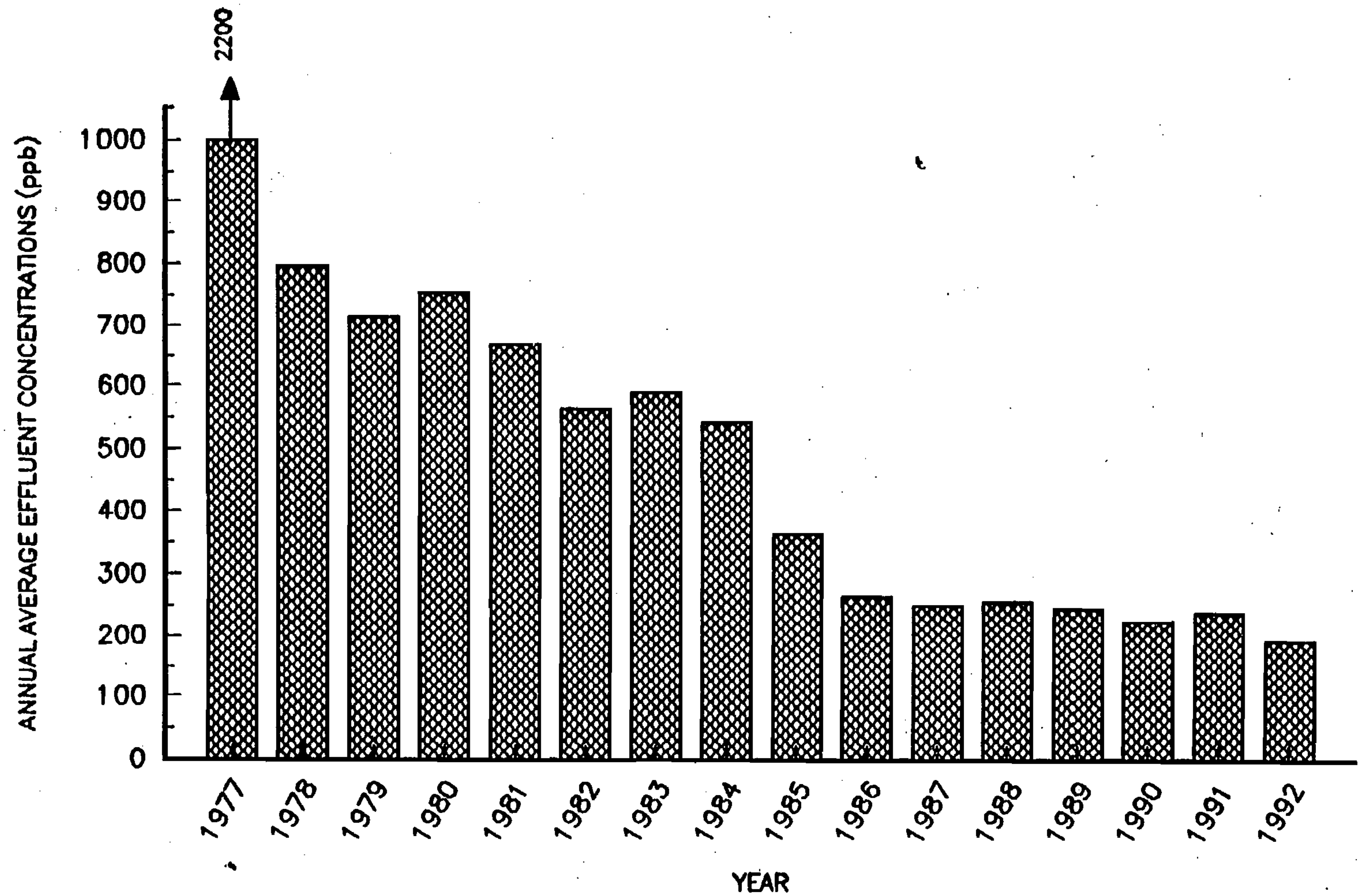
Several metals are of concern in water bodies because, at high enough concentrations, they can be toxic to aquatic life. **Figure 3** presents the decline of the concentration of total heavy metals (cadmium, chromium, copper, lead, nickel, and zinc) in the Easterly wastewater treatment plant effluent, the District's largest discharge to Lake Erie. This decline is mostly attributable to improved pollutant removal effectiveness at the treatment plant and implementation of the District's pretreatment program.

The declines in the effluent concentrations of two individual metals, chromium and nickel, are presented in **Figures 4 and 5**. Each of these declines are largely due to industry's installation and operation of pretreatment equipment to remove metals from wastewater before its discharge to the sewer system. Implementation of the District's pretreatment program began in 1975. Ten years later, in 1985, the District became "control authority" with the responsibility for enforcing federal pretreatment regulations.

The decline in the Easterly plant's effluent concentration of lead is presented in **Figure 6**. It is probable that, besides industrial pretreatment, this decline is largely due to the phase-out of leaded gasoline use. The phase-out began in the 1970's, and as lead levels continue to decline in the air and in the soils, so do the lead levels in municipal wastewater.

Figures 7 to 10 present 1992 concentrations of six heavy metals measured in the Easterly wastewater treatment plant effluent. In **Figures 7 and 8**, these concentrations are compared with the plant's current NPDES (National Pollutant Discharge Elimination System) limits set for these metals by the Ohio EPA. They are also compared with the water quality standards ("WQS") set by the Ohio EPA to protect aquatic life in Lake Erie from toxicity. In every case, the effluent concentrations of the metals are lower than the plant's discharge limits and they are meeting Lake Erie water quality standards.

In **Figures 9 and 10**, the effluent concentrations are compared with water quality standards proposed by the U.S. EPA in the Great Lakes Water Quality Initiative ("GLI"). They are also compared in these figures with federal drinking water maximum contaminant levels, although these standards do not apply to Lake Erie waters except at public water supply intakes. The comparisons indicate that the metals concentrations in the Easterly plant's effluent are not only low enough to meet the proposed water quality standards but that, with the single exception of the highest cadmium concentration, they are low enough for safe drinking!

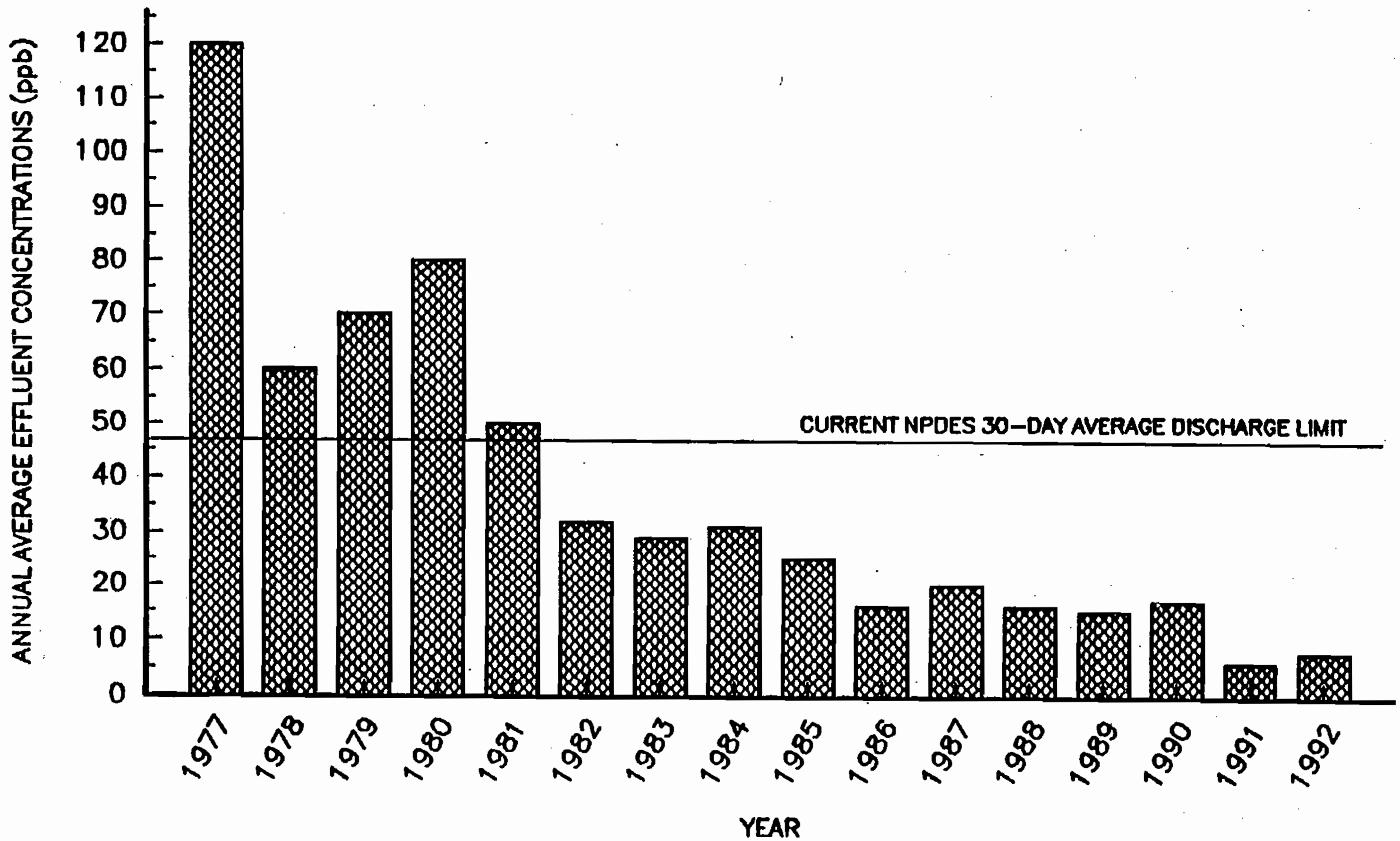


EASTERLY WASTEWATER TREATMENT PLANT

TOTAL METALS (Cd, Cr, Cu, Pb, Ni and Zn)

Figure 3

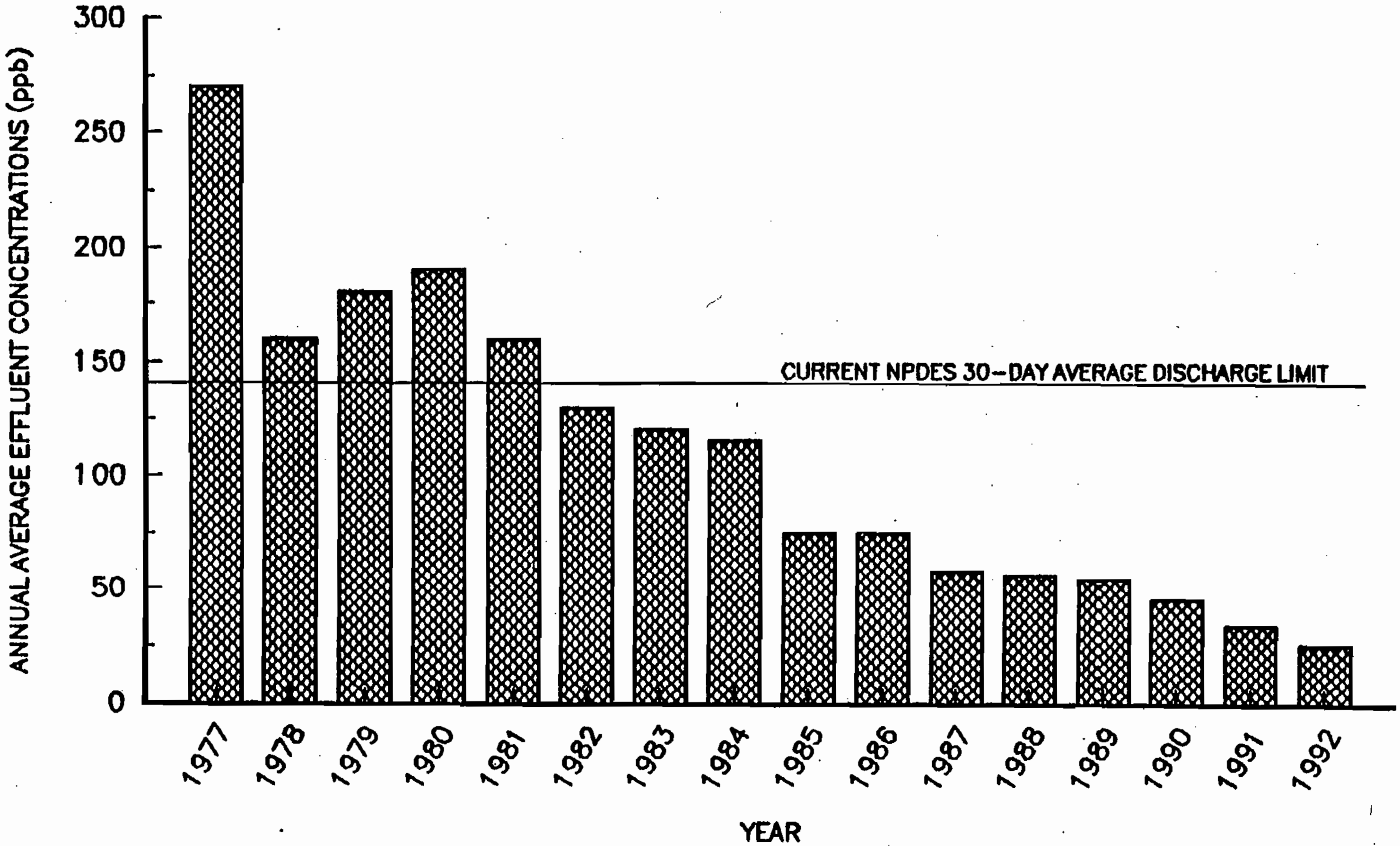
TCD/MTLTOTAL 11/26/93



EASTERLY WASTEWATER TREATMENT PLANT
CHROMIUM

Figure 4

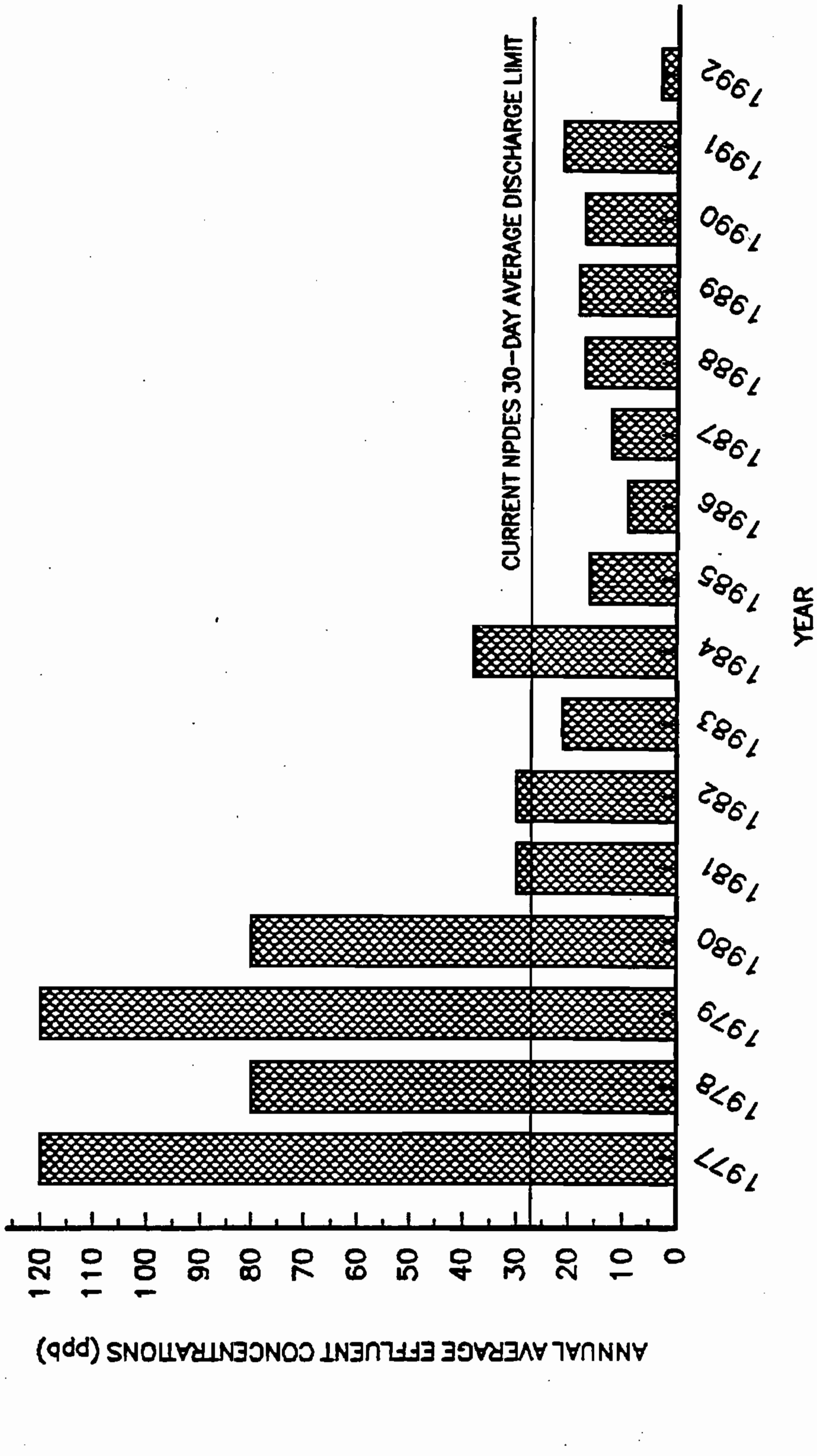
TCD/MTLCR 11/26/93



EASTERLY WASTEWATER TREATMENT PLANT
NICKEL

Figure 5

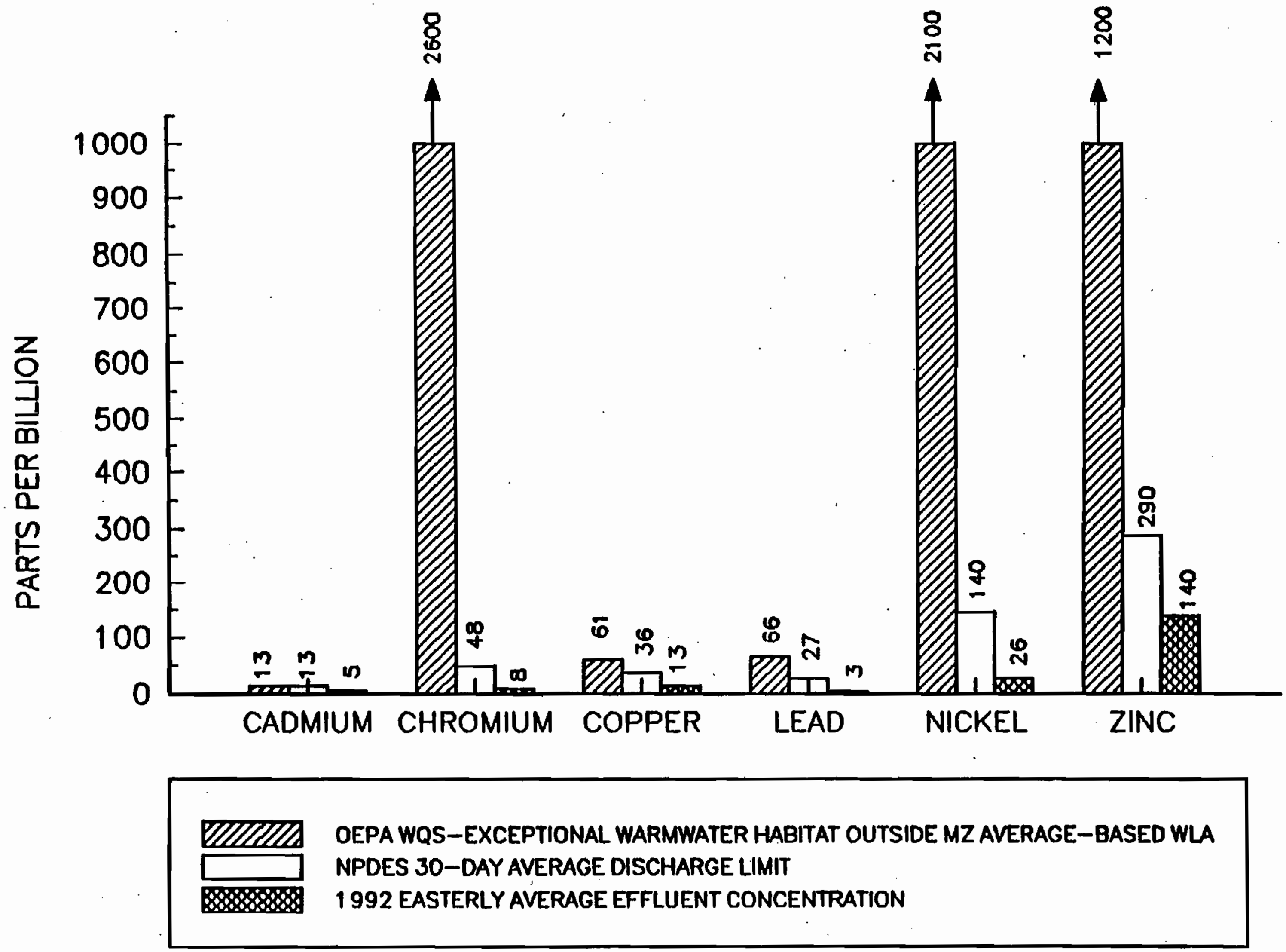
TCD/MTLNI 11/26/93



EASTERLY WASTEWATER TREATMENT PLANT
LEAD

Figure 6

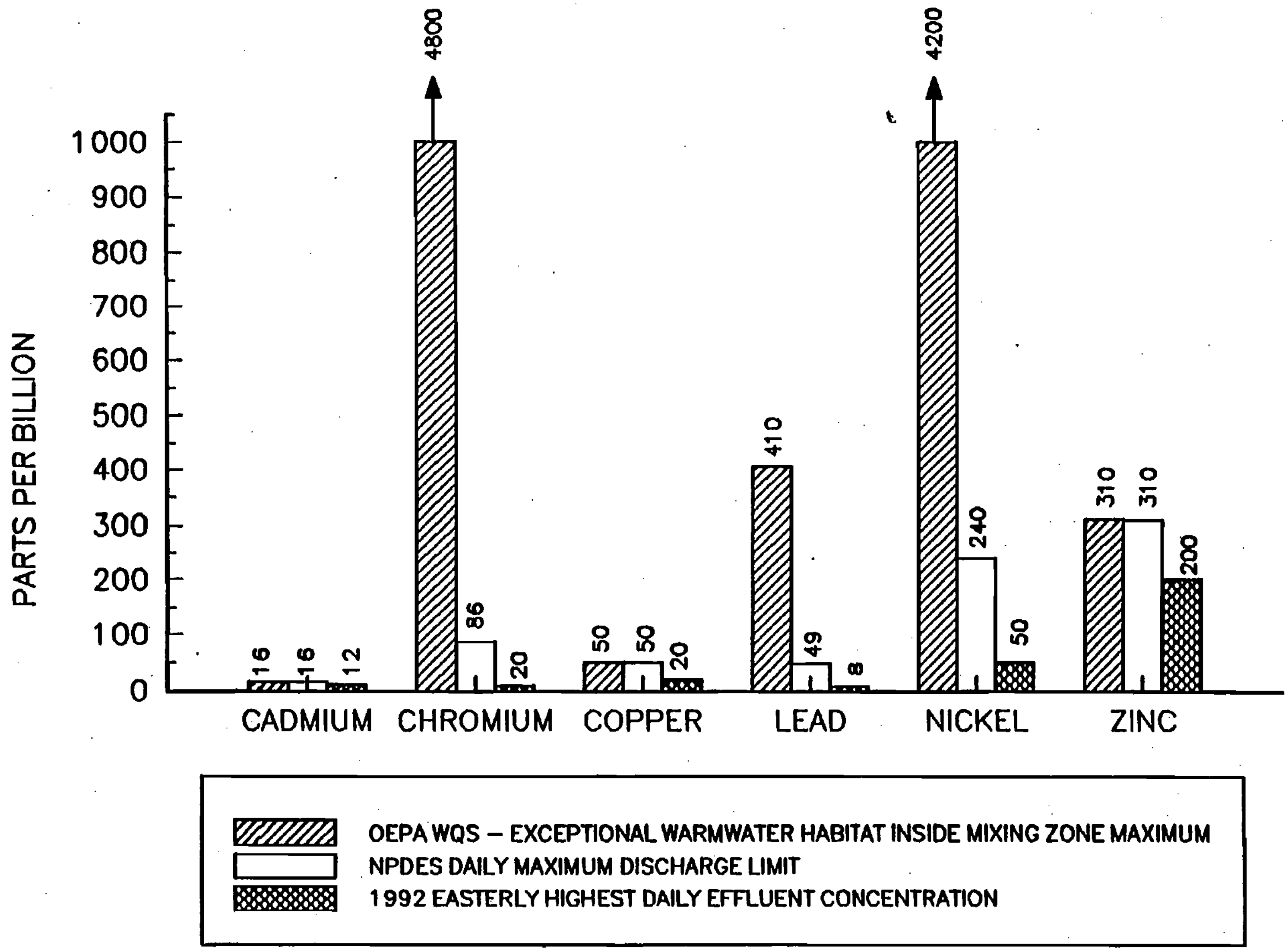
TCD/MTLPB11/26/93



EASTERLY WASTEWATER TREATMENT FACILITY

Figure 7

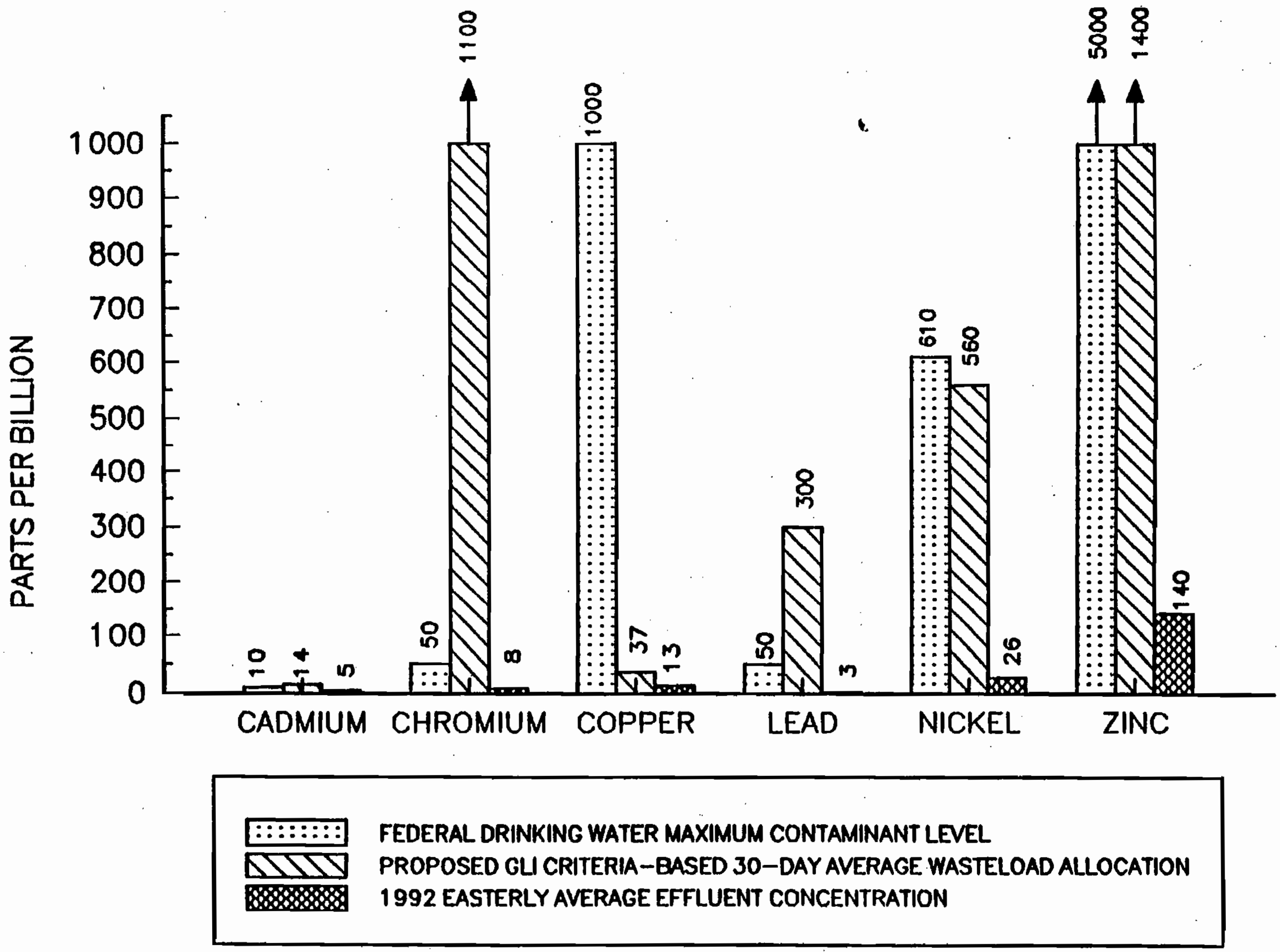
TCD/METALS2 11/26/93



EASTERLY WASTEWATER TREATMENT FACILITY

Figure 8

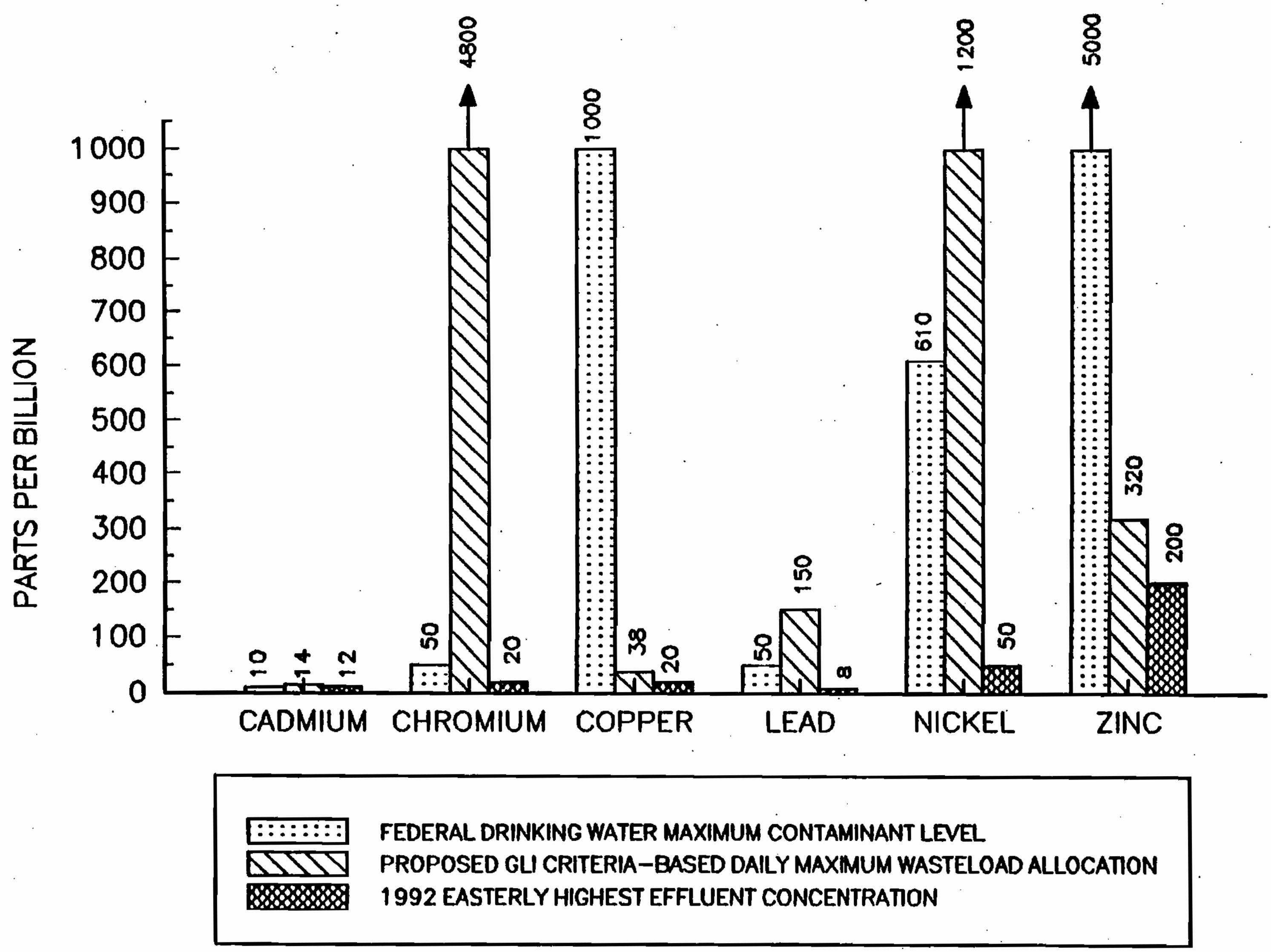
TCD/METALS-E 11/26/93



EASTERLY WASTEWATER TREATMENT FACILITY

TCD/METALS4 11/26/93

Figure 9



EASTERLY WASTEWATER TREATMENT FACILITY

Figure 10

TCD/METALS3 11/26/93

CUYAHOGA RIVER WATER QUALITY

By the late 1960's, the Cuyahoga River had achieved its reputation as a notorious example of this nation's heavily polluted waterways. Although this reputation may have been warranted years ago, the water quality of the Cuyahoga River has improved tremendously over the last couple of decades. Just how much it has improved can be seen in comparisons of historical data with more recent data. The data displayed in the following graphs are not, in some cases, the most recent data collected, but the improvement trends they reveal have continued into the present.

Figure 11 presents dissolved oxygen (D.O.) levels measured along the Cuyahoga River in 1954 compared with D.O. levels measured along the river in 1984. The D.O. concentrations are presented by "river mile," which is the distance in miles upstream from the river's mouth at Lake Erie.

Sufficiently high dissolved oxygen levels are critical for the survival of aquatic life. The Ohio EPA has set a minimum D.O. standard for the protection of aquatic life at 4.0 milligrams per liter. **Figure 11** shows that the D.O. concentrations in 1954 were failing to meet this D.O. standard throughout the entire length of the Cuyahoga River between Akron and Lake Erie. In fact, for much of the river no dissolved oxygen could be found at all! Conversely, the D.O. concentrations thirty years later, in 1984, were found to be well above the standard everywhere in the river except the navigation channel (downstream of river mile 5.6). D.O. levels in this channel continued to be depressed because dredging to maintain an artificial river depth there has resulted in a long water retention time with insufficient reaeration. Nevertheless, even in the navigation channel, D.O. levels were being measured in 1984 much higher than in 1954, when dissolved oxygen in this stretch was nonexistent.

Low dissolved oxygen levels in waterways occur due to the presence of oxygen-demanding materials. In addition to naturally occurring debris, these materials include organic waste matter and ammonia - both constituents of sanitary sewage. Microorganisms break down these materials in water but, in the process, they consume large quantities of oxygen. If sewage has not received adequate treatment for removal of these materials before its discharge, it can cause dissolved oxygen deficiencies in waterways, threatening aquatic life.

An analytical method used to measure the presence of the oxygen-demanding materials is the test for "biochemical oxygen demand" (BOD). **Figure 12** compares BOD levels measured along the Cuyahoga River in 1954 with BOD levels measured along the river in 1984. The comparison shows a dramatic decrease in BOD levels throughout the river during this thirty-year period. The decrease is attributable to more effective and more complete treatment of sewage.

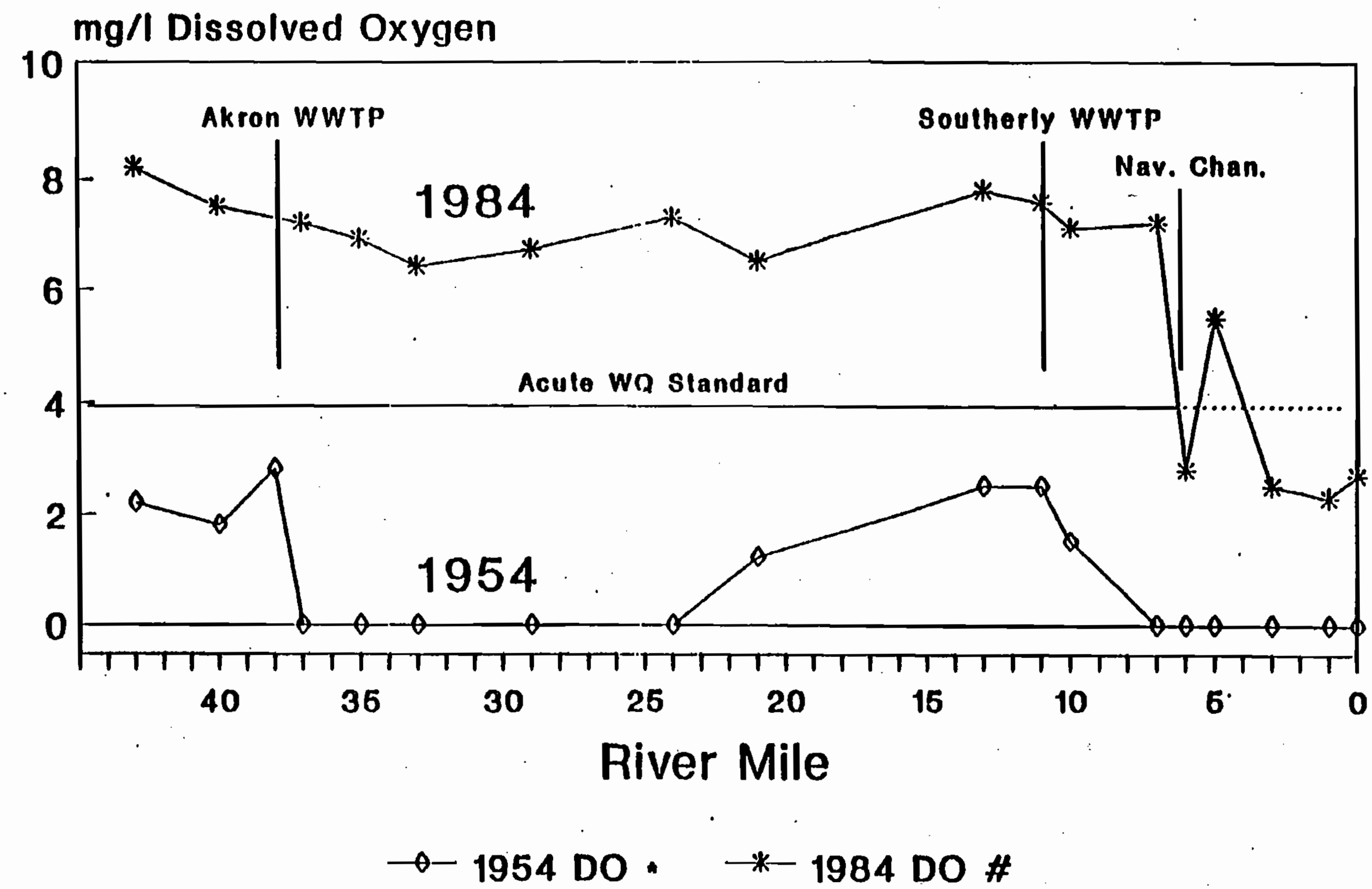
In addition to having oxygen-demanding properties, ammonia at high levels can be toxic to aquatic life. **Figure 13** shows that in 1965 ammonia levels throughout the Cuyahoga River were much higher than when they were measured again in 1984. As was the case for oxygen-demanding materials in general, the ammonia decrease was attributable to improved conveyance and treatment of sewage. After the District installed the advanced wastewater treatment process of nitrification at the Southerly plant in the mid-1980's, ammonia levels in the Cuyahoga River dropped even further. This further decline is evident in **Figure 14**. The contribution of ammonia from the Southerly plant has been lowered to the point where the ammonia levels in the river downstream of the plant's effluent are now indistinguishable from the levels of ammonia upstream of the plant's effluent.

Another indicator of the presence of insufficiently treated sewage in a waterway is an elevated concentration of fecal coliform bacteria. These bacteria are found in the intestinal tracts of warm-blooded animals including humans. They are not themselves harmful to aquatic life or humans, but their elevated levels in waterways can indicate the presence of sewage containing oxygen-demanding materials. Furthermore, they may indicate the presence of other microorganisms which can cause diseases in people who use the water.

Therefore, declines in concentrations of fecal coliform bacteria in waterways usually mean lower risks of harm to aquatic life and lower risks of disease in humans. **Figure 15** shows that the fecal coliform concentrations in the Cuyahoga River have declined significantly since the 1970's.

Intensive sampling during the summer of 1990 for fecal coliform bacteria was performed by the District and other organizations to obtain data for the Cuyahoga River Remedial Action Plan. This sampling effort provided an opportunity for comparison with results from a previous intensive sampling which had been performed by the City of Cleveland during the summer of 1972. This comparison is presented in **Figures 16 and 17**, and it is yet more evidence of the dramatic water quality improvement which has occurred in the Cuyahoga River during recent years.

CUYAHOGA RIVER DISSOLVED OXYGEN TRENDS

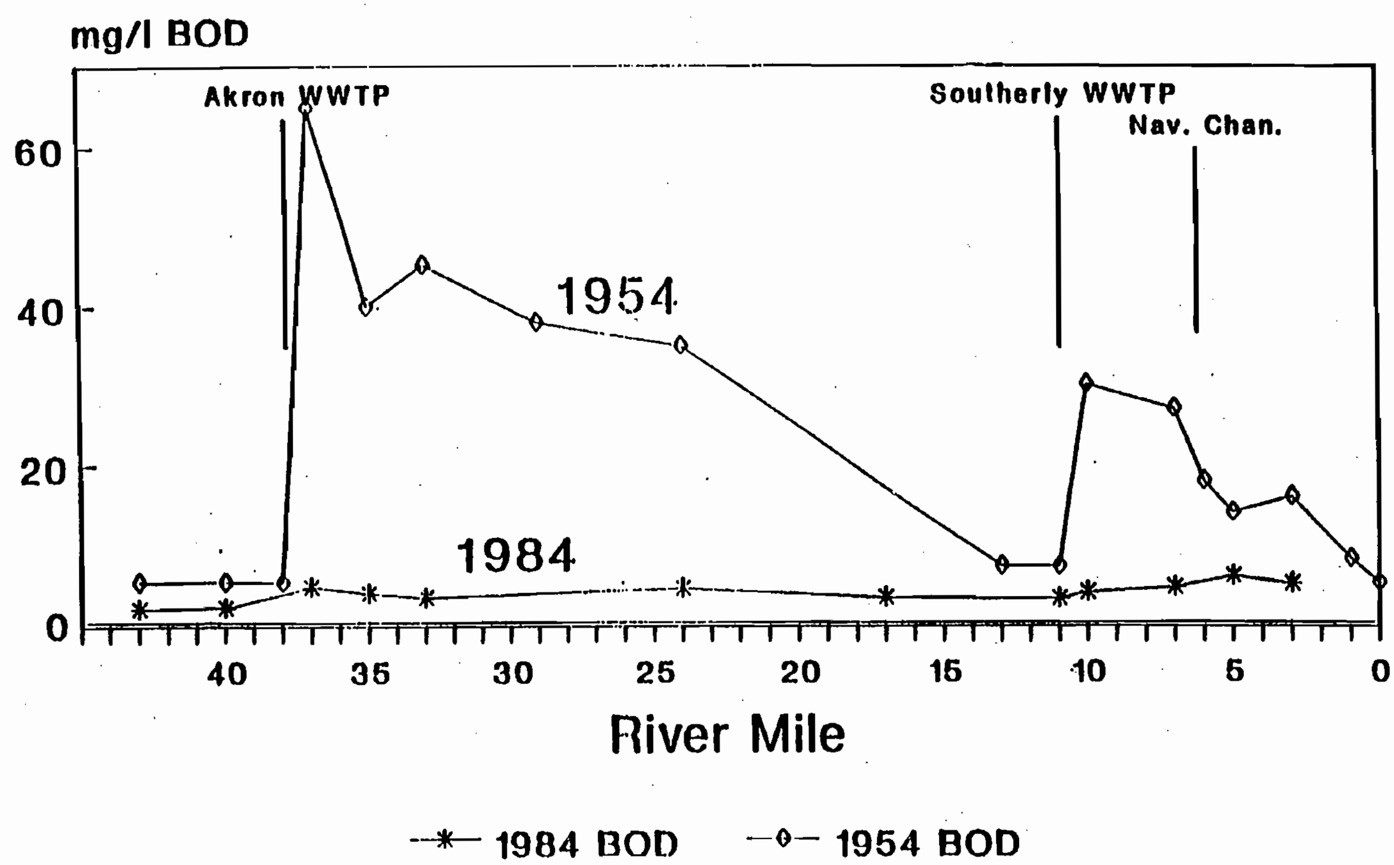


• One day grab samples
Average of five sampling runs

DATA COMPILED BY OHIO EPA

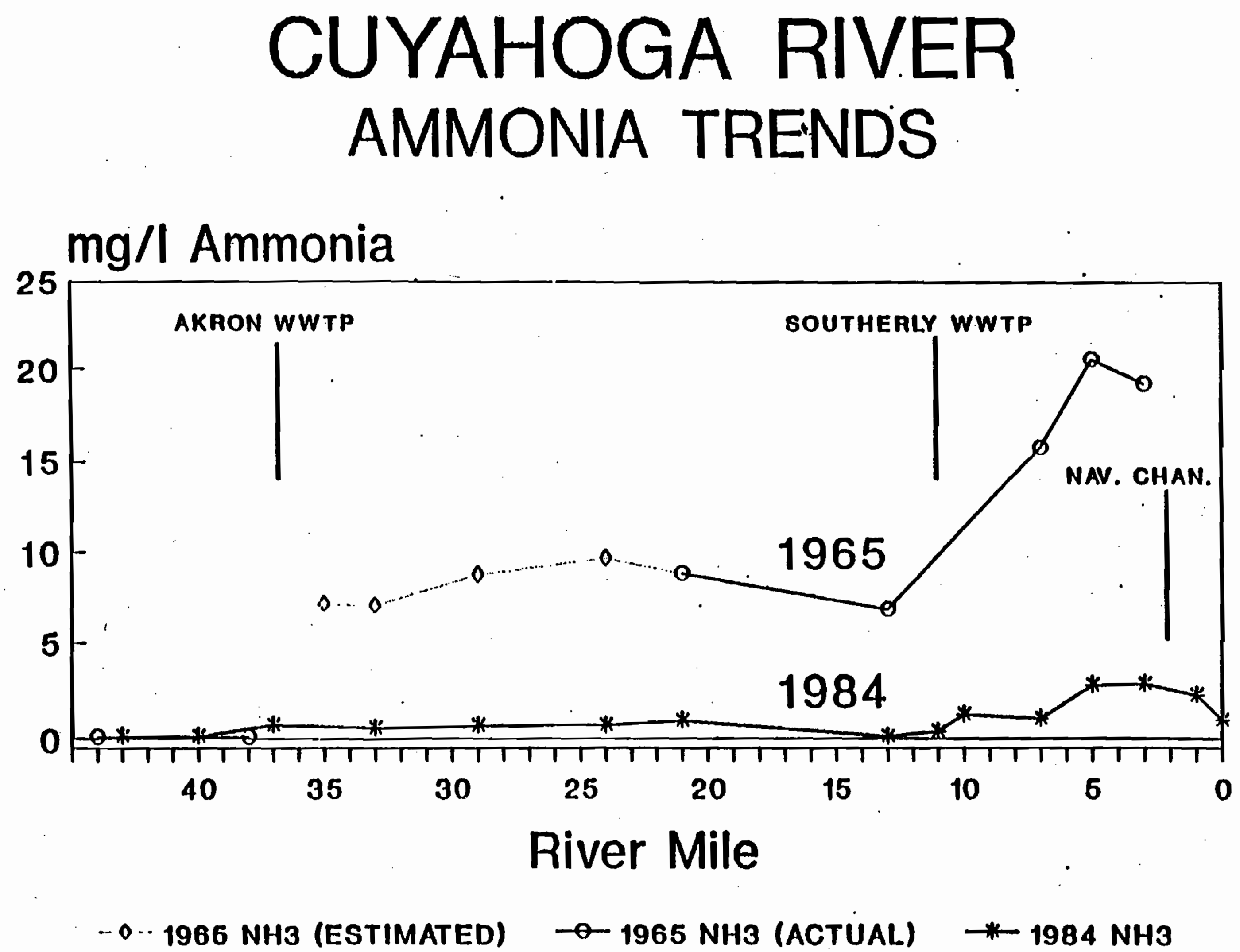
Figure 11

CUYAHOGA RIVER BIOCHEMICAL OXYGEN DEMAND



DATA COMPLIED BY OHIO EPA

Figure 12



DATA COMPILED BY OHIO EPA

Figure 13

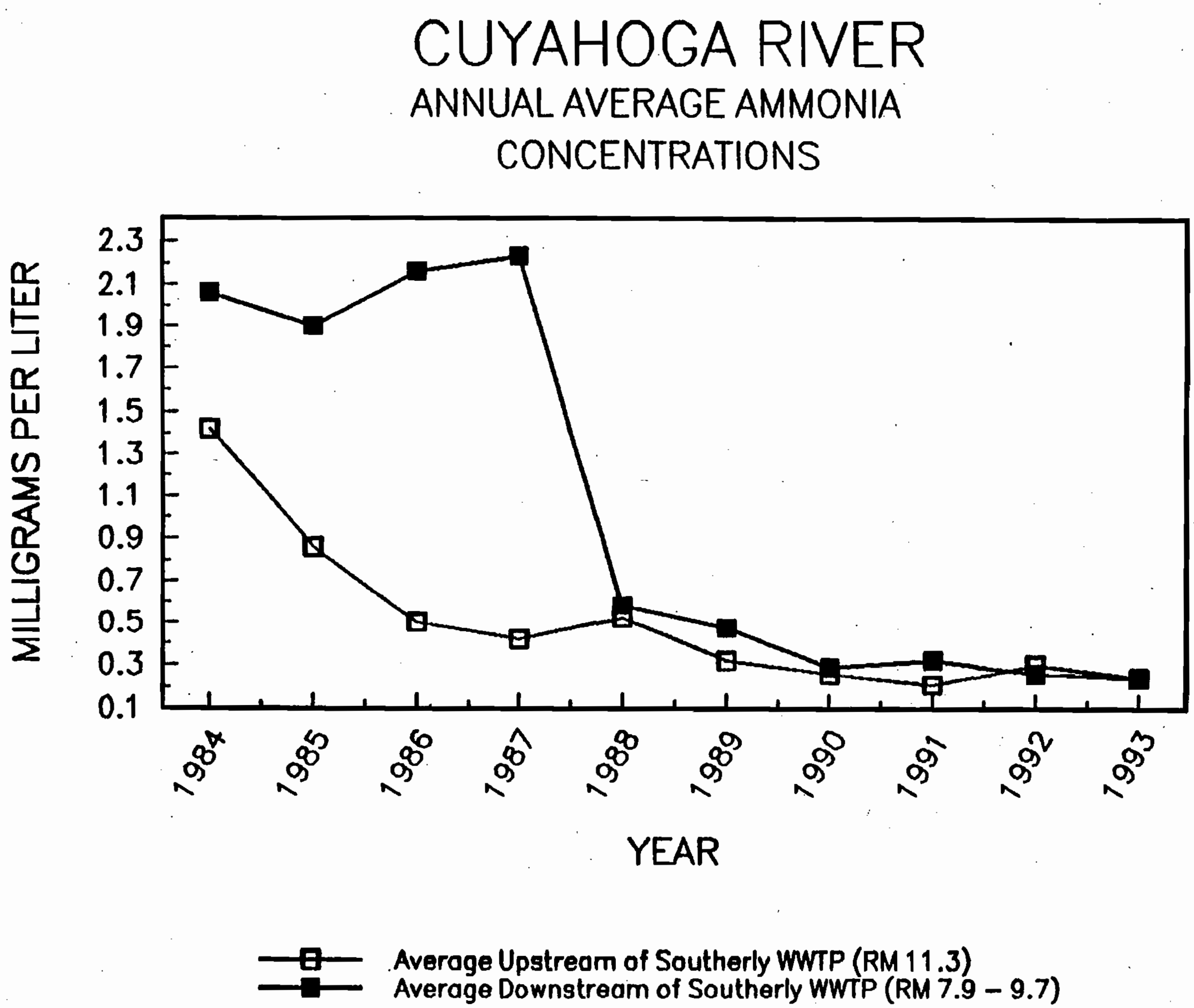


Figure 14

TDNH3SP 6/21/94

CUYAHOGA RIVER

MAY—TO—OCTOBER FECAL COLIFORM CONCENTRATIONS

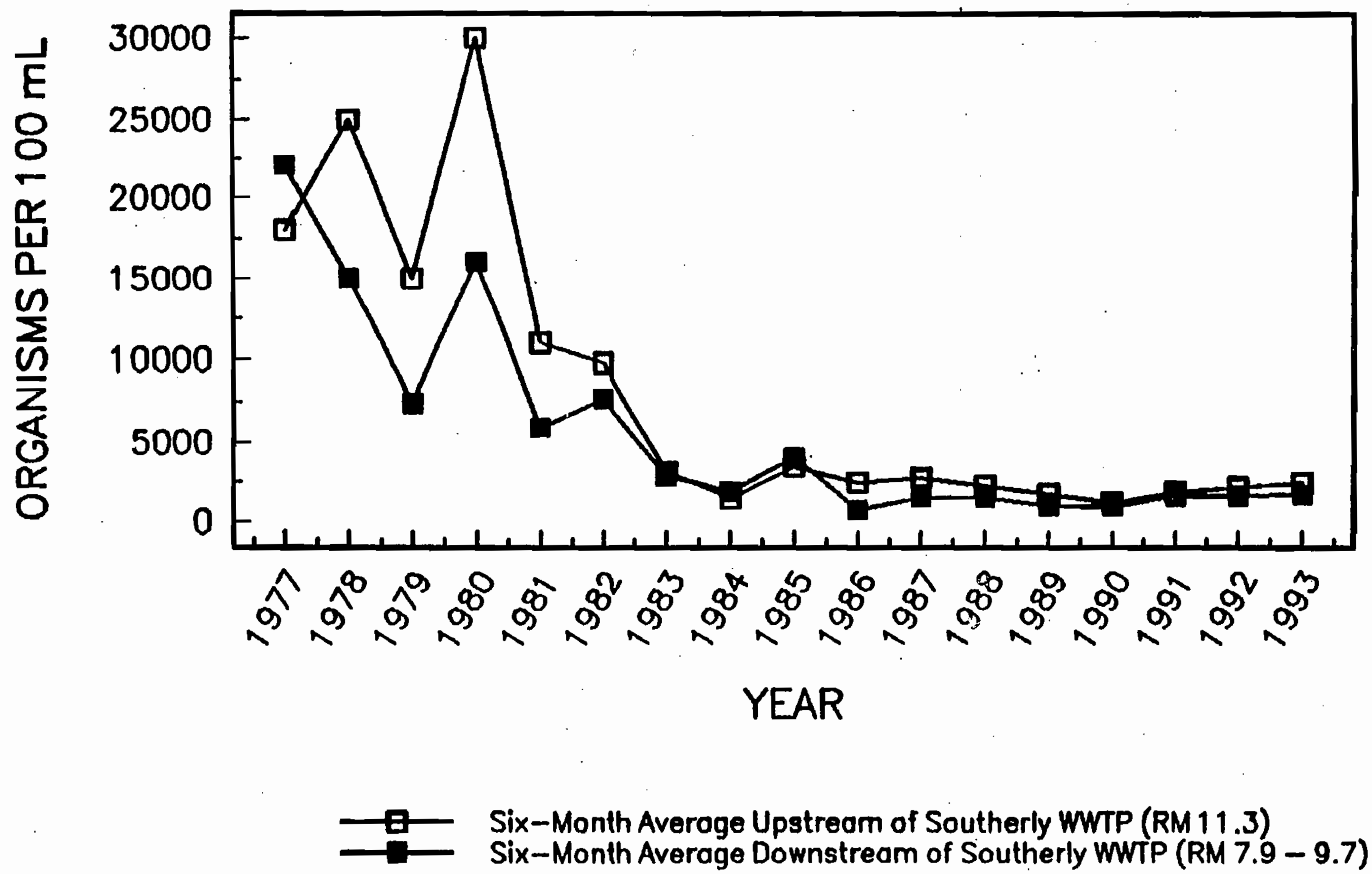


Figure 15

TDFCOLSP 6/21/94

Figure 16

CUYAHOGA RIVER FECAL COLIFORM DATA

Upstream of Southerly WWTP (RM 11.3)

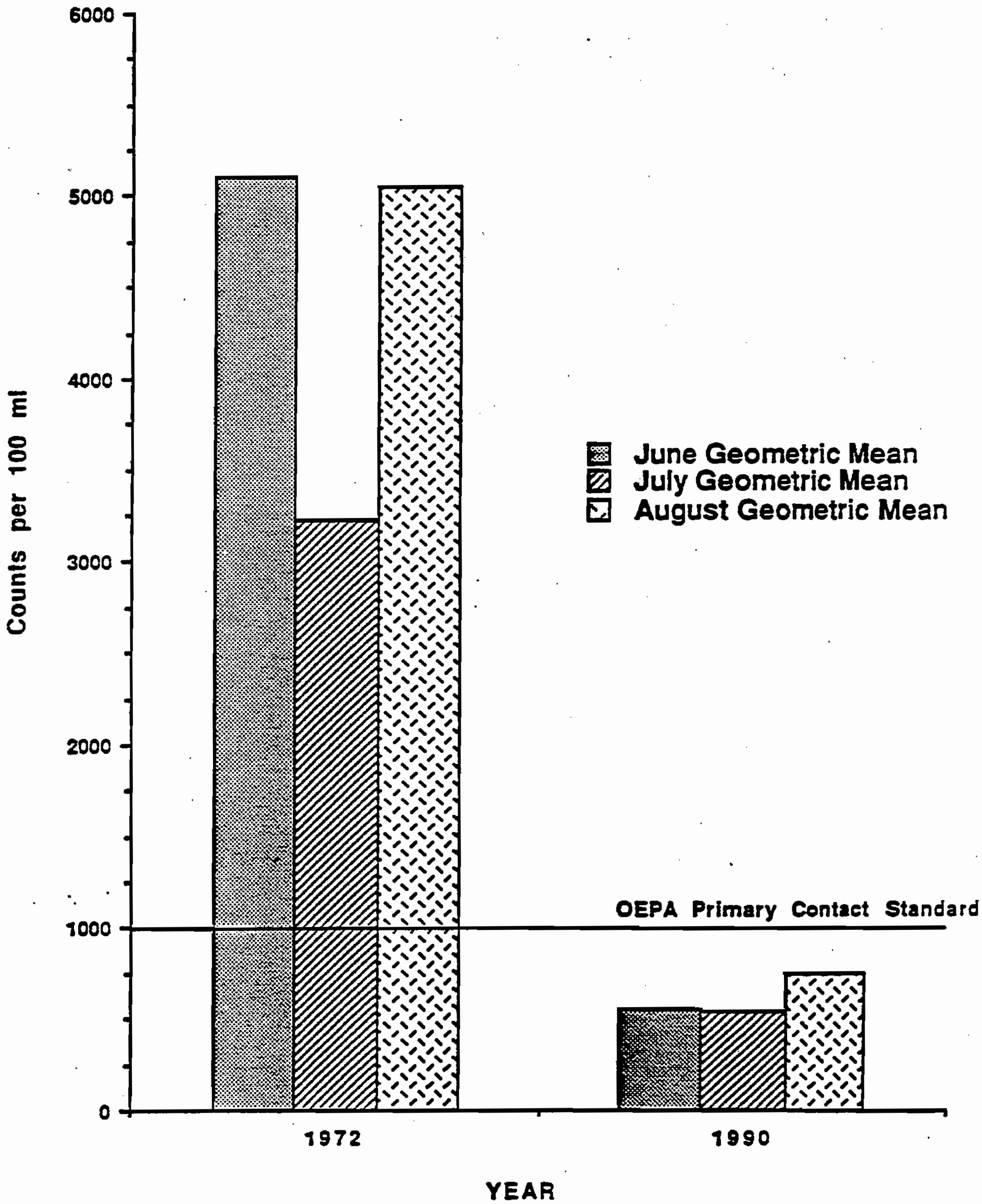
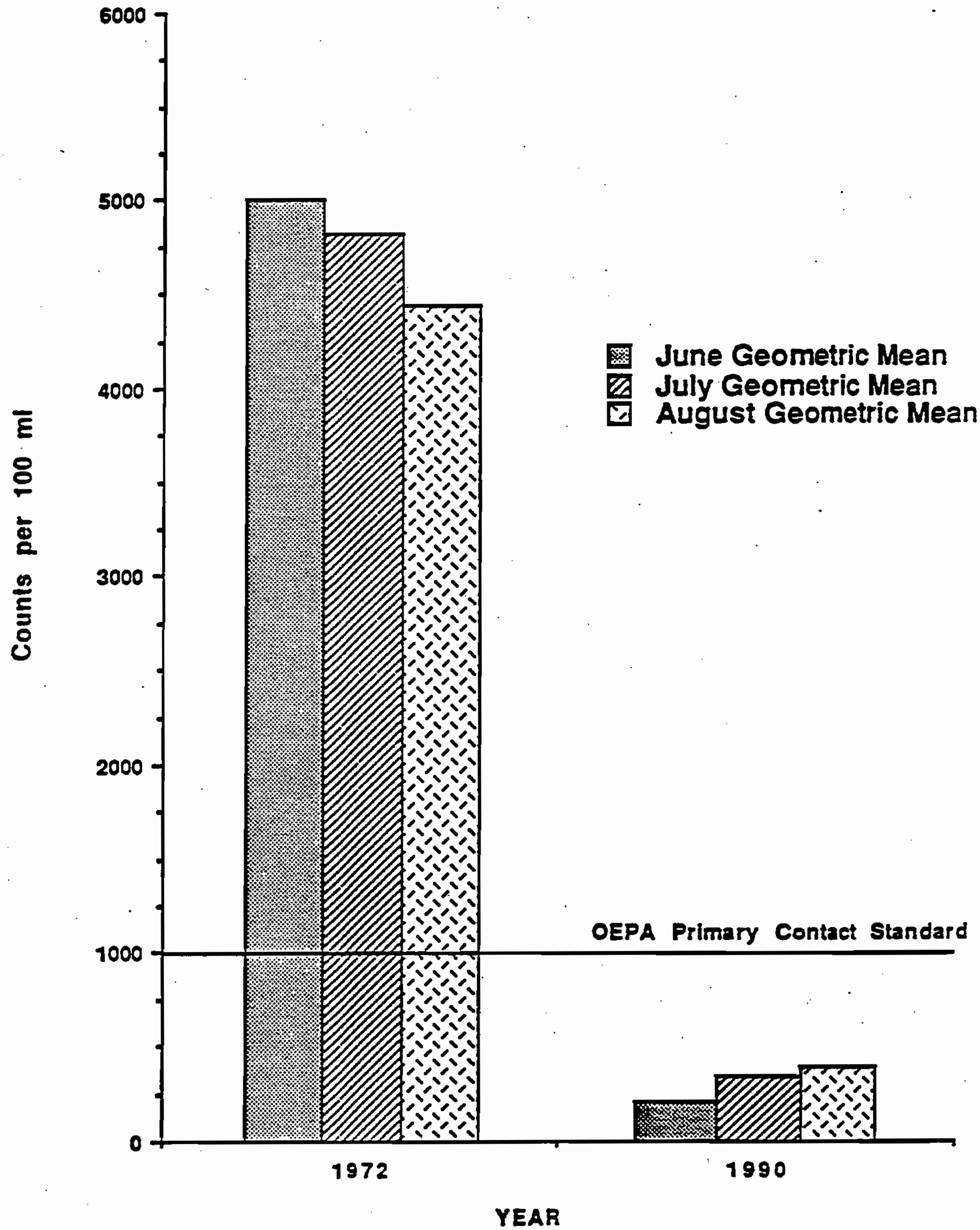


Figure 17

CUYAHOGA RIVER FECAL COLIFORM DATA

Downstream of Southerly WWTP (RM 7.9)



POLLUTANT LOADINGS FROM SOUTHERLY

Despite increased flows from an expanding service area, loadings of pollutants to the Cuyahoga River from the Southerly wastewater treatment plant have declined dramatically since the 1970's. Reductions in loadings of three types of pollutants - oxygen-demanding materials, suspended solids, and heavy metals - are shown in **Figures 18, 19, and 20.**

The reductions in biochemical oxygen demand and suspended solids loadings are attributable to improved pollutant removal effectiveness at the treatment plant through facility expansion, equipment upgrades, and enhanced operation. The reduction in heavy metals loadings is attributable to both pollutant removal at the plant and the District's implementation and enforcement of its pretreatment program.

Figures 21 and 22 present 1993 concentrations of six heavy metals measured in the Cuyahoga River downstream of the Southerly wastewater treatment plant discharge to the river. These concentrations are compared with the current applicable State of Ohio water quality standards and also the generally more stringent standards proposed by the U.S. EPA in the Great Lakes Water Quality Initiative.

The chronic standards presented in **Figure 21** were set at levels considered to be protective against longterm toxic effects on aquatic life. The Cuyahoga River 1993 average concentrations downstream of the Southerly discharge fully met both the current and the proposed standards.

The maximum standards presented in **Figure 22** were set at levels considered to be protective against acute toxic effects on aquatic life. The highest concentrations measured in the Cuyahoga River downstream of the Southerly discharge in 1993 met both the current and proposed standards except for two metals - copper and zinc. However, in both cases, these metals had higher concentrations in the river upstream of the treatment plant discharge. This fact indicates that these failures to meet water quality standards were not attributable to the Southerly wastewater treatment plant but to other pollutant sources. Since these elevated concentrations were measured only during the occurrence of heavy rain, these sources are probably diffuse or "nonpoint" sources such as land run-off, sediment resuspension, and atmospheric deposition.

Since "point" sources, such as industrial and municipal discharges, have become increasingly and effectively controlled in recent years, the nonpoint sources constitute much higher relative contributions to surface waters. Consequently, these more difficult-to-control nonpoint sources of pollution now warrant more attention than they have received in the past.

NEORSD Southerly WWTP Treated Effluent
Loadings of Biochemical Oxygen Demand
to the Cuyahoga River

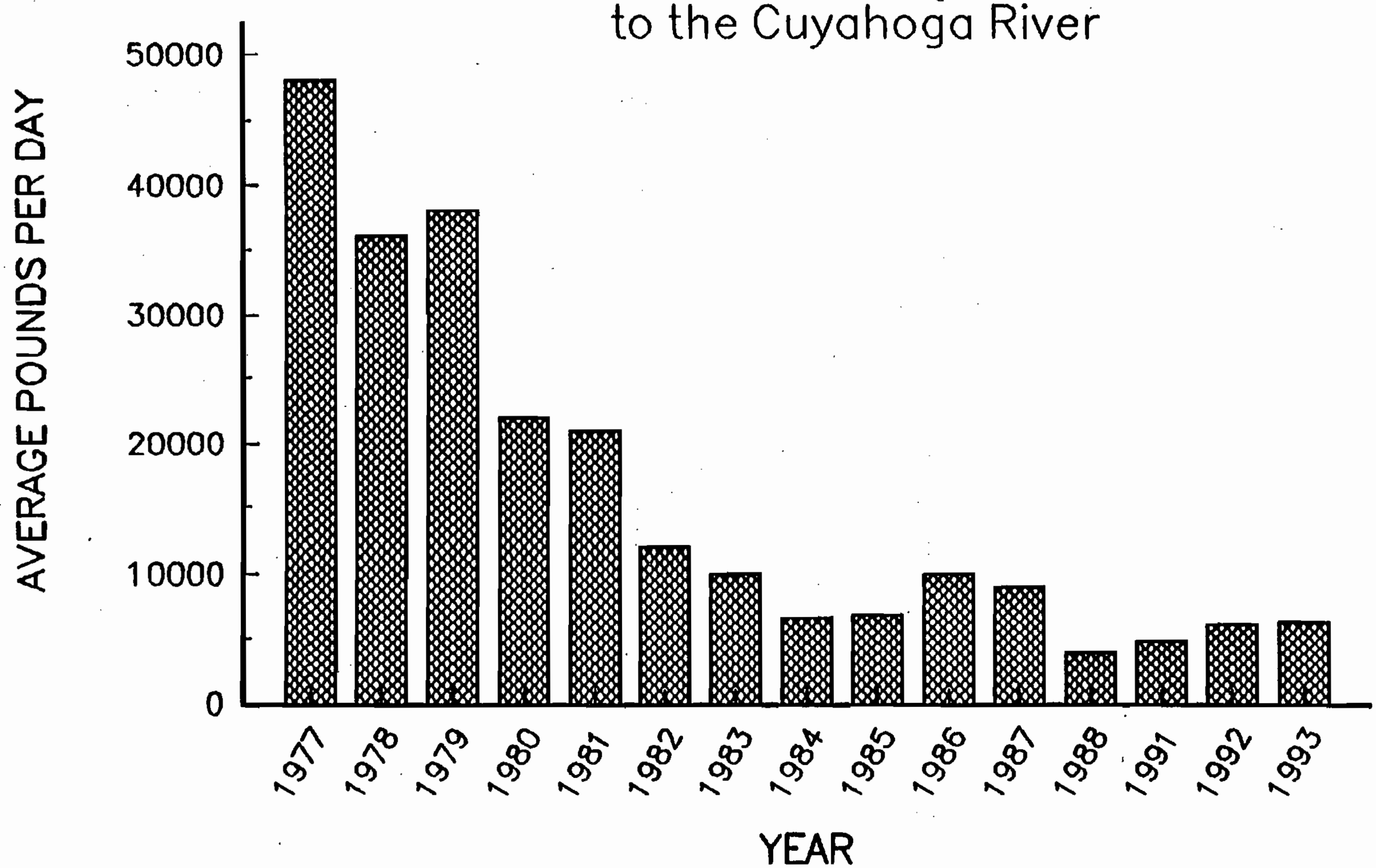


Figure 18

TDBODSP 6/21/94

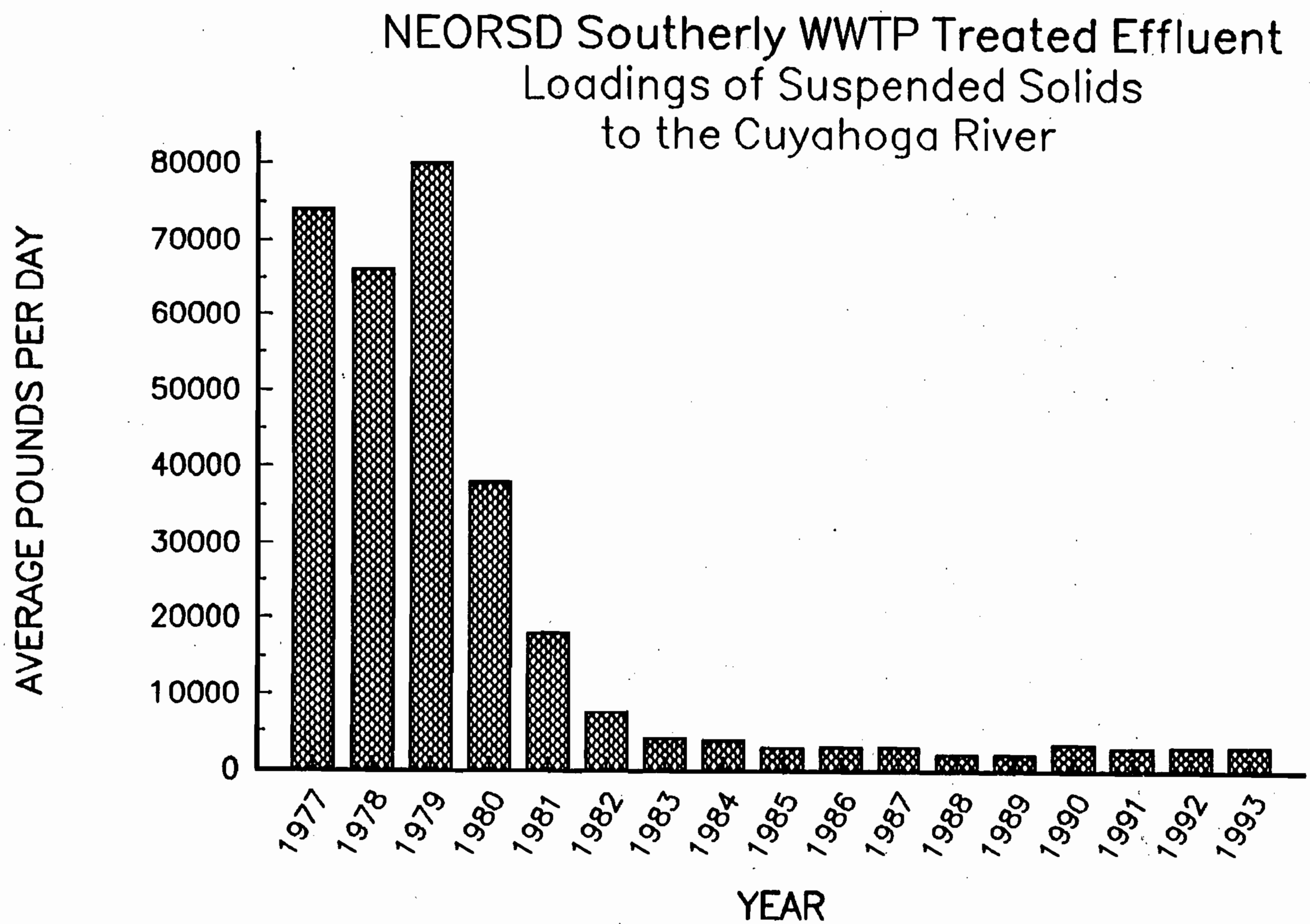
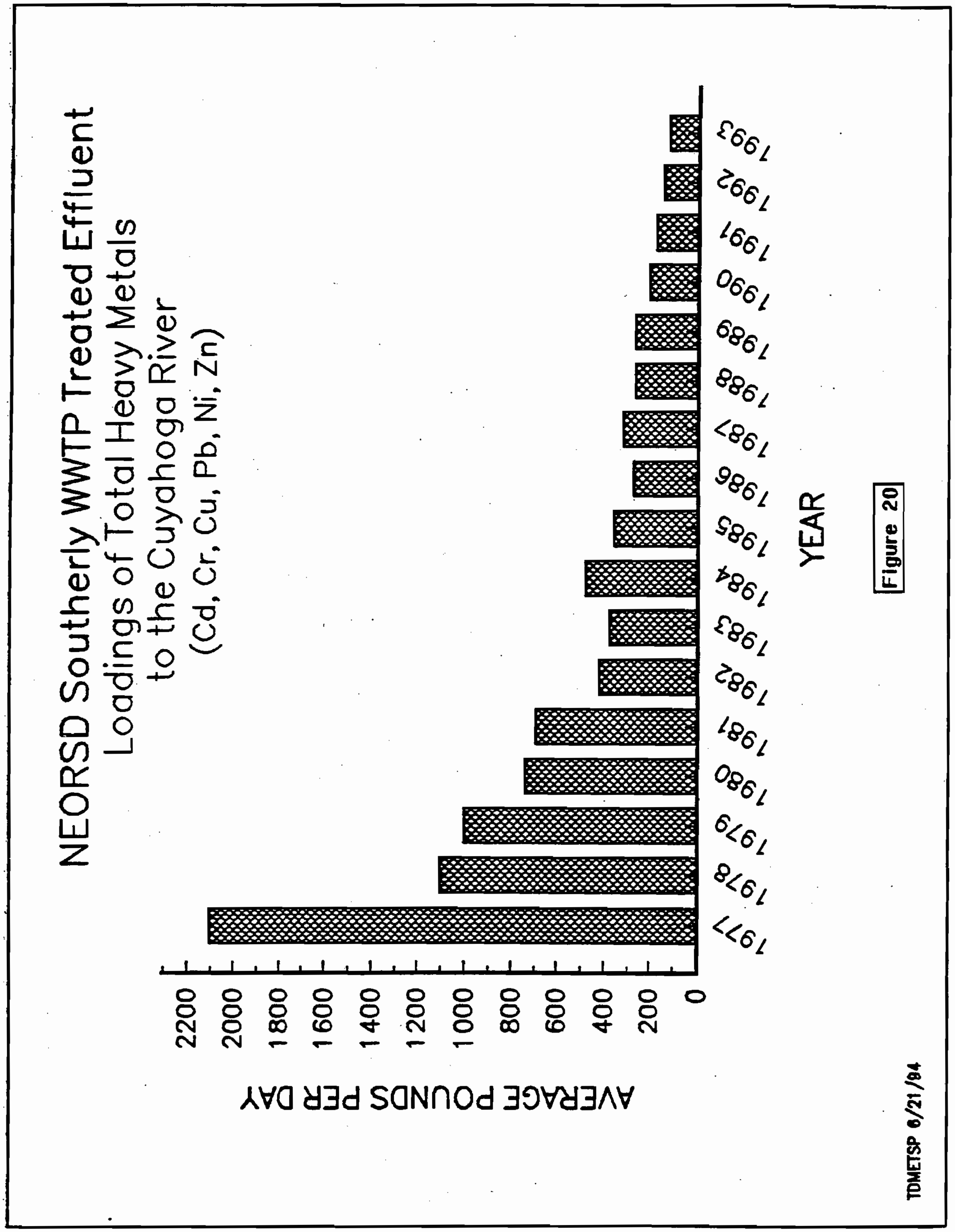
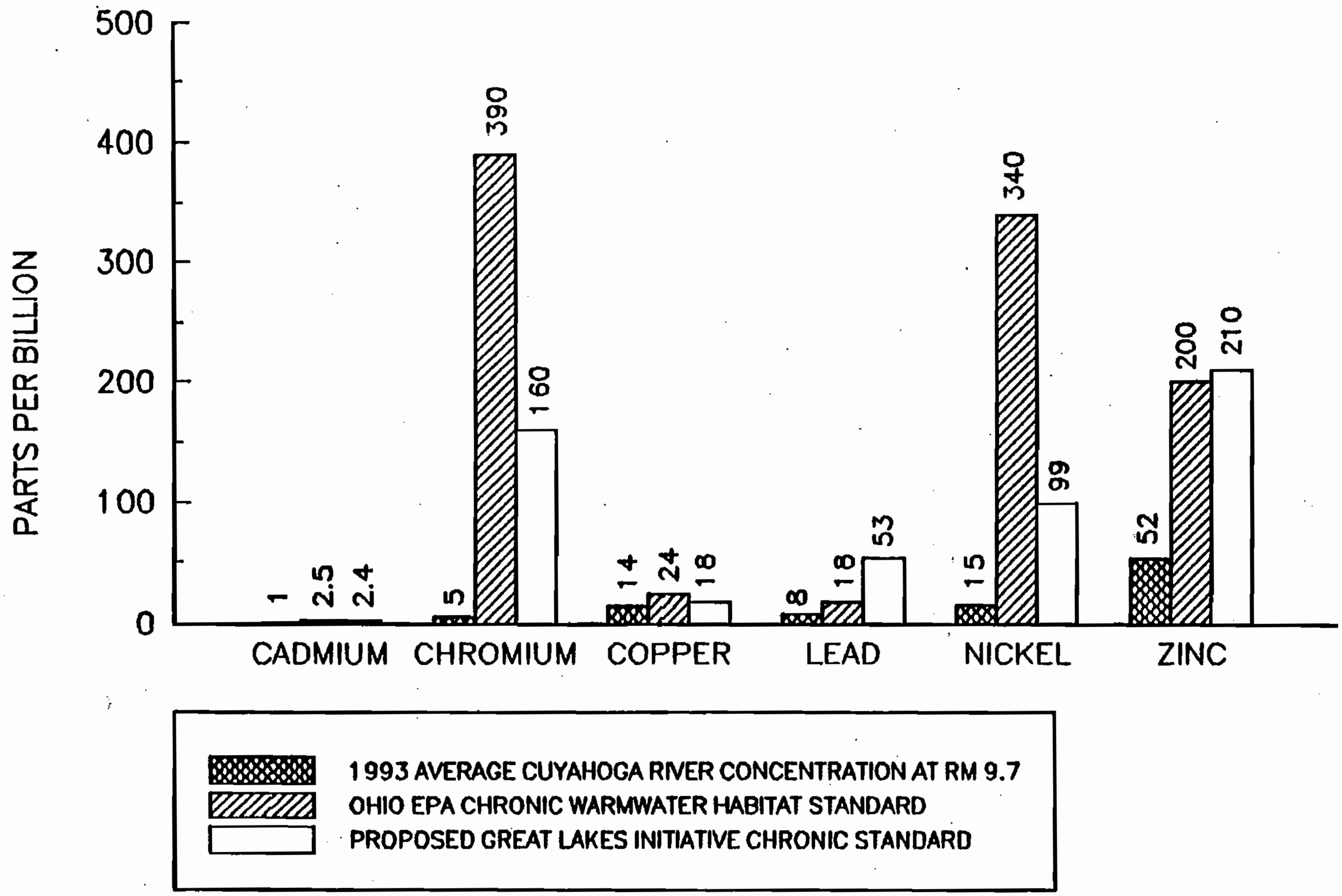


Figure 19

TDSSSP 6/21/94



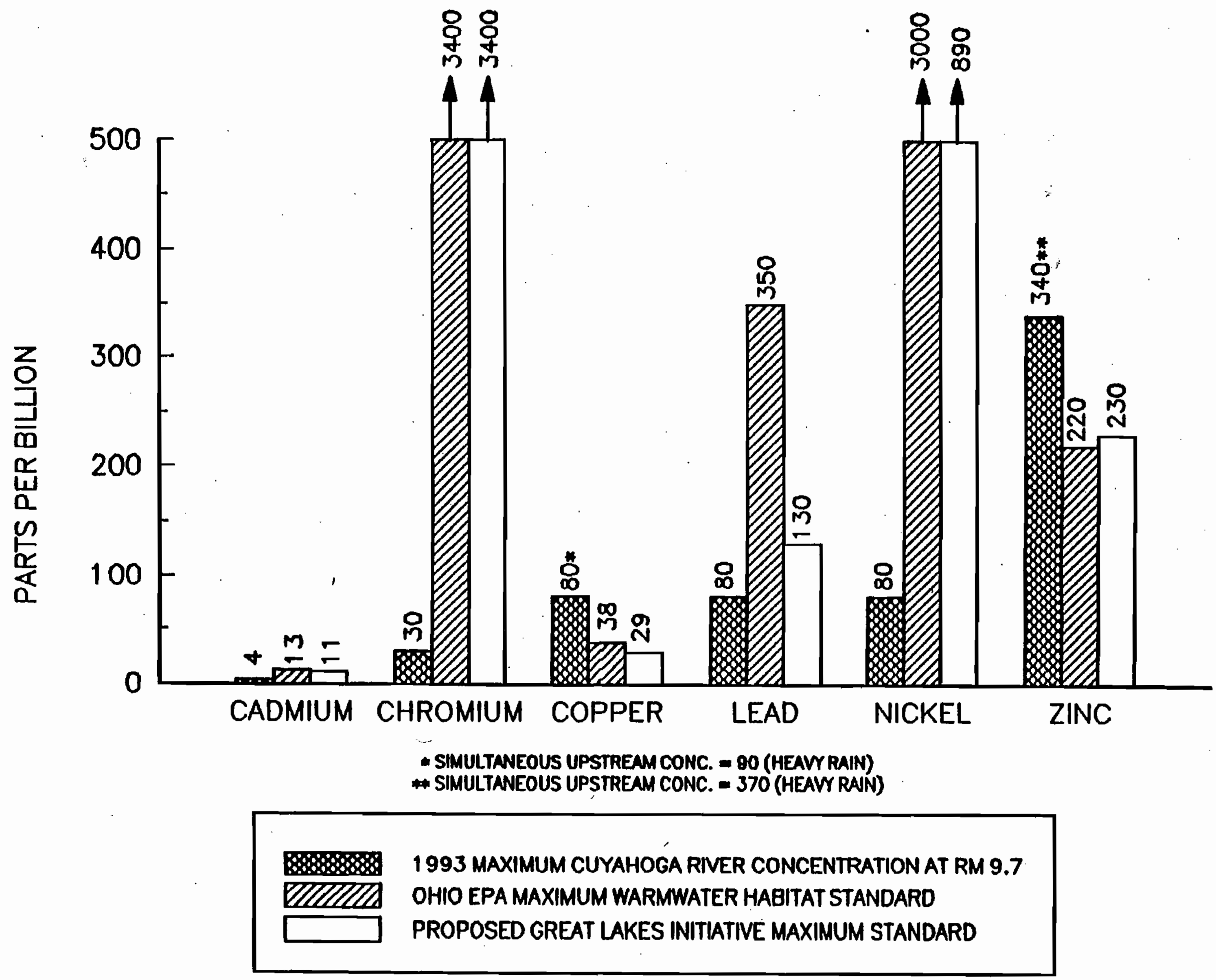
NEORSD Southerly WWTP Treated Effluent
Loadings of Total Heavy Metals
to the Cuyahoga River
(Cd, Cr, Cu, Pb, Ni, Zn)
AVERAGE POUNDS PER DAY
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
YEAR
Figure 20
TDMETSP 6/21/94



DOWNSTREAM OF SOUTHERLY TREATMENT PLANT

MTLSDSS1 /1/21/94

Figure 21



DOWNSTREAM OF SOUTHERLY TREATMENT PLANT

Figure 22

MTLSDSS2/1/21/94

CUYAHOGA RIVER INVERTEBRATES

By evaluating the aquatic life inhabiting a water body, water quality can be evaluated. One group of aquatic organisms which can provide useful water quality information is the invertebrates which live in the bottom regions of waterways. These invertebrates include insect larvae, crustaceans, snails, clams, worms, and other organisms. A high diversity of these organisms generally indicates a healthy ecosystem. Conversely, a low diversity usually indicates either that the habitat is not suitable or that the water body has been polluted. Furthermore, different types of invertebrates have different sensitivities to pollution. Therefore, knowledge of the types of organisms present and their sensitivities to pollution can reveal much about the water quality.

Indexes have been developed to evaluate aquatic invertebrates in waterways. Two of these indexes - the Invertebrate Community Index (ICI) and the Hilsenhoff Biotic Index (HBI) - are used to evaluate Cuyahoga River invertebrates in **Figures 23 and 24.**

The ICI in **Figure 23** is used to compare results from the Ohio EPA's sampling of the invertebrates in 1984 with more recent results obtained by the Ohio EPA and the District. This comparison shows that, although the invertebrates received only "fair" or "poor" ratings along the Cuyahoga River in 1984, water quality has improved to the point where most locations upstream of the navigation channel now receive a rating of "good."

The HBI in **Figure 24** indicates that all of the sites sampled upstream of the navigation channel by the District in 1991 received ratings of "good" or "very good." Because habitat becomes less suitable for most invertebrates in the downstream reaches, both indexes produced poorer ratings at the further downstream locations. The navigation channel, where the river bottom is periodically dredged and the natural banks have been replaced with steel pilings, has the least suitable habitat for invertebrates and therefore, not surprisingly, it received the poorest scores. With these artificial constraints, significantly better scores may never be achieved in the channel, regardless of water quality. Nevertheless, the river sites with more suitable habitat have shown dramatic improvement over the last decade, reflecting the river's water quality improvement.

Figure 23

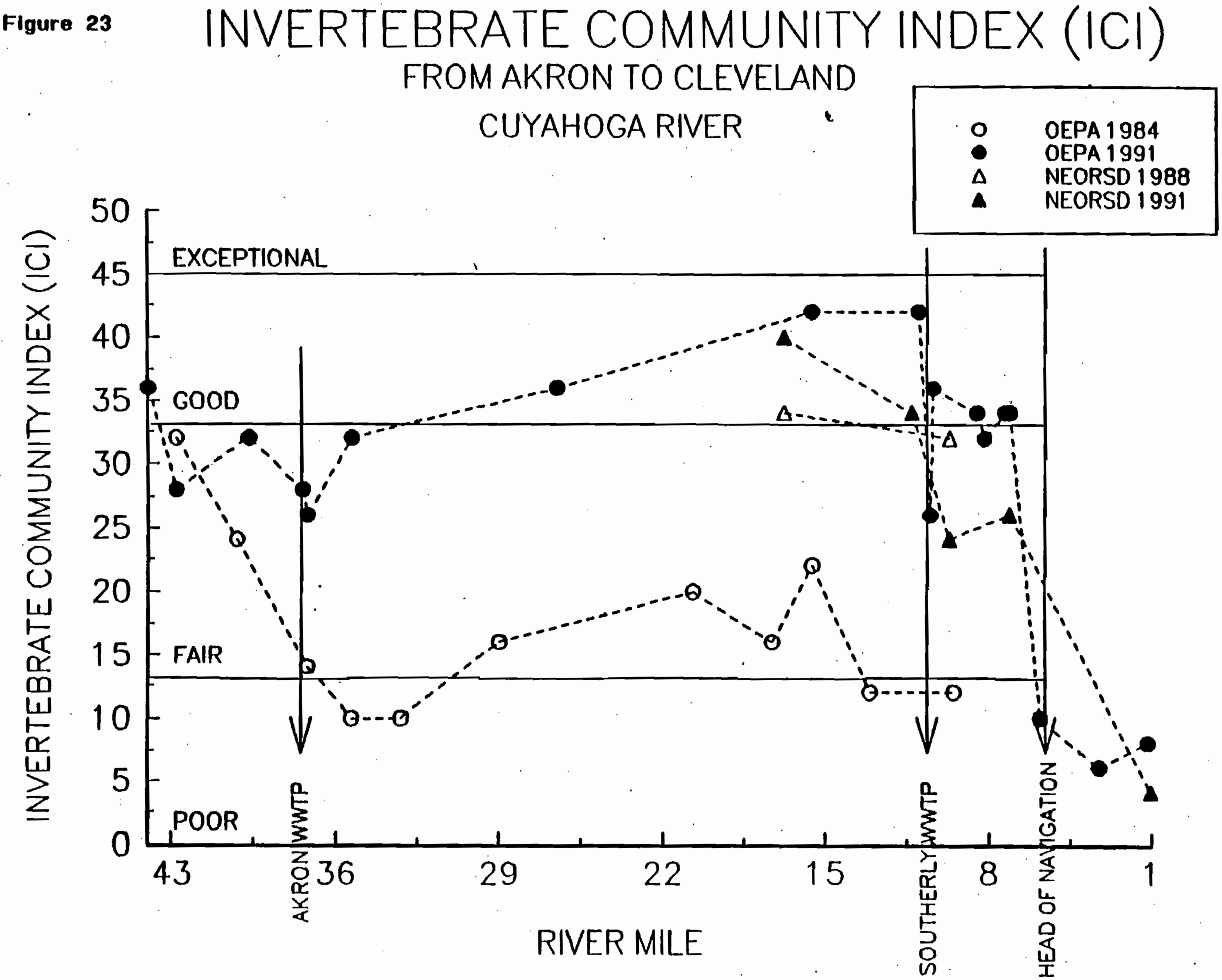
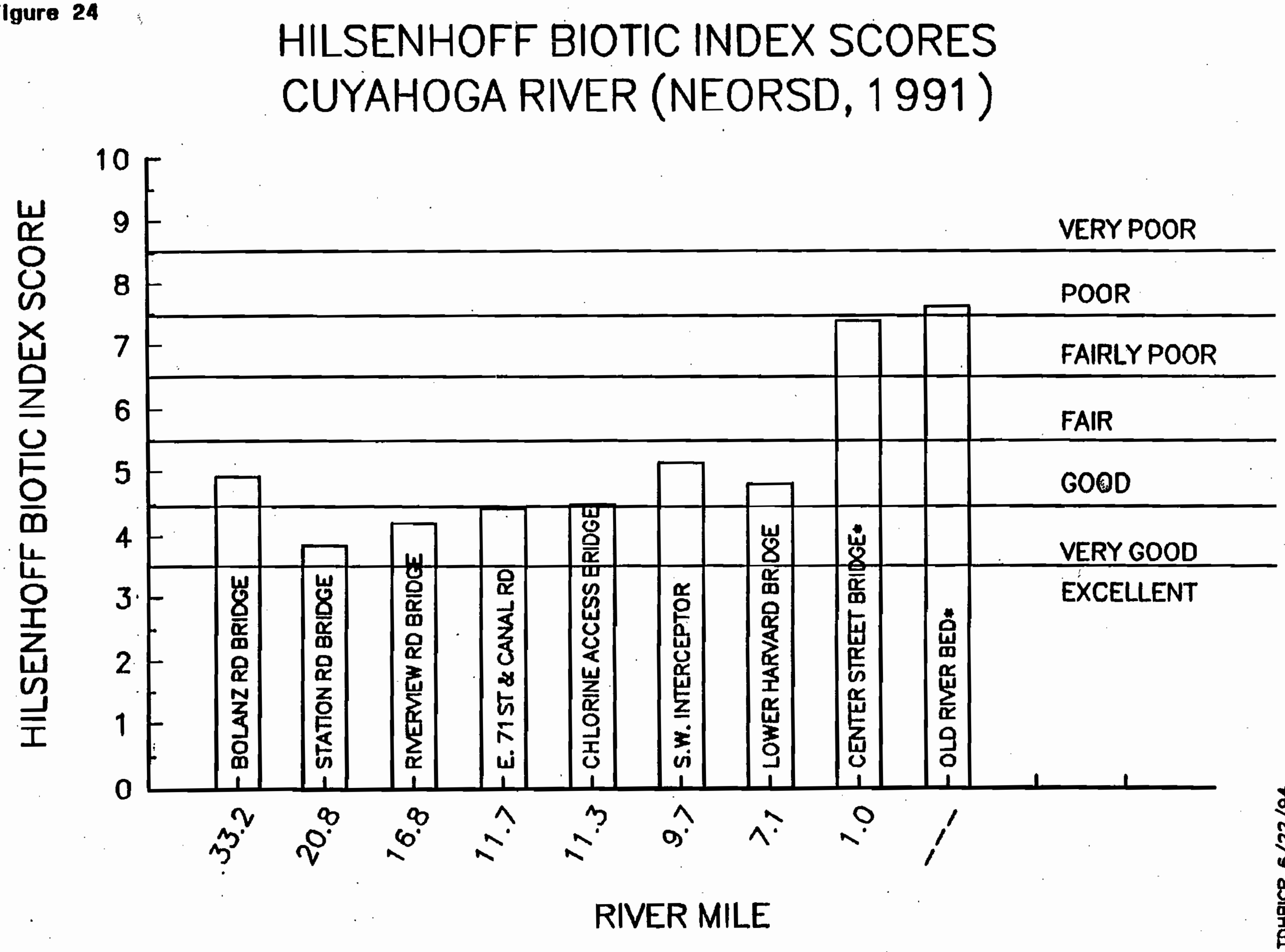

INVERTEBRATE COMMUNITY INDEX (ICI)
FROM AKRON TO CLEVELAND
CUYAHOGA RIVER
OEPA 1984
OEPA 1991
NEORSD 1988
NEORSD 1991
INVERTEBRATE COMMUNITY INDEX (ICI)
50
45
40
35
30
25
20
15
10
5
0
EXCEPTIONAL
GOOD
FAIR
POOR
AKRON WWTP
SOUTHERLY WWTP
HEAD OF NAVIGATION
43
36
29
22
15
8
1
RIVER MILE

Figure 24



* Habitat at this location does not fully meet criteria for HBI calculations; supplemental score only.

CUYAHOGA RIVER FISH

Besides invertebrates, fish can also provide useful information about water quality. As with invertebrates, the diversity and types of fish present are dependent upon both water quality and suitability of habitat.

Figures 25 and 26 present comparisons of fish index scores obtained along the Cuyahoga River by the Ohio EPA in 1984 with more recent scores obtained by the Ohio EPA and the District. Both of these comparisons show that improvements in the Cuyahoga River fish populations have occurred since 1984.

However, despite the improvements, most of the river locations are only receiving ratings of "poor." This is because the dominant fish species continue to be those which are least sensitive to habitat disturbances and/or pollution. **Figures 27 and 28**, which focus on a single site, demonstrate that the fish index scores show little, if any, improvement since the late 1980's. The extent to which this relative lack of improvement may be due to habitat disturbances, such as heavy siltation, or a slow rate of recovery from the Cuyahoga River's polluted past is a matter of continuing debate.

The failure to meet expectations for fish index scores in the Cuyahoga River should not be interpreted to mean that the river is devoid of fish life, however. On the contrary, as demonstrated by **Table 1**, at least one individual from each of 50 different fish species has been collected from the river in recent years within the boundaries of Cuyahoga County!

Perhaps, a better indication of improving conditions is the declining incidence in Cuyahoga River fish deformities, eroded fins, lesions, and tumors ("DELT anomalies"). Elevated levels of these anomalies are typically associated with pollution. **Figure 29** shows that the incidence of DELT anomalies along the Cuyahoga River has decreased significantly since 1984. In fact, it has been lowered to the point where it now differs little from the incidences measured at "reference" sites on the ecoregion's streams least impacted by pollution.

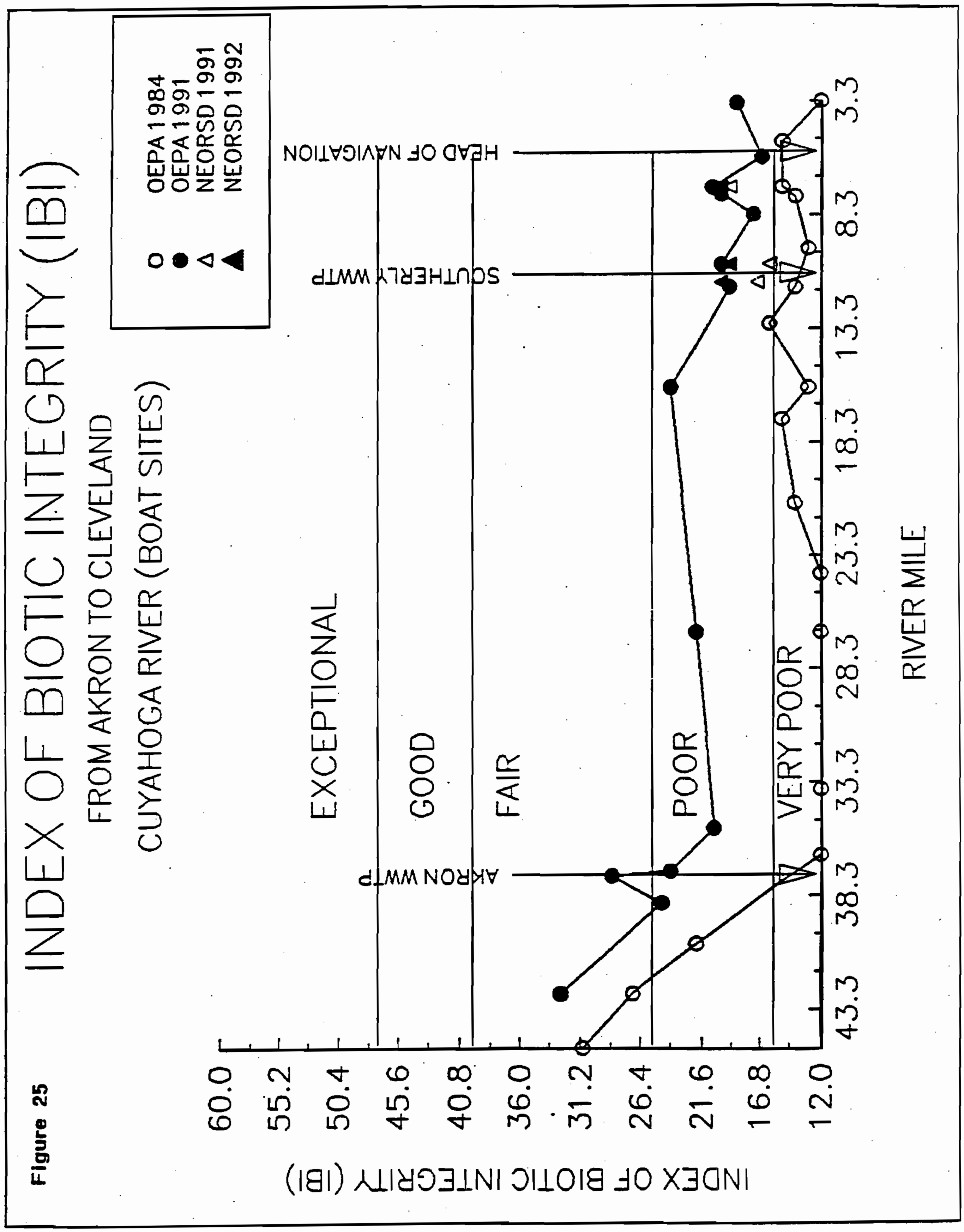


Figure 25
INDEX OF BIOTIC INTEGRITY (IBI)
FROM AKRON TO CLEVELAND
CUYAHOGA RIVER (BOAT SITES)
OEPA 1984
OEPA 1991
NEORSD 1991
NEORSD 1992
EXCEPTIONAL
GOOD
FAIR
POOR
VERY POOR
AKRON WWTP
SOUTHERLY WWTP
HEAD OF NAVIGATION
60.0
55.2
50.4
45.6
40.8
36.0
31.2
26.4
21.6
16.8
12.0
43.3
38.3
33.3
28.3
23.3
18.3
13.3
8.3
3.3
INDEX OF BIOTIC INTEGRITY (IBI)
RIVER MILE

Figure 26 MODIFIED INDEX OF WELL BEING (MIwb)

FROM AKRON TO CLEVELAND

CUYAHOGA RIVER (BOAT SITES)

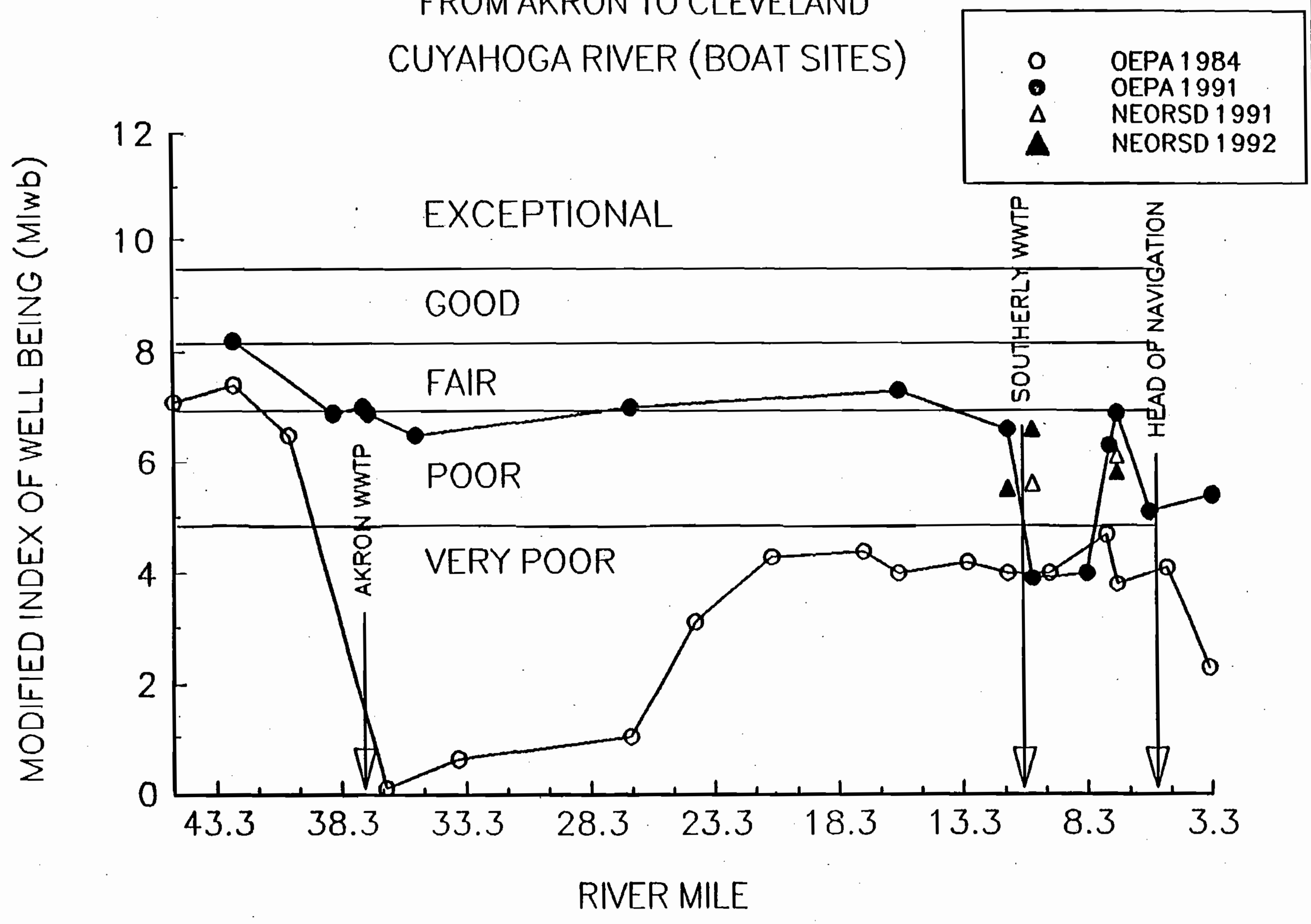


Figure 27

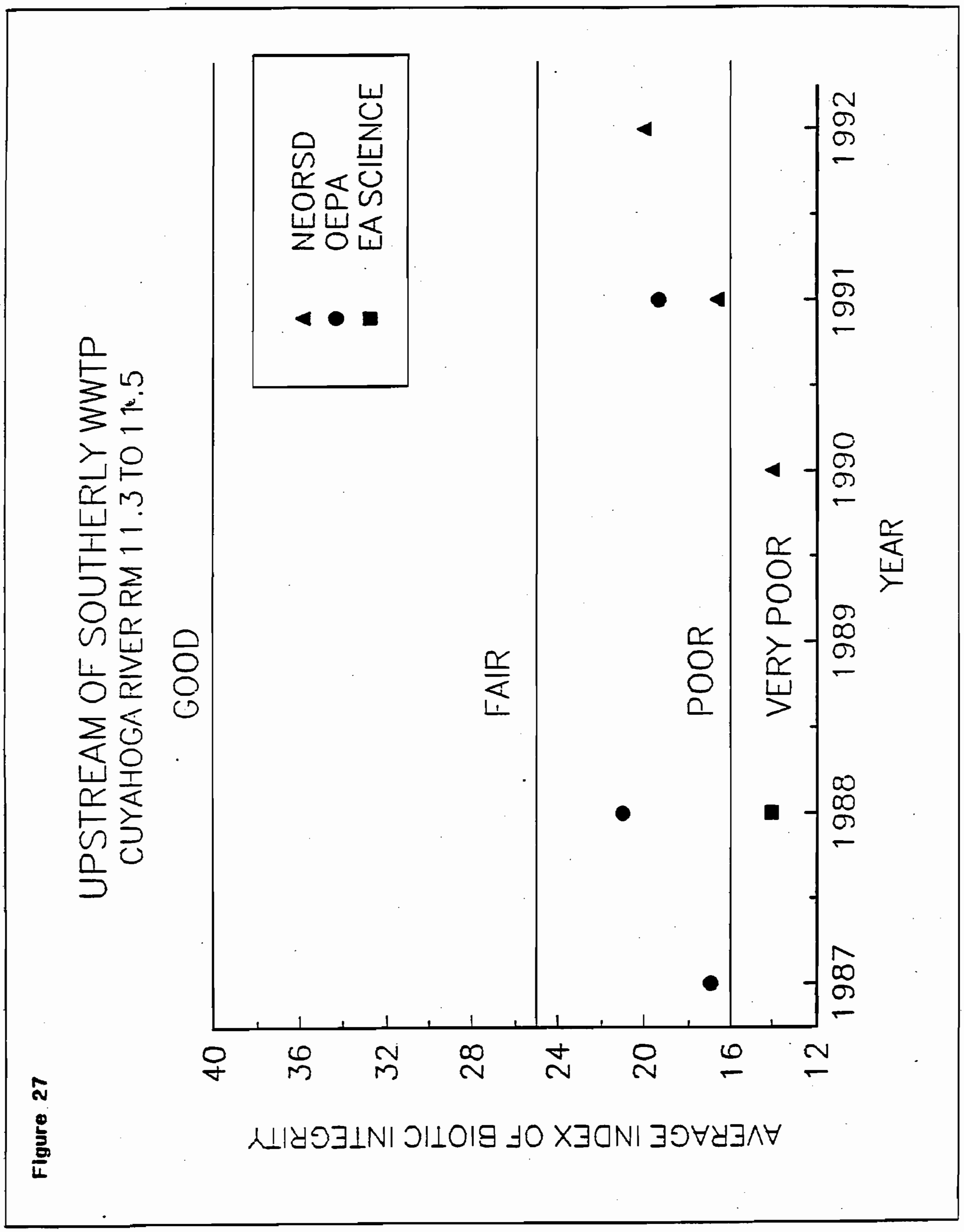

UPSTREAM OF SOUTHERLY WWTP
CUYAHOGA RIVER RM 11.3 TO 11.5
GOOD
FAIR
POOR
VERY POOR
NEORSD
OEPA
EA SCIENCE
AVERAGE INDEX OF BIOTIC INTEGRITY
40
36
32
28
24
20
16
12
1987
1988
1989
1990
1991
1992
YEAR

Figure 28

UPSTREAM OF SOUTHERLY WWTP
CUYAHOGA RIVER RM 11.3 TO 11.5

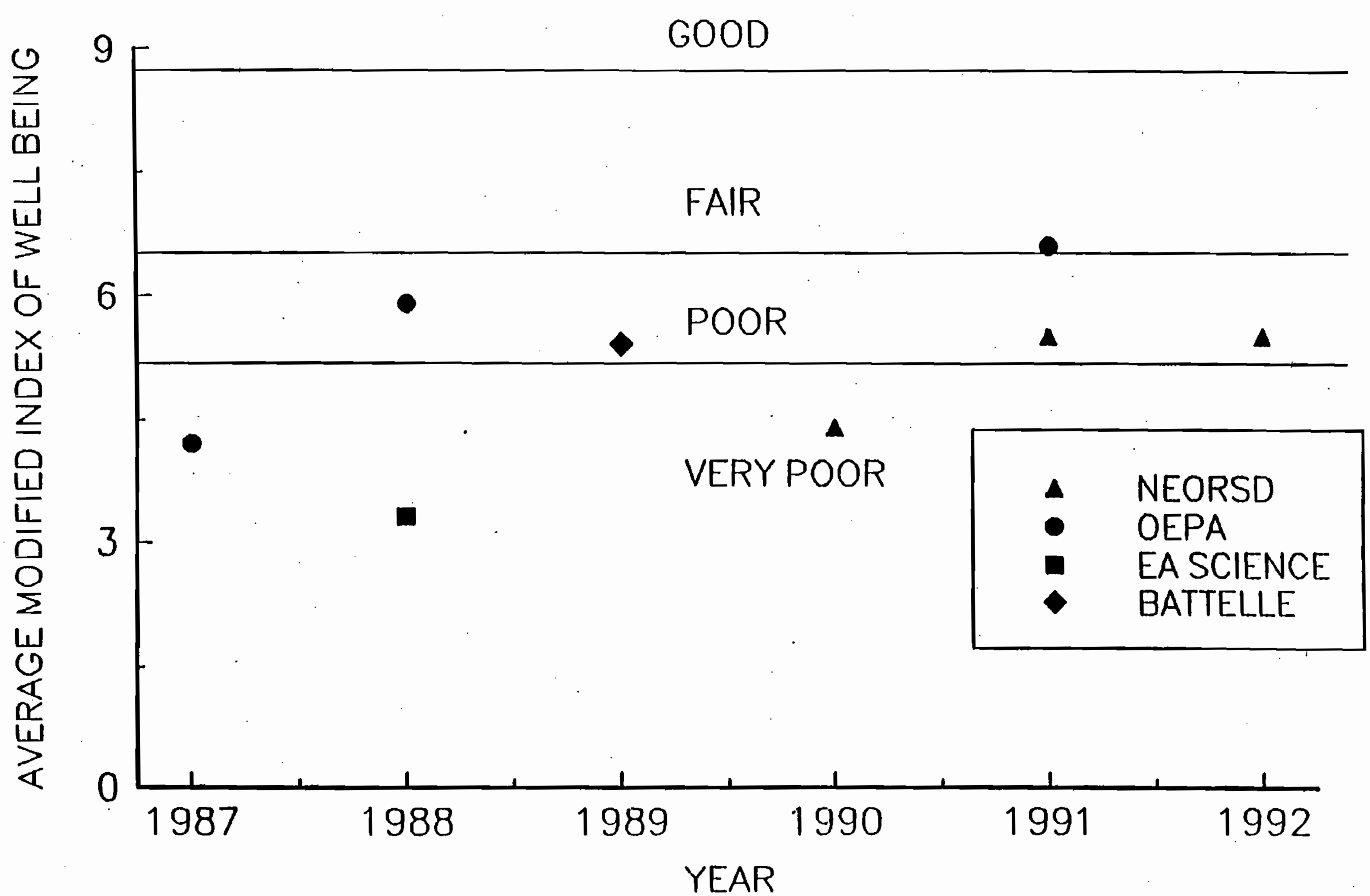


Table 1

Fish Species Collected From the Cuyahoga River in Cuyahoga County Between River Mile 20.8 and River Mile 0.0 (excluding hybrids) 1988-1993

Sources: Ohio EPA. Water Quality Monitoring & Assessment Fish Information System, 1988-1991.

Northeast Ohio Regional Sewer District Survey Data, 1988-1993.

Collection Methods: Electroshocking and seining.

Species Collected From 1988 to 1993	Pollution Tolerance*
1. Alewife (Alosa pseudoharengus)	--
2. Eastern gizzard shad (Dorosoma cepedianum)	--
3. Rainbow trout (Salmo gairdneri)	--
4. Grass pickerel (Esox americanus)	Moderately Tolerant
5. Northern pike (Esox lucius)	--
6. Bigmouth buffalo (Ictiobus cyprinellus)	--
7. Smallmouth buffalo (Ictiobus bubalus)	--
8. Central quillback carpsucker (Carpiodes cyprinus)	--
9. Black redhorse (Moxostoma duquesnei)	Common Intolerant
10. Golden redhorse (Moxostoma erythrurum)	Moderately Intolerant
11. Shorthead redhorse (Moxostoma macrolepidotum)	Moderately Intolerant
12. Northern hog sucker (Hypentelium nigricans)	Moderately Intolerant
13. Common white sucker (Catostomus commersoni)	Highly Tolerant
14. Common carp (Cyprinus carpio)	Highly Tolerant
15. Goldfish (Carassius auratus)	Highly Tolerant
16. Golden shiner (Notemigonus crysoleucas)	Highly Tolerant
17. Blacknose dace (Rhinicthys atratulus)	Highly Tolerant
18. Creek chub (Semotilus atromaculatus)	Highly Tolerant
19. Common emerald shiner (Notropis atherinoides)	--
20. Silver shiner (Notropis photogenis)	Common Intolerant
21. Common shiner (Notropis cornutus)	--
22. Spottail shiner (Notropis hudsonius)	Moderately Tolerant
23. Spotfin shiner (Notropis spilopterus)	--
24. Sand shiner (Notropis stramineus)	Moderately Intolerant
25. Silverjaw minnow (Ericymba buccata)	--
26. Northern fathead minnow (Pimephales promelas)	Highly Tolerant
27. Bluntnose minnow (Pimephales notatus)	Highly Tolerant
28. Central stoneroller minnow (Campostoma anomalum)	--
29. Grass carp (Ctenophargngodon idella)	--
30. Channel catfish (Ictalurus punctatus)	--
31. Yellow bullhead (Ictalurus natalis)	Highly Tolerant
32. Brown bullhead (Ictalurus nebulosus)	Highly Tolerant
33. Black bullhead (Ictalurus melas)	Moderately Tolerant
34. Trout-perch (Percopsis omiscomaycus)	--

(Continued on following page.)

Table 1 (continued)

Species Collected From 1988 to 1993	Pollution Tolerance*
35. White bass (*Morone chrysops*)	—
36. White perch (*Morone americana*)	—
37. White crappie (*Pomoxis annularis*)	—
38. Black crappie (*Pomoxis nigromaculatus*)	—
39. Northern rockbass (*Ambloplites rupestris*)	—
40. Northern smallmouth bass (*Micropterus dolomieui*)	Moderately Intolerant
41. Northern largemouth bass (*Micropterus salmoides*)	—
42. Warmouth sunfish (*Lepomis gulosus*)	—
43. Green sunfish (*Lepomis cyanellus*)	Highly Tolerant
44. Northern bluegill sunfish (*Lepomis macrochirus*)	Moderately Tolerant
45. Northern longear sunfish (*Lepomis megalotis*)	Moderately Intolerant
46. Pumpkinseed sunfish (*Lepomis gibbosus*)	Moderately Tolerant
47. Yellow perch (*Perca flavescens*)	—
48. Northern logperch darter (*Percina caprodes*)	Moderately Intolerant
49. Greenside darter (*Etheostoma blennioides*)	Moderately Intolerant
50. Freshwater drum (*Aplodinotus grunniens*)	Moderately Tolerant

*Pollution Tolerances from: Ohio Environmental Protection Agency. 1989. *Biological Criteria for the Protection of Aquatic Life*, Volume III.

INCIDENCE OF DEFORMITIES, ERODED FINS, LESIONS AND TUMORS IN CUYAHOGA RIVER FISH

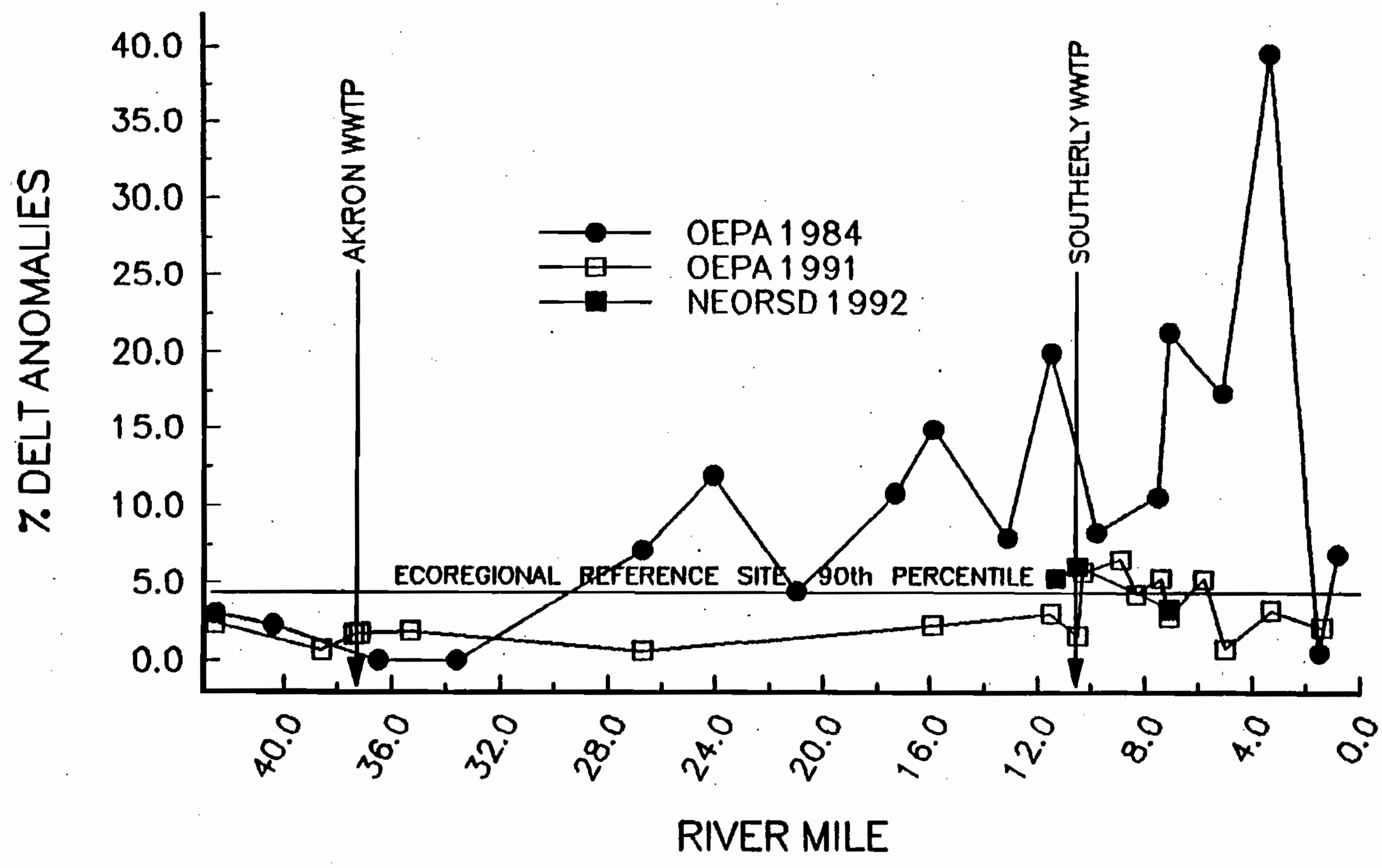


Figure 29

TDDLTACR 6/27/94

CHEMICAL CONTAMINANTS IN FISH

Certain chemicals present in waterways can accumulate in fish flesh to levels much higher than the levels at which they are found in the water. These chemicals can be of concern if they reach levels in the fish high enough to increase the risk of adverse health effects in people who eat the fish.

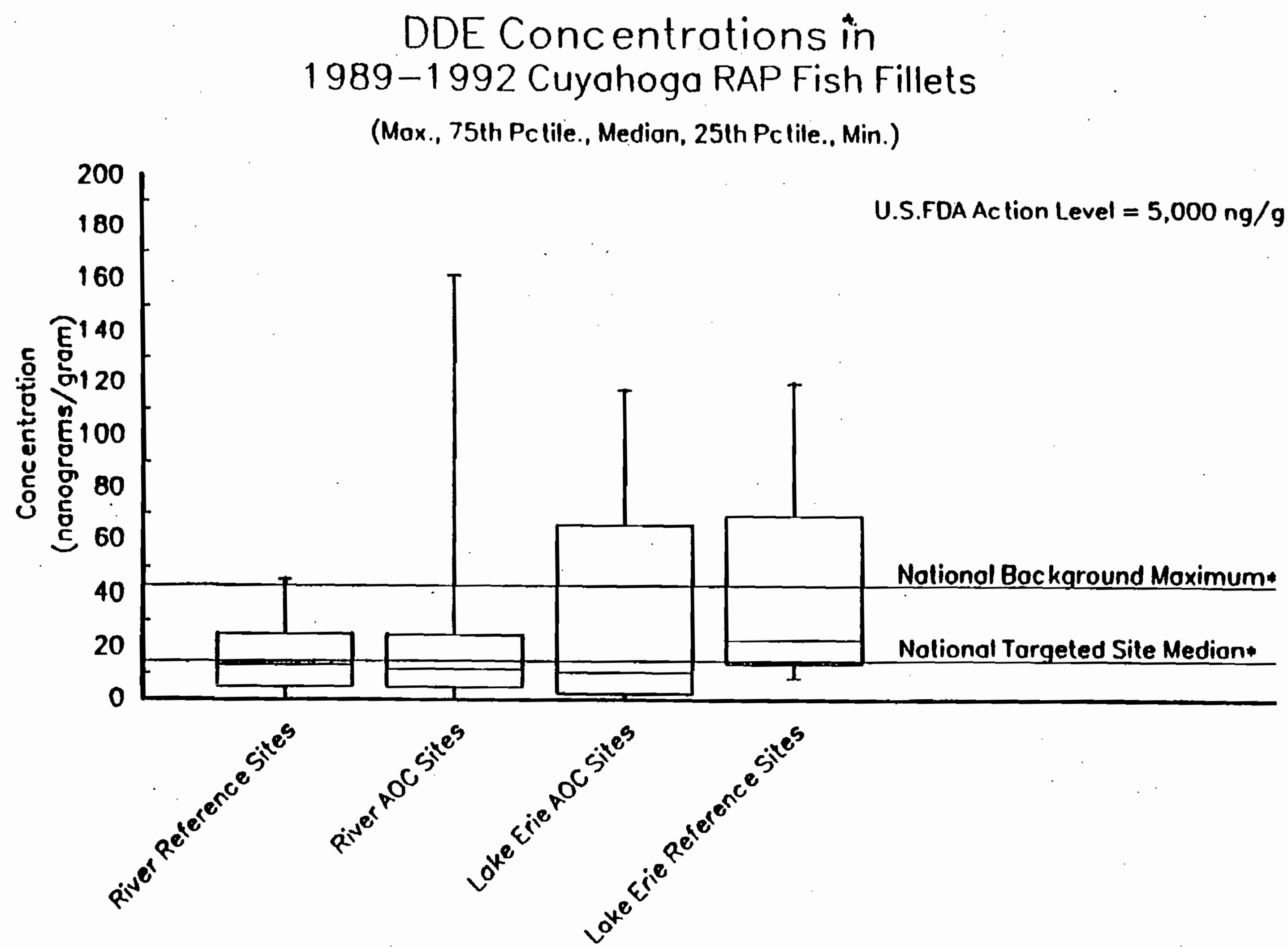
In 1989 through 1992, the District and several other organizations participated in an intensive effort for the Cuyahoga River Remedial Action Plan (RAP) to determine the levels of chemicals in the flesh of fish captured in the Cuyahoga River and Lake Erie near the Cleveland shoreline. The Ohio Department of Health issued an advisory based upon the results from this study recommending that people limit their consumption of certain fish species caught in these areas. However, the results indicated that certain other species could be eaten safely without restriction. Furthermore, none of the species analyzed had chemical concentrations high enough to warrant avoiding consumption altogether. (For fish advisory information, call the Ohio Department of Health at 614-644-6447.)

Figures 30, 31, and 32 summarize the results from the RAP study for three of the more than 100 different types of chemicals analyzed for: PCB, DDE, and mercury. The manufacture, use, and discharge to the environment of PCB, which had various industrial and commercial uses, and DDE, which is a breakdown product of the banned pesticide DDT, have been prohibited since the 1970's. PCB and DDE continue to appear in fish flesh because they are very resistant to breakdown and they persist in the environment, such as in sediments, from use many years ago. Mercury is a metal which is found at trace levels throughout the environment. Mercury now comes largely from fossil fuel combustion and natural sources.

The graphs show that PCB is present at higher levels in fish from the more heavily urbanized "AOC" (Area of Concern) and Lake Erie sites, which are near where most PCB use had occurred. The concentrations of DDE were more uniform, while the concentrations of mercury were, on average, slightly lower at AOC sites than at the reference sites outside the AOC. The graphs also show that each of these chemicals had levels in fish from the Cleveland area quite similar to levels recently measured by the U.S. EPA in fish caught across the nation. The national study included both "targeted sites" in urban, agricultural, and industrial areas and "background sites" in areas without identified pollutant sources.

Figures 33 and 34 present results from studies of chemicals in fish caught elsewhere in the Great Lakes. Both graphs demonstrate that the levels of these chemicals in the fish have declined steadily since the late 1960's and early 1970's. This information attests to the success of past efforts to increase the safety of eating fish from the Great Lakes and across the country.

Figure 31

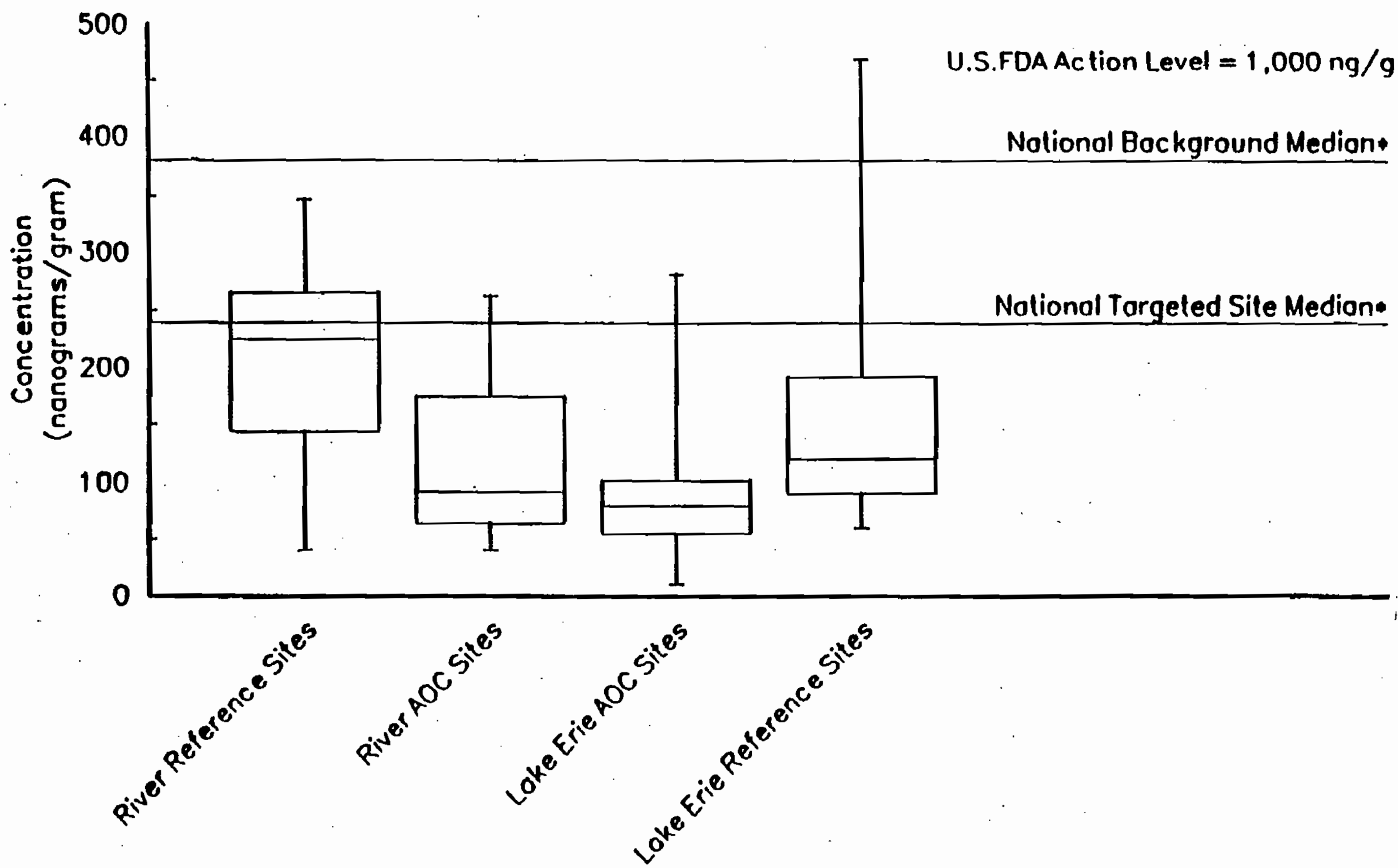


* National fillet data from U.S. EPA, September 1992

Figure 32

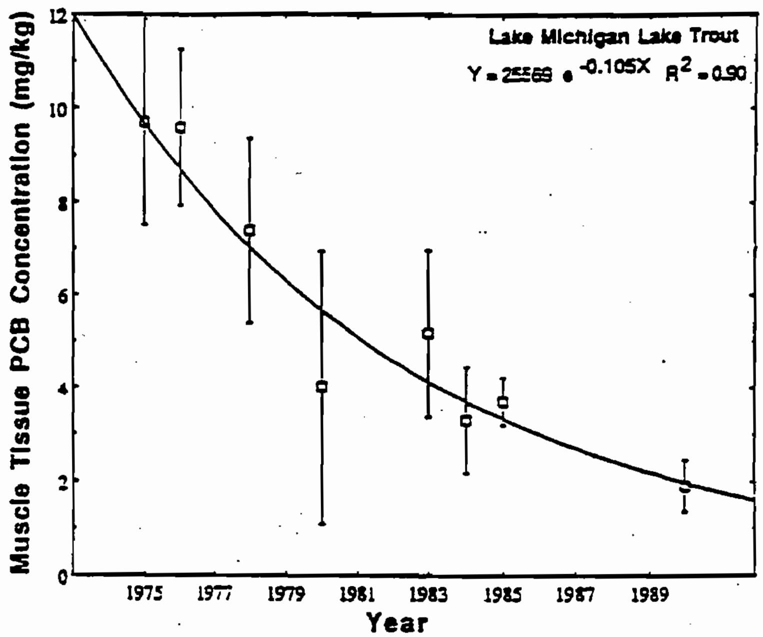
Mercury Concentrations in 1989–1992 Cuyahoga RAP Fish Fillets

(Max., 75th Pctile., Median, 25th Pctile., Min.)



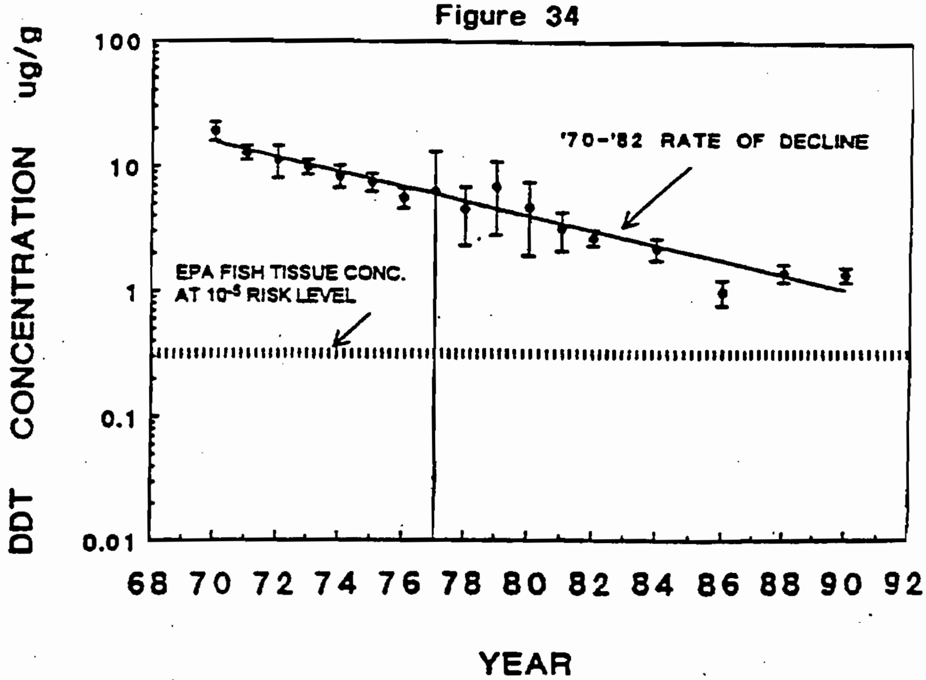
* National fillet data from U.S. EPA, September 1992

Figure 33



Total polychlorinated biphenyl (PCB) concentrations in samples of 620 mm to 640 mm mean length lake trout from Wisconsin waters of Lake Michigan 1975-1990, mean concentrations and standard error. Y = PCB concentration (mg/kg) and X = year (after 1900) (Miller et al, 1992).

Figure 34



DDT concentration in Lake Michigan lake trout (mean and 95% confidence interval) (EPA 1993).

WILDLIFE

Of course, fish are consumed not only by people but also by many wildlife species. In some cases, these wildlife species may be more vulnerable than humans to chemical contaminants in the fish. Wildlife may rely more heavily upon fish consumption for survival, they may not be as selective in their diet as people can be, or they may simply be more sensitive to certain chemicals.

An example of a wildlife species which has historically suffered ill effects from chemical pollution is our national symbol, the bald eagle. Because its diet consists chiefly of dead or dying fish, the eagle is especially vulnerable to chemicals which accumulate in fish. Levels of the pesticide DDT along with destruction of the eagle's natural habitat were largely responsible for the near-extinction of the Ohio bald eagle population in recent decades. However, as demonstrated by **Figure 35**, the population of bald eagles in Ohio along the Lake Erie shoreline has exhibited a strong recovery since the banning of DDT in 1972. This success is further indicated by the information presented in **Figure 36**, which shows that, in all but two of the years since 1979, the Ohio eagles have exceeded the rate of reproduction necessary for a stable population (0.7 eaglets per nest). Such successes across the country have led to the U.S. Fish & Wildlife Service's proposal in June 1994 to remove the bald eagle from the government's endangered species list.

Another fish-eating bird species which has historically exhibited ill effects linked with chemicals in the environment is the double-crested cormorant. Photographs of cormorants with abnormalities such as twisted bills have received wide publicity in recent years. Indeed, as shown in **Figure 37**, the incidence of these abnormalities has been higher at some Great Lakes locations than the incidence at reference sites outside the Great Lakes. However, as shown in **Figure 38**, cormorant populations in all of the Great Lakes have increased dramatically in recent years to the point where their numbers are now higher than at any other time in this century. The success of the cormorant populations is clearly no longer inhibited by chemical pollution.

Figure 35

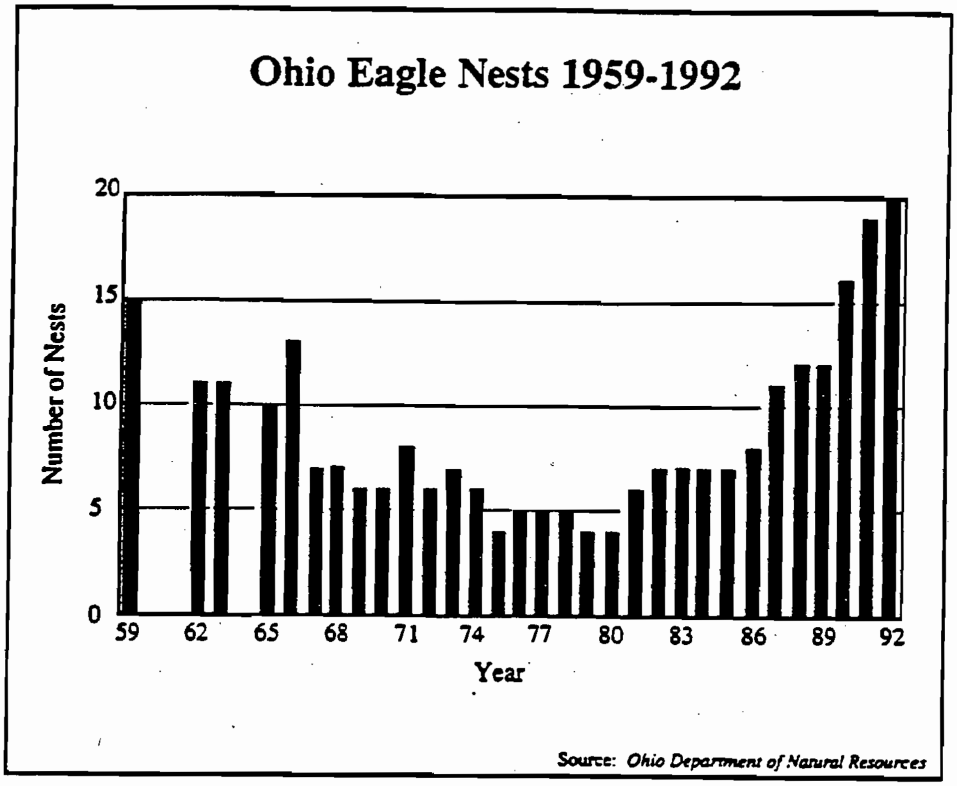
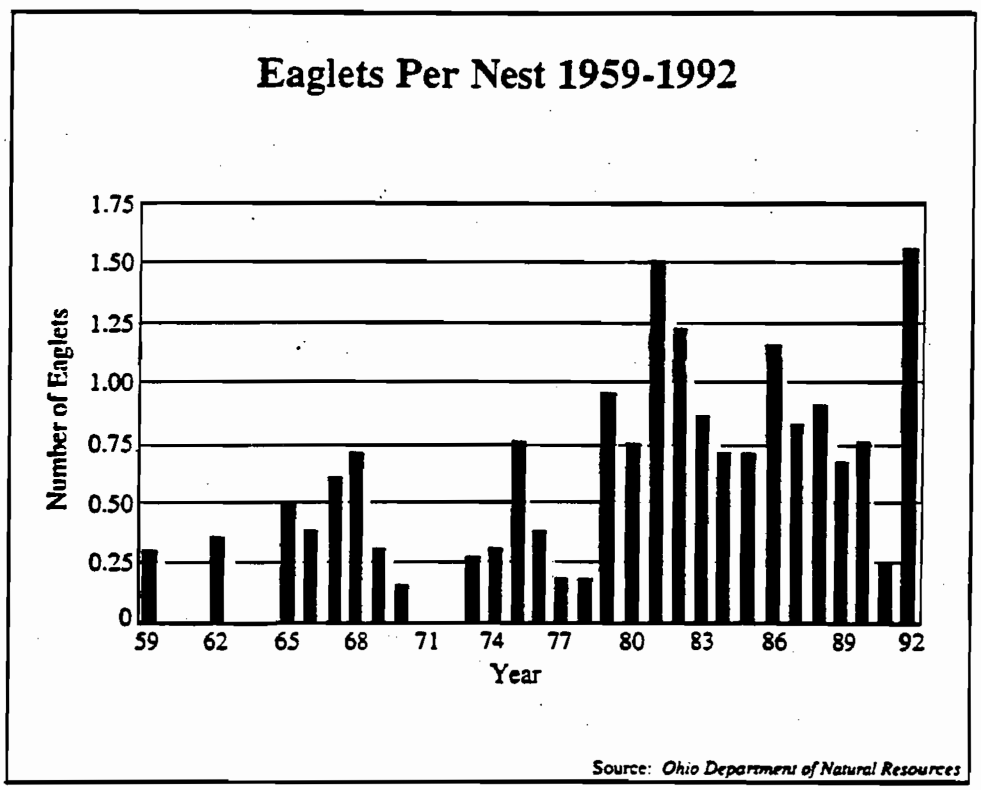
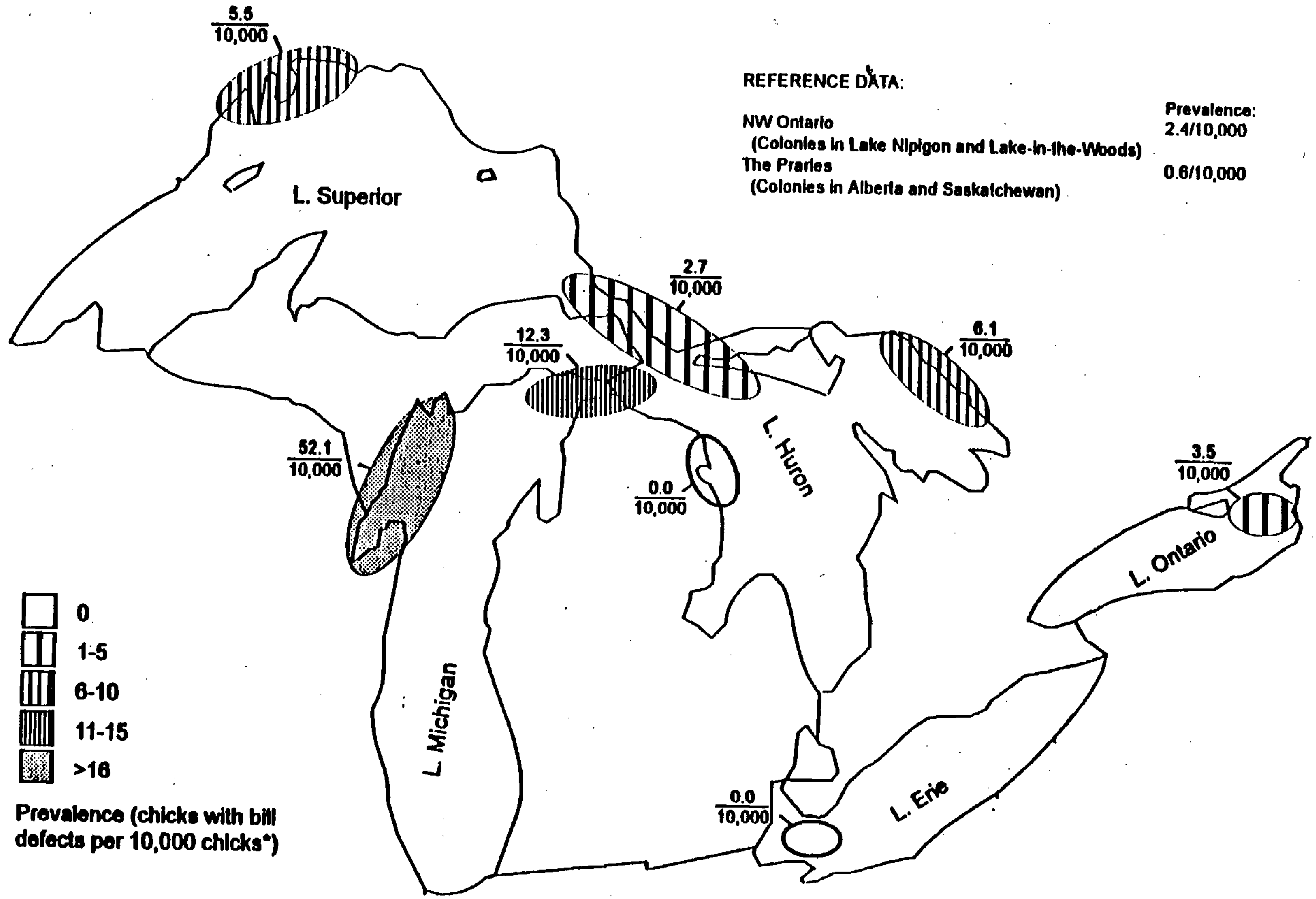


Figure 36

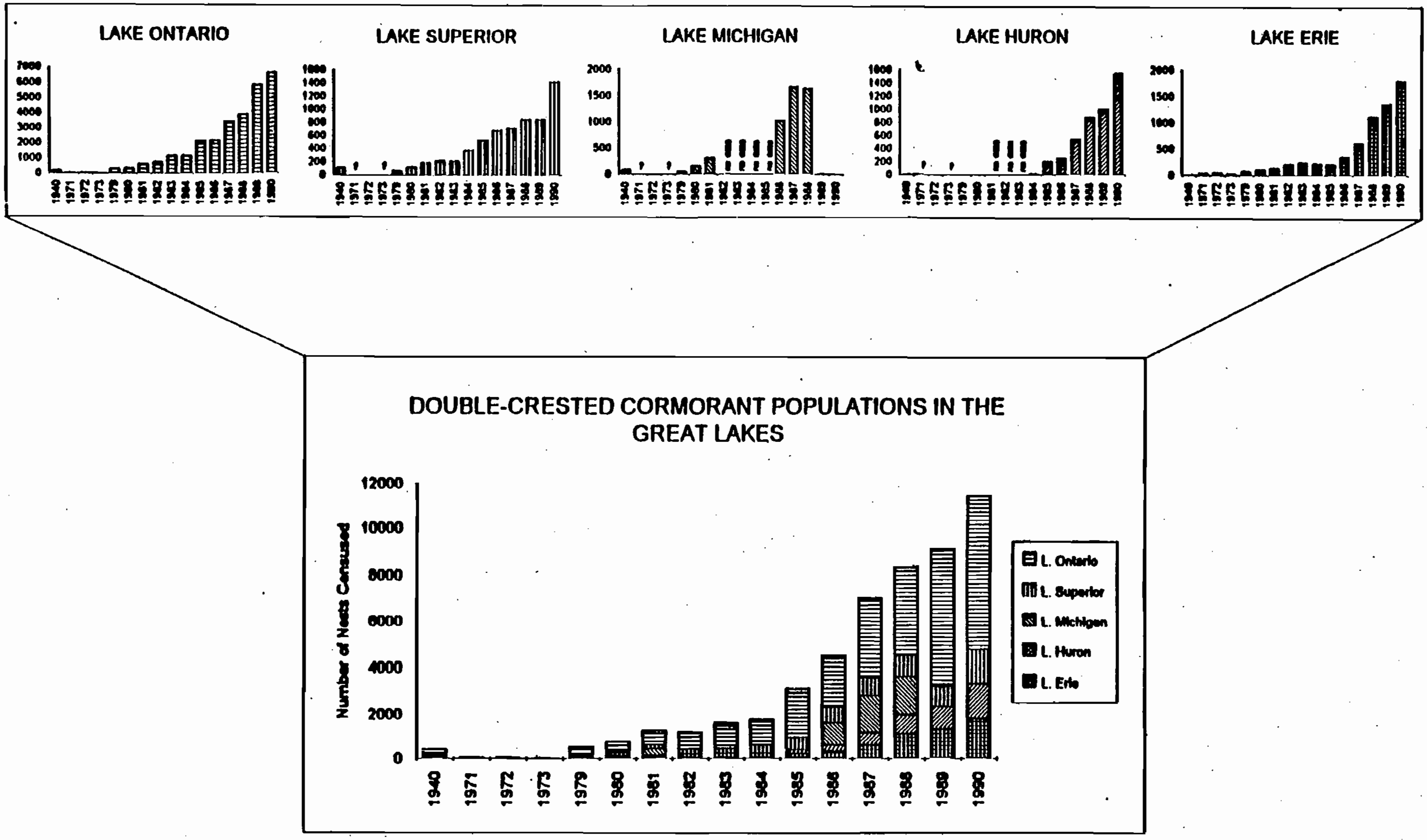




Geographical variation in observation of bill defects in cormorant chicks, 1979-1987 (Fox et al, 1991).

* *Prevalence refers to the number of chicks with defects divided by the number of chicks examined expressed on a per 10,000 chick basis.*

Figure 37



Lake-wide population levels of double-crested cormorants on the Great Lakes, 1940-1990 (Environment Canada, 1991).

Figure 38

COMBINED SEWER OVERFLOWS

As the benefits from improved wastewater treatment plant effectiveness and industrial wastewater control are achieved, the District is facing other challenges. One of the greatest challenges for the future is the further control of combined sewer overflows (CSO's).

The sewer systems in older, larger cities, including Cleveland, were designed to collect both sanitary sewage and stormwater. These combined sewer systems convey the sanitary sewage and the stormwater to the wastewater treatment plants unless the system becomes hydraulically overloaded. This situation can occur during a large rain event and, to avoid flooding in the service area, the system has been designed to relieve the overload by releasing the combined sanitary sewage and stormwater directly into the environment.

Combined sewer systems can be environmentally beneficial in that they provide treatment for pollutants in stormwater that would have been discharged to the environment without treatment if the system had consisted of separate sanitary and storm sewers. However, during the larger rain events, the combined sewer overflows carry untreated pollutants from sanitary sewage directly into the environment and can cause water pollution problems in areas downstream of the overflow locations.

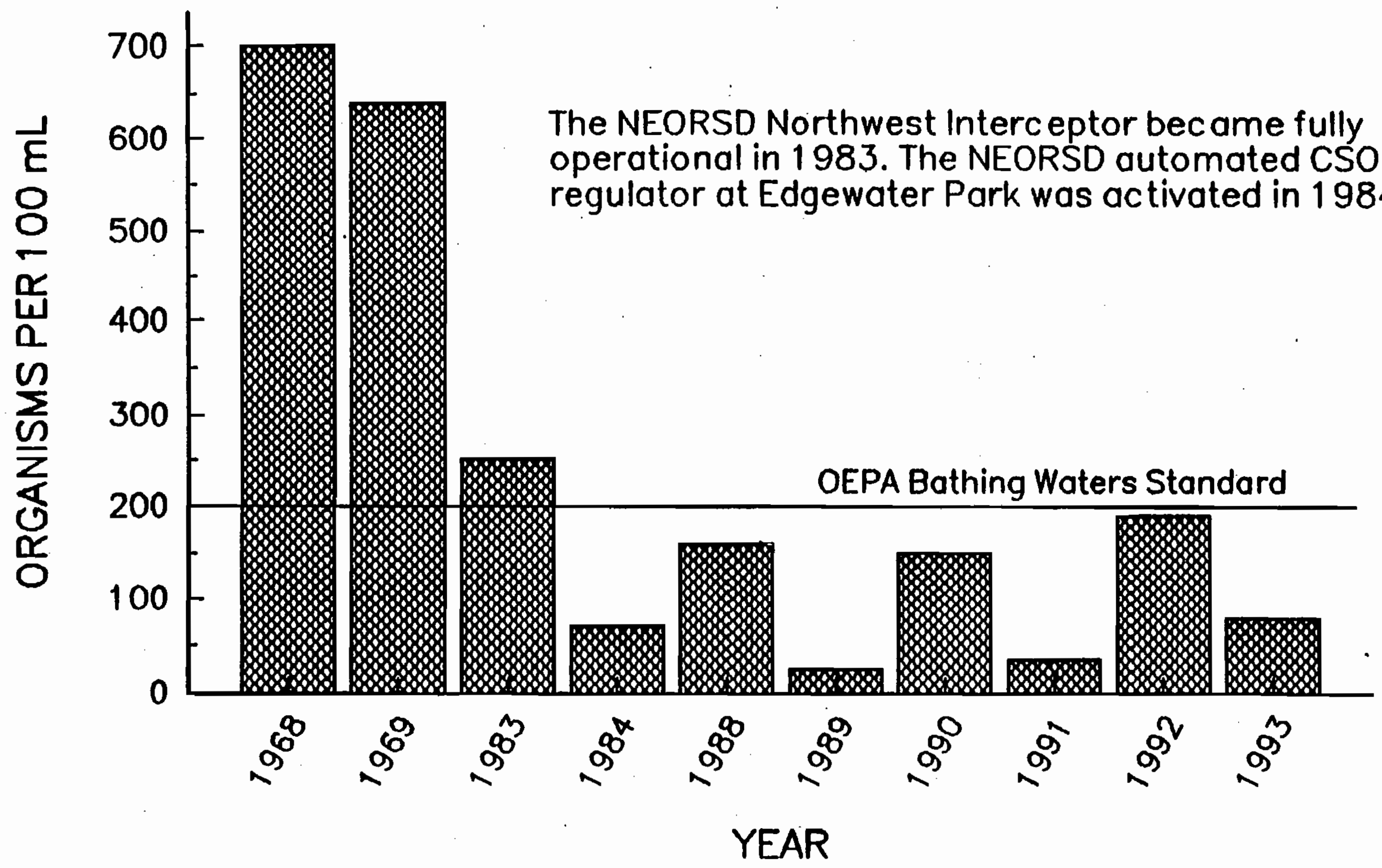
One of the highest priority pollution problems to which combined sewer overflows contribute is temporarily elevated bacteria levels at public swimming beaches. As the fecal coliform bacteria levels increase at locations of high human water contact, so does the risk of contracting sewage-transmitted diseases. A specific location of concern due to the close proximity of a major combined sewer overflow is Edgewater Beach on Cleveland's west side.

Since the 1970's, the District has pioneered a program to maximize the storage of wet weather flows within the combined sewer system and minimize the impacts from combined sewer overflows. This program involves computer-regulated gates and dams in the sewers. One of the program's priority targets for control was the combined sewer overflow at Edgewater Park. In 1984, the District activated at this location an automated CSO regulator which was designed to divert overflows resulting from heavy rain events into the District's newly constructed Northwest Interceptor. This large intercepting sewer would then convey the combined sewage to the Westerly wastewater treatment plant rather than allowing it to overflow to Lake Erie near Edgewater Beach. **Figure 39** shows the lower bacteria levels at Edgewater Beach resulting from the activation of this system.

Despite the CSO control program's successes, further control will be required in the future. **Figure 40** compares wet weather levels of fecal coliform bacteria with dry weather levels at several locations along Cleveland's Lake Erie shoreline. This comparison shows that bacteria concentrations in water bodies affected by combined sewer overflows can be significantly elevated following storm events. It is an example of the environmental problems yet to be addressed through CSO control programs. The District is committed to providing leadership in the national effort to achieve the most cost-beneficial combined sewer overflow control possible.

Figure 39

GEOMETRIC MEAN FECAL COLIFORM LEVELS IN LAKE ERIE AT EDGEWATER BEACH



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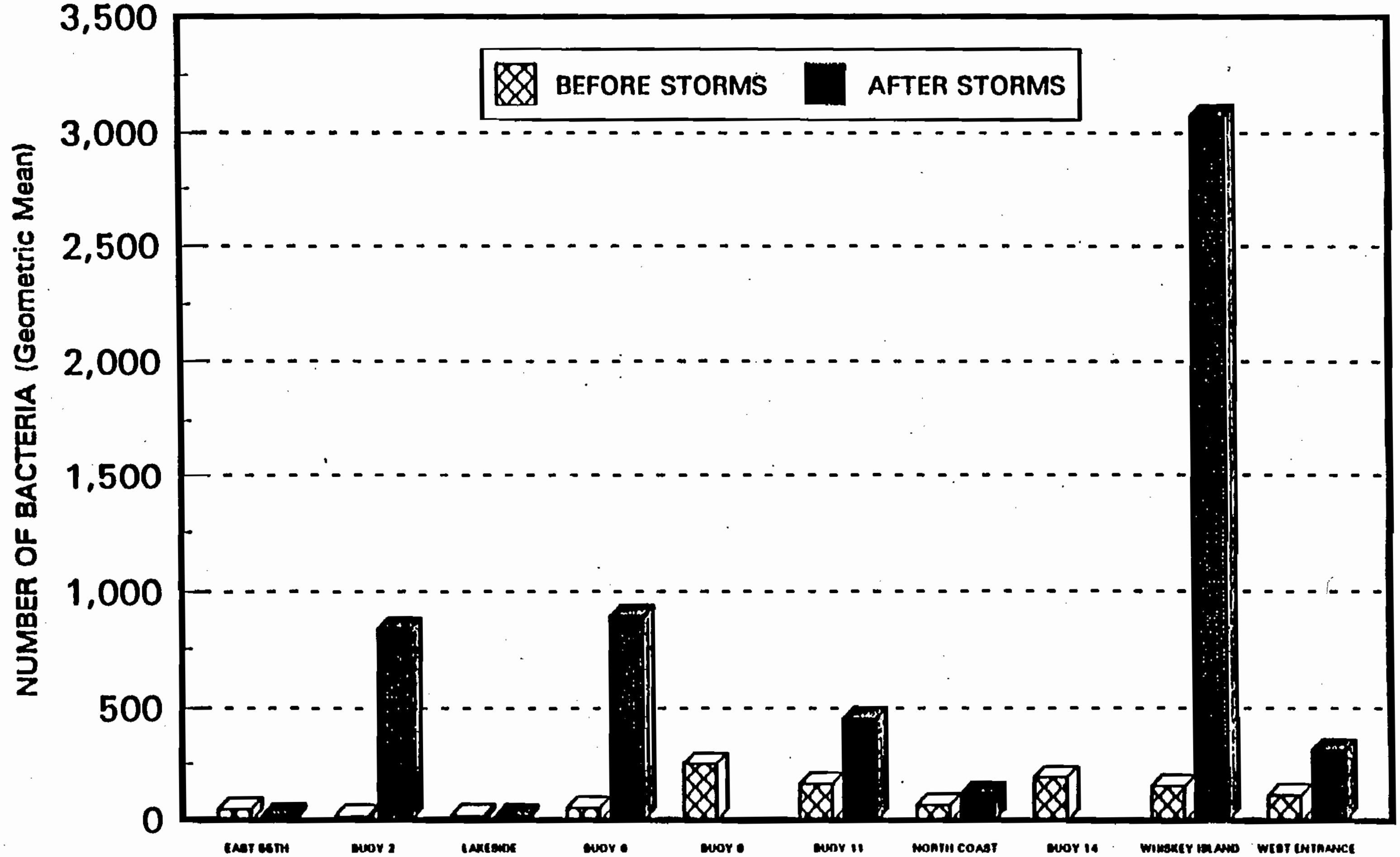
From City of Cleveland/ODH/NEORSD Data

COMPARISON OF BACTERIA LEVELS IN THE LAKE BEFORE AND AFTER RAINSTORMS - CLEVELAND NEARSHORE AREA -



SOURCE: CUYAHOGA RAP BACTERIAL INVESTIGATION TASK GROUP, 1990 SAMPLING

Figure 40

WATER QUALITY MONITORING

Although wet weather environmental impacts from combined sewer overflows and stormwater will increasingly receive attention in the future, dry weather impacts cannot be ignored. As the sewer system ages, sewer leaks and system malfunctions become more likely. Very often, these dry weather sources of pollution can be far more damaging to the environment than wet weather sources because they occur when pollutant concentration is at its maximum and dilution in the water body is at its minimum.

Through the District's sewer maintenance and stream monitoring programs, dry weather sources of pollution are identified so that corrective measures can be taken. One example of the environmental improvements which occur when such action is taken is provided by the west branch of Big Creek. In 1990, the District repaired a sewer which had been leaking raw sewage into the creek during dry weather. **Figure 41** shows the dramatic decrease in the creek's downstream bacteria concentrations immediately following the repair. **Table 2** shows the gradual increase in aquatic life diversity which was observed downstream following this and other corrective measures taken to remove pollution from Big Creek.

No matter how effective a wastewater treatment plant is at removing pollutants, how effective a pretreatment program is at controlling industrial sources, or how effective a CSO control program is at minimizing wet weather overflows, serious environmental damage can still occur if the sewer system fails to effectively convey sewage to the treatment plant. Therefore, the District's monitoring efforts will continue to be an essential component in the overall effort to protect, maintain, and improve the quality of our area's waterways. These monitoring efforts can greatly benefit from citizen awareness and involvement. If you suspect, through appearance or odor, that a local water body has been contaminated by sewage, please report all relevant information as soon as possible to the District's Environmental & Maintenance Services Center at 216-641-6000.

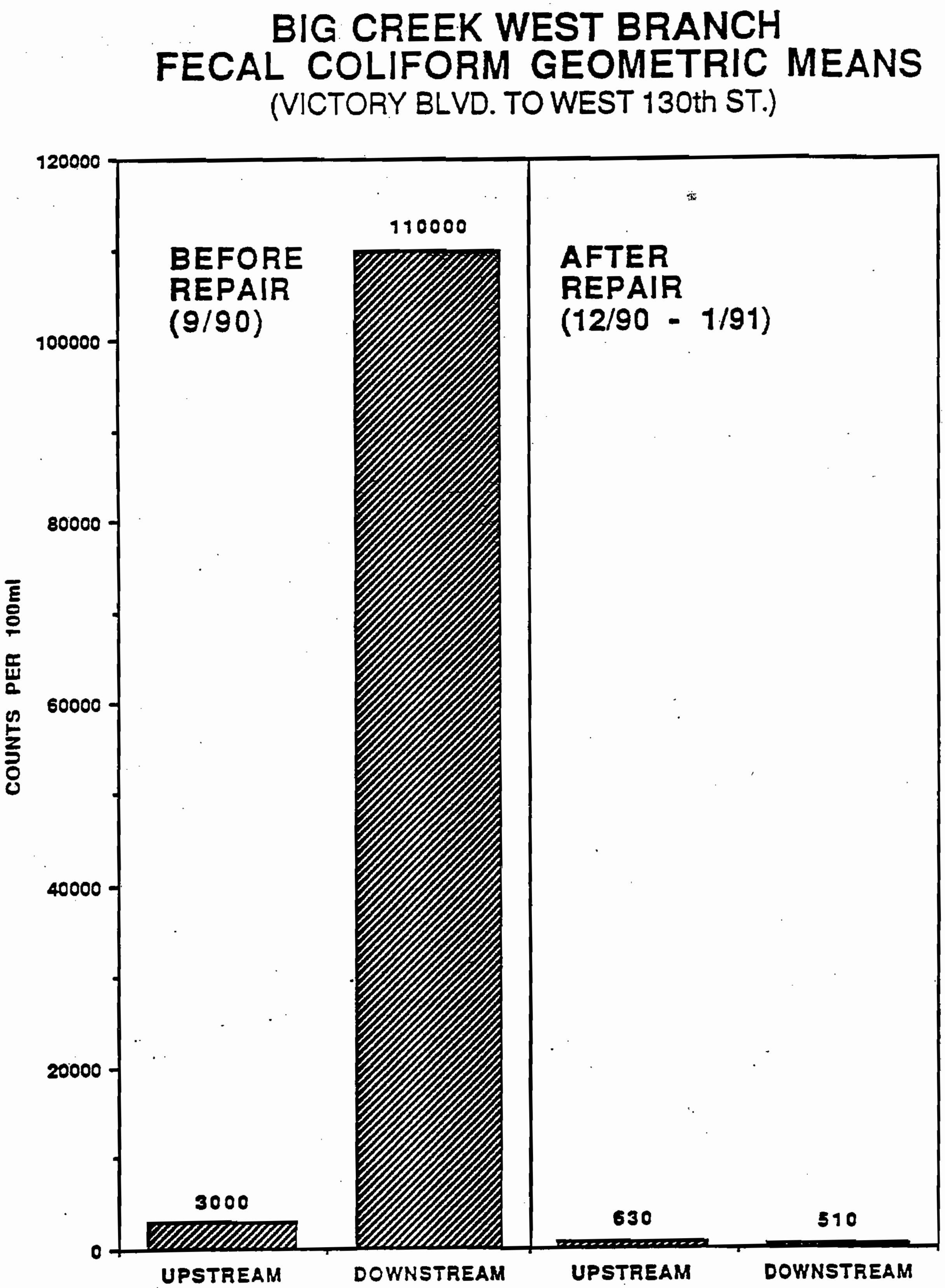

BIG CREEK WEST BRANCH
FECAL COLIFORM GEOMETRIC MEANS
(VICTORY BLVD. TO WEST 130th ST.)
COUNTS PER 100ml
120000
100000
80000
60000
40000
20000
0
BEFORE
REPAIR
(9/90)
AFTER
REPAIR
(12/90 - 1/91)
110000
3000
630
510
UPSTREAM
DOWNSTREAM
UPSTREAM
DOWNSTREAM

Figure 41

Table 2

Benthos Collected at NEORSD Site #27 (Big Creek West Branch) in 1989:

Physella sp. (pouch snails)

Benthos Collected at NEORSD Site #27 (Big Creek West Branch) in 1990:

Oligochaeta (sludgeworms)
Helobdella stagnalis (leeches)
Hydropsyche betteni (caddisfly larvae)
Thienemannimyia sp. gr. (midgefly larvae)
Cricotopus sp. (midgefly larvae)
Cricotopus trifascia (midgefly larvae)
Physella sp. (pouch snails)

Benthos Collected at NEORSD Site #27 (Big Creek West Branch) in 1991:

Dugesia tigrina (flatworms)
Dina (Moorebdella) microstoma (leeches)
Erpobdella punctata (leeches)
Helobdella stagnalis (leeches)
Asellus sp. (pillbugs)
Crangonyx gracilis complex (scuds)
Enallagma sp. (damselfly larvae)
Coenagrion sp./Enallagma sp. complex (damselfly larvae)
Ischnura sp. (damselfly larvae)
Plathemis sp. (dragonfly larvae)
Tipula sp. (cranefly larvae)
Thienemannimyia sp. gr. (midgefly larvae)
Cricotopus bicinctus (midgefly larvae)
Physella sp. (pouch snails)
Helisoma sp. (planorbid snails)

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Figure 41

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