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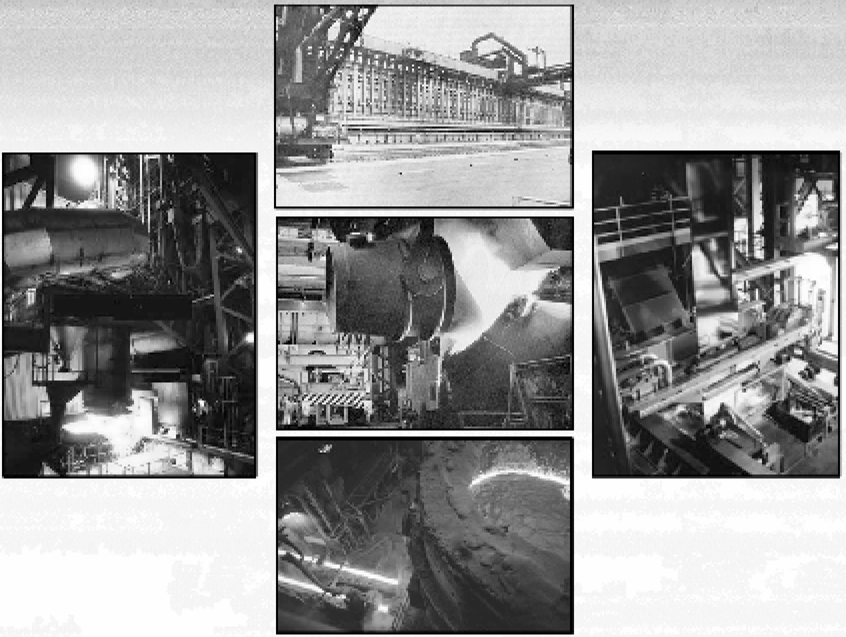

ENVIRONMENTAL ASSESSMENT OF THE PROPOSED EFFLUENT GUIDELINES FOR THE IRON AND STEEL INDUSTRY

Volume I

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EXECUTIVE SUMMARY

This report presents an environmental assessment of the water quality-related benefits that would be expected from the U.S. Environmental Protection Agency's (EPA) promulgation of proposed effluent limitations guidelines, pretreatment standards, and new source performance standards for the iron and steel point source category. EPA estimates that, under current (baseline) conditions, 198 iron and steel facilities[1] discharge approximately 253 million pounds per year (lb/year) of priority and nonconventional pollutants. The proposed rule is expected to reduce this pollutant loading by 22 percent, to 198 million lb/year. The proposed rule is also estimated to provide annual monetized benefits ranging from $1.07 million to $2.61 million (1997 dollars). The range reflects the uncertainty in evaluating the effects of the proposed rule and in placing a monetary value on those effects. The estimate of reported benefits also understates the total benefits expected to result under this proposed rule. Additional benefits, which cannot be quantified in this assessment, include improved ecological conditions, improvements to recreational activities (other than fishing), reduced noncarcinogenic (systemic) human health hazards (other than lead), and reduced discharge of conventional pollutants. Table ES-1 summarizes the environmental effects and benefits of the proposed effluent guidelines and standards.

[1] Of a total of 254 iron and steel facilities, 56 facilities are zero dischargers, and therefore are not included in the analysis. EPA had sufficient data to model 150 of the remaining 198 facilities. EPA used scaling techniques to extrapolate the results of the 150 facilities to the national level of 198.

Summary of Environmental Effects/Benefits Extrapolated to National Level (198 Facilities)

(a) Ambient Water Quality Effects

EPA analyzed the environmental effects associated with discharges from 198 iron and steel facilities. The analysis compared modeled instream pollutant concentrations to ambient water quality criteria (AWQC)[2] or to toxic effect levels. EPA estimates that current discharge loadings contribute to instream concentrations in excess of AWQC in 269 cases at 55 receiving streams. The proposed rule is expected to reduce the number of instream concentrations exceeding AWQC to 175 at 51 receiving streams, allowing 4 streams to obtain "contaminant-free" status. EPA monetizes the attainment of the contaminant-free status based on improvements in recreational fishing opportunities and on the nonuse (intrinsic) value of the streams. The estimated monetized benefit of this improvement ranges from $0.38 million to $1.35 million (1997 dollars).

[2] In performing this analysis, EPA used guidance documents published by EPA that recommend numeric human health and aquatic life water quality criteria for numerous pollutants. States often consult these guidance documents when adopting water quality criteria as part of their water quality standards. However, because those State-adopted criteria may vary, EPA used the nationwide criteria guidance as the most representative values.

Table ES-1. Summary of Environmental Effects/Benefits of the Proposed Effluent Guidelines and Standards for the Iron and Steel Industry [a]

	Current	Proposed Rule	Summary of Benefits
Loadings (million lb/yr) [b, c]	253	198	22 percent reduction
Number of Instream Excursions for Pollutants That Exceed AWQC	269 at 55 streams	175 at 51 streams	4 streams become "contaminant-free" [d] Monetized benefits (recreational/nonuse) = $0.38 to $1.35 million
Excess Annual Cancer Cases [e]	0.31	0.29	Reduction of 0.02 cases each year Monetized benefits = $0.05 to $0.25 million
Population Potentially at Risk to Lead Exposure [e]	948,000	948,000	Annual benefits: • Reduction of 0.036 cases of adult and neonatal premature mortality • Prevention of aggregate loss of 57 IQ points in children Monetized benefits = $0.64 to $1.01 million
Population Potentially Exposed to Other Noncarcinogenic Health Risks [e]	900	none	Health effects to exposed population eliminated Benefits not quantifiable
POTWs Experiencing Inhibition	none of 61	none of 61	No baseline impacts
Improved POTW Biosolid Quality	0 metric tons	0 metric tons	No baseline impacts
Total Monetized Benefits			**$1.07 to 2.61 million** (1997 dollars)

a. Modeled results from 103 direct and 47 indirect facilities were extrapolated to represent 198 iron and steel facilities.
b. Loadings are representative of 60 priority and nonconventional pollutants evaluated; 4 conventional pollutants and 6 nonconventional pollutants are not included.
c. Loadings account for POTW removals.
d. "Contaminant-free" from iron and steel discharges; however, potential contamination from other point source discharges and nonpoint sources is still possible.
e. Through consumption of contaminated fish.

(b) Human Health Effects

EPA estimates that carcinogens in the current discharge loadings from the 198 iron and steel facilities could be responsible for 0.31 total excess annual cancer cases from the consumption of contaminated fish. The proposed rule is expected to reduce the carcinogenic loadings and the estimated excess annual cancer cases to 0.29. In addition, the proposed rule is expected to reduce lead discharges into 104 receiving streams, reducing the potential lead-related health effects through the consumption of lead-contaminated fish for an estimated 948,000 persons. EPA estimates that the proposed rule will reduce lead uptake enough to avoid the aggregate loss of 57 IQ points in 18,000 children and to reduce the number of cases of premature mortality by 0.036 in 930,000 adults and neonates. The estimated monetized benefit of these reductions in human health effects ranges from \$0.69 million to \$1.26 million (1997 dollars). EPA also projects that the proposed rule will eliminate the hazard to approximately 900 people potentially exposed to additional systemic toxicant effects from consumption of contaminated fish. A monetary value of these benefits could not be estimated.

(c) POTW Effects

EPA estimates that none of the 61 publicly owned treatment works (POTWs) considered in this assessment are experiencing inhibition problems or impaired biosolid quality due to iron and steel wastewater discharges. EPA therefore projects no potential economic benefits from reduced biosolid disposal costs.

(d) Basis of Conclusions

This environmental assessment bases its conclusion of the water quality-related benefits on aggregate site-specific analyses of current conditions and of changes expected to result from compliance with the proposed iron and steel effluent guidelines and standards for Best Available Technology

Economically Achievable (BAT) and Pretreatment Standards for Existing Sources (PSES). The proposed regulations limit the discharges of pollutants into navigable waters of the United States and the introduction of pollutants into POTWs from existing sources and from new sources in seven iron and steel subcategories. These categories are cokemaking, steel finishing, nonintegrated steelmaking and hot forming, integrated and stand-alone hot forming, ironmaking, integrated steelmaking, and other. Many iron and steel facilities have more than one subcategory-defined production line. In these cases, loadings from each subcategory are aggregated to estimate the combined environmental effects of the proposed rule.

Modeling Techniques

EPA employed stream dilution modeling techniques to assess the potential impacts and benefits of the proposed effluent guidelines and standards. Using site-specific analyses, EPA estimated instream pollutant concentrations for 60 priority and nonconventional pollutants[3] under current (baseline) and proposed treatment levels. Chapter 10 of the Technical Development Document explains more about these estimates. EPA analyzed the effects on water quality from direct and indirect discharge operations separately. EPA had sufficient data to analyze water quality impacts for 150 of the 198 iron and steel facilities. EPA extrapolated the results to the national level of 198 facilities using the statistical methodology for estimating costs, loads, and economic impacts. EPA combined the impacts for each of the subcategories to estimate water quality effects as a result of the proposed rule.

EPA assessed the potential impacts and benefits in terms of effects on aquatic life, human health, and POTW operations. EPA projected the benefits to aquatic life by comparing the modeled instream pollutant concentrations to published EPA aquatic life criteria guidance or to toxic effect levels. EPA projected human health benefits by (1) comparing estimated instream pollutant concentrations to health-

[3] Evaluations do not include the impacts of 4 conventional and 6 nonconventional pollutants when modeling the effects of the proposed rule on receiving stream water quality and POTW operations or when evaluating the potential fate and toxicity of discharged pollutants. The discharge of these pollutants may adversely affect human health and the environment.

based toxic effect values or criteria derived using standard EPA methodology, (2) estimating the potential reductions of carcinogenic risk and noncarcinogenic hazard (systemic) from consuming contaminated fish and drinking water, and (3) estimating the potential reductions of lead exposure from consuming contaminated fish.

The assessment estimated upper-bound individual cancer risks, population risks, and systemic hazards using modeled instream pollutant concentrations and standard EPA assumptions. The assessment evaluated modeled pollutant concentrations in fish and drinking water to estimate cancer risk and systemic hazards among the general population (drinking water only), sport anglers and their families, and subsistence anglers and their families. The assessment also evaluated modeled pollutant concentrations in fish to estimate human health effects from exposure to lead among sport anglers and their families, and subsistence anglers and their families. EPA assessed improvements in aquatic habitats using its findings of reduced occurrence of instream pollutant concentrations in excess of both aquatic life and human health criteria or toxic effect levels. EPA expects that these improvements in aquatic habitats will improve the quality and value of recreational fishing opportunities and nonuse (intrinsic) values of the receiving streams.

The environmental assessment also evaluated the potential inhibition of POTW operations and potential contamination of sewage biosolids (which limits its use for land application) based on current and proposed pretreatment levels. EPA estimated inhibition of POTW operations by comparing modeled POTW influent concentrations to available inhibition levels. EPA assessed the potential contamination of sewage biosolids by comparing projected pollutant concentrations in sewage biosolids to available EPA regulatory standards for land application and surface disposal of sewage biosolids.

Pollutant Fate and Toxicity

EPA identified a total of 70 pollutants of concern (28 priority pollutants, 4 conventional pollutants, and 38 nonconventional pollutants) in waste streams from iron and steel facilities. EPA evaluated 60 of these pollutants with sufficient data to assess their potential fate and toxicity on the basis of known physical-chemical properties, and aquatic life and human health toxicity data.

Most of the 70 pollutants have at least one known toxic effect. EPA determined that 23 exhibit moderate to high toxicity to aquatic life, 16 are classified as known or probable human carcinogens, 39 are human systemic toxicants, 23 have drinking water values, and 28 are designated as priority pollutants. In terms of projected partitioning among media, 16 of the evaluated pollutants are moderately to highly volatile (potentially causing risk to exposed populations via inhalation), 25 have a moderate to high potential to bioaccumulate in aquatic biota (potentially accumulating in the food chain and causing increased risk to higher trophic level organisms and to exposed human populations via consumption of fish and shellfish), 18 are moderately to highly adsorptive to solids, and 8 are resistant to biodegradation or are slowly biodegraded.

Documented Impacts

This report also summarizes documented environmental impacts on aquatic life, human health, and receiving stream water quality. The summaries are based on a review of an EPA enforcement and compliance report, State 303(d) lists of impaired waterbodies, and State fishing advisories.

States identified at least 17 impaired waterbodies, with industrial point sources as a potential source of impairment, that receive direct discharges from iron and steel facilities (and other sources). States also issued fish consumption advisories for 12 waterbodies that receive direct discharges from iron and steel facilities (and other sources). The advisories are for mercury, a pollutant of concern for the iron and steel industry. Over 25 fish consumption advisories were reported in the *1997 Update of Listing of Fish and Wildlife Advisories* for waterbodies that receive wastewater discharges from iron and steel facilities. However, the majority of advisories are for chemicals that are not pollutants of concern for the iron and steel industry. In addition, EPA identified in its *1998 Enforcement and Compliance Assurance*

Accomplishment Reports by the Office of Enforcement and Compliance Assurance (OECA) significant noncompliance (SNC) rates (most egregious violations under each program or statute) for iron and steel facilities. Of the 27 integrated mills inspected in fiscal years (FY) 1996 and 1997, 26 facilities were out of compliance with one or more statutes, and 18 facilities were in SNC. In FY 1998, of the 23 integrated mills inspected, the number in SNC included 9 facilities for water permits, 17 facilities for air, and 7 facilities with Resource Conservation and Recovery Act (RCRA) violations. SNC rates for 91 mini-mills included 19 facilities for air, 2 facilities for water permits, and 4 facilities for RCRA. Key compliance and environmental problems included groundwater contamination from slag disposal, contaminated sediments from steelmaking, electric arc furnace dust, unregulated sources, SNCs from recurring and single peak violations, and no baseline testing.

1. INTRODUCTION

This environmental assessment quantifies the water quality-related benefits associated with achievement of the Best Available Technology (BAT) and Pretreatment Standards for Existing Sources (PSES) proposed by the U.S. Environmental Protection Agency (EPA) to regulate iron and steel facilities. Using site-specific analyses of current conditions and changes in discharges associated with the proposed regulation, EPA estimated instream pollutant concentrations for 60 priority and nonconventional pollutants from direct and indirect discharges in seven industry subcategories (cokemaking, steel finishing, nonintegrated steelmaking and hot forming, integrated and stand-alone hot forming, ironmaking, integrated steelmaking, and other) using stream dilution modeling.

The assessment evaluates the potential impacts and benefits to aquatic life by comparing the modeled instream pollutant concentrations to published EPA aquatic life criteria guidance or toxic effect levels. The assessment evaluates the potential benefits to human health by (1) comparing estimated instream concentrations to health-based water quality toxic effect levels or EPA's published water quality criteria, (2) estimating the potential reduction of carcinogenic risk and noncarcinogenic hazard (systemic) from consuming contaminated fish or drinking water, and (3) estimating the potential reduction of lead exposure from consuming contaminated fish. The assessment monetizes reductions in carcinogenic risks using estimated willingness-to-pay values for avoiding premature mortality to which monetary values can be applied. The assessment monitizes reductions in exposure to lead based on dose-response functions related to specific health endpoints (IQ levels in children 0-6 years and adult/neonatal premature mortality) to which monetary values can be applied. The assessment projects potential ecological benefits, including nonuse (intrinsic) benefits, by estimating improvements in recreational fishing habitats and, in turn, by estimating a monetary value for enhanced recreational fishing opportunities. The assessment estimates economic productivity benefits on the basis of reduced POTW sewage sludge contamination (e.g., reducing contamination increases the number of allowable sludge uses or disposal options).

In addition, the assessment evaluates the potential fate and toxicity of pollutants of concern associated with iron and steel wastewater on the basis of known characteristics of each chemical. The assessment also reviews recent reports and databases for evidence of documented environmental impacts (e.g., case studies) on aquatic life, human health, and receiving stream water quality.

This assessment does not evaluate impacts associated with releases of 4 conventional pollutants (biological oxygen demand [BOD], oil and grease (measured as hexane extractable material [HEM] and silica gel-treated HEM), total suspended solids [TSS]) and 6 nonconventional pollutants (chemical oxygen demand [COD], total organic carbon [TOC], total recoverable phenolics, total kjeldahl nitrogen, amenable cyanide, and weak acid dissociable cyanide). However, the discharge of these pollutants may adversely affect human health and the environment. For example, habitat degradation may result from increased suspended particulate matter that reduces light penetration and primary productivity or from the accumulation of sludge particles that alter benthic spawning grounds and feeding habitats. Oil and grease can have lethal effects on fish by coating the surface of gills and causing asphyxia, by depleting oxygen levels as a result of excessive BOD, or by reducing stream reaeration because of surface film. Oil and grease can also have detrimental effects on waterfowl by destroying the buoyancy and insulation of their feathers. Bioaccumulation of oily substances can cause human health problems including tainting of fish and bioaccumulation of carcinogenic polycyclic aromatic compounds. High COD and BOD_5 levels can deplete oxygen concentrations in water, which can result in fish mortality or other adverse effects in fish. High TOC levels may interfere with water quality by causing taste and odor problems in water and mortality in fish.

Following this introduction, Section 2 of this report describes the methodologies used to evaluate projected water quality impacts and projected impacts on POTW operations for direct and indirect discharging facilities (including potential human health risks and benefits, ecological benefits, and economic productivity benefits); to evaluate the potential fate and toxicity of pollutants of concern; and to evaluate documented environmental impacts. Section 3 describes data sources and information used to evaluate water quality impacts, such as facility-specific data; information used to evaluate POTW operations; water quality criteria; and information used to evaluate human health risks and benefits, ecological benefits, economic productivity benefits, pollutant fate and toxicity, and documented environmental impacts. Section 4 provides a summary of the results of this assessment, and Section 5 is a complete list of references cited in the report. The appendices presented in Volume II provide additional detail on the specific information addressed in the main report.

2. METHODOLOGY

2.1 Projected Water Quality Impacts

This assessment evaluates the water quality impacts and associated risks/benefits of iron and steel discharges at various treatment levels by (1) comparing projected instream concentrations with ambient water quality criteria (AWQC),[4] (2) estimating the human health risks and benefits associated with the consumption of fish and drinking water from waterbodies impacted by iron and steel facilities, (3) estimating the ecological benefits associated with improved recreational fishing habitats on impacted waterbodies, and (4) estimating the economic productivity benefits based on reduced sewage sludge contamination at POTWs receiving the wastewater of iron and steel facilities. The assessment analyzes the impacts and associated risks/benefits for a representative sample set of 103 direct discharging facilities and 47 indirect discharging facilities. The assessment extrapolates the results to the national level based on the statistical methodology used for estimating costs, loads, and economic impacts. The following sections describe the methodologies used in this evaluation.

2.1.1 Comparison of Instream Concentrations with Ambient Water Quality Criteria

The instream concentration analysis quantifies and compares current and proposed BAT/PSES pollutant releases and uses stream modeling techniques to evaluate potential aquatic life and human health impacts resulting from those releases. The analysis compares projected instream concentrations for each pollutant to EPA water quality criteria or, for pollutants for which no water quality criteria have been developed, to toxic effect levels (i.e., lowest reported or estimated toxic concentration). The analysis also evaluates inhibition of POTW operation and sludge

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[4] In performing this analysis, EPA used guidance documents published by EPA that recommend numeric human health and aquatic life water quality criteria for numerous pollutants. States often consult these guidance documents when adopting water quality criteria as part of their water quality standards. However, because those State-adopted criteria may vary, EPA used the nationwide criteria guidance as the most representative values.

contamination. Sections 2.1.1.1 through 2.1.1.3 describe the methodologies and assumptions used for evaluating the impacts of direct and indirect discharging facilities.

2.1.1.1 *Direct Discharging Facilities*

Using a stream dilution model that does not account for fate processes other than complete immediate mixing, the analysis calculates projected instream concentrations at current and proposed BAT treatment levels for stream segments with direct discharging facilities. For stream segments with multiple iron and steel facilities, pollutant loadings are summed, if applicable, before concentrations are calculated. The dilution model used for estimating instream concentrations is as follows.

$$C_{is} \quad \frac{L/OD}{FF \quad SF} \; x \; CF \qquad \text{(Eq. 1)}$$

where:

C_{is}	=	instream pollutant concentration (micrograms per liter [Fg/L])
L	=	facility pollutant loading (pounds/year [lb/year])
OD	=	facility operation (days/year)
FF	=	facility flow (million gallons/day [gal/day])
SF	=	receiving stream flow (million gal/day)
CF	=	conversion factors for units

The analysis uses various resources, as described in Section 3.1.1 of this report, to derive the facility-specific data (i.e., pollutant loading, operating days, facility flow, and stream flow) used in Eq. 1. One of 3 receiving stream flow conditions (1Q10 low flow, 7Q10 low flow, and harmonic mean flow) is used for the two treatment levels; use depends on the type of criterion or toxic effect level intended for comparison. To estimate potential acute and chronic aquatic life impacts, the analysis uses the 1Q10 and 7Q10 flows, which are the lowest 1-day and the lowest consecutive 7-day average flow during any 10-year period, respectively, as recommended in the *Technical Support Document for Water Quality-based Toxics Control* (U.S. EPA, 1991). EPA defines the harmonic mean flow as the inverse mean of reciprocal daily arithmetic mean flow values. EPA recommends the long-term harmonic mean flow as the design flow for assessing potential human health impacts because it provides a more conservative estimate than the arithmetic mean flow. Because 7Q10 flows have no consistent relationship with the long-term mean dilution, they are not appropriate for assessing potential human health impacts.

For assessing impacts on aquatic life, the analysis uses the facility operating days to represent the exposure duration; the calculated instream concentration is thus the average concentration *on days the facility is discharging wastewater*. For assuming long-term human health impacts, it sets the operating days (exposure duration) at 365 days. The calculated instream concentration is thus the average concentration *on all days of the year*. Although this calculation for human health impacts leads to a lower calculated concentration because of the additional dilution from days when the facility is not in operation, it is consistent with the conservative assumption that the target population is present to consume drinking water and contaminated fish every day for an entire lifetime.

Because stream flows are not available for hydrologically complex waters such as bays, estuaries, and oceans, the analysis uses site-specific critical dilution factors (DFs) or estuarine dissolved concentration potentials (DCPs) to predict pollutant concentrations for facilities discharging to estuaries and bays, if applicable, as follows:

$$C_{es} \quad \left[\left(\frac{L/OD}{FF} \right) x \ CF \right] / \ DF \qquad \text{(Eq. 2)}$$

where:

C_{es} = estuary pollutant concentration (Fg/L)
L = facility pollutant loading (lb/year)
OD = facility operation (days/year)
FF = facility flow (million gal/day)
DF = critical dilution factor
CF = conversion factors for units

$$C_{es} \quad \frac{L \ x \ DCP \ x \ CF}{BL} \qquad \text{(Eq. 3)}$$

where:

C_{es} = estuary pollutant concentration (Fg/L)
L = facility pollutant loading (lb/year)
DCP = dissolved concentration potential (milligrams per liter [mg/L])
CF = conversion factor for units
BL = benchmark load (10,000 tons/year)

A survey of States and Regions conducted by EPA's Office of Pollution Prevention and Toxics (OPPT), *Mixing Zone Dilution Factors for New Chemical Exposure Assessments*, Draft Report, (U.S. EPA, 1992), provides the site-specific critical DFs. The analysis uses acute critical DFs to evaluate acute aquatic life effects, whereas it uses chronic critical DFs to evaluate chronic aquatic life or adverse human health effects. The analysis assumes that the drinking water intake and fishing location are at the edge of the chronic mixing zone.

The Strategic Assessment Branch of the National Oceanic and Atmospheric Administration's (NOAA) Ocean Assessments Division developed DCPs based on freshwater inflow and salinity gradients to predict pollutant concentrations in each estuary in the National Estuarine Inventory (NEI) Data Atlas. NOAA applies these DCPs to predict concentrations. NOAA did not consider pollutant fate and designated the DCPs to simulate concentrations of nonreactive dissolved substances under well-mixed steady-state conditions given an annual load of 10,000 tons. In addition, the DCPs reflect the predicted estuary-wide response and may not be indicative of site-specific locations.

The analysis determines potential impacts on freshwater quality by comparing projected instream pollutant concentrations (Eq. 1) at reported facility flows, 1Q10 and 7Q10 low flows, and harmonic mean receiving stream flows with EPA AWQC or toxic effect levels for the protection of aquatic life and human health. The analysis compares projected estuary pollutant concentrations (Eq. 2 and Eq. 3), based on critical DFs or DCPs, to EPA AWQC or toxic effect levels to determine impacts. To determine water quality criteria excursions, the analysis divides the projected instream or estuary pollutant concentration by the EPA water quality criteria or toxic effect levels. A value greater than 1.0 indicates an excursion.

2.1.1.2 *Indirect Discharging Facilities*

The analysis uses a 2-stage process to assess the impacts of indirect discharging facilities. First, water quality impacts are evaluated as described in subsection (a) below. Next, impacts on POTWs are considered as described in subsection (b).

(a) Water Quality Impacts

Using a stream dilution model that does not account for a fate process other than complete immediate mixing, the analysis calculates projected instream concentrations at current and proposed PSES treatment levels for stream segments receiving wastewaters from indirect discharging facilities. For stream segments with multiple iron and steel facilities, pollutant loadings are summed, if applicable, before concentrations are calculated. The dilution model used for estimating instream concentrations is as follows:

$$C_{is} \quad (L/OD) \ x \ \frac{(1 \ \ TMT) \ x \ CF}{PF \quad SF} \qquad \text{(Eq. 4)}$$

where:

C_{is}	=	instream pollutant concentration (Fg/L)
L	=	facility pollutant loading (lb/year)
OD	=	facility operation (days/year)
TMT	=	POTW treatment removal efficiency
PF	=	POTW flow (million gal/day)
SF	=	receiving stream flow (million gal/day)
CF	=	conversion factors for units

The analysis uses various resources, as described in Section 3.1.1 of this report, to derive the facility-specific data (i.e., pollutant loading, operating days, facility flow, and stream flow) used in Eq. 4. One of 3 receiving stream flow conditions (1Q10 low flow, 7Q10 low flow, and harmonic mean flow) is used for the two treatment levels. The analysis uses site-specific critical DFs or estuarine DCPs to predict pollutant concentrations for facilities discharging to estuaries and bays, if applicable, as follows:

$$C_{es} \quad \left[\left(\frac{L/OD \ x \ (1 \ TMT)}{PF} \right) \ x \ CF \right] / \ DF \qquad \text{(Eq. 5)}$$

where:

C_{es}	=	estuary pollutant concentration (Fg/L)
L	=	facility pollutant loading (lb/year)
OD	=	facility operation (days/year)
TMT	=	POTW treatment removal efficiency
PF	=	POTW flow (million gal/day)
DF	=	critical dilution factor
CF	=	conversion factors for units

$$C_{es} \quad \frac{L \ x \ (1 \ TMT) \ x \ DCP \ x \ CF}{BL} \qquad \text{(Eq. 6)}$$

where:

C_{es} = estuary pollutant concentration (Fg/L)
L = facility pollutant loading (lb/year)
TMT = POTW treatment removal efficiency
DCP = dissolved concentration potential (mg/L)
CF = conversion factors for units
BL = benchmark load (10,000 tons/year)

The analysis determines potential impacts on freshwater quality by comparing projected instream pollutant concentrations (Eq. 4) at reported POTW flows, 1Q10 and 7Q10 low flows, and harmonic mean receiving stream flows with EPA AWQC or toxic effect levels for the protection of aquatic life and human health. The analysis compares projected estuary pollutant concentrations (Eq. 5 and Eq. 6), based on critical DFs or DCPs, to EPA AWQC or toxic effect levels to determine impacts. To determine water quality criteria excursions, the analysis divides the projected instream or estuary pollutant concentration by the EPA AWQC or toxic effect levels. (See Section 2.1.1.1 for discussion of stream flow conditions, application of DFs or DCPs, assignment of exposure duration, and comparison with criteria or toxic effect levels.) A value greater than 1.0 indicates an excursion.

(b) Impacts on POTWs

The analysis calculates impacts on POTW operations in terms of inhibition of POTW processes (i.e., inhibition of microbial degradation processes) and contamination of POTW sludges. Contamination is defined as a pollutant concentration that exceeds the levels at which sewage sludge may be land applied or surface disposed under 40 CFR Part 503. To determine inhibition of POTW operations, the analysis divides calculated POTW influent levels (Eq. 7) by chemical-specific inhibition threshold levels. Excursions are indicated by a value greater than 1.0.

$$C_{pi} \quad \frac{L/OD}{PF} \ x \ CF \qquad \text{(Eq. 7)}$$

where:

C_{pi}	=	POTW influent concentration (Fg/L)
L	=	facility pollutant loading (lb/year)
OD	=	facility operation (days/year)
PF	=	POTW flow (million gal/day)
CF	=	conversion factors for units

The analysis evaluates contamination levels of sludge (and thus its use for land application, etc.) by dividing projected pollutant concentrations in sludge (Eq. 8) by available EPA-developed criteria values for sludge. A value greater than 1.0 indicates an excursion.

$$C_{sp} \quad C_{pi} \ x \ TMT \ x \ PART \ x \ SGF \qquad \text{(Eq. 8)}$$

where:

C_{sp}	=	sludge pollutant concentration (milligrams per kilogram [mg/kg])
C_{pi}	=	POTW influent concentration (Fg/L)
TMT	=	POTW treatment removal efficiency
PART	=	chemical-specific sludge partition factor
SGF	=	sludge generation factor (5.96 parts per million [ppm])

The analysis derives facility-specific data and information used to evaluate POTWs from the sources described in Sections 3.1.1 and 3.1.2. For facilities that discharge to the same POTW, the analysis sums their individual loadings, if applicable, before calculating the POTW influent and sludge concentrations.

The partition factor is a measure of the tendency for the pollutant to partition in sludge when it is removed from wastewater. For predicting sludge generation, the model assumes that 1,400 pounds of sludge are generated for each 1 million gallons of wastewater processed (Metcalf & Eddy, Inc.,1972). This results in a sludge generation factor of 5.96 mg/kg per Fg/L (i.e., for every 1 Fg/L of pollutant removed from wastewater and partitioned to sludge, the concentration in sludge is 5.96 mg/kg dry weight).

2.1.1.3 *Assumptions and Caveats*

The instream and POTW analyses assume the following:

- Background concentrations of each pollutant, both in the receiving stream and in the POTW influent, are equal to zero; therefore, the analysis evaluates only the impacts of discharging facilities.

- The analysis uses an exposure duration of 365 days to determine the likelihood of actual excursions of human health criteria or toxic effect levels.

- Complete mixing of discharge flow and stream flow occurs across the stream at the discharge point; therefore, the analysis calculates an "average stream" concentration, even though the actual concentration may vary across the width and depth of the stream.

- The intake process water and noncontact cooling water at each facility, and the water discharged to a POTW, are obtained from a source other than the receiving stream for 29 iron and steel facilities as identified in the facility questionnaire; all other noncontact cooling waters and process waters are obtained from the receiving stream.

- The stream dilution model includes the process water and noncontact cooling water in estimating the instream concentrations only for those facilities whose waters are obtained from a source other than the receiving stream.

- The pollutant load to the receiving stream is continuous and is representative of long-term facility operations. These assumptions may overestimate risks to human health and aquatic life, but may underestimate potential short-term effects.

- The analysis uses 1Q10 and 7Q10 receiving stream flow rates to estimate aquatic life impacts; harmonic mean flow rates are used to estimate human health impacts. It estimates 1Q10 low flows using the results of a regression analysis of 1Q10 and 7Q10 flows from representative U.S. rivers and streams conducted by Versar, Inc., for EPA's Office of Pollution Prevention and Toxics (OPPT) (Versar, 1992). Harmonic mean flows are estimated from the mean and 7Q10 flows as recommended in the *Technical Support Document for Water Quality-based Toxics Control* (U.S. EPA, 1991). These flows may not be the same as those used by specific States to assess impacts.

- C The analysis adjusts the 7Q10 receiving stream flow rate to equal the facility or POTW flow rate for receiving streams where the facility or POTW flow rate is greater than the 7Q10 flow rate.

- C The analysis assumes effluent pollutant concentrations at proposed BAT treatment levels are equal to effluent pollutant concentrations at current treatment levels for those pollutants and sites/subcategories where pollutants were never detected above minimum levels or where there is a projected reduction in flow but not a projected reduction in load (i.e., loads used in the cost-effectiveness analysis).

- C The analysis does not consider pollutant fate processes such as sediment adsorption, volatilization, and hydrolysis. This may result in estimated instream concentrations that are environmentally conservative (higher).

- C The analysis assigns a removal efficiency of zero to pollutants without a specific POTW treatment removal efficiency value (provided by EPA or found in the literature). Pollutants without a specific partition factor are assigned a value of zero.

- C Sludge criteria levels are available for only 7 pollutants: arsenic, cadmium, copper, lead, mercury, selenium, and zinc.

- C The analysis uses AWQC or toxic effect levels developed for freshwater organisms for facilities discharging to estuaries or bays.

2.1.2 Estimation of Human Health Risks and Benefits

The analysis evaluates the potential benefits to human health by estimating the risks (carcinogenic and noncarcinogenic hazard [systemic]) associated with reducing pollutant levels in fish tissue and drinking water from current to proposed treatment levels. EPA monetizes the reduction in carcinogenic risks using estimated willingness-to-pay values for avoiding premature mortality. The analysis also evaluates the potential benefits to human health by estimating blood lead levels associated with reducing lead levels in fish tissue. EPA monetizes this reduction using estimated willingness-to-pay values for avoiding a decrease in a child’s intelligence quotient (IQ) and avoiding premature adult and neonatal mortality. Sections 2.1.2.1 and 2.1.2.2 describe the methodology and assumptions used to evaluate the human health risks and benefits (carcinogenic and systemic) from the consumption of fish tissue and drinking water derived from waterbodies impacted by direct and indirect discharging facilities. Sections 2.1.2.3 and 2.1.2.4 describe the methodology and assumptions used to evaluate lead-related human health risks and benefits from the consumption of fish tissue derived from the same waterbodies.

2.1.2.1 *Carcinogenic and Systemic Human Health Risks and Benefits*

(a) Fish Tissue

To determine the potential benefits, in terms of reduced cancer cases, associated with reducing pollutant levels in fish tissue, the analysis estimates lifetime average daily doses (LADDs) and individual risk levels for each pollutant discharged from a facility on the basis of the instream pollutant concentrations calculated at current and proposed BAT/PSES treatment levels in the site-specific stream dilution analysis (see Section 2.1.1). EPA presents estimates for sport anglers and their families, and subsistence anglers and their families. LADDs are calculated as follows:

$$LADD \quad (C \times IR \times BCF \times F \times D) \;/\; (BW \times LT) \qquad \text{(Eq. 9)}$$

where:

LADD	=	potential lifetime average daily dose (milligrams per kilogram per day [mg/kg-day])
C	=	exposure concentration (mg/L)
IR	=	ingestion rate (see Section 2.1.2.2, Assumptions)
BCF	=	bioconcentration factor (liters per kilogram [L/kg]; whole body x 0.5)
F	=	frequency duration (365 days/year)
D	=	exposure duration (70 years)
BW	=	body weight (70 kg)
LT	=	lifetime (70 years x 365 days/year)

Individual risks are calculated as follows:

$$R \quad LADD \ x \ SF \qquad \text{(Eq. 10)}$$

where:

R	=	individual risk level
LADD	=	potential lifetime average daily dose (mg/kg-day)
SF	=	cancer slope factor $(mg/kg\text{-}day)^{-1}$

The analysis then applies the estimated individual pollutant risk levels to the potentially exposed populations of sport anglers and subsistence anglers to estimate the potential number of excess annual cancer cases occurring over the life of the population. It then sums the number of excess cancer cases on a pollutant, facility, and overall industry basis. The analysis assumes the number of reduced cancer cases to be the difference between the estimated risks at current and proposed BAT/PSES treatment levels.

EPA estimates a monetary value of benefits to society from avoided cancer cases using estimates of society's willingness to pay to avoid the risk of cancer-related premature mortality. Although it is not certain that all cancer cases will result in death, to develop a worst-case estimate, this analysis values avoided cancer cases on the basis of avoided *mortality*. To value mortality, the analysis uses a range of values recommended by an EPA Office of Policy Analysis (OPA) review of studies quantifying individuals' willingness to pay to avoid risks to life (Fisher, Chestnut, and Violette, 1989; and Violette and Chestnut, 1986). The reviewed studies used hedonic wage and contingent valuation analyses in labor markets to estimate the amounts that individuals are willing to pay to avoid slight increases in risk of mortality or the amount they will need to be compensated to accept a slight increase in risk of mortality. The willingness-to-pay values estimated in those studies are associated with small changes in the probability of mortality. To estimate a willingness to pay for avoiding certain or high-probability mortality events, EPA extrapolated the estimated values for a 100 percent probability event.[5] EPA uses the resulting estimates of the value of a

[5] These estimates, however, do not represent the willingness to pay to avoid the certainty of death.

"statistical life saved" to value regulatory effects that are expected to reduce the incidence of mortality.

From this review of willingness-to-pay studies, OPA recommends a range of $1.6 to $8.5 million (1986 dollars) for valuing an avoided event of premature mortality or a statistical life saved. A more recent survey of value-of-life studies by Viscusi (1992) also supports this range with the finding that value-of-life estimates are clustered in the range of $3 to $7 million (1990 dollars). For this analysis, the figures recommended in the OPA study are adjusted to 1997 using the relative change in the Employment Cost Index of Total Compensation for All Civilian Workers from 1986 to 1997 (49 percent). Using the change in nominal Gross Domestic Product (GDP) instead of change in inflation as the basis for adjustment in the willingness-to-pay values accounts for the expectation that willingness-to-pay to avoid risk is a normal economic good, and that, accordingly, society's willingness to pay to avoid risk will increase as national income increases. Updating to 1997 dollars yields a range of $2.4 to $12.6 million.

The analysis estimates potential reductions in risks due to reproductive, developmental, or other chronic and subchronic toxic effects by comparing the estimated lifetime average daily dose and the oral reference dose (RfD) for a given chemical pollutant as follows:

$$HQ \quad ORI/RfD \qquad \text{(Eq. 11)}$$

where:

HQ	=	hazard quotient
ORI	=	oral intake (LADD x BW, mg/day)
RfD	=	reference dose (mg/day assuming a body weight of 70 kg)

The analysis then calculates a hazard index (i.e., sum of individual pollutant hazard quotients) for each facility or receiving stream. A hazard index greater than 1.0 indicates that toxic effects may occur in exposed populations. The analysis then sums and compares the sizes of the affected subpopulations at current and proposed BAT/PSES treatment levels to assess benefits in terms of reduced systemic toxicity. Although the analysis could not estimate the monetary value of benefits to society associated with a reduction in the number of individuals exposed to pollutant levels that are likely to result in systemic health effects, it expects any reduction in risk will yield human health-related benefits.

(b) Drinking Water

The analysis determines potential benefits associated with reducing pollutant levels in drinking water in a manner similar to that used for fish tissue. The analysis calculates LADDs for drinking water consumption as follows:

$$LADD \quad (C \times IR \times F \times D) / (BW \times LT) \qquad \text{(Eq. 12)}$$

where:

LADD	=	potential lifetime average daily dose (mg/kg-day)
C	=	exposure concentration (mg/L)
IR	=	ingestion rate (2L/day)
F	=	frequency duration (365 days/year)
D	=	exposure duration (70 years)
BW	=	body weight (70 kg)
LT	=	lifetime (70 years x 365 days/year)

The analysis applies estimated individual pollutant risk levels greater than 10^{-6} (1E-6) to the populations served by any drinking water utilities within 50 miles downstream of each discharge site to determine the number of excess annual cancer cases that may occur during the life of the population. It evaluates systemic toxicant effects by estimating the sizes of populations exposed to pollutants from a given facility, the sum of whose individual hazard quotients yields a hazard index greater than 1.0. If applicable, EPA estimates a monetary value of benefits to society from avoided cancer cases, as described above in subsection (a).

2.1.2.2 *Assumptions and Caveats (Carcinogenic and Systemic Analyses)*

The analyses of human health risks and benefits use the following assumptions:

- A linear relationship exists between pollutant loading reductions and benefits attributed to the cleanup of surface waters.

- The analysis does not assess synergistic effects of multiple chemicals on aquatic ecosystems; therefore, the total benefit of reducing toxics may be underestimated.

- EPA's Science Advisory Board (SAB) recently recommended that the value of a statistical life (VSL) be adjusted downward using a discount factor to account for latency in cases (such as cancer) where there is a lag between exposure and mortality. This adjustment was not performed in the current analysis because EPA requires more information to estimate latency periods associated with cancers caused by iron and steel pollutants. For example, the risk assessments for several pollutants are based on data from animal bioassays; these data are not sufficiently reliable to estimate a latency period for humans.

- The analysis estimates the total number of individuals who might consume recreationally caught fish and the number who rely on fish on a subsistence basis in each State, in part by assuming that these anglers regularly share their catch with family members; therefore, the number of anglers in each State is multiplied by the State's average household size. The analysis does not include benefits to the general population because the location of facilities in relation to commercial fisheries is unknown.

- Subsistence anglers make up 5 percent of the resident anglers in a given State; the other 95 percent are sport anglers.

- Recreationally valuable species occur or are taken in the vicinity of the discharges included in the evaluation.

- The analysis of fish tissue uses ingestion rates of 12.1 grams per day for sport anglers and 124.1 grams per day for subsistence anglers (U.S. EPA, 2000a). These ingestion rates are based on uncooked fish weights and use data from all ages of the population surveyed. They represent the 90th and the 99th percentiles, respectively, of the empirical distribution of the U.S. per capita freshwater/estuarine finfish and shellfish consumption, and do not include the consumption of marine fish.

- A State's resident anglers fish all rivers or estuaries within a State equally, and the fish are consumed only by the population within that State.

- The analysis estimates the sizes of populations potentially exposed to discharges to rivers or estuaries that border more than one State using only populations within the State in which the facility is located.

- The analysis estimates the size of the population potentially exposed to fish caught in an impacted waterbody in a given State using the ratio of impacted river miles to total river miles or of impacted estuary square miles to total estuary square miles. The number of miles potentially impacted by a facility's discharge is 50 miles for rivers and the total surface area of the various estuarine zones for estuaries.

- When estimating the pollutant concentration in drinking water or fish, the analysis does not consider pollutant fate processes (e.g., sediment adsorption, volatilization, hydrolysis); consequently, estimated concentrations are environmentally conservative (higher).

2.1.2.3 *Lead-Related Human Health Risks and Benefits*

Research has shown that the ingestion of lead may cause adverse health effects in children and adults. Elevated blood levels in children may impair intellectual development as measured by reduced IQ levels. Ingestion of lead by adults may cause numerous cardiovascular problems including hypertension, coronary heart disease, and strokes. These ailments may cause premature death, particularly in adults 40-74 years of age. In addition, elevated blood lead levels in pregnant women may increase the risk of neonatal mortality due to decreased gestational age and low birthweight.

EPA estimates the potential benefits of reduced lead exposure (resulting from reduced consumption of contaminated fish tissue) associated with reduced neurological and cognitive effects in children (0-6 years of age) as well as reduced cases of premature adult (40-74 years of age) and neonatal mortality.[6] This analysis of lead-related health effects is based on dose-response functions

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[6] The analysis does not consider potential benefits associated with reducing lead levels in drinking water. EPA has issued a drinking water standard for lead and it is assumed that drinking water treatment systems will reduce

related to specific health endpoints to which monetary values can be applied. EPA uses the methodologies developed for assessing human health risks from lead at Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)/RCRA sites (U.S. EPA, 1996a) and for estimating the benefits of the Clean Air Act (U.S. EPA, 1997a). EPA presents estimates for children living in sport and subsistence anglers households, prenatal children, and adult men/women sport and subsistence anglers.

(a) Children's Health Risks and Benefits - IQ Levels

To determine the potential benefits to children in terms of reduced lead exposure (associated with reducing lead levels in fish tissue), the analysis first estimates the instream lead concentrations at current and proposed BAT/PSES treatment levels (see Section 2.1.1). The analysis then projects the average daily doses (ADDs) for lead based on the instream concentrations, the bioconcentration factor for lead, and fish consumption rates for children, as follows:

$$ADD \quad \frac{C \ x \ IR \ x \ BCF}{CF} \qquad \text{(Eq. 13)}$$

where:

ADD	=	potential average daily dose (Fg/day)
C	=	exposure concentration (Fg/L)
IR	=	ingestion rate for children (see Section 2.1.2.4, Assumptions)
BCF	=	bioconcentration factor for lead (49 L/kg)
CF	=	conversion factors for units

The analysis estimates the changes in blood lead levels resulting from the changes in environmental lead levels by using EPA's *Integrated Exposure Uptake Biokinetic (IEUBK) Model for Lead in Children* (U.S. EPA, 1994). This model allows the user to estimate the geometric

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concentrations below adverse effect thresholds.

mean blood lead concentration for a hypothetical child or populations of children. Using the estimated ADD, the model estimates a plausible distribution of blood lead concentrations centered on the geometric mean (GM) blood lead concentration.

The analysis then applies the change in the estimated geometric mean blood lead level (from current to proposed BAT/PSES) to the potentially exposed child populations by multiplying the estimated populations of sport anglers and subsistence anglers by the corresponding estimated percentage of children in the anglers' families. The analysis uses the *Statistical Abstract of the United States: 1997* (U.S. Bureau of the Census, 1997) to estimate the percentage of the population between 0 and 6 years of age (10.31 percent). The analysis estimates the change in children's IQ levels as follows:

$$(\textit{Avoided Loss of IQ Points}) = \Delta GM \ x \ 1.117 \ x \ 0.25 \ x \ (POP/7) \qquad \text{(Eq. 14)}$$

where:

(Avoided Loss of IQ Points)	=	total reduction of IQ points in affected population
ΔGM	=	change in the geometric mean of affected populations' blood lead levels
1.117	=	ratio between the expected value (mean) of the distribution and the geometric mean
0.25	=	decrease in IQ points expected for every 1 μg/dL increase in blood lead level
POP	=	number of affected children (0-6 years of age) in anglers' families
7	=	exposure duration (7 years)

EPA estimates a monetary value of benefits to society from avoided loss of IQ points to approximate society's willingness-to-pay to avoid the loss. To value the loss of IQ points, the analysis considers the effects of IQ loss on decreased present value of expected lifetime earnings. Reduced IQ has direct and indirect effects on earnings. The direct effects are decreased job attainment and performance. Indirect effects include reduced years of schooling and reduced labor force participation. The analysis models the overall impact from a one-point reduction in IQ as a sum of these direct and indirect effects on lifetime earnings.

Using 1992 Bureau of the Census data on earnings, the adjusted value of expected lifetime earnings equals the present value for an individual entering the labor force at age 18 and working until age 67. Given a three percent social discount rate and current survival probabilities, and the assumption that real wages grow one percent per year, the analysis uses the present value of lifetime earnings of a person born today in the United States as presented in *Economic, Environmental, and Benefits Assessment of the Proposed Metal Products and Machinery (MP&M) Regulation* (U.S. EPA, 2000b). The value is adjusted to $412,000 (1997 dollars) using the Consumer Pricing Index (CPI). EPA then estimates the total effect of IQ on earnings by combining the value of lifetime earnings ($412,000, 1997 dollars) with the estimate of percent wage loss per IQ point of 2.626 percent (U.S. EPA, 2000b). This results in $10,820 (1997 dollars) per IQ point.

The analysis further adjusts the effect of IQ on earnings by valuing the cost of education. The increase in lifetime earnings from additional education equals the gross return on education. The cost of the education must be subtracted from the gross return to obtain the net increase in earnings from additional education. The cost of education has two components: the direct cost of the education and the opportunity cost of lost income during the education. In this analysis, EPA uses the U.S. Department of Education's reported $7,299 average per-student annual expenditure in public primary and secondary schools in 1996-1997 as an estimate of the educational cost (U.S. Department of Education, 2000). Using the estimated effect of IQ on educational attainment (0.1007 years/IQ point) (U.S. EPA, 2000b), the estimated cost of an additional 0.1007 years of education per IQ point is $735 (i.e., 0.1007 x $7,299). The average level of educational attainment in the population over age 25 is 12.9 years. The marginal educational cost is, therefore, assumed to occur at age 19, resulting in a discounted present value cost of $420 (1997 dollars). The opportunity cost of lost income is the difference between full-time and part-time earnings. The analysis uses the discounted value of lost income associated with being in school an additional 0.1007 years, as presented in *Economic, Environmental, and Benefits Assessment of the Proposed Metal Products and Machinery (MP&M) Regulation* (U.S. EPA, 2000b). The value is adjusted to $690 (1997 dollars) at age zero using the CPI.

Subtracting the education ($420, 1997 dollars) and opportunity costs ($690, 1997 dollars) from the percent wage loss per IQ point of $10,820 (1997 dollars) results in a value of $9,710 (1997 dollars) per IQ point.

(b) Neonatal and Adult Health Risks and Benefits - Mortality

A number of studies (U.S. EPA, 1990a) have linked fetal exposure to lead to several adverse health effects. These effects include premature birth, reduced birth weight, late fetal death, and increases in infant mortality. In 1991, the Centers for Disease Control (CDC) developed a methodology to estimate changes in infant mortality due to changes in maternal blood lead levels during pregnancy. Combining the relationship of gestational age as a function of maternal blood level and infant mortality as a function of gestational age results in a decreased risk of infant mortality of 0.0001 for each 1 Fg/dL decrease in maternal blood lead level during pregnancy (U.S. EPA, 1997a). EPA uses the estimated willingness-to-pay values for avoiding a mortality to estimate the monetary benefit associated with risks of neonatal mortality. The neonatal percentage of the population of sport and subsistence anglers' families (1.48 percent) is based on the average birth rate in the United States in 1995 (U.S. Bureau of the Census, 1997). The estimates of the value of a statistical life range from $2.4 to $12.6 million (1997 dollars) (see Section 2.1.2.1).

The health effects of lead exposure in adults, included in the benefits analysis, are based only on lead's effects on blood pressure (BP) as it relates to premature mortality. The estimated relationship between this health effect and lead exposure differs between men and women.

EPA estimates the potential health benefits to adults using a methodology similar to that used in estimating health benefits to children. The analysis first estimates the instream lead concentrations at current and proposed BAT/PSES treatment levels (see Section 2.1.1). The analysis then projects the changes in the blood level distribution in the affected adult population by modifying the dose-response relationship recommended in EPA's *Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with*

Adult Exposure to Lead in Soil (U.S. EPA, 1996a). The modified Interim Guidance equation is as follows:

$$PbB\ adult,\ central \quad PbB_{adult,0} \quad \frac{PbC\ x\ BCF\ x\ IR \quad AF \quad BKSF \quad F \quad CF}{AT} \qquad \text{(Eq. 15)}$$

where:

$PbB_{adult,\ central}$	=	central estimate of blood lead level concentrations (Fg/dL)
$PbB_{adult,0}$	=	typical blood level concentration (Fg/dL) in adults in the absence of exposures via fish consumption (2.0 Fg/dL, U.S. EPA, 1996a)
PbC	=	exposure concentration (Fg/L)
BCF	=	bioconcentration factor (49 L/kg)
IR	=	ingestion rate (g/day)
AF	=	absolute gastrointestinal absorption fraction (0.03, Maddaloni et al., 1998)
BKSF	=	biokinetic slope factor relating (*quasi-steadystate)* increases in typical adult blood level concentrations to average daily lead uptake (0.4 Fg/dL PbB increase per Fg/day lead uptake)
F	=	frequency duration (days/year)
AT	=	averaging time (365 days/year)
CF	=	conversion factor

The analysis then quantifies the effect of blood lead levels on changes in BP to predict the probability of premature mortality in men and women using the following equations:

$$\hat{I}DBP_{men} \quad 1.4\ x\ \ln\left(\frac{PbB_1}{PbB_2}\right) \qquad \text{(Eq. 16)}$$

where:

$\hat{I}DBP_{men}$	=	change in men's diastolic BP expected from change in blood lead levels
1.4	=	coefficient relating blood pressure to blood lead level
PbB_1	=	blood lead level at current discharge levels (Fg/dL)
PbB_2	=	blood lead level at proposed BAT/PSES discharge levels (Fg/dL)

$$\Delta DBP_{women} = (0.6 \ x \ 1.4) \ x \ \ln\left(\frac{PbB_1}{PbB_2}\right) \qquad \text{(Eq. 17)}$$

where:

ΔDBP_{women}	=	change in women's diastolic BP expected from change in blood lead levels
0.6	=	percent change in blood pressure of women versus men
1.4	=	coefficient relating blood pressure to blood lead level
PbB_1	=	blood lead level at current discharge levels (μg/dL)
PbB_2	=	blood lead level at proposed BAT/PSES discharge levels (μg/dL)

The analysis quantifies the relationship between blood pressure and premature mortality for men and women as follows:

$$\Delta Pr(MORT_{men}) = \frac{1}{1+e^{-(a+b \cdot DBP_2)}} - \frac{1}{1+e^{-(a+b \cdot DBP_1)}} \qquad \text{(Eq. 18)}$$

where:

$\Delta Pr(MORT_{men})$	=	change in two-year probability of death in men
a, b	=	coefficients which vary by age group (see Section 2.1.2.4, Assumptions)
DBP_1	=	mean diastolic blood pressure at proposed BAT/PSES levels (80)
DBP_2	=	mean diastolic blood pressure at current discharge levels ($DBP_1 + \Delta DBP_{men}$)

$$\Delta Pr(MORT_{women}) = \frac{1}{1+e^{-(-5.40374+0.01511 \cdot DBP_2)}} - \frac{1}{1+e^{-(-5.40374+0.01511 \cdot DBP_1)}} \qquad \text{(Eq. 19)}$$

where:

$\Delta Pr(MORT_{women})$	=	change in two-year probability of death in women
DBP_1	=	mean diastolic blood pressure at proposed BAT/PSES levels (80)
DBP_2	=	mean diastolic blood pressure at current discharge levels ($DBP_1 + \Delta DBP_{women}$)
5.40374/0.01511	=	coefficients for women 45 to 74

EPA monetizes the reductions in premature mortality for men by first estimating the changes in annual probability of premature mortality for men in three different age groups (40-54, 55-64, 65-74). EPA then calculates avoided premature death cases by multiplying the estimated change in annual probability of premature mortality by the relevant population of men (sport and subsistence anglers). The analysis uses the *Statistical Abstract of the United States: 1997* (U.S. Bureau of the Census, 1997) to estimate the percentages of the population that fall into the various age groups (men 40-54 = 9.86 percent; men 55-64 = 3.83 percent; and men 65-74 = 3.14 percent). Changes in premature mortality are valued based on the value of a statistical life saved. Estimates of this value ranges from $2.4 to $12.6 million (1997 dollars) and is based on the willingness-to-pay to avoid the risk of death (see Section 2.1.2.1). EPA monetizes the reductions in premature mortality for women using the same methodology. The analysis for women uses 14.35 percent as the percentage of the population that falls into the 45-74 age group.

2.1.2.4 *Assumptions and Caveats (Lead Analysis)*

In addition to the assumptions presented in Section 2.1.2.2, the analyses of lead-related human health risks and benefits use the following assumptions:

- Currently, quantitative dose-response functions for most health effects associated with lead exposure do not exist. Therefore, these analyses do not provide a comprehensive estimate of health benefits from reduced lead discharges from iron and steel facilities.

- EPA estimates the health risks and monetary benefits for reduced IQ levels in children using the methodology and equations presented in EPA's *The Benefits and Costs of the Clean Air Act: 1970 to 1990*. (U.S. EPA, 1997a)

- The children's health risks and benefits analysis uses the following fish tissue ingestion rates for children in sport anglers' families (U.S. EPA, 1997b):

Age	Rate (g/day)
0.5-1	3.3579
1-2	4.1697
2-3	4.9077
3-4	5.6457
4-5	6.4206
5-6	7.2693
6-7	6.2376

Ingestion rates for children of subsistence anglers are obtained by multiplying the recreational rates by a factor of 10, the ratio of ingestion rates for subsistence (124.1 g/day) to sport anglers (12.1 g/day).

- The children's health risks and benefits analysis does not consider all lead-related health effects. Health effects not quantified include fetal effects from maternal exposure (diminished IQ and reduced birth weight), low IQ, permanent brain structure changes, slowed/delayed growth, delinquent and antisocial behavior, metabolic effects, impaired hearing, probable cancer, and lead effects in children over 6 years of age. Additional benefits not quantified include costs of lead screening, medical treatment, and special education. Therefore, this analysis does not provide a comprehensive estimate of children's health benefits from reduced lead discharges from iron and steel facilities.

- The population of children affected by increased lead exposure up to age 6 is divided by 7 to avoid double counting the results from the IEUBK model. This creates some undercounting because in the first year of the analysis children ages 1-6 are not accounted for, while presumably they are affected by lead exposure.

- Lead bioavailability varies across chemical forms in which lead can exist and is influenced by many factors including nutritional status and timing of meals. EPA uses the default media-specific bioavailability in the IEUBK model for the children's health risks and benefits analysis.

- When exposure and uptake values are not specified, the IEUBK model provides default values. EPA uses the same default values at current and proposed BAT/PSES discharge levels to characterize exposure rates for pathways other than fish consumption (i.e., air, dust, soil, water). Therefore, the analysis estimates only blood lead levels attributable to the consumption of lead-contaminated fish.

- The probability of adult male mortality (as shown in Eq. 18) is calculated using the following coefficients: for ages 40-54, a = 5.3158 and b = 0.03516; for ages 55-64, a = 4.89528 and b = 0.01866; and for ages 65-74, a = 3.05723 and b =

0.00547 (U.S. EPA, 1997a).

- EPA estimates the health risks and monetary benefits for reduced premature adult and neonatal mortality using the methodology and equations contained in *Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil*. (U.S. EPA, 1996a) and in *EPA's The Benefits and Costs of the Clean Air Act: 1970 to 1990* (U.S. EPA, 1997a).

- The analyses presented in this report do not account for increased risks of hypertension, coronary heart disease, cerebrovascular accidents, and brain infractions associated with increased blood lead levels, so the overall benefits from reduced lead discharges from iron and steel facilities are underestimated.

- In estimating blood pressure changes, EPA assumes that a diastolic level of 80 is representative of a normal adult (American Heart Association, 2000).

- A gastrointestinal absorption fraction of 0.03 is used for lead ingested in fish tissue based on a recent study (Maddaloni et al., 1998). This value is a reasonable estimate for most adults. This analysis does not address individuals who are at unusually high risk (e.g., pregnant women, individuals with poor nutritional habits, and individuals with metabolic disorders).

2.1.3 Estimation of Ecological Benefits

The analysis evaluates the potential ecological benefits of the final regulation by estimating improvements in the recreational fishing habitats that are adversely impacted by iron and steel wastewater discharges. The analysis first identifies stream segments in which the proposed regulation is expected to eliminate all occurrences of pollutant concentrations in excess of both aquatic life and human health AWQC or toxic effect levels (see Section 2.1.1). The analysis expects that the elimination of pollutant concentrations in excess of AWQC will result in significant improvements in aquatic habitats, which will then improve the quality and value of recreational fishing opportunities. The estimate of the monetary value to society of improved recreational fishing opportunities is based on the concept of a "contaminant-free fishery" as presented by Lyke (1993).

Research by Lyke (1993) shows that anglers may place a significantly higher value on a contaminant-free fishery than a fishery with some level of contamination. Specifically, Lyke estimates the consumer surplus[7] associated with Wisconsin's recreational Lake Michigan trout and salmon fishery, and the additional value of the fishery if it was completely free of contaminants affecting aquatic life and human health. Two analyses form the basis of Lyke's results:

1. A multiple-site, trip-generation, travel cost model was used to estimate net benefits associated with the fishery under baseline conditions (i.e., contaminated).

2. A contingent valuation model was used to estimate willingness-to-pay values for the fishery if it was free of contaminants.

Both analyses used data collected from licensed anglers before the 1990 season. The estimated incremental-benefit values associated with freeing the fishery of contaminants range from 11.1 percent to 31.3 percent of the value of the fishery under current conditions.

To estimate the gain in value of stream segments identified as showing improvements in aquatic habitats as a result of the final regulation, the analysis estimates the baseline recreational fishery value of the stream segments on the basis of estimated annual person-days of fishing per segment and estimated values per person-day of fishing. To calculate annual person-days of fishing per segment, the analysis uses estimates of the affected (exposed) recreational fishing populations (see Section 2.1.2). The analysis then multiplies the number of anglers by estimates of the average number of fishing days per angler in each State to estimate the total number of fishing days for each segment. The analysis calculates the baseline value for each fishery by multiplying the estimated total number of fishing days by an estimate of the net benefit that anglers receive from

[7] Consumer surplus is generally recognized as the best measure from a theoretical basis for valuing the net economic welfare or benefit to consumers from consuming a particular good or service. An increase or decrease in consumer surplus for particular goods or services as the result of regulation is a primary measure of the gain or loss in consumer welfare resulting from the regulation.

a day of fishing, where net benefit represents the total value of the fishing day, exclusive of any fishing-related costs (license fee, travel costs, bait, etc.) incurred by the angler. This analysis uses a range of median net benefit values for warm-water and cold-water fishing days ($31.68 and $40.12, respectively, in 1997 dollars). Summing all benefitting stream segments provides a total baseline recreational fishing value of stream segments that are expected to benefit by elimination of pollutant concentrations in excess of AWQC.

To estimate the increase in value resulting from elimination of pollutant concentrations in excess of AWQC, the analysis multiplies the baseline value for benefitting stream segments by the incremental gain in value associated with achievement of the "contaminant-free" condition. Using Lyke's estimated increase in value, from 11.1 to 31.3 percent, multiplying the baseline value by these values yields a range of the expected increase in value for stream segments that are expected to benefit by elimination of pollutant concentrations in excess of AWQC.

In addition, EPA expects nonuse (intrinsic) benefits to the general public as a result of the improvements in water quality described above. These nonuse benefits (option values, aesthetics, existence values, and request values) are based on the premise that individuals who never visit or otherwise use a natural resource might nevertheless be affected by changes in its status or quality (Fisher and Raucher, 1984). Nonuse benefits are not associated with current use of the affected ecosystem or habitat, but rather arise from (1) the *realization* of the improvement in the affected ecosystem or habitat that results from reduced effluent discharges, and (2) the value that individuals place on the *potential for use* sometime in the future. Nonuse benefits can be substantial for some resources, and Fisher and Raucher conservatively estimate nonuse values as one-half of the recreational benefits. Because this approximation applies only to recreational fishing benefits for recreational anglers and does not take into account nonuse values for nonanglers or for uses other than fishing by anglers, EPA estimates only a portion of the nonuse benefits.

2.1.3.1 *Assumptions and Caveats*

The ecological benefits analysis uses the following major assumptions:

- C The analysis does not consider background concentrations of the iron and steel pollutants of concern in the receiving stream.

- C The estimated benefit of improved recreational fishing opportunities is only a limited measure of the value to society of the improvements in aquatic habitats expected to result from the proposed regulation; increased assimilation capacity of the receiving stream, improvements in taste and odor, or improvements to other recreational activities, such as swimming and wildlife observation, are not addressed.

- C The analysis includes significant simplifications and uncertainties; thus, the monetary value to society of improved recreational fishing opportunities may be over- or underestimated. (see Sections 2.1.1.3 and 2.1.2.2.)

- C Potential overlap may exist in the valuation of improved recreational fishing opportunities and avoided cancer cases from fish consumption. This potential is considered to be minor in terms of numerical significance.

2.1.4 Estimation of Economic Productivity Benefits

The analysis estimates potential economic productivity benefits on the basis of reduced sewage sludge contamination due to the proposed regulation. The treatment of wastewaters generated by iron and steel facilities produces a sludge that contains pollutants removed from the wastewaters. As required by law, POTWs must use environmentally sound practices in managing and disposing of this sludge. The analysis expects the PSES levels to generate sewage sludges with reduced pollutant concentrations. As a result, the POTWs may be able to use or dispose of the sewage sludges with reduced pollutant concentrations at lower costs.

To determine the potential benefits, in terms of reduced sewage sludge disposal costs, the analysis calculates the sewage sludge pollutant concentrations at current and proposed PSES levels (see Section 2.1.1.2). It then compares pollutant concentrations to sewage sludge pollutant limits for surface disposal and land application (minimum ceiling limits and pollutant concentration limits). The analysis projects that a POTW that meets all pollutant limits as a result of pretreatment will benefit from the increase in options for sewage sludge use or disposal. The amount of the benefit deriving from changes in sewage sludge use or disposal practices depends on the sewage sludge use or disposal practices employed under current levels. The analysis assumes that POTWs will choose the least expensive sewage sludge use or disposal practice for which their sewage sludge meets pollutant limits. POTWs with sewage sludge whose baseline qualifies for land application will dispose of their sewage sludge by land application; likewise, POTWs with sewage sludge that meets surface disposal limits (but not the land application ceiling or pollutant limits) will dispose of their sewage sludge at surface disposal sites.

EPA calculates the economic benefit for POTWs receiving wastewater from an iron and steel facility by multiplying the cost differential between baseline and postcompliance sludge use or disposal practices by the quantity of sewage sludge that shifts into meeting land application (minimum ceiling limits and pollutant concentration limits) or surface disposal limits. Using these cost differentials, the analysis calculates cost reductions from changes in sewage sludge use or disposal for each POTW.

$$SCR \quad PF \times S \times CD \times PD \times CF \qquad \text{(Eq. 20)}$$

where:

SCR	=	estimated POTW sewage sludge use or disposal cost reductions resulting from the proposed regulation (1997 dollars)
PF	=	POTW flow (million gal/year)
S	=	sewage sludge to wastewater ratio (1,400 lb [dry weight] per million gallons of water)
CD	=	estimated cost differential between least costly composite baseline use or disposal method for which POTW qualifies and least costly use or disposal method for which POTW qualifies postcompliance (1997 dollars/dry metric ton)
PD	=	percentage of sewage sludge disposed
CF	=	conversion factor for units

2.1.4.1 *Assumptions and Caveats*

The economic productivity benefits analysis uses the following major assumptions:

- Of the POTW sewage sludge generated in the United States, 13.4 percent is generated at POTWs that are located too far from agricultural land and surface disposal sites for these use or disposal practices to be economical. The analysis does not associate this percentage of sewage sludge with benefits from shifts to surface disposal or land application.
- The analysis does not estimate benefits expected from reduced record-keeping requirements and exemption from certain sewage sludge management practices.
- No definitive source of cost-saving differentials exists. The analysis may overestimate or underestimate the cost differentials.
- Sewage sludge use or disposal costs vary by POTW. Actual costs incurred by POTWs affected by the proposed iron and steel regulation may differ from those estimates.
- Because of the unavailability of data on baseline pollutant loadings from all industrial sources, those data are not included in the analysis.

2.2 <u>Pollutant Fate and Toxicity</u>

Human and ecological exposure and risk from environmental releases of toxic chemicals depend largely on toxic potency, intermedia partitioning, and chemical persistence. These factors in turn depend on chemical-specific properties relating to toxicological effects on living organisms, physical state, hydrophobicity/lipophilicity, and reactivity, as well as on the mechanism and media of release and site-specific environmental conditions.

The methodology used in assessing the fate and toxicity of pollutants associated with iron and steel wastewaters consists of three steps: (1) identification of pollutants of concern, (2) compilation of physical-chemical and toxicity data, and (3) categorization assessment.

The following sections describe these steps in detail, as well as present a summary of the major assumptions and limitations associated with this methodology.

2.2.1 Identification of Pollutants of Concern

EPA conducted a sampling and analytical program at 16 steel industry sites. EPA sampled and analyzed a broad list of pollutants to identify pollutants present in wastewaters from each type of process operation and to determine their fate in industry wastewater treatment systems. EPA identified as pollutants of concern all pollutants that met these following screening criteria:

- The pollutant was detected at greater than or equal to ten times the minimum level (ML) concentration in at least 10 percent of all untreated process wastewater samples,
- The mean detected concentration in untreated process wastewater samples was greater than the mean detected concentration in the source water samples, and
- The mean detected concentration in all process wastewater samples was greater than the mean detected concentration in the source water samples.

In the waste streams from direct discharging iron and steel facilities, EPA detected 70 pollutants (28 priority pollutants, 4 conventional pollutant parameters, and 38 nonconventional pollutants) in waste streams that met the selection criteria. EPA identified these pollutants as pollutants of concern and evaluated them to assess their potential fate and toxicity based on known characteristics of each chemical.

In the waste streams from indirect discharging iron and steel facilities, EPA detected 66 pollutants (27 priority, 4 conventional pollutant parameters, and 35 nonconventional pollutants) in waste streams that met the selection criteria. EPA identified these pollutants as pollutants of concern and evaluated them to assess their potential fate and toxicity based on known characteristics of each chemical.

2.2.2 Compilation of Physical-Chemical and Toxicity Data

The chemical-specific data needed to conduct the fate and toxicity evaluation for this study include aquatic life criteria or toxic effect data for native aquatic species, human health reference doses (RfDs) and cancer potency slope factors (SFs), EPA maximum contaminant levels (MCLs) for drinking water protection, Henry's Law constants, soil/sediment (organic-carbon) adsorption coefficients (K_{oc}), and bioconcentration factors (BCFs) for native aquatic species and aqueous aerobic biodegradation half-lives (BD).

Sources of the above data include EPA AWQC documents and updates, EPA's Assessment Tools for the Evaluation of Risk (ASTER) and the associated Aquatic Information Retrieval System (AQUIRE) and Environmental Research Laboratory-Duluth fathead minnow database, EPA's Integrated Risk Information System (IRIS), EPA's 1997 Health Effects Assessment Summary Tables (HEAST), EPA's 1998 Region III Risk-Based Concentration (RBC) Table, EPA's 1996 Superfund Chemical Data Matrix, EPA's 1989 Toxic Chemical Release Inventory Risk Screening Guide, Syracuse Research Corporation's CHEMFATE database, EPA and other government reports, scientific literature, and other primary and secondary data sources. To ensure that the examination is as comprehensive as possible, this analysis has taken alternative measures to compile data for chemicals for which physical-chemical property and/or toxicity data are not presented in the sources listed above. To the extent possible, EPA estimates values for the chemicals using the quantitative structure-activity relationship (QSAR) model incorporated in ASTER or, for some physical-chemical properties, using published linear regression correlation equations.

(a) Aquatic Life Data

The analysis obtains ambient criteria or toxic effect concentration levels for the protection of aquatic life primarily from EPA's AWQC documents and EPA's ASTER. For several pollutants, EPA has published ambient water quality criteria for the protection of freshwater aquatic life from acute effects. The acute value represents a maximum allowable 1-hour average concentration of a pollutant at any time that protects aquatic life from lethality. For pollutants for which no acute water quality criteria have been developed by EPA, the analysis uses an acute value from published aquatic toxicity test data or an estimated acute value from the ASTER QSAR model. When selecting values from the literature, the analysis prefers measured concentrations from flow-through studies under typical pH and temperature conditions. In addition, the test organism must be a North American resident species of fish or invertebrate. The hierarchy used to select the appropriate acute value is listed below in descending order of priority.

1. National acute freshwater quality criteria

2. Lowest reported acute test values (96-hour LC_{50} for fish and 48-hour EC_{50}/LC_{50} for daphnids)

3. Lowest reported LC_{50} test value of shorter duration, adjusted to estimate a 96-hour exposure period

4. Lowest reported LC_{50} test value of longer duration, up to a maximum of 2 weeks exposure

5. Estimated 96-hour LC_{50} from the ASTER QSAR model

The analysis uses BCF data from numerous data sources, including EPA's AWQC documents and EPA's ASTER. Where measured BCF values are not available for several chemicals, the analysis estimates the parameter using the octanol-water partition coefficient or solubility of the chemical. Lyman et al. (1982) details such methods. The analysis then reviews multiple values and selects a representative value according to the following guidelines:

- Resident U.S. fish species are preferred over invertebrates or estimated values.

- Edible tissue or whole fish values are preferred over nonedible or viscera values.

- Estimates derived from octanol-water partition coefficients are preferred over estimates based on solubility or other estimates, unless the estimate comes from EPA's AWQC documents.

The analysis uses the most conservative value (i.e., the highest BCF) among comparable candidate values.

(b) Human Health Data

Human health toxicity data include chemical-specific RfD for noncarcinogenic effects and potency SF for carcinogenic effects. The analysis obtains RfDs and SFs first from EPA's IRIS, and secondarily uses EPA's HEAST or EPA's Region III RBC Table. The RfD is an estimate of a daily exposure level for the human population, including sensitive subpopulations, that is likely to be without an appreciable risk of deleterious noncarcinogenic health effects over a lifetime (U.S. EPA, 1989a). A chemical with a low RfD is more toxic than a chemical with a high RfD. Noncarcinogenic effects include systemic effects (e.g., reproductive, immunological, neurological, circulatory, or respiratory toxicity), organ-specific toxicity, developmental toxicity, mutagenesis, and lethality. EPA recommends a threshold-level assessment approach for these systemic and other effects, because several protective mechanisms must be overcome prior to the appearance of an adverse noncarcinogenic effect. In contrast, EPA assumes that cancer growth can be initiated from a single cellular event and therefore should not be subject to a threshold-level assessment approach. The SF is an upper-bound estimate of the probability of cancer per unit intake of a chemical over a lifetime (U.S. EPA, 1989a). A chemical with a large SF has greater potential to cause cancer than a chemical with a small SF.

Other chemical designations related to potential adverse human health effects include EPA assignment of a concentration limit for protection of drinking water, and EPA designation as a priority pollutant. EPA establishes drinking water criteria and standards, such as the MCL, under authority of the Safe Drinking Water Act (SDWA). Current MCLs are available from EPA's Office of Water. EPA has designated 126 chemicals and compounds as priority pollutants under the authority of the Clean Water Act (CWA).

(c) Physical-Chemical Property Data

The analysis uses 2 measures of physical-chemical properties to evaluate environmental fate: Henry's Law constant (HLC) and organic-carbon adsorption partition coefficient (K_{oc}).

HLC is the ratio of vapor pressure to solubility and is indicative of the propensity of a chemical to volatilize from surface water (Lyman et al., 1982). The larger the HLC, the more likely that the chemical will volatilize. The analysis obtains most HLCs from EPA's Office of Pesticides and Toxic Substances' (OPTS) 1989 *Toxic Chemical Release Inventory Risk Screening Guide* (U.S. EPA, 1989b), the Office of Solid Waste's (OSW) *Superfund Chemical Data Matrix* (U.S. EPA, 1996b), or the QSAR system (U.S. EPA, 1998-1999), maintained by EPA's Environmental Research Laboratory in Duluth, Minnesota.

K_{oc} is indicative of the propensity of an organic compound to adsorb to soil or sediment particles and, therefore, to partition to such media. The larger the K_{oc}, the more likely that the chemical will adsorb to solid material. The analysis obtains most K_{oc}s from Syracuse Research Corporation's CHEMFATE database and EPA's 1989 *Toxic Chemical Release Inventory Risk Screening Guide* (U.S. EPA, 1989b).

The biodegradation half-life (BD) is the empirically derived length of time during which half the amount of a chemical in water is degraded by microbial action in the presence of oxygen. BD is indicative of the environmental persistence of a chemical released into the water column. The analysis obtains most BDs from the *Handbook of Environmental Degradation Rates* (Howard, 1991) and EPA's Environmental Research Laboratory-Duluth's QSAR.

2.2.3 Categorization Assessment

The objective of evaluating fate and toxicity potential is to place chemicals into groups with qualitative descriptors of potential environmental behavior and impact. These groups are based on categorization schemes derived for the following descriptors:

- Acute aquatic toxicity (high, moderate, or slightly toxic)
- Volatility from water (high, moderate, slight, or nonvolatile)
- Adsorption to soil/sediment (high, moderate, slight, or nonadsorptive)
- Bioaccumulation potential (high, moderate, slight, or nonbioaccumulative)
- Biodegradation potential (fast, moderate, slow, or resistant)

With the use of appropriate key parameters, and where sufficient data exist, these categorization schemes identify the relative aquatic and human toxicity and bioaccumulation potential for each chemical associated with iron and steel wastewater. In addition, the categorization schemes identify the potential of each chemical to partition to various media (air, sediment/sludge, or water) and to persist in the environment. The analysis uses these schemes for screening purposes only; they do not take the place of detailed pollutant assessments that analyze all fate and transport mechanisms.

This evaluation also identifies chemicals that (1) are known, probable, or possible human carcinogens; (2) are systemic human health toxicants; (3) have EPA human health drinking water standards; and (4) are designated as priority pollutants by EPA. The results of this analysis can provide a qualitative indication of potential risk posed by the release of these chemicals. Actual risk depends on the magnitude, frequency, and duration of pollutant loading; site-specific environmental conditions; proximity and number of human and ecological receptors; and relevant exposure pathways. The following discussion outlines the categorization schemes and presents the ranges of parameter values that define the categories.

(a) Acute Aquatic Toxicity

Key Parameter: Acute aquatic life criteria/LC_{50} or other benchmark (AT) (Fg/L)

Using acute criteria or lowest reported acute test results (generally 96-hour and 48-hour durations for fish and invertebrates, respectively), the analysis groups chemicals according to their relative short-term effects on aquatic life.

Categorization Scheme:

$AT < 100$	Highly toxic
$1{,}000 \geq AT \geq 100$	Moderately toxic
$AT > 1{,}000$	Slightly toxic

This scheme, used as a rule-of-thumb guidance by EPA's OPPT for Premanufacture Notice (PMN) evaluations, indicates chemicals that could potentially cause lethality to aquatic life downstream of discharges.

(b) Volatility from Water

Key Parameter: Henry's Law constant (HLC) (atm-m^3/mol)

$$\text{HLC} \quad \frac{\text{Vapor Pressure (atm)}}{\text{Solubility (mol/m}^3\text{)}} \qquad \text{(Eq. 21)}$$

HLC is the measured or calculated ratio of vapor pressure to solubility at ambient conditions. This parameter indicates the potential for organic substances to partition to air in a two-phase (air and water) system. A chemical's potential to volatilize from surface water can be inferred from HLC.

Categorization Scheme:

$HLC > 10^{-3}$	Highly volatile
$10^{-3} \geq HLC \geq 10^{-5}$	Moderately volatile
$10^{-5} > HLC \geq 3 \times 10^{-7}$	Slightly volatile
$HLC < 3 \times 10^{-7}$	Essentially nonvolatile

This scheme, adopted from Lyman et al. (1982), indicates chemical potential to volatilize from process wastewater and surface water, thereby reducing the threat to aquatic life and human health via contaminated fish consumption and drinking water, yet potentially causing risk to exposed populations via inhalation.

(c) Adsorption to Soil/Sediments

Key Parameter: Soil/sediment (organic-carbon) adsorption coefficient (K_{oc})

K_{oc} is a chemical-specific adsorption parameter for organic substances that is largely independent of the properties of soil or sediment and can be used as a relative indicator of adsorption to such media. K_{oc} is highly inversely correlated with solubility, well correlated with octanol-water partition coefficient, and fairly well correlated with BCF.

Categorization Scheme:

$K_{oc} > 10{,}000$	Highly adsorptive
$10{,}000 \geq K_{oc} \geq 1{,}000$	Moderately adsorptive
$1{,}000 > K_{oc} \geq 10$	Slightly adsorptive
$K_{oc} < 10$	Essentially nonadsorptive

This scheme evaluates substances that may partition to solids and potentially contaminate sediment underlying surface water or land receiving sewage sludge applications. Although a high K_{oc} value indicates that a chemical is more likely to partition to sediment, it also indicates that a chemical may be less bioavailable.

(d) Bioaccumulation Potential

Key Parameter: Bioconcentration factor (BCF)

$$BCF = \frac{\text{Equilibrium chemical concentration in organism (wet weight)}}{\text{Mean chemical concentration in water}} \qquad \text{(Eq. 22)}$$

BCF is a good indicator of potential to accumulate in aquatic biota through uptake across an external surface membrane.

Categorization Scheme:

$BCF > 500$	High potential
$500 \geq BCF \geq 50$	Moderate potential
$50 > BCF \geq 5$	Slight potential
$BCF < 5$	Nonbioaccumulative

This scheme identifies chemicals that may be present in fish or shellfish tissues at higher levels than in surrounding water. These chemicals may accumulate in the food chain and increase exposure to higher-trophic-level populations, including people who consume their sport catch or commercial seafood.

(e) Biodegradation Potential

Key Parameter: Aqueous aerobic biodegradation half-life (BD) (days)

Biodegradation, photolysis, and hydrolysis are three potential mechanisms of organic chemical transformation in the environment. The analysis selects BD to represent chemical persistence on the basis of its importance and the abundance of measured or estimated data relative to other transformation mechanisms.

Categorization Scheme:

BD # 7	Fast
7 < BD # 28	Moderate
28 < BD # 180	Slow
180 < BD	Resistant

This scheme is based on classification ranges given in a recent compilation of environmental fate data (Howard, 1991). The scheme gives an indication of chemicals that are likely to biodegrade in surface water and therefore not persist in the environment. However, biodegradation products can be less toxic, equally as toxic, or even more toxic than the parent compound.

2.2.4 Assumptions and Limitations

The following two subsections summarize the major assumptions and limitations associated with the data compilation and categorization schemes.

(a) Data Compilation

- If data are readily available from electronic databases, the analysis does not search other primary and secondary sources.
- Many of the data are estimated and therefore can have a high degree of associated uncertainty.
- For some chemicals, neither measured nor estimated data are available for key categorization parameters. In addition, chemicals identified for this study do not represent a complete set of wastewater constituents. As a result, this analysis does not completely assess iron and steel wastewater.

(b) Categorization Schemes

- The analysis does not consider receiving waterbody characteristics, pollutant loading amounts, exposed populations, and potential exposure routes.
- For several categorization schemes, the analysis groups chemicals using arbitrary order-of-magnitude data breaks. Combined with data uncertainty, this may lead to an overstatement or understatement of the characteristics of a chemical.
- Data derived from laboratory tests may not accurately reflect conditions in the field.
- Available aquatic toxicity and bioconcentration test data may not represent the most sensitive species.
- The biodegradation potential may not be a good indicator of persistence for organic chemicals that rapidly photodegrade or hydrolyze, since the analysis does not consider these degradation mechanisms.

2.3 Documented Environmental Impacts

EPA reviewed State 303(d) lists of impaired water, State fishing advisories, and reports for evidence of documented environmental impacts on aquatic life, human health, and the quality of receiving water due to discharges of pollutants from iron and steel facilities. The analysis compiles and summarizes reported impacts by facility.

3. DATA SOURCES

3.1 Water Quality Impacts

The analysis uses readily available EPA and other agency databases, models, and reports to evaluate water quality impacts. The following six sections describe the various data sources used in the analysis.

3.1.1 Facility-Specific Data

EPA's Engineering and Analysis Division (EAD) provided projected iron and steel facility effluent process flows, facility operating days, and pollutant loadings (Appendix A) in May 2000 and July 2000 (U.S. EPA, 2000c). EAD determined an average performance level (the "long-term average") that a facility with well-designed and well-operated model technologies (which reflect the appropriate level of control) is capable of achieving. This long-term average (LTA) was calculated from data from the facilities using the model technologies for the option. The LTAs were based on pollutant concentrations collected from three data sources: EPA sampling episodes, the 1997 analytical and product follow-up survey, and data submitted by industry. Facilities reported the annual quantity discharged to surface waters and POTWs in one of two versions (short or detailed) of the *U.S. EPA Collection of 1997 Iron and Steel Industry Data* (U.S. EPA, 1997c). EAD multiplied the annual quantity discharged by the facility (facility flow) by the LTA for each pollutant and converted the results to the proper units to calculate the loading (in pounds per year) for each pollutant at each facility.

The analysis identifies the locations of iron and steel facilities on receiving streams using the U.S. Geological Survey (USGS) cataloging and stream segment (reach) numbers contained in EPA's Industrial Facilities Discharge (IFD) File (U.S. EPA, 2000d). It also uses latitude-longitude coordinates, if available, to locate facilities or POTWs that have not been assigned a reach number in the IFD database. The names, locations, and flow data for the POTWs to which the indirect facilities discharge are obtained from the 1997 iron and steel questionnaire (U.S. EPA, 1997c), EPA's 1996 Needs Survey (U.S. EPA, 1996c), the IFD database, and EPA's Permit Compliance System (PCS) (U.S. EPA, 2000e). If these sources do not yield information for a facility, alternative measures are taken to obtain a complete set of receiving streams and POTWs.

The analysis obtains the receiving stream flow data from either the W.E. Gates study data or measured stream flow data, both of which are contained in EPA's GAGE file (U.S. EPA, 2000f). The W.E. Gates study contains calculated average and low flow statistics based on the best available flow data and on drainage areas for reaches throughout the United States. The GAGE file also includes average and low flow statistics based on measured data from USGS gaging stations. EPA contacted State environmental agencies for additional information, as necessary. The analysis obtains dissolved concentration potentials (DCPs) for estuaries and bays from the Strategic Assessment Branch of NOAA's Ocean Assessments Division (NOAA/U.S. EPA, 1989a-c, 1991) (Appendix B). Critical dilution factors are obtained from the *Mixing Zone Dilution Factors for New Chemical Exposure Assessments* (U.S. EPA, 1992).

3.1.2 Information Used To Evaluate POTW Operations

The primary source of the POTW treatment removal efficiencies is the *Fate of Priority Pollutants in Publicly Owned Treatment Works*, commonly referred to as the "50-POTW Study" (U.S. EPA, 1982). This study presents data on the performance of 50 well-operated POTWs that employ secondary biological treatment in removing pollutants. Each sample was analyzed for 3 conventional, 16 nonconventional, and 126 priority toxic pollutants. Additionally, because of the large number of pollutants of concern for the iron and steel industry, EPA also uses data from the National Risk Management Research Laboratory (NRMRL) Treatability Database (formerly called the Risk Reduction Engineering Laboratory (RREL) database) (U.S. EPA, 1995a). For pollutants of concern not found in the 50-POTW Study, EPA uses data from the NRMRL database, using only treatment technologies representative of typical POTW secondary treatment operations (activated sludge, activated sludge with filtration, aerated lagoons).

The analysis obtains inhibition values from the *Guidance Manual for Preventing Interference at POTWs* (U.S. EPA, 1987) and from *CERCLA Site Discharges to POTWs: Guidance Manual* (U.S. EPA, 1990b). The most conservative values for activated sludge are used. For pollutants with no specific inhibition value, the analysis uses a value based on compound type, such as aromatics (Appendix C).

The analysis obtains sewage sludge regulatory levels, if available for the pollutants of concern, from the *Standards for the Use or Disposal of Sewage Sludge, Final Rule* (U.S. EPA, 1995b). The analysis uses pollutant limits established for the final use or disposal of sewage sludge when the sewage sludge is applied to agricultural and nonagricultural land (Appendix C). Sludge partition factors are obtained from the *Report to Congress on the Discharge of Hazardous Wastes to Publicly-Owned Treatment Works (Domestic Sewage Study)* (U.S. EPA, 1986) (Appendix C).

3.1.3 Water Quality Criteria

The analysis obtains the AWQC (or toxic effect levels) for the protection of aquatic life and human health from a variety of sources, including EPA criteria documents, EPA's ASTER, and EPA's IRIS (Appendix C). It uses ecological toxicity estimations when published values are not available. The hierarchies used to select the appropriate aquatic life and human health values are described in the following sections.

3.1.3.1 *Aquatic Life*

EPA establishes AWQC for many pollutants for the protection of freshwater aquatic life (acute and chronic criteria). The acute value represents a maximum allowable 1-hour average concentration of a pollutant at any time and can be related to acute toxic effects on aquatic life. The chronic value represents the average allowable concentration of a toxic pollutant over a 4-day period at which a diverse genera of aquatic organisms and their uses should not be unacceptably affected, provided that these levels are not exceeded more than once every 3 years.

For pollutants for which no AWQC are developed, the analysis uses specific toxicity values (acute and chronic effect concentrations reported in published literature or estimated using various application techniques). When selecting values from the literature, the analysis prefers measured concentrations from flow-through studies under typical pH and temperature conditions. The test organism has to be a North American resident species of fish or invertebrate. The hierarchies used to select the appropriate acute and chronic values are listed below in descending order of priority.

Acute Aquatic Life Values:

1. National acute freshwater quality criteria
2. Lowest reported acute test values (96-hour LC_{50} for fish and 48-hour EC_{50}/LC_{50} for daphnids)
3. Lowest reported LC_{50} test value of shorter duration, adjusted to estimate a 96-hour exposure period
4. Lowest reported LC_{50} test value of longer duration, up to a maximum of 2 weeks of exposure
5. Estimated 96-hour LC_{50} from the ASTER QSAR model

Chronic Aquatic Life Values:

1. National chronic freshwater quality criteria
2. Lowest reported maximum allowable toxicant concentration (MATC), lowest-observed-effect concentration (LOEC), or no-observed-effect concentration (NOEC)
3. Lowest reported chronic growth or reproductive toxicity test concentration

4. Estimated chronic toxicity concentration from a measured acute:chronic ratio for a less sensitive species, QSAR model, or default acute:chronic ratio of 10:1

3.1.3.2 *Human Health*

EPA establishes AWQC for the protection of human health in terms of a pollutant's toxic effects, including carcinogenic potential, using two exposure routes: (1) ingesting the pollutant via contaminated aquatic organisms only, and (2) ingesting the pollutant via both water and contaminated aquatic organisms. The values are determined as follows.

<u>For Toxicity Protection (ingestion of organisms only)</u>:

$$HH_{oo} \quad \frac{RfD \ x \ CF}{IR_f \ x \ BCF} \qquad \text{(Eq. 23)}$$

where:

HH_{oo}	=	human health value (Fg/L)
RfD	=	reference dose for a 70-kg individual (mg/day)
IR_f	=	fish ingestion rate (0.0065 kg/day)
BCF	=	bioconcentration factor (L/kg)
CF	=	conversion factor for units (1,000 Fg/mg)

<u>For Carcinogenic Protection (ingestion of organisms only)</u>:

$$HH_{oo} \quad \frac{BW \ x \ RL \ x \ CF}{SF \ x \ IR_f \ x \ BCF} \qquad \text{(Eq. 24)}$$

where:

HH_{oo}	=	human health value (Fg/L)
BW	=	body weight (70 kg)

RL	=	risk level (10^{-6})
SF	=	cancer slope factor $(mg/kg\text{-}day)^{-1}$
IR_f	=	fish ingestion rate (0.0065 kg/day)
BCF	=	bioconcentration factor (L/kg)
CF	=	conversion factor for units (1,000 Fg/mg)

<u>For Toxicity Protection (ingestion of water and organisms)</u>:

$$HH_{wo} \quad \frac{RfD \; x \; CF}{IR_w \quad (IR_f \; x \; BCF)} \qquad \text{(Eq. 25)}$$

where:

HH_{wo}	=	human health value (Fg/L)
RfD	=	reference dose for a 70-kg individual (mg/day)
IR_w	=	water ingestion rate (2 L/day)
IR_f	=	fish ingestion rate (0.0065 kg/day)
BCF	=	bioconcentration factor (L/kg)
CF	=	conversion factor for units (1000 Fg/mg)

<u>For Carcinogenic Protection (ingestion of water and organisms)</u>:

$$HH_{wo} \quad \frac{BW \; x \; RL \; x \; CF}{SF \; x \; (IR_w \quad (IR_f \; x \; BCF))} \qquad \text{(Eq. 26)}$$

where:

HH_{wo}	=	human health value (Fg/L)
BW	=	body weight (70 kg)
RL	=	risk level (10^{-6})
SF	=	cancer slope factor $(mg/kg\text{-}day)^{-1}$
IR_w	=	water ingestion rate (2 L/day)
IR_f	=	fish ingestion rate (0.0065 kg/day)
BCF	=	bioconcentration factor (L/kg)
CF	=	conversion factor for units (1,000 Fg/mg)

The analysis derives the values for ingesting water and organisms by assuming an average daily ingestion rate of 2 liters of water, an average daily fish consumption rate of 6.5 grams of potentially contaminated fish products, and an average adult body weight of 70 kilograms (U.S. EPA, 1991). If EPA has established a slope factor, the analysis uses values protective of carcinogenicity to assess the potential effects on human health.

The analysis develops protective concentration levels for carcinogens in terms of nonthreshold lifetime risk level, using criteria at a risk level of 10^{-6} (1E-6). This risk level indicates a probability of 1 additional case of cancer for every 1 million persons exposed. Toxic effects criteria for noncarcinogens include systemic effects (e.g., reproductive, immunological, neurological, circulatory, or respiratory toxicity), organ-specific toxicity, developmental toxicity, mutagenesis, and lethality.

The hierarchy used to select the most appropriate human health criteria values is listed below in descending order of priority:

1. Human health criteria values calculated using EPA's IRIS RfDs or SFs in conjunction with adjusted 3 percent lipid BCF values derived from *Quality Criteria for Water* (U.S. EPA, 1980). Three percent is the mean lipid content of fish tissue reported in the study from which the average daily fish consumption rate of 6.5 g/day is derived.

2. Human health criteria values calculated using current IRIS RfDs or SFs and representative BCF values for common North American species of fish or invertebrates or estimated BCF values.

3. Human health criteria values calculated using RfDs or SFs from EPA's HEAST or EPA's Region III RBC Table in conjunction with adjusted 3 percent lipid BCF values derived from *Quality Criteria for Water* (U.S. EPA, 1980).

4. Human health criteria values calculated using current RfDs or SFs from HEAST or EPA's Region III RBC Table and representative BCF values for common North American species of fish or invertebrates or estimated BCF values.

5. Criteria from the *Quality Criteria for Water* (U.S. EPA, 1980).

6. Human health values calculated using RfDs or SFs from data sources other than

IRIS, HEAST, or Region III RBC Table.

This hierarchy is based on Section 2.4.6 of the *Technical Support Document for Water Quality-based Toxics Control* (U.S. EPA, 1991), which recommends using the most current risk information from IRIS when estimating human health risks. In cases where chemicals have both RfDs and SFs from the same level of the hierarchy, the analysis calculates human health values using the formulas for carcinogenicity, which always result in the more stringent value, given the risk levels employed.

3.1.4 Information Used To Evaluate Human Health Risks and Benefits

The analysis obtains fish ingestion rates for adult sport and subsistence anglers from the draft report *Estimated Per Capita Fish Consumption in the United Sates, Based on the Data Collected by the United States Department of Agriculture's 1994-1996 Continuing Survey of Food Intakes by Individuals* (U.S. EPA, 2000a). Fish ingestion rates for children are obtained from the *Exposure Factors Handbook* (U.S. EPA, 1997b). Data on average household size are obtained from the *Statistical Abstract of the United States: 1995* (U.S. Bureau of the Census, 1995). Population and birth rate data are obtained from the *Statistical Abstract of the United States: 1997* (U.S. Bureau of the Census, 1997). Data concerning the number of anglers in each State (i.e., resident anglers) are obtained from the 1991 *National Survey of Fishing, Hunting, and Wildlife Associated Recreation* (U.S. Dept. of the Interior FWS, 1991). The total number of river miles or estuary square miles within a State are obtained from the 1990 *National Water Quality Inventory Report to Congress* (U.S. EPA, 1990c). The analysis identifies drinking water utilities located within 50 miles downstream from each discharge site using EPA's REACHSCAN (U.S. EPA, 2000g). The population served by a drinking water utility is obtained from EPA's Safe Drinking Water Information System (SDWIS) (U.S. EPA, 2000h). The average per-student annual expenditure of public primary and secondary schools is obtained from the *Digest of Education Statistics, 1999* (U.S. Department of Education, 2000). The effect of IQ on education, percent wage loss per IQ point, and the discounted value of lost income associated with additional schooling are obtained from *Economic, Environmental, and Benefits Assessment of the Proposed Metal Products and Machinery (MP&M) Regulation* (U.S. EPA, 2000b). Changes in blood lead levels resulting from the changes in environmental lead are estimated using the *Guidance Manual for the Integrated Exposure Uptake Biokinetic (IEUBK) Model for Lead in Children* (U.S. EPA, 1994). Health risks and monetary benefits for reduced IQ levels in children are estimated using the methodology and equations presented in *The Benefits and Costs of the Clean Air Act: 1970 to 1990* (U.S. EPA, 1997a). Health risks and monetary benefits for reduced premature adult and neonatal mortality are estimated using the methodology and equations contained in *Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil* (U.S. EPA, 1996a). Willingness-to-pay values are obtained from OPA's review of the 1989 and 1986 studies "The Value of Reducing Risks of Death: A Note on New Evidence" (Fisher et al., 1989) and *Valuing Risks: New Information on the Willingness to Pay for Changes in Fatal Risks* (Violette and Chestnut, 1986). The analysis adjusts values to 1997 on the basis of the relative change in the Employment Cost Index of Total Compensation for all Civilian Workers. Information used in the evaluation is presented in Appendix D.

3.1.5 Information Used To Evaluate Ecological Benefits

The analysis uses the concept of a "contaminant-free fishery" and the estimate of an increase in the consumer surplus associated with a contaminant-free fishery which are presented in *Discrete Choice Models to Value Changes in Environmental Quality: A Great Lakes Case Study*, a thesis submitted at the University of Wisconsin-Madison (Lyke, 1993). The analysis uses data concerning the number of resident anglers in each State and average number of fishing days per angler in each State obtained from the 1991 *National Survey of Fishing, Hunting, and Wildlife Associated Recreation* (U.S. Dept. of the Interior, FWS, 1991) (Appendix D). Median net benefit values for warm-water and cold-water fishing days are obtained from *Nonmarket Values from Two Decades of Research on Recreational Demand* (Walsh et al., 1990). The analysis adjusts values to 1997, on the basis of the change in the Consumer Price Index for all urban consumers, as published by the Bureau of Labor Statistics. The concept and methodology of estimating nonuse (intrinsic) benefits, based on improved water quality, are obtained from "Intrinsic Benefits of Improved Water Quality: Conceptual and Empirical Perspectives" (Fisher and Raucher, 1984).

3.1.6 Information Used To Evaluate Economic Productivity Benefits

The analysis obtains sewage sludge pollutant limits for surface disposal and land application (ceiling limits and pollutant concentration limits) from the *Standards for the Use or Disposal of Sewage Sludge, Final Rule* (U.S. EPA, 1995b). Cost savings resulting from shifts in sludge use or disposal practices (from composite baseline use and disposal practices) are obtained from the *Regulatory Impact Analysis of Proposed Effluent Limitations, Guidelines and Standards for the Metal Products and Machinery Industry (Phase I)* (U.S. EPA, 1995c). The analysis adjusts savings, if applicable, to 1997 using the Construction Cost Index published in the *Engineering News Record*. In that report, EPA consulted a wide variety of sources, including the following:

C 1988 National Sewage Sludge Survey

C 1985 EPA *Handbook for Estimating Sludge Management Costs*

C 1989 EPA *Regulatory Impact Analysis of the Proposed Regulations for Sewage Sludge Use and Disposal*

C Interviews with POTW operators

C Interviews with State government solid waste and waste pollution control experts

C Review of trade and technical literature on sewage sludge use or disposal practices and costs

C Research organizations with expertise in waste management

Information used in the evaluation is presented in Appendix D.

3.2 Pollutant Fate and Toxicity

The analysis obtains the chemical-specific data needed to conduct the fate and toxicity evaluation from various sources as discussed in Section 2.2.2 of this report. Aquatic life and human health values are presented in Appendix C, as well as physical-chemical property data.

3.3 Documented Environmental Impacts

The analysis obtains data concerning environmental impacts from the 1998 State 303(d) lists of impaired waterbodies (U.S. EPA, 1998a), the 1998 *National Listing of Fish and Wildlife Consumption Advisories* (U.S. EPA, 1998b), and EPA's *Enforcement and Compliance Assurance, FY 98 Accomplishments Report* (U.S. EPA, 1999).

4. SUMMARY OF RESULTS

4.1 Projected Water Quality Impacts

4.1.1 Comparison of Instream Concentrations with Ambient Water Quality Criteria

The results of this analysis indicate the water quality benefits of controlling discharges from iron and steel facilities to surface waters and POTWs. The following two sections summarize potential aquatic life and human health impacts on receiving stream water quality and on POTW operations and their receiving streams for direct and indirect discharges. All tables referred to in these sections are presented at the end of Section 4. Appendices E, F, and G present the results of the stream and POTW modeling.

4.1.1.1 *Direct Discharging Facilities*

(a) Sample Set

The analysis evaluates the effects of direct wastewater discharges on receiving stream water quality at **current** and **proposed BAT** discharge levels for 103 iron and steel facilities directly discharging 60 pollutants to 77 receiving streams (Table 1). At **current** discharge levels, these 103 facilities discharge 211.9 million pounds per year of priority and nonconventional pollutants (Table 2). The proposed iron and steel guidelines will reduce these loadings to 162.8 million pounds per year at **proposed BAT** discharge levels, a 23 percent reduction.

The analysis projects that modeled instream pollutant concentrations will exceed **human health criteria** or toxic effect levels (developed for consumption of water and organisms) in 35 percent of the receiving streams (27 of the total 77) at **current** discharge levels and in 25 percent (19 of the total 77) of the receiving streams at **proposed BAT** discharge levels (Table 3). Using a target risk of 10^{-6} (1E-6) for the carcinogens, the analysis projects that 12 pollutants at **current** discharge levels and 11 pollutants at **proposed BAT** discharge levels will exceed instream criteria or toxic effect levels (Table 4). The analysis also projects a total of 6 pollutants will exceed **human health criteria** or toxic effect levels (developed for consumption of organisms only) in 21 percent of the receiving streams (16 of the total 77) at **current** discharge levels (Tables 3 and 4). The proposed iron and steel guidelines will eliminate excursions of the instream criteria or toxic effect levels in 3 of the receiving streams.

The analysis projects that modeled instream pollutant concentrations of 7 pollutants will exceed **acute aquatic life criteria** or toxic effect levels in 25 percent of the receiving streams (19 of the total 77) at **current** discharge levels (Tables 3 and 4). The analysis also projects modeled instream concentrations of 16 pollutants will exceed **chronic aquatic life criteria** or toxic effect levels in 48 percent of the receiving streams (37 of the total 77) (Tables 3 and 4). The proposed iron and steel guidelines will reduce **acute aquatic life** excursions to 3 pollutants in 17 percent of the receiving streams (13 of the total 77) and **chronic aquatic life** excursions to 12 pollutants in 40 percent of the receiving streams (31 of the total 77).

Table 1. Evaluated Pollutants of Concern (60) Discharged from 103 Direct Discharging Iron and Steel Facilities

CAS Number	Pollutant	Subcategory: Cokemaking	Steel Finishing	Nonintegrated Steelmaking and Hot Forming	Integrated and Stand-Alone Hot Forming	Ironmaking	Integrated Steelmaking	Other
C005	Nitrate/Nitrite	X	X	X		X	X	
50328	Benzo(a)pyrene	X						
56553	Benzo(a)anthracene	X						
57125	Total Cyanide	X	X			X		
62533	Aniline	X						
67641	Acetone	X	X					
71432	Benzene	X						
85018	Phenanthrene	X				X		
91203	Naphthalene	X						
91576	2-Methylnaphthalene	X						
95487	o-Cresol	X				X		
95534	o-Toluidine	X						
98555	alpha-Terpineol		X					
100027	4-Nitrophenol					X		
105679	2,4-Dimethylphenol	X				X		
106445	p-Cresol	X				X		
108952	Phenol	X				X	X	
110861	Pyridine	X				X		
112403	n-Dodecane		X					
112958	n-Eicosane	X						
117817	Bis(2-ethylhexyl)Phthalate		X					
124185	n-Decane		X					
129000	Pyrene	X						
132649	Dibenzofuran	X						
142621	Hexanoic Acid		X					
205992	Benzo(b)fluoranthene	X						
206440	Fluoranthene	X				X		
207089	Benzo(k)fluoranthene	X						
218019	Chrysene	X						
302045	Thiocyanate	X				X		
544763	n-Hexadecane		X					
593453	n-Octadecane	X						
612942	2-Phenylnaphthalene	X						
7429905	Aluminum		X	X		X	X	X
7439896	Iron		X	X	X	X	X	X
7439921	Lead		X	X	X	X	X	
7439954	Magnesium		X		X	X	X	
7439965	Manganese		X	X	X	X	X	
7439976	Mercury	X				X	X	
7439987	Molybdenum		X	X	X	X	X	
7440020	Nickel		X	X	X	X		
7440224	Silver						X	
7440280	Thallium					X		
7440315	Tin		X				X	
7440326	Titanium		X	X		X	X	
7440360	Antimony		X	X	X		X	
7440382	Arsenic	X	X		X	X		
7440393	Barium		X					
7440428	Boron	X	X	X		X		
7440439	Cadmium					X	X	
7440473	Chromium		X	X	X	X	X	
7440484	Cobalt		X				X	
7440508	Copper		X	X	X	X	X	
7440622	Vanadium						X	
7440666	Zinc		X	X	X	X	X	
7664417	Ammonia As Nitrogen (NH3-N	X	X	X	X	X	X	
7782492	Selenium	X				X		
14808798	Sulfate		X	X				
16984488	Fluoride		X	X	X	X	X	
18540299	Chromium, Hexavalent		X	X				

Source: U.S. EPA, Engineering and Analysis Division (EAD), May 16, 2000, Loading Files; September 19, 2000, Loading File for Cokemaking Subcategory.

Table 2. Summary of Pollutant Loadings for Evaluated Iron and Steel Facilities
(Sample Set/National Level)

	Loadings (Million Pounds-per-Year)*		Total***
	Direct Dischargers	Indirect Dischargers	
Current	211.9/234.5	15.1/18.7	227.1/253.2
Proposed BAT/PSES**	162.8/180.0	14.2/17.6	177.0/197.6
No. of Pollutants Evaluated	60	56	60
No. of Facilities Evaluated	103/131	47/67	150/198

* Loadings are representative of pollutants evaluated; conventional and nonconventional pollutants such as TSS, BOD_5, COD, TOC, TKN, total phenols, amenable cyanide, weak acid dissociable cyanide, and oil and grease are not evaluated.

** BAT3 for cokemaking subcategory, BAT1 for all other subcategories; PSES1 for all subcategories.

*** The same pollutant may be discharged from a number of direct and indirect facilities; therefore, the total does not equal the sum of pollutants.

Source: U.S. EPA, Engineering and Analysis Division (EAD), May 16, 2000, Loading Files; September 19, 2000, Loading File for Cokemaking Subcategory.

Table 3. Summary of Projected Criteria Excursions for Iron and Steel Direct Dischargers (All Subcategories)
(Sample Set)

	Acute Aquatic Life	Chronic Aquatic Life	Human Health Water and Orgs.	Human Health Orgs. Only	Total*
Current					
Stream (No.)	19	37	27	16	41
Pollutants (No.)	7 (1.0-105.0)	16 (1.0-371.7)	12 (1.1-2,072)	6 (1.2-2,072)	26
Total Excursions	**35**	**98**	**66**	**37**	
Proposed BAT**					
Stream (No.)	13	31	19	13	39
Pollutants (No.)	3 (1.0-105.0)	12 (1.0-371.7)	11 (1.1-1,955)	6 (1.0-1,955)	21
Total Excursions	**18**	**53**	**47**	**32**	

NOTE: Numbers in parentheses represent the range in the magnitude of excursions.
Number of streams evaluated = 77, number of facilities = 103, and number of pollutants = 60.
Pollutants detected at or below the minimum level were assumed to be present at the minimum level.
* Pollutants may exceed criteria on a number of streams; therefore, total does not equal sum of pollutants exceeding criteria.
** **BAT3** for cokemaking subcategory; **BAT1** for other subcategories. Projected excursions calculated assuming effluent pollutant concentrations at **proposed BAT** are equal to effluent pollutant concentrations at **current** for those pollutants and sites/subcategories where pollutants were never detected above minimum level. Also, projected excursions calculated assuming effluent pollutant concentrations at **proposed BAT** are equal to effluent pollutant concentrations at **current** for select pollutants and sites/subcategories where there is a projected reduction in flow but not a projected reduction in load (i.e., loads used in the cost-effectiveness analysis).
May 16, 2000, Loading Files; September 19, 2000, Loading File for Cokemaking Subcategory.

(b) National Extrapolation

The analysis extrapolates the sample set data to the national level using the statistical methodology for estimating costs, loads, and economic impacts. The analysis extrapolates values from the sample set of 103 iron and steel facilities directly discharging 60 pollutants to 77 receiving streams (Table 3) to 131 iron and steel facilities discharging 60 pollutants to 100 receiving streams (Table 5). At **current** discharge levels, these 131 facilities discharge 234.5 million pounds per year of priority and nonconventional pollutants (Table 2). The proposed iron and steel guidelines will reduce these loadings to 180.0 million pounds per year at **proposed BAT** discharge levels, a 23 percent reduction.

Table 4. Summary of Pollutants Projected to Exceed Criteria for Iron and Steel Direct Dischargers (All Subcategories) (Sample Set)

	Number of Excursions							
	Acute Aquatic Life		Chronic Aquatic Life		Human Health Water and Orgs.		Human Health Orgs. Only	
	Current	Proposed BAT	Current	Proposed BAT	Current	Proposed BAT	Current	Proposed BAT
Aluminum	0	0	2 (1.8)	1(1.8)	0	0	0	0
Antimony	0	0	0	0	2 (1.2-1.5)	1 (1.2)	0	0
Arsenic	0	0	0	0	22 (1.2-74.0)	13 (1.1-12.8)	9 (1.3-9.3)	4 (1.0-1.6)
Benzo(a)anthracene	0	0	0	0	6 (2.3-132.1)	6 (2.5-132.0)	6 (2.1-123.8)	6 (2.4-123.8)
Benzo(b)fluoranthene	0	0	0	0	7 (1.8-277.2)	7 (1.6-277.2)	7 (1.8-277.2)	7 (1.6-277.2)
Benzo(k)fluoranthene	0	0	0	0	4 (1.6-27.5)	4 (1.6-27.5)	4 (1.6-27.5)	4 (1.6-27.5)
Benzo(a)pyrene	0	0	1 (4.4)	1 (4.2)	10 (2.4-2,072)	10 (1.5-1,955)	10 (2.4-2,072)	10 (1.5-1,955)
Bis(2-ethylhexyl)phthalate	0	0	0	0	1 (2.7)	1 (1.4)	0	0
Boron	0	0	5 (1.2-5.0)	2 (2.1-2.9)	0	0	0	0
Chromium	0	0	1 (1.5)	0	0	0	0	0
Chromium, hexavalent	1 (7.5)	0	1 (9.1)	1 (1.1)	0	0	0	0
Chrysene	0	0	0	0	1 (1.2)	1 (1.2)	1 (1.2)	1 (1.1)
Copper	8 (1.0-36.0)	1 (4.5)	8 (1.2-43.9)	1 (5.6)	0	0	0	0
Cyanide	7 (1.2-105.0)	7 (1.0-105.0)	15 (1.1-371.7)	10 (1.2-371.7)	0	0	0	0
Fluoride	14 (1.0-13.8)	10 (1.1-13.8)	33 (1.0-116.3)	28 (1.2-116.3)	0	0	0	0

Table 4. Summary of Pollutants Projected to Exceed Criteria for Iron and Steel Direct Dischargers (All Subcategories) (Sample Set) (continued)

	Number of Excursions							
	Acute Aquatic Life		Chronic Aquatic Life		Human Health Water and Orgs.		Human Health Orgs. Only	
	Current	Proposed BAT	Current	Proposed BAT	Current	Proposed BAT	Current	Proposed BAT
Iron	0	0	5 (1.3-6.9)	1 (1.3)	8 (1.1-13.6)	2 (2.4-3.7)	0	0
Lead	1 (1.9)	0	11 (1.0-41.3)	3 (1.1-1.6)	0	0	0	0
Manganese	0	0	0	0	3 (1.1-1.6)	1 (1.1)	0	0
Magnesium	0	0	2 (1.4-1.6)	1 (1.0)	0	0	0	0
Molybdenum	0	0	6 (1.2-30.9)	3 (1.1-1.8)	0	0	0	0
Nickel	0	0	3 (1.6-2.9)	0	0	0	0	0
Nitrate/Nitrite	0	0	0	0	1 (2.0)	0	0	0
Selenium	1 (1.3)	0	1 (3.1)	1 (1.6)	0	0	0	0
Silver	0	0	0	0	0	0	0	0
Thiocyanate	0	0	1 (4.2)	0	0	0	0	0
Toluidine,o-	0	0	0	0	1 (1.6)	1 (1.6)	0	0
Zinc	3 (1.3-8.8)	0	3 (1.1-7.5)	0	0	0	0	0

NOTE: Number of pollutants evaluated = 60
Numbers outside parentheses represent the number of excursions; numbers in parentheses represent the range in the magnitude of excursions.

May 16, 2000 Loading Files; September 19, 2000 Loading File for Cokemaking Subcategory.

Table 5. Summary of Projected Criteria Excursions for Iron and Steel Direct Dischargers (All Subcategories)
(National Level)

	Acute Aquatic Life	Chronic Aquatic Life	Human Health Water and Orgs.	Human Health Orgs. Only	Total*
Current					
Stream (No.)	23	47	30	17	51
Pollutants (No.)	7 (1.0-105.0)	16 (1.0-371.7)	12 (1.1-2,072)	6 (1.2-2,072)	26
Total Excursions	**40**	**116**	**69**	**38**	
Proposed BAT**					
Stream (No.)	16	41	20	14	49
Pollutants (No.)	3 (1.0-105.0)	12 (1.0-371.7)	11 (1.1-1,955)	6 (1.0-1,955)	21
Total Excursions	**22**	**68**	**48**	**33**	

NOTE: Numbers in parentheses represent the range in the magnitude of excursions.
Number of streams evaluated = 100, number of facilities = 131, and number of pollutants = 60.
Pollutants detected at or below the minimum level were assumed to be present at the minimum level.

* Pollutants may exceed criteria on a number of streams; therefore, total does not equal sum of pollutants exceeding criteria.

** **BAT3** for cokemaking subcategory; **BAT1** for other subcategories. Projected excursions calculated assuming effluent pollutant concentrations at **proposed BAT** are equal to effluent pollutant concentrations at **current** for those pollutants and sites/subcategories where pollutants were never detected above minimum level. Also, projected excursions calculated assuming effluent pollutant concentrations at **proposed BAT** are equal to effluent pollutant concentrations at **current** for select pollutants and sites/subcategories where there is a projected reduction in flow but not a projected reduction in load (i.e., loads used in the cost-effectiveness analysis).

May 16, 2000, Loading Files; September 19, 2000, Loading File for Cokemaking Subcategory.

The analysis projects that extrapolated instream pollutant concentrations will exceed **human health criteria** or toxic effect levels (developed for consumption of water and organisms) in 30 percent of the receiving streams (30 of the total 100) at **current** discharge levels and in 20 percent of the receiving streams (20 of the total 100) at **proposed BAT** discharge levels (Table 5). The analysis projects excursions of **human health criteria** or toxic effect levels (developed for consumption of organisms only) in 17 percent of the receiving streams (17 of the total 100) at **current** discharge levels (Table 5). The proposed iron and steel guidelines will reduce the excursions of **human health criteria** or toxic effect levels (developed for consumption of organisms only) from 17 to 14 receiving streams.

In addition, the analysis projects that extrapolated instream pollutant concentrations will exceed **acute aquatic life criteria** in 23 percent of the receiving streams (23 of the total 100) at **current** discharge levels (Table 5). The proposed regulation will reduce excursions to 16 percent of the receiving streams (16 of the total 100). The analysis projects that extrapolated instream pollutant concentrations will exceed **chronic aquatic life criteria** in 47 percent (47 of the total 100) and 41 percent (41 of the total 100) of the receiving streams at **current** and **proposed BAT** discharge levels, respectively (Table 5).

4.1.1.2 *Indirect Discharging Facilities*

(a) Sample Set

The analysis evaluates the effects of POTW wastewater discharges on receiving stream water quality at **current** and **proposed PSES** discharge levels for 47 indirect iron and steel facilities discharging 56 pollutants to 43 POTWs located on 43 receiving streams (Table 6). At **current** discharge levels, these 47 facilities discharge 15.1 million pounds per year of priority and nonconventional pollutants (Table 2). The proposed iron and steel guidelines will reduce these loadings to 14.2 million pounds per year at **proposed PSES** discharge levels, a 6 percent reduction.

Table 6. Evaluated Pollutants of Concern (56) Discharged from 47 Indirect Discharging Iron and Steel Facilities

CAS Number	Pollutant	Subcategory						
		Cokemaking	Steel Finishing	Nonintegrated Steelmaking and Hot Forming	Integrated and Stand-Alone Hot Forming	Ironmaking	Integrated Steelmaking	Other
C005	Nitrate/Nitrite		X	X		X	X	
50328	Benzo(a)pyrene	X						
56553	Benzo(a)anthracene	X						
57125	Total Cyanide	X	X			X		
67641	Acetone	X	X					
71432	Benzene	X						
85018	Phenanthrene	X						
91203	Naphthalene	X						
91576	2-Methylnaphthalene	X						
95487	o-Cresol	X				X		
95534	o-Toluidine	X						
98555	alpha-Terpineol		X					
105679	2,4-Dimethylphenol	X				X		
106445	p-Cresol					X		
108952	Phenol						X	
110861	Pyridine	X				X		
112403	n-Dodecane		X					
117817	Bis(2-ethylhexyl)Phthalate		X					
124185	n-Decane		X					
129000	Pyrene	X						
132649	Dibenzofuran	X						
142621	Hexanoic Acid		X					
205992	Benzo(b)fluoranthene	X						
206440	Fluoranthene	X				X		
207089	Benzo(k)fluoranthene	X						
218019	Chrysene	X						
302045	Thiocyanate	X				X		
544763	n-Hexadecane		X					
612942	2-Phenylnaphthalene	X						
7429905	Aluminum		X	X		X	X	X
7439896	Iron		X	X	X	X	X	X
7439921	Lead		X	X	X	X	X	
7439954	Magnesium		X		X	X	X	
7439965	Manganese		X	X	X	X	X	
7439976	Mercury						X	
7439987	Molybdenum		X	X	X	X	X	
7440020	Nickel		X	X	X	X		
7440224	Silver						X	
7440280	Thallium					X		
7440315	Tin		X				X	
7440326	Titanium		X	X		X	X	
7440360	Antimony		X	X	X		X	
7440382	Arsenic		X		X	X		
7440393	Barium		X					
7440428	Boron	X	X	X		X		
7440439	Cadmium					X	X	
7440473	Chromium		X	X	X	X	X	
7440484	Cobalt		X				X	
7440508	Copper		X	X	X	X	X	
7440622	Vanadium						X	
7440666	Zinc		X	X	X	X	X	
7664417	Ammonia As Nitrogen (NH3-N	X	X	X	X	X	X	
7782492	Selenium					X		
14808798	Sulfate		X	X				
16984488	Fluoride	X	X	X	X	X	X	
18540299	Chromium, Hexavalent		X	X				

Source: U.S. EPA, Engineering and Analysis Division (EAD), May 16, 2000, Loading Files

Using a target risk of 10^{-6} (1E-6) for the carcinogens, the analysis projects that modeled instream pollutant concentrations will not exceed **human health criteria** or toxic effect levels (developed for either the consumption of water and organisms or for the consumption of organisms only) at **current** or **proposed PSES** discharge levels (Table 7). Because the analysis projects no excursions, it does not extrapolate these results to the national level.

The analysis projects that modeled instream pollutant concentrations will not exceed **acute aquatic life criteria** or toxic effect levels in any of the receiving streams at **current** or **proposed PSES** discharge levels (Table 7). Therefore, the analysis does not extrapolate these results to the national level. The analysis does project that modeled instream concentrations of 2 pollutants at **current** discharge levels will exceed **chronic aquatic life criteria** or toxic effect levels in 7 percent of the receiving streams (3 of the total 43). The proposed iron and steel guidelines will reduce excursions of the 2 pollutants from 3 to 2 receiving streams (Tables 7 and 8).

In addition, the analysis evaluates the potential impact of the 47 indirect discharging iron and steel facilities, which discharge to 43 POTWs, in terms of inhibition of POTW operation and contamination of sludge. The analysis projects that no inhibition problems or sludge contamination problems will occur at any of the POTWs (Table 9). Because the analysis projects no impacts at POTWs, the analysis does not extrapolate these results to the national level.

(b) National Extrapolation

The analysis extrapolates the sample set data to the national level using the statistical methodology for estimating costs, loads, and economic impacts. The analysis extrapolates values from the sample set of 47 indirect iron and steel facilities discharging 56 pollutants to 43 POTWs located on 43 receiving streams (Table 7) to 67 indirect iron and steel facilities discharging 56 pollutants to 61 POTWs with outfalls on 61 receiving streams (Table 10). At **current** discharge levels, these 67 facilities discharge 18.7 million pounds per year of priority and nonconventional pollutants (Table 2). The proposed iron and steel guidelines will reduce these loadings to 17.6 million pounds per year at **proposed PSES** discharge levels, a 6 percent reduction.

The analysis projects that extrapolated instream pollutant concentrations will exceed only **chronic aquatic life criteria** or toxic effect levels in 7 percent of the receiving streams (4 of the total 61) at **current** discharge levels (Table 10). The proposed iron and steel guidelines will eliminate excursions in 2 of the 4 receiving streams at **proposed PSES** discharge levels.

4.1.2 Estimation of Human Health Risks and Benefits

The analysis evaluates the potential benefits to human health by estimating the risks (carcinogenic and systemic) associated with current and reduced pollutant levels in fish tissue and drinking water. The analysis also evaluates the potential benefits to human health by estimating blood lead levels associated with reducing lead levels in fish tissue. Sections 4.1.2.1 and 4.1.2.2 summarize potential human health impacts (carcinogenic and systemic) from the consumption of fish tissue and drinking water that are derived from waterbodies impacted by direct and indirect discharging facilities. Potential lead-related human health impacts from the consumption of fish tissue that are derived from the same waterbodies are also summarized. The analysis estimates risks for recreational (sport) and subsistence anglers and their families, as well as the general population (drinking water). Appendices H, I, and J present the results of the modeling.

Table 7. Summary of Projected Criteria Excursions for Iron and Steel Indirect Dischargers (All Subcategories)
(Sample Set)

	Acute Aquatic Life	Chronic Aquatic Life	Human Health Water and Orgs.	Human Health Orgs. Only	Total*
<u>Current</u>					
Stream (No.)	0	3	0	0	3
Pollutants (No.)	0	2 (1.3-7.1)	0	0	2
Total Excursions	**0**	**5**	**0**	**0**	
<u>Proposed PSES</u>**					
Stream (No.)	0	2	0	0	2
Pollutants (No.)	0	2 (1.3-4.8)	0	0	2
Total Excursions	**0**	**4**	**0**	**0**	

NOTE: Numbers in parentheses represent the range in the magnitude of excursions.
Number of streams evaluated = 43, number of POTWs = 43, number of facilities = 47, and number of pollutants = 56.
Pollutants detected at or below the minimum level were assumed to be present at the minimum level.

* Pollutants may exceed criteria on a number of streams; therefore, total does not equal sum of pollutants exceeding criteria.
** **PSES1** for all subcategories.

May 16, 2000, Loading Files.

Table 8. Summary of Pollutants Projected to Exceed Criteria for Iron and Steel Indirect Dischargers (All Subcategories) (Sample Set)

	Number of Excursions							
	Acute Aquatic Life		Chronic Aquatic Life		Human Health Water and Orgs.		Human Health Orgs. Only	
	Current	Proposed PSES	Current	Proposed PSES	Current	Proposed PSES	Current	Proposed PSES
Fluoride	0	0	2 (1.3-1.8)	2 (1.3-1.8)	0	0	0	0
Molybdenum	0	0	3 (3.5-7.1)	2 (1.9-4.8)	0	0	0	0

NOTE: Number of pollutants evaluated = 56.
Numbers outside parentheses represent the number of excursions; numbers in parentheses represent the range in the magnitude of excursions.

May 16, 2000, Loading Files.

Table 9. Summary of Projected POTW Inhibition and Sludge Contamination Problems from Iron and Steel Indirect Dischargers (All Subcategories)
(Sample Set)

	Biological Inhibition	Sludge Contamination	Total
Current			
POTWs (No.)	0	0	0
Pollutants (No.)	0	0	0
Total Problems	**0**	**0**	
Proposed PSES*			
POTWs (No.)	0	0	0
Pollutants (No.)	0	0	0
Total Problems	**0**	**0**	

NOTE: Number of POTWs evaluated = 43, number of facilities = 47, and number of pollutants = 56.
Pollutants detected at or below minimum level were assumed to be present at the minimum level.
* **PSES1** for all subcategories.

May 16, 2000, Loading Files.

4.1.2.1 *Direct Discharging Facilities*

(a) Sample Set

The analysis evaluates the effects of direct wastewater discharges on human health from the consumption of fish tissue and drinking water at **current** and **proposedBAT** discharge levels for 103 iron and steel facilities directly discharging 60 pollutants to 77 receiving streams.**Fish Tissue (Carcinogenic and Systemic)** -- At **current** discharge levels, 28 receiving streams have total estimated individual-pollutant cancer risks greater than 10^{-6} (1E-6) due to the discharge of 7 carcinogens (Tables 11 and 12). The analysis projects total estimated risks greater than 10^{-6} (1E-6) for **sport anglers** and **subsistence anglers**. At **current** discharge levels, total excess annual cancer cases are estimated to be 3.0E-1. At **proposed BAT** discharge levels, 23 receiving streams have a total estimated individual-pollutant cancer risk greater than 10^{-6} (1E-6) due to the discharge of 7 carcinogens (Tables 11 and 12). The analysis again projects total estimated risks greater than 10^{-6} (1E-6) for **sport anglers** and **subsistence anglers**. Total excess annual cancer cases will be reduced to an estimated 2.9E-1 at **proposedBAT** discharge levels (Table 11). Based on the reduction of total excess cancer cases (1.0E-2), the monetary value of benefits to society from avoided cancer cases ranges from $24,000 to $126,000 (1997 dollars).

In addition, the analysis projects systemic toxicant effects (hazard index greater than 1.0) in 3 receiving streams from 2 pollutants at **current** discharge levels (Table 13). An estimated population of 868 **subsistence anglers** and their families are projected to be affected. The proposed iron and steel guidelines will eliminate systemic toxicant effects. A monetary value of these benefits to society could not be estimated.

Table 10 . Summary of Projected Criteria Excursions for Iron and Steel Indirect Dischargers (All Subcategories)
(National Level)

	Acute Aquatic Life	Chronic Aquatic Life	Human Health Water and Orgs.	Human Health Orgs. Only	Total*
Current					
Stream (No.)	0	4	0	0	4
Pollutants (No.)	0	2 (1.3-7.1)	0	0	2
Total Excursions	**0**	**6**	**0**	**0**	
Proposed PSES**					
Stream (No.)	0	2	0	0	2
Pollutants (No.)	0	2 (1.3-4.8)	0	0	2
Total Excursions	**0**	**4**	**0**	**0**	

NOTE: Numbers in parentheses represent the range in the magnitude of excursions.
Number of streams evaluated = 61, number of POTWs = 61, number of facilities = 67, and number of pollutants = 56.
Pollutants detected at or below the minimum level were assumed to be present at the minimum level.

* Pollutants may exceed criteria on a number of streams; therefore, total does not equal sum of pollutants exceeding criteria.
** **PSES1** for all subcategories.

May 16, 2000, Loading Files.

Fish Tissue (Lead) -- At the **proposed BAT** discharge levels, the ingestion of lead-contaminated fish tissue by children (ages 0-6) of sport and subsistence anglers is reduced at 39 receiving streams (Table 14). The analysis projects a potentially exposed population of 15,000 children. Based on the annual reduction in total IQ loss (55.83 points), the monetary value of benefits to society from avoided loss of IQ points is $542,000 (1997 dollars) (Table 14). Additionally, the ingestion of lead-contaminated fish tissue by adult sport and subsistence anglers is reduced at 55 receiving streams (Table 14). The analysis projects that the proposed guidelines will reduce premature mortality by an estimated 3.0E-2 cases annually for 191,000 men (ages 40-74), 9.8E-4 cases annually for 163,000 women (ages 45-74), and 3.5E-3 cases annually for 17,000 neonates. Based on the reductions in blood pressure, as it relates to premature mortality, the total annual monetary benefits to society from avoided mortality range from $83,000 to $435,000 (1997 dollars) (Table 14).

Drinking Water -- At **current** discharge levels, the analysis projects that 22 receiving streams will have total estimated individual pollutant cancer risks greater than 10^{-6} (1E-6) due to the discharge of 6 carcinogens (Table 15). Estimated risks range from 1.1E-6 to 8.7E-5. Drinking water utilities are located within 50 miles downstream of 3 sites that discharge 2 carcinogens with risks greater than 10^{-6} (1E-6). However, EPA has published a drinking water standard for the 2 carcinogens, and the analysis assumes that drinking water treatment systems will reduce concentrations to below adverse effect thresholds. Therefore, the analysis projects no total excess annual cancer cases (Table 15). In addition, the analysis projects no systemic toxicant effects (hazard index greater than 1.0) at **current** or **proposed BAT** discharge levels (Table 13).

Table 11. Summary of Potential Human Health Impacts for Iron and Steel Direct Dischargers (All Subcategories) (Fish Tissue Consumption) (Sample Set)

	Total Individual Cancer Risks > 10^{-6}	Total Excess Annual Cancer Cases
<u>Current</u>		
Streams (No.)	28	NA/NA
Carcinogens (No.)	7	NA
Sport Anglers	18 (1.3E-6 to 4.6E-3)	1.9E-1
Subsistence Anglers	28 (2.9E-6 to 4.7E-2)	1.1E-1
TOTAL		**3.0E-1**
<u>Proposed BAT</u>*		
Streams (No.)	23	NA/NA
Carcinogens (No.)	7	NA
Sport Anglers	15 (1.2E-6 to 4.4E-3)	1.9E-1
Subsistence Anglers	23 (1.2E-6 to 4.4E-2)	1.0E-1
TOTAL		**2.9E-1**

NOTE: Number of streams evaluated = 77, number of facilities = 103 and number of pollutants = 60.
Table presents results for those streams/facilities for which the projected excess cancer risk exceeds 10^{-6} (1E-6).
Primary chemicals contributing to the excess cancer risk are included in summary even if cancer risk did not exceed 10^{-6} (1E-6).
Pollutants detected at or below minimum level were assumed to be present at the minimum level.

NA = Not Applicable

* **BAT3** for cokemaking subcategory; **BAT1** for other subcategories. Projected cancer risks/cases calculated assuming effluent pollutant concentrations at **<u>proposed BAT</u>** are equal to effluent pollutant concentrations at **<u>current</u>** for those pollutants and sites/subcategories where pollutants were never detected above minimum level. Also, projected cancer risks/cases calculated assuming effluent pollutant concentrations at **<u>proposed BAT</u>** are equal to effluent pollutant concentrations at **<u>current</u>** for select pollutants and sites/subcategories where there is a projected reduction in flow, but not a projected reduction in load (i.e., loads used in the cost-effectiveness analysis).

May 16, 2000, Loading Files; September 19, 2000, Loading File for Cokemaking Subcategory.

Table 12. Summary of Pollutants Projected to Cause Human Health Impacts for Iron and Steel Direct Dischargers (All Subcategories)
(Fish Tissue Consumption)
(Sample Set)

	Cancer Risks >10^{-6}/ Excess Annual Cancer Cases Sport Anglers	Cancer Risks >10^{-6}/ Excess Annual Cancer Cases Subsistence Anglers
Current:		
Stream No. 1		
Arsenic	1.7E-6/4.6E-5	1.7E-5/2.5E-5
Benzo(a)anthracene	3.2E-5/8.9E-4	3.3E-4/4.8E-4
Benzo(a)pyrene	4.4E-4/1.2E-2	4.5E-3/6.5E-3
Benzo(b)fluoranthene	7.6E-5/2.1E-3	7.8E-4/1.1E-3
Benzo(k)fluoranthene	7.8E-6/2.1E-4	8.0E-5/1.1E-4
Chrysene	0/NA	2.9E-6/4.2E-6
Stream No. 2		
Arsenic	3.3E-6/8.9E-5	3.3E-5/4.8E-5
Benzo(a)anthracene	2.3E-4/6.3E-3	2.4E-3/3.4E-3
Benzo(a)pyrene	3.8E-3/1.0E-1	3.9E-2/5.6E-2
Benzo(b)fluoranthene	5.0E-4/1.4E-2	5.2E-3/7.4E-3
Benzo(k)fluoranthene	5.0E-5/1.4E-3	5.1E-4/7.4E-4
Chrysene	2.2E-6/5.9E-5	2.2E-5/3.2E-5
Stream No. 3		
Benzo(a)anthracene	1.7E-6/4.7E-5	1.8E-5/2.6E-5
Benzo(a)pyrene	3.6E-5/9.7E-4	3.6E-4/5.2E-4
Benzo(b)fluoranthene	3.3E-6/9.1E-5	3.4E-5/4.9E-5
Benzo(k)fluoranthene	0/NA	3.2E-6/4.6E-6
Stream No. 4		
Arsenic	7.8E-6/2.1E-4	8.0E-5/1.2E-4
Stream No. 5		
Arsenic	2.3E-6/1.5E-4	2.3E-5/8.3E-5
Benzo(a)anthracene	2.1E-5/1.4E-3	2.1E-4/7.5E-4
Benzo(a)pyrene	2.8E-4/1.9E-2	2.9E-3/1.0E-2
Benzo(b)fluoranthene	4.8E-5/3.3E-3	5.0E-4/1.8E-3
Benzo(k)fluoranthene	4.9E-6/3.3E-4	5.1E-5/1.8E-4
Chrysene	0/NA	1.9E-6/6.6E-6
Stream No. 6		
Arsenic	2.9E-6/1.9E-4	2.9E-5/1.0E-4
Bis(2-ethylhexyl)phthalate	0/NA	3.0E-6/1.1E-5
Stream No. 7		
Arsenic	1.4E-5/9.7E-4	1.5E-4/5.2E-4

Table 12. Summary of Pollutants Projected to Cause Human Health Impacts for Iron and Steel Direct Dischargers (All Subcategories)
(Fish Tissue Consumption) (Continued)
(Sample Set)

	Cancer Risks $>10^{-6}$/ Excess Annual Cancer Cases Sport Anglers	Cancer Risks $>10^{-6}$/ Excess Annual Cancer Cases Subsistence Anglers
Stream No. 8		
Arsenic	0/NA	3.5E-6/1.0E-5
Bis(2-ethylhexyl)phthalate	0/NA	5.1E-7/1.5E-6
Stream No. 9		
Arsenic	1.7E-5/9.5E-4	1.7E-4/5.1E-4
Stream No. 10		
Arsenic	0/NA	7.0E-6/1.7E-5
Stream No. 11		
Arsenic	0/NA	6.8E-6/1.6E-5
Bis(2-ethylhexyl)phthalate	0/NA	4.6E-7/1.1E-6
Stream No. 12		
Arsenic	2.9E-6/7.6E-5	3.0E-5/4.1E-5
Stream No. 13		
Arsenic	0/NA	5.2E-6/7.2E-6
Benzo(a)anthracene	1.7E-5/4.4E-4	1.7E-4/2.4E-4
Benzo(a)pyrene	4.8E-5/1.3E-3	5.0E-4/6.9E-4
Benzo(b)fluoranthene	3.2E-5/8.5E-4	3.3E-4/4.6E-4
Benzo(k)fluoranthene	3.0E-6/7.9E-5	3.1E-5/4.3E-5
Chrysene	0/NA	1.7E-6/2.4E-6
Stream No. 14		
Benzo(a)anthracene	1.5E-7/6.1E-6	1.5E-6/3.3E-6
Benzo(a)pryene	4.7E-6/1.9E-4	4.8E-5/1.0E-4
Benzo(b)fluoranthene	2.9E-7/1.2E-5	2.9E-6/6.3E-6
Stream No. 15		
Arsenic	2.9E-7/4.2E-6	3.0E-6/2.3E-6
Benzo(a)anthracene	3.6E-7/5.1E-6	3.7E-6/2.8E-6
Benzo(a)pyrene	4.4E-6/6.2E-5	4.5E-5/3.4E-5
Benzo(b)fluoranthene	4.4E-7/6.3E-6	4.5E-6/3.4E-6
Stream No. 16		
Benzo(a)anthracene	1.3E-7/5.3E-6	1.3E-6/2.9E-6
Benzo(a)pyrene	9.3E-7/3.8E-5	9.5E-6/2.1E-5
Benzo(b)fluoranthene	2.5E-7/1.0E-5	2.6E-6/5.5E-6
Stream No. 17		
Arsenic	3.7E-6/1.5E-4	3.8E-5/8.3E-5
Bis(2-ethylhexyl)phthalate	1.5E-6/6.3E-5	1.6E-5/3.4E-5

Table 12. Summary of Pollutants Projected to Cause Human Health Impacts for Iron and Steel Direct Dischargers (All Subcategories)
(Fish Tissue Consumption) (Continued)
(Sample Set)

	Cancer Risks $>10^{-6}$/ Excess Annual Cancer Cases Sport Anglers	Cancer Risks $>10^{-6}$/ Excess Annual Cancer Cases Subsistence Anglers
Stream No. 18		
Arsenic	0/NA	3.5E-6/7.6E-6
Stream No. 19		
Arsenic	0/NA	2.9E-6/6.9E-6
Bis(2-ethylhexyl)phthalate	0/NA	4.3E-7/1.0E-6
Stream No. 20		
Arsenic	0/NA	2.1E-6/4.6E-6
Bis(2-ethylhexyl)phthalate	0/NA	1.1E-6/2.4E-6
Stream No. 21		
Arsenic	0/NA	3.4E-6/8.1E-6
Bis(2-ethylhexyl)phthalate	0/NA	1.1E-6/2.7E-6
Stream No. 22		
Arsenic	0/NA	4.1E-6/9.7E-6
Stream No. 23		
Arsenic	0/NA	2.9E-6/6.8E-6
Stream No. 24		
Arsenic	0/NA	3.9E-6/9.2E-6
Stream No. 25		
Benzo(a)anthracene	1.3E-7/5.7E-6	1.3E-6/3.1E-6
Benzo(a)pyrene	1.7E-6/7.8E-5	1.8E-5/4.2E-5
Benzo(b)fluoranthene	3.0E-7/1.3E-5	3.1E-6/7.2E-6
Stream No. 26		
Benzo(a)anthracene	4.4E-7/2.5E-5	4.5E-6/1.4E-5
Benzo(a)pyrene	6.0E-6/3.4E-4	6.1E-5/1.8E-4
Benzo(b)fluoranthene	1.0E-6/5.9E-5	1.1E-5/3.2E-5
Benzo(k)fluoranthene	1.1E-7/6.0E-6	1.1E-6/3.2E-6
Stream No. 27		
Arsenic	7.5E-6/1.1E-3	7.6E-5/5.9E-4
Benzo(a)anthracene	4.0E-6/5.8E-4	4.1E-5/3.1E-4
Benzo(a)pyrene	9.5E-5/1.4E-2	9.8E-4/7.5E-3
Benzo(b)fluoranthene	9.5E-6/1.4E-3	9.8E-5/7.5E-4
Benzo(k)fluoranthene	9.5E-7/1.4E-4	9.8E-6/7.5E-5
Bis(2-ethylhexyl)phthalate	0/NA	1.5E-6/1.2E-5

Table 12. Summary of Pollutants Projected to Cause Human Health Impacts for Iron and Steel Direct Dischargers (All Subcategories)
(Fish Tissue Consumption) (Continued)
(Sample Set)

	Cancer Risks $>10^{-6}$/ Excess Annual Cancer Cases Sport Anglers	Cancer Risks $>10^{-6}$/ Excess Annual Cancer Cases Subsistence Anglers
Stream No. 28		
Arsenic	0/NA	5.8E-6/1.2E-5
Benzo(a)anthracene	7.4E-6/3.0E-4	7.6E-5/1.6E-4
Benzo(a)pyrene	1.9E-4/7.8E-3	2.0E-3/4.2E-3
Benzo(b)fluoranthene	1.4E-5/5.8E-4	1.5E-4/3.1E-4
Benzo(k)fluoranthene	1.3E-6/5.5E-5	1.4E-5/2.9E-5

Table 12. Summary of Pollutants Projected to Cause Human Health Impacts for Iron and Steel Direct Dischargers (All Subcategories)
(Fish Tissue Consumption) (Continued)
(Sample Set)

	Cancer Risks $>10^{-6}$/ Excess Annual Cancer Cases Sport Anglers	Cancer Risks $>10^{-6}$/ Excess Annual Cancer Cases Subsistence Anglers
Proposed BAT*:		
Stream No. 1		
Arsenic	0/NA	2.5E-6/3.5E-6
Benzo(a)anthracene	3.4E-5/9.4E-4	3.5E-4/5.1E-4
Benzo(a)pyrene	4.7E-4/1.3E-2	4.8E-3/6.9E-3
Benzo(b)fluoranthene	8.1E-5/2.2E-3	8.3E-4/1.2E-3
Benzo(k)fluoranthene	8.3E-6/2.3E-4	8.5E-5/1.2E-4
Chrysene	0/NA	3.1E-6/4.5E-6
Stream No. 2		
Arsenic	1.8E-6/5.0E-5	1.9E-5/2.7E-5
Benzo(a)anthracene	2.3E-4/6.3E-3	2.4E-3/3.4E-3
Benzo(a)pyrene	3.6E-3/9.7E-2	3.6E-2/5.2E-2
Benzo(b)fluoranthene	5.0E-4/1.4E-2	5.2E-3/7.4E-3
Benzo(k)fluoranthene	5.0E-5/1.4E-3	5.1E-4/7.4E-4
Chrysene	2.1E-6/5.8E-5	2.2E-5/3.2E-5
Stream No. 3		
Benzo(a)anthracene	1.5E-6/4.0E-5	1.5E-5/2.2E-5
Benzo(a)pyrene	2.7E-5/7.3E-4	2.8E-4/4.0E-4
Benzo(b)fluoranthene	2.8E-6/7.8E-5	2.9E-5/4.2E-5
Benzo(k)fluoranthene	0/NA	2.7E-6/3.9E-6
Stream No. 4		
Arsenic	0/NA	9.7E-6/1.4E-5
Stream No. 5		
Arsenic	0/NA	4.0E-6/1.4E-5
Benzo(a)anthracene	2.2E-5/1.5E-3	2.2E-4/7.9E-4
Benzo(a)pyrene	3.0E-4/2.0E-2	3.0E-3/1.1E-2
Benzo(b)fluoranthene	5.1E-5/3.5E-3	5.2E-4/1.9E-3
Benzo(k)fluoranthene	5.2E-6/3.5E-4	5.3E-5/1.9E-4
Chrysene	0/NA	2.0E-6/7.0E-6
Stream No. 6		
Arsenic	1.4E-6/9.7E-5	1.5E-5/5.3E-5
Bis(2-ethylhexyl)phthalate	0/NA	1.5E-6/5.4E-6
Stream No. 7		
Arsenic	2.9E-6/2.0E-4	3.0E-5/1.1E-4

Table 12. Summary of Pollutants Projected to Cause Human Health Impacts for Iron and Steel Direct Dischargers (All Subcategories) (Fish Tissue Consumption) (Continued) (Sample Set)

	Cancer Risks $>10^{-6}$/ Excess Annual Cancer Cases Sport Anglers	Cancer Risks $>10^{-6}$/ Excess Annual Cancer Cases Subsistence Anglers
Stream No. 8		
Arsenic	0/NA	3.5E-6/1.0E-5
Bis(2-ethylhexyl)phthalate	0/NA	5.1E-7/1.5E-6
Stream No. 9		
Arsenic	0/NA	7.0E-6/2.1E-5
Stream No. 10		
Arsenic	0/NA	1.4E-6/3.3E-6
Stream No. 11		
Arsenic	0/NA	4.5E-6/1.1E-5
Bis(2-ethylhexyl)phthalate	0/NA	3.2E-7/7.5E-7
Stream No. 12		
Arsenic	2.9E-6/7.6E-5	3.0E-5/4.1E-5
Stream No. 13		
Arsenic	0/NA	5.2E-6/7.2E-6
Benzo(a)anthracene	1.7E-5/4.4E-4	1.7E-4/2.4E-4
Benzo(a)pyrene	4.8E-5/1.3E-3	5.0E-4/6.9E-4
Benzo(b)fluoranthene	3.2E-5/8.5E-4	3.3E-4/4.6E-4
Benzo(k)fluoranthene	3.0E-6/7.9E-5	3.1E-5/4.3E-5
Chrysene	0/NA	1.7E-6/2.4E-6
Stream No. 14		
Benzo(a)anthracene	1.5E-7/6.1E-6	1.5E-6/3.3E-6
Benzo(a)pryene	2.7E-6/1.1E-4	2.8E-5/6.0E-5
Benzo(b)fluoranthene	2.9E-7/1.2E-5	2.9E-6/6.3E-6
Stream No. 15		
Arsenic	0/NA	1.2E-6/8.7E-7
Benzo(a)anthracene	2.7E-7/3.9E-6	2.8E-6/2.1E-6
Benzo(a)pyrene	3.4E-6/4.8E-5	3.4E-5/2.6E-5
Benzo(b)fluoranthene	3.4E-7/4.8E-6	3.5E-6/2.6E-6
Stream No. 16		
Benzo(a)anthracene	1.2E-7/5.1E-6	1.3E-6/2.7E-6
Benzo(a)pyrene	8.8E-7/3.6E-5	9.1E-6/2.0E-5
Benzo(b)fluoranthene	2.4E-7/9.8E-6	2.4E-6/5.3E-6
Stream No. 17		
Arsenic	1.9E-6/7.8E-5	1.9E-5/4.2E-5
Bis(2-ethylhexyl)phthalate	7.8E-7/3.2E-5	8.0E-6/1.7E-5

Table 12. Summary of Pollutants Projected to Cause Human Health Impacts for Iron and Steel Direct Dischargers (All Subcategories)
(Fish Tissue Consumption) (Continued)
(Sample Set)

	Cancer Risks >10^{-6}/ Excess Annual Cancer Cases Sport Anglers	Cancer Risks >10^{-6}/ Excess Annual Cancer Cases Subsistence Anglers
Stream No. 20		
Arsenic	0/NA	1.9E-6/4.1E-6
Bis(2-ethylhexyl)phthalate	0/NA	9.3E-7/2.0E-6
Stream No. 21		
Arsenic	0/NA	1.7E-6/4.1E-6
Bis(2-ethylhexyl)phthalate	0/NA	5.6E-7/1.3E-6
Stream No. 24		
Arsenic	0/NA	1.2E-6/2.8E-6
Stream No. 26		
Benzo(a)anthracene	4.4E-7/2.5E-5	4.5E-6/1.4E-5
Benzo(a)pyrene	6.0E-6/3.4E-4	6.1E-5/1.8E-4
Benzo(b)fluoranthene	1.0E-6/5.9E-5	1.1E-5/3.2E-5
Benzo(k)fluoranthene	1.1E-7/6.0E-6	1.1E-6/3.2E-6
Stream No. 27		
Arsenic	0/NA	6.9E-6/5.3E-5
Benzo(a)anthracene	4.5E-6/6.5E-4	4.6E-5/3.5E-4
Benzo(a)pyrene	8.1E-5/1.2E-2	8.4E-4/6.4E-3
Benzo(b)fluoranthene	1.1E-5/1.6E-3	1.1E-4/8.4E-4
Benzo(k)fluoranthene	1.1E-6/1.6E-4	1.1E-5/8.4E-5

Table 12. Summary of Pollutants Projected to Cause Human Health Impacts for Iron and Steel Direct Dischargers (All Subcategories)
(Fish Tissue Consumption) (Continued)
(Sample Set)

	Cancer Risks $>10^{-6}$/ Excess Annual Cancer Cases Sport Anglers	Cancer Risks $>10^{-6}$/ Excess Annual Cancer Cases Subsistence Anglers
Stream No. 28		
Arsenic	0/NA	1.6E-6/3.5E-6
Benzo(a)anthracene	7.5E-6/3.1E-4	7.7E-5/1.6E-4
Benzo(a)pyrene	1.4E-4/5.5E-3	1.4E-3/3.0E-3
Benzo(b)fluoranthene	1.4E-5/5.9E-4	1.5E-4/3.2E-4
Benzo(k)fluoranthene	1.4E-6/5.5E-5	1.4E-5/3.0E-5

NOTE: Number of streams evaluated = 77, number of facilities = 103, and number of pollutants = 60. Table presents results for those streams/facilities for which the projected excess cancer risk exceeds 10^{-6} (1E-6). Primary chemicals contributing to the excess cancer risk are included in summary, even if cancer risk did not exceed 10^{-6} (1E-6).
Pollutants detected at or below minimum level were assumed to be present at the minimum level.

* **BAT**3 for cokemaking subcategory; **BAT**1 for other subcategories. Projected cancer risks/cases calculated assuming effluent pollutant concentrations at **proposed BAT** are equal to effluent pollutant concentrations at **current** for those pollutants and sites/subcategories where pollutants were never detected above minimum level. Also, projected cancer risks/cases calculated assuming effluent pollutant concentrations at **proposed BAT** are equal to effluent pollutant concentrations at **current** for select pollutants and sites/subcategories where there is a projected reduction in flow, but not a projected reduction in load (i.e., loads used in the cost-effectiveness analysis).

NA = Not Applicable

May 16, 2000, Loading Files; September 19, 2000, Loading File for Cokemaking Subcategory.

Table 13. Summary of Potential Systemic Human Health Impacts for Iron and Steel Direct Dischargers (All Subcategories) (Fish Tissue and Drinking Water Consumption) (Sample Set)

	Fish Tissue Hazard Indices > 1	Drinking Water Hazard Indices >1
Current		
Streams (No.)	3	0***
Pollutants (No.)	2*	0
General Population	NA	0
Sport Anglers	0	0
Subsistence Anglers	3 (1.6 - 5.3)	0
Affected Population	868	
Proposed BAT**		
Streams (No.)	0	0***
Pollutants (No.)	0	0
General Population	NA	0
Sport Anglers	0	0
Subsistence Anglers	0	0

NOTE: Number of streams evaluated = 77, number of facilities = 103, and number of pollutants = 60.
Table presents results for those streams/facilities for which the projected hazard indices exceed 1.0. [See footnote *** below.]
Pollutants detected at or below minimum level were assumed to be present at the minimum level.
NA = Not Applicable

* Thallium and Copper

** **BAT3** for cokemaking subcategory; **BAT1** for other subcategories. Projected hazard indices calculated assuming effluent pollutant concentrations at **proposed BAT** are equal to effluent pollutant concentrations at **current** for those pollutants and sites/subcategories where pollutants were never detected above minimum level. Also, projected hazard indices calculated assuming effluent pollutant concentrations at **proposed BAT** are equal to effluent pollutant concentrations at **current** for select pollutants and sites/subcategories where there is a projected reduction in flow, but not a projected reduction in load (i.e., loads used in the cost-effectiveness analysis).

*** Total hazard indices exceed 1.0 at 7 streams at **current** and at 3 streams at **proposed BAT**. However, at all of these streams, one or more of the following modifying factors negate the concern: pollutants' critical effects and target organs differ, no drinking water utilities are located within 50 miles downstream, or drinking water treatment systems are assumed to reduce concentrations below adverse effect thresholds.

May 16, 2000, Loading File; September 19, 2000, Loading File for Cokemaking Subcategory.

Table 14. Summary of Potential Lead-Related Human Health Impacts for Iron and Steel Direct Dischargers
(All Subcategories) (Fish Tissue Consumption)
(Sample Set)

Health Effect	Improved Streams (No.)	Exposed Populations			Reduced Cases/ IQ Points	Total Annual Benefit ($ 1997)
		Gender	Age Group	Size		
Premature Mortality	55	Men	40-54 55-64 65-74	112,000 43,000 36,000	0.0250 0.0034 0.0017	$60,000 - $315,000 $8,200 - $43,000 $4,100 - $21,000
	55	Women	45-74	163,000	0.00098	$2,400 - $12,000
	55	Both	Neonates	17,000	0.0035	$8,400 - $44,000
Subtotal					0.035	**$83,000 - $435,000**
IQ Changes	39	Both	0-6	15,000	55.83	$542,000 - $542,000
Total Benefits						$625,000 - $977,000

Note: Number of streams evaluated = 77 and number of facilities = 103.

May 16, 2000, Loading Files; September 19, 2000, Loading File for Cokemaking Subcategory.

(b) National Extrapolation

The analysis extrapolates the sample set data to the national level using the statistical methodology used for estimating costs, loads, and economic impacts. The analysis extrapolates values from the sample set of 103 iron and steel facilities directly discharging 60 pollutants to 77 receiving streams to 131 iron and steel facilities discharging 60 pollutants to 100 receiving streams.

Fish Tissue (Carcinogenic and Systemic) -- At **current** discharge levels, 31 receiving streams have total estimated individual-pollutant cancer risks greater than 10^{-6} (1E-6) due to the discharge of 7 carcinogens (Table 16). The analysis projects total estimated risks greater than 10^{-6} (1E-6) for **sport anglers** and **subsistence anglers**. At **current** discharge levels, total excess annual cancer cases are estimated at 3.1E-1 (Table 16). At **proposed BAT** discharge levels, 24 receiving streams have total estimated individual-pollutant cancer risks greater than 10^{-6} (1E-6) due to the discharge of 7 carcinogens. The analysis again projects total estimated risks greater than 10^{-6} (1E-6) for **sport anglers** and **subsistence anglers**. Total excess annual cancer cases will be reduced to 2.9E-1 at **proposed BAT** discharge levels (Table 16). Based on the reduction of total excess cancer cases (2.0E-2), the monetary value of benefits to society from avoided cancer cases ranges from $48,000 to $252,000 (1997 dollars). In addition, the analysis projects that the systemic toxicant effects (hazard index greater than 1.0) at 3 receiving streams for 874 subsistence anglers and their families will be eliminated at **proposed BAT** discharge levels (Table 17).

Table 15. Summary of Potential Human Health Impacts for Iron and Steel Direct Dischargers (All Subcategories) (Drinking Water Consumption) (Sample Set)

	Total Individual Cancer Risks > 10^{-6}	Total Excess Annual Cancer Cases
<u>Current</u>		
Streams (No.)	22	NA
Carcinogens (No.)	6** (1.1E-6 to 8.7E-5)	NA
With Drinking Water Utility # 50 miles	3	NA
Carcinogens (No.)	2*** (1.2E-6 to 5.0E-6)	0
<u>Proposed BAT</u>*		
Streams	14	NA
Carcinogens (No.)	6** (1.3E-6 to 7.8E-5)	NA
With Drinking Water Utility # 50 miles	1	NA
Carcinogens (No.)	2*** (2.6E-6)	0

NOTE: Number of streams evaluated = 77, number of facilities = 103, and number of pollutants = 60. Table presents results for those streams/facilities for which the projected excess cancer risk for any pollutant exceeds 10^{-6} (1E-6). Primary chemicals contributing to the excess cancer risk are included in summary even if cancer risk did not exceed 10^{-6} (1E-6).

Pollutants detected at or below minimum level were assumed to be present at the minimum level.

* **BAT3** for cokemaking subcategory; **BAT1** for other subcategories. Projected cancer risks/cases calculated assuming effluent pollutant concentrations at **<u>proposed BAT</u>** are equal to effluent pollutant concentrations at **<u>current</u>** for those pollutants and sites/subcategories where pollutants were never detected above minimum level. Also, projected cancer risks/cases calculated assuming effluent pollutant concentrations at **<u>proposed BAT</u>** are equal to effluent pollutant concentrations at **<u>current</u>** for select pollutants and sites/subcategories where there is a projected reduction in flow, but not a projected reduction in load (i.e., loads used in the cost-effectiveness analysis).

** Arsenic, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, o-Toluidine, and Bis(2-ethylhexyl)phthalate.

*** Arsenic and Benzo(a)pyrene. EPA has published a drinking water standard for the 2 carcinogens and it is assumed that drinking water treatment systems will reduce concentrations below adverse effect thresholds.

May 16, 2000, Loading Files; September 19, 2000, Loading File for Cokemaking Subcategory.

Table 16. Summary of Potential Human Health Impacts for Iron and Steel Direct Dischargers (All Subcategories) (Fish Tissue Consumption) (National Level)

	Total Individual Cancer Risks > 10^{-6}	Total Excess Annual Cancer Cases
Current		
Streams (No.)	31	NA/NA
Carcinogens (No.)	7	NA
Sport Anglers	19 (1.3E-6 to 4.6E-3)	2.0E-1
Subsistence Anglers	31 (2.9E-6 to 4.7E-2)	1.1E-1
TOTAL		**3.1E-1**
Proposed BAT*		
Streams (No.)	24	NA/NA
Carcinogens (No.)	7	NA
Sport Anglers	16 (1.2E-6 to 4.4E-3)	1.9E-1
Subsistence Anglers	24 (1.2E-6 to 4.4E-2)	1.0E-1
TOTAL		**2.9E-1**

NOTE: Number of streams evaluated = 100, number of facilities = 131, and number of pollutants = 60.
Table presents results for those streams/facilities for which the projected excess cancer risk exceeds 10^{-6} (1E-6).
Primary chemicals contributing to the excess cancer risk are included in summary even if cancer risk did not exceed 10^{-6} (1E-6).
Pollutants detected at or below minimum level were assumed to be present at the minimum level.

NA = Not Applicable

* **BAT3** for cokemaking subcategory; **BAT1** for other subcategories. Projected cancer risks/cases calculated assuming effluent pollutant concentrations at **proposed BAT** are equal to effluent pollutant concentrations at **current** for those pollutants and sites/subcategories where pollutants were never detected above minimum level. Also, projected cancer risks/cases calculated assuming effluent pollutant concentrations at **proposed BAT** are equal to effluent pollutant concentrations at **current** for select pollutants and sites/subcategories where there is a projected reduction in flow, but not a projected reduction in load (i.e., loads used in the cost-effectiveness analysis).

May 16, 2000, Loading Files; September 19, 2000, Loading File for Cokemaking Subcategory.

Fish Tissue (Lead) -- At the **proposed BAT** discharge levels, the ingestion of lead-contaminated fish tissue by children (ages 0-6) of sport and subsistence anglers is reduced at 46 receiving streams (Table 18). The analysis projects a potentially exposed population of 17,000 children. Based on the annual reduction of total IQ loss (57.26 points), the monetary value of benefits to society from avoided loss of IQ points is $556,000 (1997 dollars) (Table 18). Additionally, the ingestion of lead-contaminated fish tissue by adult sport and subsistence anglers is reduced at 68 receiving streams (Table 18). The analysis projects that the proposed guidelines will reduce premature mortality by an estimated 3.1E-2 cases annually for 200,000 men (ages 40-74), 1.0E-3 cases annually for 170,000 women (ages 45-74), and 3.6E-3 cases annually for 18,000 neonates. Based on the reductions in blood pressure, as it relates to premature mortality, the total annual monetary benefits to society from avoided mortality ranges from $86,000 to $451,000 (1997 dollars) (Table 18).

Drinking Water -- At **current** discharge levels, 27 receiving streams have total estimated individual-pollutant cancer risks greater than 10^{-6} (1E-6) due to the discharge of 6 carcinogens (Table 19). Drinking water utilities are located within 50 miles downstream of 5 sites that discharge 2 carcinogens with risks greater than 10^{-6} (1E-6). However, EPA has published a drinking water standard for the 2 carcinogens and the analysis assumes that drinking water treatment systems will reduce concentrations to below adverse effect thresholds. Therefore, the analysis projects no total excess cancer cases. In addition, the analysis projects no systemic toxicant effects (hazard index greater than 1.0) at **current** or **proposed BAT** discharge levels (Table 17).

Table 17. Summary of Potential Systemic Human Health Impacts for Iron and Steel Direct Dischargers (All Subcategories) (Fish Tissue and Drinking Water Consumption) (National Level)

	Fish Tissue Hazard Indices > 1	Drinking Water Hazard Indices >1
Current		
Streams (No.)	3	0***
Pollutants (No.)	2*	0
General Population	N/A	0
Sport Anglers	0	0
Subsistence Anglers	3 (1.6 - 5.3)	0
Affected Population	874	
Proposed BAT**		
Streams (No.)	0	0***
Pollutants (No.)	0	0
General Population	N/A	0
Sport Anglers	0	0
Subsistence Anglers	0	0

NOTE: Number of streams evaluated = 100, number of facilities = 131, and number of pollutants = 60.
Table presents results for those streams/facilities for which the projected hazard indices exceed 1.0. [See footnote *** below.]
Pollutants detected at or below minimum level were assumed to be present at the minimum level.

* Thallium and Copper

** **BAT3** for cokemaking subcategory; **BAT** for other subcategories. Projected hazard indices calculated assuming effluent pollutant concentrations at **proposed BAT** are equal to effluent pollutant concentrations at **current** for those pollutants and sites/subcategories where pollutants were never detected above minimum level. Also, projected hazard indices calculated assuming effluent pollutant concentrations at **proposed BAT** are equal to effluent pollutant concentrations at **current** for select pollutants and sites/subcategories where there is a projected reduction in flow, but not a projected reduction in load (i.e., loads used in the cost-effectiveness analysis).

*** Total hazard indices exceed 1.0 at 7 streams at **current** and at 3 streams at **proposed BAT**. However, at all of these streams, one or more of the following modifying factors negate the concern: pollutants' critical effects and target organs differ, no drinking water utilities are located within 50 miles downstream, or drinking water treatment systems are assumed to reduce concentrations below adverse effect thresholds.

May 16, 2000, Loading Files; September 19, 2000, Loading File for Cokemaking Subcategory.

Table 18. Summary of Potential Lead-Related Human Health Impacts for Iron and Steel Direct Dischargers
(All Subcategories) (Fish Tissue Consumption)
(National Level)

Health Effect	Improved Streams (No.)	Exposed Populations			Reduced Cases/ IQ Points	Total Annual Benefits ($ 1997)
		Gender	Age Group	Size		
Premature Mortality	68	Men	40-54 55-64 65-74	117,000 46,000 37,000	0.026 0.0035 0.0017	$62,000 - $328,000 $8,400 - $44,000 $4,100 - $21,000
	68	Women	45-74	170,000	0.0010	$2,400 - $13,000
	68	Both	Neonates	18,000	0.0036	$8,600 - $45,000
Subtotal					**0.036**	**$86,000 - $451,000**
IQ Changes	46	Both	0-6	17,000	57.26	$556,000 - $556,000
Total Benefits						**$642,000 - $1,007,000**

Note: Number of streams evaluated = 100, and number of facilities = 131.

May 16, 2000, Loading Files; September 19, 2000, Loading File for Cokemaking Subcategory.

Table 19. Summary of Potential Human Health Impacts for Iron and Steel
Direct Dischargers (All Subcategories) (Drinking Water Consumption)
(National Level)

	Total Individual Cancer Risks > 10^{-6}	Total Excess Annual Cancer Cases
Current		
Streams (No.)	27	NA
Carcinogens (No.)	6** (1.1E-6 to 8.7E-5)	NA
With Drinking Water Utility # 50 miles	5	NA
Carcinogens (No.)	2*** (1.2E-6 to 5.0E-6)	0
Proposed BAT*		
Streams	15	NA
Carcinogens (No.)	6** (1.3E-6 to 7.8E-5)	NA
With Drinking Water Utility # 50 miles	1	NA
Carcinogens (No.)	2*** (2.6E-6)	0

NOTE: Number of streams evaluated = 100, number of facilities = 131, and number of pollutants = 60.
Table presents results for those streams/facilities for which the projected excess cancer risk for any pollutant exceeds 10^{-6} (1E-6).
Primary chemicals contributing to the excess cancer risk are included in summary even if cancer risk did not exceed 10^{-6} (1E-6).
Pollutants detected at or below minimum level were assumed to be present at the minimum level.

* **BAT3** for cokemaking subcategory; **BAT1** for other subcategories. Projected cancer risks/cases calculated assuming effluent pollutant concentrations at **proposed BAT** are equal to effluent pollutant concentrations at **current** for those pollutants and sites/subcategories where pollutants were never detected above minimum level. Also, projected cancer risks/cases calculated assuming effluent pollutant concentrations at **proposed BAT** are equal to effluent pollutant concentrations at **current** for select pollutants and sites/subcategories where there is a projected reduction in flow, but not a projected reduction in load (i.e., loads used in the cost-effectiveness analysis).

** Arsenic, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, o-Toluidine, and Bis(2-ethylhexyl)phthalate.

*** Arsenic and Benzo(a)pyrene. EPA has published a drinking water standard for the 2 carcinogens and it is assumed that drinking water treatment systems will reduce concentrations below adverse effect thresholds.

May 16, 2000, Loading Files; September 19, 2000, Loading File for Cokemaking Subcategory.

4.1.2.2 *Indirect Discharging Facilities*

(a) Sample Set

The analysis evaluates the effects of POTW wastewater discharges on human health from the consumption of fish tissue and drinking water at **current** and **proposed PSES** discharge levels for 47 iron and steel facilities discharging 56 pollutants to 43 POTWs with outfalls on 43 receiving streams.

Fish Tissue (Carcinogenic and Systemic) -- At **current** discharge levels, 4 receiving streams have total estimated individual-pollutant cancer risks greater than 10^{-6} (1E-6) due to the discharge of 3 carcinogens (Tables 20 and 21). The analysis projects total estimated risks greater than 10^{-6} (1E-6) for only **subsistence anglers**. At **current** discharge levels, total excess annual cancer cases are estimated to be 6.0E-5 (Table 20). At **proposed PSES** discharge levels, the 4 receiving streams have total estimated individual-pollutant cancer risks greater than 10^{-6} (1E-6) due to the discharge of 2 carcinogens (Tables 20 and 21). The analysis again projects total estimated risks greater than 10^{-6} (1E-6) for only **subsistence anglers**. Total excess annual cancer cases will be reduced to 5.7E-5 at **proposed PSES** levels (Table 20). Based on the reduction of total excess cancer cases (3.0E-6), the monetary value of benefits to society from avoided cancer cases is less than $100 (1997 dollars). In addition, the analysis projects no systemic toxicant effects (hazard index greater than 1.0) at **current** or **proposed PSES** discharge levels (Table 22).

Fish Tissue (Lead) -- At the **proposed PSES** discharge levels, the ingestion of lead-contaminated fish tissue by children (ages 0-6) of sport and subsistence anglers is reduced at 4 receiving streams (Table 23). The analysis projects a potentially exposed population of 800 children. Based on the annual reduction of total IQ loss (0.026 points) the monetary value of benefits to society from avoided loss of IQ points is $250 (1997 dollars) (Table 23). Additionally, the ingestion of lead-contaminated fish tissue by adult sport and subsistence anglers is reduced at 24 receiving streams (Table 23). The analysis projects that the proposed guidelines will reduce premature mortality by an estimated 3.1E-5 cases annually for 181,000

Table 20. Summary of Potential Human Health Impacts for Iron and Steel Indirect Dischargers (All Subcategories) (Fish Tissue Consumption) (Sample Set)

	Total Individual Cancer Risks > 10^{-6}	Total Excess Annual Cancer Cases
Current		
Streams (No.)	4	NA/NA
Carcinogens (No.)	3	NA
Sport Anglers	0	NA
Subsistence Anglers	4 (1.9E-6 to 4.7E-6)	6.0E-5
TOTAL		**6.0E-5**
Proposed PSES *		
Streams (No.)	4	NA/NA
Carcinogens (No.)	2	NA
Sport Anglers	0	NA
Subsistence Anglers	4 (1.9E-6 to 4.3E-6)	5.7E-5
TOTAL		**5.7E-5**

NOTE: Number of streams evaluated = 43, number of POTWs = 43, number of facilities = 47, and number of pollutants = 56.
Table presents results for those streams/facilities for which the projected excess cancer risk exceeds 10^{-6} (1E-6).
Primary chemicals contributing to the excess cancer risk are included in summary even if cancer risk did not exceed 10^{-6} (1E-6).
Pollutants detected at or below minimum level were assumed to be present at the minimum level.

NA = Not Applicable
* **PSES1** for all subcategories.

May 16, 2000, Loading Files.

Table 21. Summary of Pollutants Projected to Cause Human Health Impacts for Iron and Steel Indirect Dischargers (All Subcategories)
(Fish Tissue Consumption)
(Sample Set)

	Cancer Risks $>10^{-6}$/ Excess Annual Cancer Cases Sport Anglers	Cancer Risks $>10^{-6}$/ Excess Annual Cancer Cases Subsistence Anglers
Current:		
Stream No. 1		
Benzo(a)pyrene	0/NA	1.6E-6/3.4E-6
Benzo(b)fluoranthene	0/NA	2.9E-7/6.3E-7
Stream No. 2		
Benzo(a)pyrene	0/NA	3.2E-6/7.6E-6
Benzo(b)fluoranthene	0/NA	5.9E-7/1.4E-6
Stream No. 3		
Benzo(a)pyrene	0/NA	2.5E-6/8.9E-6
Benzo(b)fluoranthene	0/NA	4.6E-7/1.6E-6
Stream No. 4		
Arsenic	0/NA	4.2E-7/3.2E-6
Benzo(a)pyrene	0/NA	3.6E-6/2.8E-5
Benzo(b)fluoranthene	0/NA	6.6E-7/5.1E-6
Proposed PSES*:		
Stream No. 1		
Benzo(a)pyrene	0/NA	1.6E-6/3.4E-6
Benzo(b)fluoranthene	0/NA	2.9E-7/6.3E-7
Stream No. 2		
Benzo(a)pyrene	0/NA	3.2E-6/7.6E-6
Benzo(b)fluoranthene	0/NA	5.9E-7/1.4E-6
Stream No. 3		
Benzo(a)pyrene	0/NA	2.5E-6/8.9E-6
Benzo(b)fluoranthene	0/NA	4.6E-7/1.6E-6
Stream No. 4		
Benzo(a)pyrene	0/NA	3.6E-6/2.8E-5
Benzo(b)fluoranthene	0/NA	6.6E-7/5.1E-6

NOTE: Number of streams evaluated = 43, number of POTWs = 43, number of facilities = 47, and number of pollutants = 56. Table presents results for those streams/facilities for which the projected excess cancer risk exceeds 10^{-6} (1E-6). Primary chemicals contributing to the excess cancer risk are included in summary, even if cancer risk did not exceed 10^{-6} (1E-6).
Pollutants detected at or below minimum level were assumed to be present at the minimum level.

NA = Not Applicable

* **PSES1** for all subcategories.

May 16, 2000, Loading Files.

Table 22. Summary of Potential Systemic Human Health Impacts for Iron and Steel Indirect Dischargers (All Subcategories) (Fish Tissue and Drinking Water Consumption) (Sample Set)

	Fish Tissue Hazard Indices > 1	Drinking Water Hazard Indices >1
Current		
Streams (No.)	0	0
Pollutants (No.)	0	0
General Population	NA	0
Sport Anglers	0	0
Subsistence Anglers	0	0
Proposed PSES *		
Streams (No.)	0	
Pollutants (No.)	0	0
General Population	NA	0
Sport Anglers	0	0
Subsistence Anglers	0	0
		0

NOTE: Number of streams evaluated = 43, number of POTWs = 43, number of facilities = 47, and number of pollutants = 56.
Table presents results for those streams/facilities for which the projected hazard indices exceed 1.0.
Pollutants detected at or below minimum level were assumed to be present at the minimum level.

NA = Not Applicable
* **PSES1** for all subcategories.

May 16, 2000, Loading Files.

men (ages 40-74), estimated 3.1E-5 cases annually for 181,000 men (ages 40-74), 1.0E-6 cases annually for 155,000 women (ages 45-74), and 3.4E-6 cases annually for 16,000 neonates. Based on the reductions in blood pressure, as it relates to premature mortality, the total annual monetary benefits to society from avoided mortality range from $85 to $450 (1997 dollars) (Table 23).

Drinking Water -- At **current** and **proposed PSES** discharge levels, the analysis projects that no receiving streams will have total estimated individual-pollutant cancer risks greater than 10^{-6} (1E-6) (Table 24).

(b) National Extrapolation

The analysis extrapolates the sample set data to the national level using the statistical methodology for estimating costs, loads, and economic impacts. Extrapolated values are based on the sample set of 47 iron and steel facilities discharging 56 pollutants to 43 POTWs with outfalls on 43 receiving streams. The analysis extrapolates these values to 67 iron and steel facilities discharging 56 pollutants to 61 POTWs located on 61 receiving streams.

Fish Tissue (Carcinogenic and Systemic) -- At **current** discharge levels, 4 receiving streams have total estimated individual-pollutant cancer risks greater than 10^{-6} (1E-6) due to the discharge of 3 carcinogens (Table 25). The analysis projects total estimated risks greater than 10^{-6} (1E-6) for only **subsistence anglers**. At **current** discharge levels, total excess annual cancer cases are estimated to be 6.0E-5 (Table 25). At **proposed PSES** discharge levels, the 4 receiving streams have total estimated individual-pollutant cancer risks greater than 10^{-6} (1E-6) due to the discharge of 2 carcinogens (Table 25). The analysis again projects total estimated risks greater than 10^{-6} (1E-6) for only **subsistence anglers**. Total excess annual cancer cases will be reduced to 5.7E-5 at **proposed PSES** discharge levels (Table 25). Based on the reduction of total excess cancer cases (3.0E-6), the monetary value of benefits

Table 23. Summary of Potential Lead-Related Human Health Impacts for Iron and Steel Indirect Dischargers (All Subcategories) (Fish Tissue Consumption) (Sample Set)

Health Effect	**Improved Streams (No.)**	**Exposed Populations**			**Reduced Cases/ IQ Points**	**Total Annual Benefits ($ 1997)**
		Gender	**Age Group**	**Size**		
Premature Mortality	24	Men	40-54 55-64 65-74	106,000 41,000 34,000	0.000026 0.0000036 0.0000018	$60 - $330 $10 - $45 $5 - $20
	24	Women	45-74	155,000	0.0000010	$0 - $10
	24	Both	Neonates	16,000	0.0000034	$10 - $45
Subtotal					**0.000036**	**$85 - $450**
IQ Changes	4	Both	0-6	800	0.026	$250 - $250
Total Benefits						**$340 - $700**

Note: Number of streams evaluated = 43, and number of facilities = 47.

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Table 24. Summary of Potential Human Health Impacts for Iron and Steel Indirect Dischargers (All Subcategories) (Drinking Water Consumption) (Sample Set)

	Total Individual Cancer Risks > 10^{-6}	Total Excess Annual Cancer Cases
<u>Current</u>		
Streams (No.)	0	NA
Carcinogens (No.)	0	NA
With Drinking Water Utility # 50 miles	0	NA
Carcinogens (No.)	0	NA
<u>Proposed PSES</u> *		
Streams	0	NA
Carcinogens (No.)	0	NA
With Drinking Water Utility # 50 miles	0	NA
Carcinogens (No.)	0	NA

NOTE: Number of streams evaluated = 43, number of POTWs = 43, number of facilities = 47, and number of pollutants = 56.
Table presents results for those streams/facilities for which the projected excess cancer risk for any pollutant exceeds 10^{-6} (1E-6).
Primary chemicals contributing to the excess cancer risk are included in summary even if cancer risk did not exceed 10^{-6} (1E-6).
Pollutants detected at or below minimum level were assumed to be present at the minimum level.

NA = Not Applicable
* **PSES1** for all subcategories.

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Table 25. Summary of Potential Human Health Impacts for Iron and Steel Indirect Dischargers (All Subcategories) (Fish Tissue Consumption) (National Level)

	Total Individual Cancer Risks > 10^{-6}	Total Excess Annual Cancer Cases
Current		
Streams (No.)	4	NA/NA
Carcinogens (No.)	3	NA
Sport Anglers	0	NA
Subsistence Anglers	4 (1.9E-6 to 4.7E-6)	6.0E-5
TOTAL		**6.0E-5**
Proposed PSES *		
Streams (No.)	4	NA/NA
Carcinogens (No.)	2	NA
Sport Anglers	0	NA
Subsistence Anglers	4 (1.9E-6 to 4.3E-6)	5.7E-5
TOTAL		**5.7E-5**

NOTE: Number of streams evaluated = 61, number of POTWs = 61, number of facilities = 67, and number of pollutants = 56.
Table presents results for those streams/facilities for which the projected excess cancer risk exceeds 10^{-6} (1E-6).
Primary chemicals contributing to the excess cancer risk are included in summary even if cancer risk did not exceed 10^{-6} (1E-6).
Pollutants detected at or below minimum level were assumed to be present at the minimum level.

NA = Not Applicable
* **PSES1** for all subcategories.

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to society from avoided cancer cases is less than $100 (1997 dollars). In addition, the analysis projects no systemic toxicant effects (hazard index greater than 1.0) at **current** or **proposed PSES** discharge levels (Table 26).

Fish Tissue (Lead) – At the **proposed PSES** discharge levels, the ingestion of lead-contaminated fish tissue by children (ages 0-6) of sport and subsistence anglers is reduced at 5 receiving streams (Table 27). The analysis projects a potentially exposed population of 1,000 children. Based on the annual reduction of total IQ loss (0.030 points), the monetary value of benefits to society from avoided loss of IQ points is $290 (1997 dollars) (Table 27). Additionally, the ingestion of lead contaminated fish tissue by adult sport and subsistence anglers is reduced at 37 receiving streams (Table 27). The analysis projects that the proposed guidelines will reduce premature mortality by an estimated 3.6E-5 cases annually for 280,000 men (ages 40-74), 1.2E-6 cases annually for 238,000 women (ages 45-74), and 3.9E-6 cases annually for 24,000 neonates. Based on the reductions in blood pressure, as it relates to premature mortality, the total annual monetary benefits to society from avoided mortality range from $100 to $520 (1997 dollars) (Table 27).

Drinking Water -- At **current** and **proposed PSES** discharge levels, the analysis projects that no receiving streams will have total estimated individual-pollutant cancer risks greater than 10^{-6} (1E-6) (Table 28).

4.1.3 Estimation of Ecological Benefits

The analysis evaluates the potential ecological benefits of the proposed regulation by estimating improvements in the recreational fishing habitats that are adversely impacted by direct and indirect iron and steel wastewater discharges. Impacts include acute and chronic toxicity, sublethal effects on metabolic and reproductive functions, physical destruction of spawning and feeding habitats, and loss of prey organisms.

Table 26. Summary of Potential Systemic Human Health Impacts for Iron and Steel Indirect Dischargers (All Subcategories) (Fish Tissue and Drinking Water Consumption) (National Level)

	Fish Tissue Hazard Indices > 1	Drinking Water Hazard Indices >1
Current		
Streams (No.)	0	0
Pollutants (No.)	0	0
General Population	NA	0
Sport Anglers	0	0
Subsistence Anglers	0	0
Proposed PSES *		
Streams (No.)	0	0
Pollutants (No.)	0	0
General Population	NA	0
Sport Anglers	0	0
Subsistence Anglers	0	0

NOTE: Number of streams evaluated = 61, number of POTWs = 61, number of facilities = 67, and number of pollutants = 56.
Table presents results for those streams/facilities for which the projected hazard indices exceed 1.0.
Pollutants detected at or below minimum level were assumed to be present at the minimum level.

NA = Not Applicable
* **PSES1** for all subcategories.

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Table 27. Summary of Potential Lead-Related Human Health Impacts for Iron and Steel Indirect Dischargers (All Subcategories) (Fish Tissue Consumption) (National Level)

Health Effect	Improved Streams (No.)	Exposed Populations			Reduced Cases/ IQ Points	Total Annual Benefits ($ 1997)
		Gender	Age Group	Size		
Premature Mortality	37	Men	40-54 55-64 65-74	164,000 64,000 52,000	0.00003 0.0000041 0.0000020	$70 - $380 $10 - $50 $5 - $25
	37	Women	45-74	238,000	0.0000012	$5 - $15
	37	Both	Neonates	24,000	0.0000039	$10 - $50
Subtotal					**0.000041**	**$100 - $520**
IQ Changes	5	Both	0-6	1,000	0.030	$290 - $290
Total Benefits						**$400 - $800**

Note: Number of streams evaluated = 61, and number of facilities = 67.

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Table 28. Summary of Potential Human Health Impacts for Iron and Steel Indirect Dischargers (All Subcategories) (Drinking Water Consumption) (National Level)

	Total Individual Cancer Risks > 10^{-6}	Total Excess Annual Cancer Cases
<u>Current</u>		
Streams (No.)	0	NA
Carcinogens (No.)	0	NA
With Drinking Water Utility # 50 miles	0	NA
Carcinogens (No.)	0	NA
<u>Proposed PSES</u> *		
Streams	0	NA
Carcinogens (No.)	0	NA
With Drinking Water Utility # 50 miles	0	NA
Carcinogens (No.)	0	NA

NOTE: Number of streams evaluated = 61, number of POTWs = 61, number of facilities = 67, and number of pollutants = 56.
Table presents results for those streams/facilities for which the projected excess cancer risk for any pollutant exceeds 10^{-6} (1E-6).
Primary chemicals contributing to the excess cancer risk are included in summary even if cancer risk did not exceed 10^{-6} (1E-6).
Pollutants detected at or below minimum level were assumed to be present at the minimum level.

NA = Not Applicable
* **PSES1** for all subcategories.

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These effects will vary because of the diversity of species with differing sensitivities. For example, lead exposure can cause spinal deformities in rainbow trout. Copper exposure can affect the growth activity of algae. In addition, copper and cadmium can be acutely toxic to aquatic life, including finfish. The following sections summarize the potential monetary benefits for direct and indirect iron and steel discharges, as well as additional benefits that are not monetized.

4.1.3.1 *Direct Discharging Facilities*

(a) Sample Set

The analysis evaluates the effects of direct wastewater discharges on aquatic habitats at **current** and **proposed BAT** discharge levels for 103 iron and steel facilities discharging 60 pollutants to 77 receiving streams (Tables 1 and 3). The analysis projects that the final regulation will completely eliminate instream concentrations in excess of AWQC at 2 receiving streams (Table 3). The analysis estimates the monetary value of improved recreational fishing opportunities by first calculating the baseline value of the benefitting stream segment (Table 29). From the estimated total of 30,423 person-days fished on the 2 stream segments and the value per person-day of recreational fishing ($31.68 to $40.12, 1997 dollars), the analysis estimates a baseline value of $964,000 to $1,221,000 for the 2 stream segments (Table 29). The value of improving water quality in these fisheries is then calculated on the basis of the increase in value (11.1 percent to 31.3 percent) to anglers of achieving a contaminant-free fishing stream (Lyke, 1993). The resulting estimate of the increase in value of recreational fishing to anglers ranges from $107,000 to $382,000 (1997 dollars) (Table 29). In addition, the estimate of the nonuse (intrinsic) benefits to the general public, as a result of the same improvements in water quality, ranges from $53,500 to $191,000 (1997 dollars) (Table 29). The analysis estimates these nonuse benefits as one-half of the recreational benefits, which may be significantly underestimating them.

Table 29. Summary of Ecological (Recreational and Nonuse) Benefits for Iron and Steel Direct Dischargers (All Subcategories) (Sample Set and National Level)

Data	Number of Stream Segments with Concentrations Exceeding AWQC Eliminated	Total Fishing Days	Baseline Value of Fisheries ($ 1997)	Increased Value of Fisheries ($ 1997)
Sample Set	2	30,423	$964,000 - $1,221,000	$107,000 - $382,000
National Level	2	30,947	$980,000 - $1,242,000	$109,000 - $389,000

NOTE: Value per person-day of recreational fishing = $31.68 (warm water) and $40.12 (cold water).

Increased value of contaminant-free fishing = 11.1 to 31.3 percent.

Data	Number of Stream Segments with Concentrations Exceeding AWQC Eliminated	Increased Nonuse Value ($ 1997)
Sample Set	2	$53,500 - $191,000
National Level	2	$54,500 - $194,500

NOTE: Nonuse value estimated as one-half of the recreational benefits.

(b) National Extrapolation

The analysis extrapolates the sample set data to the national level using the statistical methodology for estimating costs, loads, and economic impacts. The analysis extrapolates values from the sample set of 103 iron and steel facilities directly discharging 60 pollutants to 77 receiving streams (Tables 1 and 3) to 131 iron and steel facilities discharging 60 pollutants to 100 receiving streams (Tables 1 and 5).

The analysis projects the final regulation will completely eliminate instream pollutant concentrations in excess of AWQC at 2 receiving streams (Table 5). The analysis estimates the benefits to recreational (sport) anglers based on improved water quality and improved value of fishing opportunities. The resulting estimate of the increase in value of recreational fishing to anglers ranges from $109,000 to $389,000 (1997 dollars) (Table 29). In addition, the resulting increase in nonuse value to the general public ranges from $54,500 to $194,500 (1997 dollars) (Table 29).

4.1.3.2 ***Indirect Discharging Facilities***

(a) Sample Set

The analysis evaluates the effects of indirect wastewater discharges on aquatic habitats at **current** and **proposedPSES** discharge levels for 47 iron and steel facilities discharging 56 pollutants to 43 POTWs with outfalls located on 43 receiving streams (Tables 6 and 7). The analysis projects that the final regulation will completely eliminate instream concentrations in excess of AWQC at 1 receiving stream (Table 7). The analysis estimates the monetary value of improved recreational fishing opportunities by first calculating the baseline value of the benefitting stream segment (Table 30). From the estimated total of 22,923 person-days fished on the 1 stream segment and the value per person-day of recreational fishing ($31.68 and $40.12, 1997 dollars), the analysis estimates a baseline value of $726,000 to $920,000 for the 1 stream segment (Table 30). The value of improving water quality in this fishery is then calculated on the basis of

Table 30. Summary of Ecological (Recreational and Nonuse) Benefits for Iron and Steel Indirect Dischargers (All Subcategories) (Sample Set and National Level)

Data	Number of Stream Segments with Concentrations Exceeding AWQC Eliminated	Total Fishing Days	Baseline Value of Fisheries ($ 1994)	Increased Value of Fisheries ($ 1997)
Sample Set	1	22,923	$726,000 - $920,000	$81,000 - $288,000
National Level	2	40,556	$1,285,000 - $1,627,000	$143,000 - $509,000

NOTE: Value per person-day of recreational fishing = $31.68 (warm water) and $40.12 (cold water).

Increased value of contaminant-free fishing = 11.1 to 31.3 percent.

Data	Number of Stream Segments with Concentrations Exceeding AWQC Eliminated	Increased Nonuse Value ($ 1997)
Sample Set	1	$40,500 - $144,000
National Level	2	$71,500 - $254,500

NOTE: Nonuse value estimated as one-half of the recreational benefits.

the increase in value (11.1 percent to 31.3 percent) to anglers of achieving a contaminant-free fishing stream (Lyke, 1993). The resulting estimate of the increase in value of recreational fishing to anglers ranges from $81,000 to $288,000 (1997 dollars) (Table 30). In addition, the estimate of the nonuse (intrinsic) benefits to the general public, as a result of the same improvements in water quality, ranges from $40,500 to $144,000 (1997 dollars) (Table 30). The analysis estimates these nonuse benefits as one-half of the recreational benefits, which may be significantly underestimating them.

(b) National Extrapolation

The analysis extrapolates the sample set data to the national level using the statistical methodology for estimating costs, loads, and economic impacts. The analysis extrapolates values from the sample set of 47 indirect iron and steel facilities discharging 56 pollutants to 43 POTWs located on 43 receiving streams (Tables 6 and 7) to 67 indirect iron and steel facilities discharging 56 pollutants to 61 POTWs located on 61 receiving streams (Tables 6 and 10).

The analysis projects the final regulation will completely eliminate instream pollutant concentrations in excess of AWQC at 2 receiving streams (Table 10). The analysis estimates the benefits to recreational (sport) anglers based on improved water quality and improved value of fishing opportunities. The resulting estimate of the increase in value of recreational fishing to anglers ranges from $143,000 to $509,000 (1997 dollars) (Table 30). In addition, the resulting increase in nonuse value to the general public ranges from $71,500 to $254,500 (1997 dollars) (Table 30).

4.2 Pollutant Fate and Toxicity

Levels of human exposure, ecological exposure, and risk from environmental releases of toxic chemicals depend largely on toxic potency, intermedia partitioning, and chemical persistence. These exposure and risk factors depend on the chemical-specific properties of toxicological effects on living organisms, physical state, hydrophobicity/lipophilicity, and reactivity, as well as on the mechanism and media of release and site-specific environmental conditions.

Using available data on the physical-chemical properties, and aquatic life and human health toxicity data for the 70 direct discharge iron and steel pollutants of concern, the analysis determines the following: 23 pollutants exhibit moderate to high toxicity to aquatic life, 39 are human systemic toxicants, 16 are classified as known or probable carcinogens, 23 have drinking water values (15 with enforceable health-based maximum contaminant levels (MCLs), 6 with a secondary MCL, and 2 with an action level for treatment), and 28 are designated by EPA as priority pollutants (Tables 31, 32, and 33). In terms of projected environmental partitioning among media, 16 of the evaluated pollutants are moderately to highly volatile (potentially causing risk to exposed populations via inhalation), 25 have a moderate to high potential to bioaccumulate in aquatic biota (potentially accumulating in the food chain and causing increased risk to higher trophic level organisms and to exposed human populations via fish and shellfish consumption), 18 are moderately to highly adsorptive to solids, and 8 are resistant to biodegradation or are slowly biodegraded.

In addition, using available data on the physical-chemical properties, and aquatic life and human health toxicity data for the 66 indirect discharge iron and steel pollutants of concern, the analysis determines the following: 22 exhibit moderate to high toxicity to aquatic life, 38 are human systemic toxicants, 15 are classified as known or probable carcinogens, 23 have drinking water values (15 with enforceable health-based MCLs, 6 with a secondary MCL, and 2 with an action level for treatment), and 27 are designated by EPA as priority pollutants (Tables 34, 35, and 36). In terms of projected environmental partitioning among media, 16 of the pollutants are moderately to highly volatile, 22 have a moderate to high potential to bioaccumulate in aquatic biota, 16 are moderately to highly adsorptive to solids, and 8 are resistant to biodegradation or are slowly biodegraded.

4.3 Documented Environmental Impacts

The analysis reviews information received from reports, State 303(d) lists of impaired waterbodies, and State fishing advisories for documented impacts due to discharges from iron and steel facilities. States identified at least 17 impaired waterbodies, with industrial point sources as a potential source of impairment, that receive direct discharges from iron and steel facilities (and other sources). These waterbodies are included on the States' 303(d) prioritized lists of impaired waterbodies (Table 37). Section 303(d) of the Water Quality Act of 1987 requires States to identify waterbodies that do not meet state water quality standards and to develop a "total maximum daily load" or TMDL for each listed waterbody. A TMDL is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, which is then allocated to the pollutant's sources. States also have issued fish consumption advisories for 12 specific waterbodies that receive direct discharges from iron and steel facilities (and other sources) (Table 38). The advisories are for mercury, an iron and steel pollutant of concern. Over 25 fish consumption advisories were issued for waterbodies that receive wastewater discharges from iron and steel facilities. However, the vast majority of advisories are for chemicals that are not pollutants of concern. In addition, EPA's *Enforcement and Compliance Assurance, FY 98 Accomplishments Report* (U.S. EPA, 1999) identified significant noncompliance (SNC) rates (most egregious violations under each program or statute) for iron and steel facilities (Table 39). Of the 27 integrated mills inspected in fiscal years (FY) 1996 and 1997, 96 percent were out of compliance with one or more statutes, and 65 percent were in SNC. In FY 1998, of the 23 integrated mills inspected, 39.1 percent of the facilities were in SNC with their water permits, 72.7 percent with air violations, and 30.4 percent with RCRA violations. SNC rates for 91 mini-mills were 21.2 percent for air, 2.7 percent for water permits, and 4.5 percent for RCRA. Key compliance and environmental problems included groundwater contamination from slag disposal, contaminated sediments from steelmaking, electric arc furnace dust, unregulated sources, SNCs from recurring and single peak violations, and no baseline testing.

Table 31. Potential Fate and Toxicity of Pollutants of Concern (70) Discharged from 103 Direct Discharging Iron and Steel Facilities

No.	CAS Number	Name	Acute Aquatic Toxicity	Volatility from Water	Adsorption to Solids	Bioaccumulation Potential	Biodegra-dation Potential	Carcinogen	Systemic Toxicant	Drinking Water Value	Priority Pollutant
1	C002	BOD 5-day (carbonaceous)	Unknown	Unknown	Unknown	Unknown	Unknown				
2	C004	Chemical Oxygen Demand (COD)	Unknown	Unknown	Unknown	Unknown	Unknown				
3	C005	Nitrate/Nitrite (NO2 + NO3-N)	Unknown	Unknown	Unknown	Unknown	Unknown		X	M	
4	C009	Total Suspended Solids (TSS)	Unknown	Unknown	Unknown	Unknown	Unknown				
5	C012	Total Organic Carbon (TOC)	Unknown	Unknown	Unknown	Unknown	Unknown				
6	C020	Total Recoverable Phenolics	Unknown	Unknown	Unknown	Unknown	Unknown				
7	C021	Total Kjeldahl Nitrogen (TKN)	Unknown	Unknown	Unknown	Unknown	Unknown				
8	C025	Amenable Cyanide	Unknown	Unknown	Unknown	Unknown	Unknown				
9	C036	Hexane Extractable Material (HEM)	Unknown	Unknown	Unknown	Unknown	Unknown				
10	C037	Silica Gel Treated HEM (SGT-HEM)	Unknown	Unknown	Unknown	Unknown	Unknown				
11	C042	Weak Acid Dissociable Cyanide	Unknown	Unknown	Unknown	Unknown	Unknown				
12	50328	Benzo(a)pyrene	High	Slight	High	High	Resistant	X		M	X
13	56553	Benzo(a)anthracene	High	Slight	High	High	Resistant	X			X
14	57125	Total Cyanide	High	Unknown	Slight	Nonbioaccumulative	Moderate		X	M	X
15	62533	Aniline	Moderate	Slight	Slight	Slight	Moderate	X			
16	67641	Acetone	Slight	Moderate	Slight	Nonbioaccumulative	Fast		X		
17	71432	Benzene	Slight	High	Slight	Slight	Moderate	X	X	M	X
18	85018	Phenanthrene	Moderate	Moderate	High	Moderate	Resistant				X
19	91203	Naphthalene	Slight	Moderate	Slight	Slight	Moderate	X	X		X
20	91576	2-Methylnaphthalene	Slight	Moderate	Moderate	High	Moderate		X		
21	95487	o-Cresol	Slight	Slight	Slight	Slight	Fast	X	X		
22	95534	o-Toluidine	Moderate	Slight	Slight	Slight	Fast	X			
23	98555	alpha-Terpineol	Slight	Moderate	Slight	Slight	Moderate				
24	100027	4-Nitrophenol	Slight	Nonvolatile	Slight	Moderate	Fast		X		X
25	105679	2,4-Dimethylphenol	Slight	Slight	Slight	Moderate	Fast		X		X
26	106445	p-Cresol	Slight	Slight	Slight	Slight	Fast	X	X		
27	108952	Phenol	Slight	Slight	Slight	Nonbioaccumulative	Fast		X		X
28	110861	Pyridine	Slight	Slight	Nonadsorptive	Nonbioaccumulative	Fast		X		
29	112403	n-Dodecane *	Slight	Unknown	High	High	Moderate				
30	112958	n-Eicosane *	Slight	Unknown	High	High	Moderate				
31	117817	Bis(2-ethylhexyl) Phthalate	Unknown	Nonvolatile	High	Moderate	Moderate	X	X	M	X
32	124185	n-Decane	Slight	Unknown	High	High	Moderate				
33	129000	Pyrene	Moderate	Moderate	High	High	Resistant		X		X
34	132649	Dibenzofuran	Slight	Moderate	Moderate	High	Moderate		X		
35	142621	Hexanoic Acid	Slight	Moderate	Slight	Slight	Moderate				
36	205992	Benzo(b)fluoranthene	Unknown	Moderate	High	High	Resistant	X			X
37	206440	Fluoranthene	High	Moderate	High	High	Resistant		X		X
38	207089	Benzo(k)fluoranthene	Unknown	Moderate	High	High	Resistant	X			X
39	218019	Chrysene	Moderate	Moderate	High	High	Resistant	X			X
40	302045	Thiocyanate	Moderate	Unknown	Unknown	Unknown	Unknown				
41	544763	n-Hexadecane *	Slight	Unknown	High	High	Moderate				
42	593453	n-Octadecane *	Slight	Unknown	High	High	Moderate				
43	612942	2-Phenylnaphthalene	Moderate	Moderate	High	High	Moderate				
44	7429905	Aluminum	Moderate	Unknown	Unknown	Moderate	Unknown		X	SM	

Table 31. Potential Fate and Toxicity of Pollutants of Concern (70) Discharged from 103 Direct Discharging Iron and Steel Facilities (continued)

No.	CAS Number	Name	Acute Aquatic Toxicity	Volatility from Water	Adsorption to Solids	Bioaccumulation Potential	Biodegra-dation Potential	Carcinogen	Systemic Toxicant	Drinking Water Value	Priority Pollutant
45	7439896	Iron	Unknown	Unknown	Unknown	Unknown	Unknown		X	SM	
46	7439921	Lead	High	Unknown	Unknown	Slight	Unknown	X		TT	X
47	7439954	Magnesium	Slight	Unknown	Unknown	High	Unknown				
48	7439965	Manganese	Unknown	Unknown	Unknown	Unknown	Unknown		X	SM	
49	7439976	Mercury	High	High	High	High	Unknown		X	M	X
50	7439987	Molybdenum	Unknown	Unknown	Unknown	Unknown	Unknown		X		
51	7440020	Nickel**	Moderate	Unknown	Slight	Slight	Unknown		X		X
52	7440224	Silver	High	Unknown	Unknown	Nonbioaccumulative	Unknown		X	SM	X
53	7440280	Thallium	Slight	Unknown	Unknown	Moderate	Unknown		X	M	X
54	7440315	Tin	Unknown	Unknown	Unknown	Unknown	Unknown		X		
55	7440326	Titanium	Unknown	Unknown	Unknown	Unknown	Unknown		X		
56	7440360	Antimony	Slight	Unknown	Unknown	Nonbioaccumulative	Unknown		X	M	X
57	7440382	Arsenic	Moderate	Unknown	Unknown	Slight	Unknown	X	X	M	X
58	7440393	Barium	Slight	Unknown	Unknown	Unknown	Unknown		X	M	
59	7440428	Boron	Unknown	Unknown	Unknown	Unknown	Unknown		X		
60	7440439	Cadmium	High	Unknown	Unknown	Moderate	Unknown	X	X	M	X
61	7440473	Chromium	Moderate	Unknown	Unknown	Slight	Unknown		X	M	X
62	7440484	Cobalt	Slight	Unknown	Unknown	Unknown	Unknown		X		
63	7440508	Copper	High	Unknown	Unknown	Moderate	Unknown		X	TT	X
64	7440622	Vanadium	Slight	Unknown	Unknown	Unknown	Unknown		X		
65	7440666	Zinc	Moderate	Unknown	Unknown	Slight	Unknown		X	SM	X
66	7664417	Ammonia As Nitrogen (NH3-N)	Slight	Moderate	Nonadsorptive	Unknown	Moderate				
67	7782492	Selenium	High	Unknown	Unknown	Nonbioaccumulative	Unknown		X	M	X
68	14808798	Sulfate	Unknown	Unknown	Unknown	Unknown	Unknown			SM	
69	16984488	Fluoride	Slight	Unknown	Unknown	Unknown	Unknown		X	M	
70	18540299	Chromium, Hexavalent	High	Unknown	Unknown	Slight	Unknown	X	X	M	X

Note: Metals, because of their physical/chemical properties, are, in general, not applicable to categorization into groups based on volatility, adsorption to solids, and biodegradation potential.

M= Maximum Contaminant Level (MCL) established for health-based effect.
SM= Secondary Maximum Contaminant Level (SMCL) established for taste or aesthetic effect.
TT= Treatment technology action level established.
* Aquatic toxicity data for n-decane are reported based on structural similarity.
** MCL of 0.1 mg/L remanded in 1995. EPA is reconsidering limit.

Table 32. Iron and Steel Toxicants Exhibiting Systemic and Other Adverse Effects*
(Direct Dischargers)

	Cas Number	Toxicant	Reference Dose Target Organ and Critical Effects
1	C005	Nitrate/Nitrite	Blood: methemoglobinemia (infants) (a)
2	57125	Total Cyanide	Whole Body, Thyroid, Nerve: weight loss, thyroid effects, and myeline degeneration
3	67641	Acetone	Liver, Kidney: increased liver and kidney weights and nephrotoxicity
4	71432	Benzene	(b)
5	91203	Naphthalene	Body Weight: decreased body weights
6	91576	2-Methylnaphthalene	(b)
7	95487	o-Cresol	Body Weight, Nervous System: decreased body weights and neurotoxicity
8	100027	4-Nitrophenol	(b)
9	105679	2,4-Dimethylphenol	General Toxicity, Blood: lethargy, hematological changes
10	106445	p-Cresol	Nervous System, Respiratory, Whole Body: hypoactivity, distress, maternal death
11	108952	Phenol	Reproductive: reduced fetal body weights
12	110861	Pyridine	Liver: increased liver weights
13	117817	Bis(2-ethylhexyl) Phthalate	Liver: increased liver weights
14	129000	Pyrene	Kidney: renal tubular pathology, decreased kidney weights
15	132649	Dibenzofuran	(b)
16	206440	Fluoranthene	Kidney, Liver, Blood: nephropathy, increased liver weights, hematological alterations, and clinical effects
17	7429905	Aluminum	(b)
18	7439896	Iron	(b)
19	7439965	Manganese	Nervous System: CNS effects
20	7439976	Mercury	Nervous System: neurotoxicity
21	7439987	Molybdenum	Urine, Joint, Blood: increased uric acid, pain and swelling, decreased copper level
22	7440020	Nickel	Body Weight: decreased body and organ weights
23	7440224	Silver	Skin: argyria
24	7440280	Thallium	(b)
25	7440315	Tin	Kidney, Liver: lesions
26	7440326	Titanium	(b)
27	7440360	Antimony	Blood: blood glucose and cholesteral, decreased longevity
28	7440382	Arsenic	Skin: hyperpigmentation, keratosis, possible vascular complications
29	7440393	Barium	Cardiovascular: increased blood pressure
30	7440428	Boron	Testis: testicular atrophy, spermatogenic arrest
31	7440439	Cadmium	Kidney: significant proteinuria
32	7440473	Chromium	No adverse effects observed (c)
33	7440484	Cobalt	(b)
34	7440508	Copper	(b)
35	7440622	Vanadium	GI, Kidney, Nervous System: GI disturbances, renal function, CNS effects
36	7440666	Zinc	Blood: anemia
37	7782492	Selenium	Respiratory: clinical selenosis
38	16984488	Fluoride	Dental: objectionable dental fluorosis
39	18540299	Chromium, Hexavalent	No adverse effects observed (c)

* Chemicals with EPA-verified or provisional human health-based reference doses (RfD), referred to as "systemic toxicants."

(a) Values for nitrate are assumed.

(b) RfD is an EPA-NCEA provisional value; Contact EPA-NCEA Superfund Technical Support Center for supporting documentation.

(c) RfD based on no-observed-adverse-effect level (NOAEL).

Table 33. Iron and Steel Human Carcinogens Evaluated, Weight-of-Evidence Classifications, and Target Organs (Direct Dischargers)

	CAS Number	Carcinogen	Weight-of-Evidence Classification	Target Organs
1	50328	Benzo(a)pyrene	B2	Stomach, Lungs
2	56553	Benzo(a)anthracene	B2	Liver, Lungs
3	62533	Aniline	B2	Spleen, Body Cavity
4	71432	Benzene	A	Blood
5	91203	Naphthalene*	C	Lungs
6	95487	o-Cresol*	C	Skin
7	95534	o-Toluidine	B2	Skin
8	106445	p-Cresol*	C	Bladder
9	117817	Bis(2-ethylhexyl) Phthalate	B2	Liver
10	205992	Benzo(b)fluoranthene	B2	Lungs, Skin
11	207089	Benzo(k)fluoranthene	B2	Lungs
12	218019	Chrysene	B2	Liver
13	7439921	Lead*	B2	Kidney
14	7440382	Arsenic	A	Skin and Lungs
15	7440439	Cadmium*	B1	Lungs, Trachea, and Bronchi
16	18540299	Chromium, Hexavalent*	A/D	Lungs

A= Human carcinogen
B1= Probable human carcinogen (limited human data)
B2= Probable human carcinogen (animal data only)
C= Possible human carcinogen
D= Not classifiable as to human carcinogenicity
* Not included in Risks and Benefits Analysis; quantitative estimate of carcinogenic risk from oral exposure not available.

Table 34. Potential Fate and Toxicity of Pollutants of Concern (66) Discharged from 47 Indirect Discharging Iron and Steel Facilities

No.	CAS Number	Name	Acute Aquatic Toxicity	Volatility from Water	Adsorption to Solids	Bioaccumulation Potential	Biodegra-dation Potential	Carcinogen	Systemic Toxicant	Drinking Water Value	Priority Pollutant
1	C002	BOD 5-day (carbonaceous)	Unknown	Unknown	Unknown	Unknown	Unknown				
2	C004	Chemical Oxygen Demand (COD)	Unknown	Unknown	Unknown	Unknown	Unknown				
3	C005	Nitrate/Nitrite (NO2 + NO3-N)	Unknown	Unknown	Unknown	Unknown	Unknown		X	M	
4	C009	Total Suspended Solids (TSS)	Unknown	Unknown	Unknown	Unknown	Unknown				
5	C012	Total Organic Carbon (TOC)	Unknown	Unknown	Unknown	Unknown	Unknown				
6	C020	Total Recoverable Phenolics	Unknown	Unknown	Unknown	Unknown	Unknown				
7	C021	Total Kjeldahl Nitrogen (TKN)	Unknown	Unknown	Unknown	Unknown	Unknown				
8	C025	Amenable Cyanide	Unknown	Unknown	Unknown	Unknown	Unknown				
9	C036	Hexane Extractable Material (HEM)	Unknown	Unknown	Unknown	Unknown	Unknown				
10	C037	Silica Gel Treated HEM (SGT-HEM	Unknown	Unknown	Unknown	Unknown	Unknown				
11	C042	Weak Acid Dissociable Cyanide	Unknown	Unknown	Unknown	Unknown	Unknown				
12	50328	Benzo(a)pyrene	High	Slight	High	High	Resistant	X		M	X
13	56553	Benzo(a)anthracene	High	Slight	High	High	Resistant	X			X
14	57125	Total Cyanide	High	Unknown	Slight	Nonbioaccumulative	Moderate		X	M	X
15	67641	Acetone	Slight	Moderate	Slight	Nonbioaccumulative	Fast		X		
16	71432	Benzene	Slight	High	Slight	Slight	Moderate	X	X	M	X
17	85018	Phenanthrene	Moderate	Moderate	High	Moderate	Resistant				X
18	91203	Naphthalene	Slight	Moderate	Slight	Slight	Moderate	X	X		X
19	91576	2-Methylnaphthalene	Slight	Moderate	Moderate	High	Moderate		X		
20	95487	o-Cresol	Slight	Slight	Slight	Slight	Fast	X	X		
21	95534	o-Toluidine	Moderate	Slight	Slight	Slight	Fast	X			
22	98555	alpha-Terpineol	Slight	Moderate	Slight	Slight	Moderate				
23	105679	2,4-Dimethylphenol	Slight	Slight	Slight	Moderate	Fast		X		X
24	106445	p-Cresol	Slight	Slight	Slight	Slight	Fast	X	X		
25	108952	Phenol	Slight	Slight	Slight	Nonbioaccumulative	Fast		X		X
26	110861	Pyridine	Slight	Slight	Nonadsorptive	Nonbioaccumulative	Fast		X		
27	112403	n-Dodecane*	Slight	Unknown	High	High	Moderate				
28	117817	Bis(2-ethylhexyl) Phthalate	Unknown	Nonvolatile	High	Moderate	Moderate	X	X	M	X
29	124185	n-Decane	Slight	Unknown	High	High	Moderate				
30	129000	Pyrene	Moderate	Moderate	High	High	Resistant		X		X
31	132649	Dibenzofuran	Slight	Moderate	Moderate	High	Moderate		X		
32	142621	Hexanoic Acid	Slight	Moderate	Slight	Slight	Moderate				
33	205992	Benzo(b)fluoranthene	Unknown	Moderate	High	High	Resistant	X			X
34	206440	Fluoranthene	High	Moderate	High	High	Resistant		X		X
35	207089	Benzo(k)fluoranthene	Unknown	Moderate	High	High	Resistant	X			X
36	218019	Chrysene	Moderate	Moderate	High	High	Resistant	X			X
37	302045	Thiocyanate	Moderate	Unknown	Unknown	Unknown	Unknown				
38	544763	n-Hexadecane*	Slight	Unknown	High	High	Moderate				
39	612942	2-Phenylnaphthalene	Moderate	Moderate	High	High	Moderate				
40	7429905	Aluminum	Moderate	Unknown	Unknown	Moderate	Unknown		X	SM	
41	7439896	Iron	Unknown	Unknown	Unknown	Unknown	Unknown		X	SM	
42	7439921	Lead	High	Unknown	Unknown	Slight	Unknown	X		TT	X
43	7439954	Magnesium	Slight	Unknown	Unknown	High	Unknown				

Table 34. Potential Fate and Toxicity of Pollutants of Concern (66) Discharged from 47 Indirect Discharging Iron and Steel Facilities (continued)

No.	CAS Number	Name	Acute Aquatic Toxicity	Volatility from Water	Adsorption to Solids	Bioaccumulation Potential	Biodegra-dation Potential	Carcinogen	Systemic Toxicant	Drinking Water Value	Priority Pollutant
44	7439965	Manganese	Unknown	Unknown	Unknown	Unknown	Unknown		X	SM	
45	7439976	Mercury	High	High	High	High	Unknown		X	M	X
46	7439987	Molybdenum	Unknown	Unknown	Unknown	Unknown	Unknown		X		
47	7440020	Nickel**	Moderate	Unknown	Slight	Slight	Unknown		X		X
48	7440224	Silver	High	Unknown	Unknown	Nonbioaccumulative	Unknown		X	SM	X
49	7440280	Thallium	Slight	Unknown	Unknown	Moderate	Unknown		X	M	X
50	7440315	Tin	Unknown	Unknown	Unknown	Unknown	Unknown		X		
51	7440326	Titanium	Unknown	Unknown	Unknown	Unknown	Unknown		X		
52	7440360	Antimony	Slight	Unknown	Unknown	Nonbioaccumulative	Unknown		X	M	X
53	7440382	Arsenic	Moderate	Unknown	Unknown	Slight	Unknown	X	X	M	X
54	7440393	Barium	Slight	Unknown	Unknown	Unknown	Unknown		X	M	
55	7440428	Boron	Unknown	Unknown	Unknown	Unknown	Unknown		X		
56	7440439	Cadmium	High	Unknown	Unknown	Moderate	Unknown	X	X	M	X
57	7440473	Chromium	Moderate	Unknown	Unknown	Slight	Unknown		X	M	X
58	7440484	Cobalt	Slight	Unknown	Unknown	Unknown	Unknown		X		
59	7440508	Copper	High	Unknown	Unknown	Moderate	Unknown		X	TT	X
60	7440622	Vanadium	Slight	Unknown	Unknown	Unknown	Unknown		X		
61	7440666	Zinc	Moderate	Unknown	Unknown	Slight	Unknown		X	SM	X
62	7664417	Ammonia As Nitrogen (NH3-N)	Slight	Moderate	Nonadsorptive	Unknown	Moderate				
63	7782492	Selenium	High	Unknown	Unknown	Nonbioaccumulative	Unknown		X	M	X
64	14808798	Sulfate	Unknown	Unknown	Unknown	Unknown	Unknown			SM	
65	16984488	Fluoride	Slight	Unknown	Unknown	Unknown	Unknown		X	M	
66	18540299	Chromium, Hexavalent	High	Unknown	Unknown	Slight	Unknown	X	X	M	X

Note: Metals, because of their physical/chemical properties, are, in general, not applicable to categorization into groups based on volatility, adsorption to solids, and biodegradation potential.

M= Maximum Contaminant Level (MCL) established for health-based effect.
SM= Secondary Maximum Contaminant Level (SMCL) established for taste or aesthetic effect.
TT= Treatment technology action level established.
* Aquatic toxicity data for n-decane are reported based on structural similarity.
** MCL of 0.1 mg/L remanded in 1995. EPA is reconsidering limit.

Table 35. Iron and Steel Toxicants Exhibiting Systemic and Other Adverse Effects*
(Indirect Dischargers)

	Cas Number	Toxicant	Reference Dose Target Organ and Critical Effects
1	C005	Nitrate/Nitrite	Methemoglobinernia (infants) (a)
2	57125	Total Cyanide	Weight loss, thyroid effects, and myeline degeneration
3	67641	Acetone	Increased liver and kidney weights and nephrotoxicity
4	71432	Benzene	(b)
5	91203	Naphthalene	Eye damage, decreased body weight
6	91576	2-Methylnaphthalene	(b)
7	95487	o-Cresol	Decreased body weights and neurotoxicity
8	105679	2,4-Dimethylphenol	General Toxicity, Blood: Lethargy, hematological changes
9	106445	p-Cresol	Hypoactivity, distress, maternal death
10	108952	Phenol	Reduced fetal body weight in rats
11	110861	Pyridine	Liver: increased liver weights
12	117817	Bis(2-ethylhexyl) Phthalate	Increased relative liver weight
13	129000	Pyrene	Kidney effects (renal tubular pathology, decreased kidney weights)
14	132649	Dibenzofuran	(b)
15	206440	Fluoranthene	Nephropathy, increased liver weights, hematological alterations, and clinical effe
16	7429905	Aluminum	(b)
17	7439896	Iron	(b)
18	7439965	Manganese	CNS effects
19	7439976	Mercury	CNS effects
20	7439987	Molybdenum	Increased uric acid
21	7440020	Nickel	Decreased body and organ weights
22	7440224	Silver	Skin: argyria
23	7440280	Thallium	(b)
24	7440315	Tin	Kidney and liver lesions
25	7440326	Titanium	(b)
26	7440360	Antimony	Blood: blood glucose and cholesteral, decreased longevity
27	7440382	Arsenic	Hyperpigmentation, keratosis, and possible vascular complications
28	7440393	Barium	Increased blood pressure
29	7440428	Boron	Testicular atrophy, spermatogenic arrest
30	7440439	Cadmium	Significant proteinuria
31	7440473	Chromium	No adverse effects observed (c)
32	7440484	Cobalt	(b)
33	7440508	Copper	(b)
34	7440622	Vanadium	GI, Kidney, Nervous System: GI disturbances, renal function, CNS effects
35	7440666	Zinc	Anemia
36	7782492	Selenium	Respiratory: clinical selerosis
37	16984488	Fluoride	Objectionable dental fluorosis
38	18540299	Chromium, Hexavalent	No adverse effects observed (c)

* Chemicals with EPA-verified or provisional human health-based reference doses (RfD), referred to as "systemic

(a) Values for nitrate are assumed.

(b) RfD is an EPA-NCEA provisional value; Contact EPA-NCEA Superfund Technical Support Center for supporting documentation.

(c) RfD based on no-observed-adverse-effect level (NOAEL).

Table 36. Iron and Steel Human Carcinogens Evaluated, Weight-of-Evidence Classifications, and Target Organs (Indirect Dischargers)

	CAS Number	Carcinogen	Weight-of-Evidence Classification	Target Organs
1	50328	Benzo(a)pyrene	B2	Stomach, Lungs
2	56553	Benzo(a)anthracene	B2	Liver, Lungs
3	71432	Benzene	A	Blood
4	91203	Naphthalene*	C	Lungs
5	95487	o-Cresol*	C	Skin
6	95534	o-Toluidine	B2	Skin
7	106445	p-Cresol*	C	Bladder
8	117817	Bis(2-ethylhexyl) Phthalate	B2	Liver
9	205992	Benzo(b)fluoranthene	B2	Skin and Lungs
10	207089	Benzo(k)fluoranthene	B2	Lungs
11	218019	Chrysene	B2	Liver
12	7439921	Lead*	B2	Kidney
13	7440382	Arsenic	A	Skin and Lungs
14	7440439	Cadmium*	B1	Lung, Trachea, and Bronchi
15	18540299	Chromium, Hexavalent*	A/D	Lungs

A= Human Carcinogen
B1= Probable human carcinogen (limited human data)
B2= Probable human carcinogen (animal data only)
C= Possible human carcinogen
D= Not classifiable as to human carcinogenicity
* Not included in Risks and Benefits Analysis; quantitative estimate of carcinogenic risk from oral exposure not available.

4.4 Summary of Environmental Effects/Benefits from Proposed Effluent Guidelines and Standards

EPA estimates that the annual monetized benefits resulting from the proposed effluent guidelines and standards will range from $1.07 million to $2.61 million (1997 dollars). Table 40 summarizes these effects/benefits. The range reflects the uncertainty in evaluating the effects of this proposed rule and in placing a monetary value on these effects. The estimate of reported benefits also understates the total benefits expected to result under this proposed rule. Additional benefits, which cannot be quantified in this assessment, include improved ecological conditions from improvements in water quality, improvements to recreational activities (other than fishing), reduced noncarcinogenic (systemic) human health hazards (other than lead), additional health benefits due to reduced lead exposure, reduced POTW costs, and reduced discharge of conventional and other pollutants.

Table 37. Modeled Direct Discharging Iron and Steel Facilities Located on Waterbodies Listed Under Section 303(d) of Clean Water Act (1998)

State	Facility Name	City	Watershed	Waterbody Name	Parameters of Concern	Priority for TMDL Development	Potential Sources of Impairment
Alabama	USX Corp.	Fairfield	Upper Black Warrior 03160112	Opossum Creek	Metals, Nonpriority Organics, Nutrients, Oil and Grease, Pesticides, pH, Priority Organics, Toxicity	—	—
	Empire Coke Tuscaloosa Steel	Holt Tuscaloosa	Upper Black Warrior 03160112	Black Warrior River	Organic Enrichment/DO	Low	Dam Construction, Flow Regulations/Modifications
	Gulf States Steel, Inc.	Gadsden	Middle Coosa 03150106	Black Creek	Priority Organics, Ammonia, Organic Enrichment/DO	Low	Industrial, Urban Runoff/Storm Sewers, Contaminated Sediments
	SMI Steel	Birmingham	Locust 03160111	Village Creek	Nonpriority Organics, Metals, Ammonia, pH, Siltation, Organic Enrichment, DO	Low	Industrial Point Sources, Municipal Point Sources, Urban Runoff/Storm Sewers, Abandoned Surface and Subsurface Mining, and Mine Tailings
California	USS-POSCO	Pittsburg	Suisun Bay 18050001	New York Slough/Suisun Bay	Copper, Mercury, Nickel, Selenium, Exotic Species, Diazinon, PCBs, Chlordane, DDT, Dieldrin, Dioxins, Furans, PCBs	—	Atmospheric Deposition, Ballast Water, Industrial Point Sources, Municipal Point Sources, Nonpoint Sources, Natural Sources, Resource Extraction, Urban Runoff/Storm Sewers
Colorado	CF&I Steel	Pueblo	Upper Arkansas 11020002	Arkansas River	Iron, Manganese, Sulfate, Selenium	Low	—

State	Facility Name	City	Watershed	Waterbody Name	Parameters of Concern	Priority for TMDL Development	Potential Sources of Impairment
Connecticut	Allegheny Ludlum Steel	Wallingford	Quinnipiac 01100004	Quinnipiac River	Bacteria	High	Wet Weather Discharges
Illinois	Northwestern Steel	Sterling	Lower Rock 07090005	Rock River	Nutrients, Suspended Solids, Noxious Aquatic Plants	251/267	Agriculture, Crop Production, Pastureland, Hydrologic Modification
	Laclede Steel	Alton	Peruque-Piasa 07110009	Mississippi River	Priority Organics, Nutrients, Siltation Suspended Solids, Habitat Alterations, Metals	3	Industrial Point Sources, Municipal Point Sources, Agriculture, Crop Production, Urban Runoff/Storm Sewers, Hydrologic/Habitat Modification
	Austeel Lemont	Lemont	Des Plaines 07120004	Chicago Ship Canal	Ammonia, Nutrients, Priority Organics, Metals, Organic Enrichment/DO, Flow Alterations, Habitat Alterations, Pathogens, pH	6	Industrial Point Sources, Municipal Point Sources, Combined Sewer Overflows, Urban Runoff/Storm Sewers, Hydrologic/Habitat Modification, Flow Regulation/Modification, In-place Contaminants
	LTV Steel	Hennepin	Lower Illinois-Senachwine Lake 07130001	Illinois River	Metals, Nutrients, Siltation, Flow Alterations, Suspended Solids, Organic Enrichment/DO, Priority Organics	5-30	Municipal Point Sources, Industrial Point Sources, Agriculture, Hydrologic/ Habitat Modification, Flow Regulation/Modification, In-place Contaminants

State	Facility Name	City	Watershed	Waterbody Name	Parameters of Concern	Priority for TMDL Development	Potential Sources of Impairment
	National Steel	Granite City	Cahokia-Joachim 07140101	Horseshoe Lake	Metals, Nutrients, Siltation, Organic Enrichment/DO, Suspended Solids, Noxious Aquatic Plants	1	Point Sources, Industrial Point Sources, Agriculture, Crop Production, Urban Runoff/ Storm Sewers, Resource Extraction, Dredge Mining, In-place Contaminants
Indiana	Inland Steel Flat Products LTV Steel Co.	East Chicago East Chicago	Little Calumet -Galien 04040001	Indiana Harbor Canal	Dissolved Oxygen, Mercury, PCBs, Lead, Pesticides	1998-2000	—
	Bethlehem Steel Corp	Chesterton	Little Calumet-Galien 04040001	Little Calumet River	Cyanide, E. Coli, Mercury, PCBs, Pesticides, Impaired Biotic Communities	2000-2012	—
	U.S. Steel	Gary	Little Calumet-Galien 04040001	Grand Calumet River	Impaired Biotic Communities, Copper, Cyanide, Mercury, PCBs, Lead, Oil and Grease, Pesticides	1998-2000	—
	National Steel	Portage	Little Calumet-Galien 04040001	Burns Ditch	E. Coli, Mercury, PCBs, Lead, Pesticides, Impaired Biotic Communities	2000-2012	—
	Plymouth Tube	Winamac	Tippecanoe 05120106	Sigerson D/ Tippecanoe River	Cyanide, Mercury, PCBs	2003-2010	—
	Allegheny Ludlum Steel	New Castle	Driftwood 05120204	Big Blue River	Cyanides, PCBs	2002-2014	—
Iowa	North Star	Wilton	Lower Cedar 07080206	Mud Creek	Ammonia, Toxics	—	—

State	Facility Name	City	Watershed	Waterbody Name	Parameters of Concern	Priority for TMDL Development	Potential Sources of Impairment
Kentucky	AK Steel Corp.	Ashland	Little Scioto-Tygarts 05090103	Ohio River	Pathogens, PCBs, Priority Organics	Second Priority	—
	North American Stainless Gallatin Steel	Carrollton Warsaw	Middle Ohio-Laughery 05090203	Ohio River	Pathogens, PCBs, Priority Organics	Second Priority	—
Maryland	Bethlehem Steel Corp.	Sparrows Point	Gunpowder-Patapsco 02060003	Bear Creek	Chromium, PCBs, Zinc	High	Point Sources, Nonpoint Sources, Legacy, Unknown
Michigan	National Steel Corp.	Ecorse	Detroit 04090004	Detroit River	Mercury, PCBs, Pathogens	—	CSOs, Untreated Sewage Discharge
	Rouge Steel Corp. Double Eagle Steel	Dearborn Dearborn	Detroit 04090004	Rouge River	Dissolved Oxygen, PCBs, Pathogens, Fish/Macroinverte-bate Community Rated Poor	—	CSOs, Untreated Sewage Discharge
North Carolina	Teledyne Allvac	Monroe	Rocky 03040105	Richardson Creek	Sediment	Low	Point Sources, Municipal Pretreatment, Nonpoint Sources, Agriculture
Ohio	Republic Engineered Steels	Lorain	Black-Rocky 04110001	Black River	Priority Organics, Nutrients, Habitat Alteration	9	Municipal Point Sources, Industrial Point Sources, Agriculture, Urban Runoff/Storm Sewers, Hydromodification, Dredging
	New Boston Coke	New Boston/ Portsmouth	Little Scioto-Tygarts 05090103	Ohio River	Metals	17	—
	AK Steel Corp.	Middletown	Lower Great Miami 05080002	Dicks Creek/Great Miami River	Metals, Ammonia, Organic Enrichment/DO, Thermal Modification, Flow Alteration	7	Municipal Point Sources, Industrial Point Sources, Land Disposal, Wastewater Hydromodification, Flow Regulation/Modification

State	Facility Name	City	Watershed	Waterbody Name	Parameters of Concern	Priority for TMDL Development	Potential Sources of Impairment
Ohio (cont'd)	Warren Consolidated CSC Industries Thomas Steel Strip	Warren Warren Warren	Mahoning 05030103	Mahoning River	Priority Organics, Metals, Ammonia, Chlorine, Nutrients, Pathogens, Oil and Grease	6	Municipal Point Sources, Industrial Point Sources, Urban Runoff/Storm Sewers, Land Disposal, Hazardous Waste, Spills, Contaminated Sediments, Unknown
	Babcox and Wilcox	Alliance	Mahononing 05030103	Ryans Run/Mahoning River	Priority Organics, Metals, Nutrients, Siltation, Pathogens	11	Industrial Point Sources, Municipal Point Sources, Agriculture, Pasture Land, Spills, Contaminated Sediments, Unknown
	Worthington Steel North Star BHP Steel	Delta Delta	Lower Maumee 04100009	Maumee River	Sitation, Organic Enrichment/D0, Habitat Alteration	13	Point Sources, Municipal Point Sources, Agriculture, Crop Production, Hydromodification, Dam Construction
	Wheeling-Pittsburgh Steel Wheeling-Pittsburgh Steel	Steubenville Mingo Junction	Upper Ohio 05030101	Ohio River	Priority Organics, Metals, Ammonia	17	—
	LTV Steel American Steel and Wire	Cleveland Cuyahoga Heights	Cuyahoga 04110002	Cuyahoga River	Priority Organics, Metals, Ammonia, Inorganics, Organic Enrichment/DO, Habitat Alteration, Oil and Grease	6	Industrial Point Sources, Municipal Point Sources, Combined Sewer Overflow, Urban Runoff/Storm Sewers

State	Facility Name	City	Watershed	Waterbody Name	Parameters of Concern	Priority for TMDL Development	Potential Sources of Impairment
Ohio (cont'd)	Ohio Coatings Co. Wheeling-Pittsburgh Steel	Yorkville Yorkville	Upper Ohio-Wheeling 05030106	Ohio River	Priority Organics, Metals, Ammonia	17	—
	Timken Co.	Canton	Tuscarawas 05040001	Nimishillen Creek	Priority Organics, Metals, Ammonia, Organic Enrichment/D0	8	Industrial Point Sources, Municipal Point Sources, Spills, Contaminated Sediments
	J&J Speciality Steel Republic Engineered Steel	Louisville Canton	Tuscarawas 05040001	East Branch Nimishillen Creek	Ammonia, Nutrients, Organic Enrichment/DO, Salinity, TDS, Chloride, Flow Alteration, Oil and Grease	8	Industrial Point Sources, Municipal Point Sources, Agriculture
	Lukens Inc. Republic Engineered Steel	Massillon Massillon	Tuscarawas 05040001	Tuscarawas River	Metals, Nutrients, Organic Enrichment/DO, Habitat Alteration	6	Industrial Point Sources, Municipal Point Sources, Combined Sewer Overflow, Urban Runoff/Storm Sewers, Hydromodification
	Copperweld Corp.	Shelby	Mohican 05040002	Tuby Run	Metals, pH, Habitat Alteration	8	Industrial Point Sources, Hydromodification, Spills
	ARMCO	Zanesville	Muskingum 05040004	Muskingum River	Organic Enrichment/DO, Thermal Modification, Habitat Alteration	13	Industrial Point Sources, Natural

State	Facility Name	City	Watershed	Waterbody Name	Parameters of Concern	Priority for TMDL Development	Potential Sources of Impairment
Oregon	Cascade Steel	McMinnville	Yamhill 17090008	S. Yamhill River	Temperature, Bacteria	—	—
	Oregon Steel Mills	Portland	Lower Willamette 17090012	Willamette River	Temperature, Mercury, Creosote, Bacteria	—	—
Pennsylvania	USS Irvin Plant USX Corp. Koppers Industry	Dravosburg Dravosburg Monessen	Lower Monongahela 05020005	Monongahela River	Pesticides (Chlordane), Priority Organics(PCBs)	—	—
	Shenango, Inc.	Pittsburgh/Neville Island	Upper Ohio 05030101	Ohio River	Pesticides (Chlordane), Priority Organics (PCBs)	—	—
	J&L Specialty Steel J&L Structural Koppel Steel	Midland Aliquippa Beaver Falls	Upper Ohio 05030101	Ohio River	Pesticides (Chlordane), Priority Organics (PCBs)	—	—
	Luken Steel	Washington	Upper Ohio 05030101	Chartiers Run	Nutrients, Siltation, Turbidity, Organic Enrichment/D0, Habitat Alterations, Metals, pH	—	Construction, Habitat Modification, Agriculture, Abandoned Mine Drainage, On-site Wastewater
	Washington Steel	Washington	Upper Ohio 05030101	Chartiers Creek	Metals, Nutrients, Siltation, Habitat Alterations, Turbidity, Pesticides (Chlordane), Priority Organics (PCBs)	—	Abandoned Mine Drainage, Urban Runoff/Storm Sources, Agriculture, Habitat Modification, Unknown

State	Facility Name	City	Watershed	Waterbody Name	Parameters of Concern	Priority for TMDL Development	Potential Sources of Impairment
Pennsylvania (cont'd)	US Steel-USX	Fairless Hills	Crosswicks-Neshaminy 02040201	Delaware River	Pesticides (Chlordane), Priority Organics (PCBs)	—	Unknown
	Carpenter Technology Corp.	Berks County	Schuylkill 02040203	Schuylkill River	Metals, Pesticides, Priority Organics (PCBs)	—	Industrial Point Sources, Unknown
	Lukens Steel Corp.	Coatesville	Brandywine-Christina 02040205	Sucker Run	Nutrients, Water/Flow Variability	—	Agriculture, Urban Runoff/Storm Sewers
				West Branch Brandywine Creek	Nutrients, Siltation	—	Agriculture
	Jersey Shore Steel Co.	Jersey Shore	Middle West Branch Susquehana 02050203	West Branch Susquehana River	Metals	High	Abandoned Mine Drainage
	Bar Technologies	Johnstown	Conemaugh 05010007	Little Conemaugh River	Metals	—	Abandoned Mine Drainage
	Allegheny Ludlum	Brackenridge	Kiskiminetas 05010008	Kiskiminetas River	Metals, Suspended Solids	—	Abandoned Mine Drainage
	Standard Steel	Burnham	Kiskiminetas 05010008	Loyalhanna Creek	Metals, Suspended Solids	—	Abandoned Mine Drainage
	Allegheny Ludlum Steel Pittsburgh Flatroll Co. Braeburn Alloy Steel	Brackenridge Pittsburgh Lower Burrell	Lower Allegheny 05010009	Allegheny River	Pesticides (Chlordane), Priority Organics (PCBs)	—	Unknown

State	Facility Name	City	Watershed	Waterbody Name	Parameters of Concern	Priority for TMDL Development	Potential Sources of Impairment
Pennsylvania (cont'd)	Sharon Tube Co. Wheatland Tube Co. Caparo Steel	Sharon Wheatland Farrell	Shenango 05030102	Shenango River	Organic Enrichment/D0, Nutrients, Habitat Alterations, Pesticides (Chlordane), Priority Organics (PCBs)	—	Hydromodification, Package Plants, Unknown
	ARMCO Inc.	Butler	Connoquenessing 05030105	Connoquenessing Creek	Pathogens, Suspended Solids		On-site Wastewater, Abandoned Mine Drainage
South Carolina	Georgetown Steel	Georgetown	Carolina-Sampit 03040207	Sampit River	Mercury	Two	—
	Nucor Steel	Huger	Cooper 03050201	Cooper River	Mercury	Two	—
Texas	USS CE-Tex Center	Baytown	North Galveston Bay 12040203	East Ditch/Cedar Bayou	Total Dissolved Solids, Organic Enrichment/Low DO, Pathogens	Medium	Nonpoint Source, Point Source
Utah	Geneva Steel	Provo/Vineyard	Utah Lake 16020201	Utah Lake	Total Dissolved Solids, Total Phosphorus, Ammonia, Benzene, Benzopyrene, BOD, Chlorine Residual, Cyanide, Lead, Napthalene, Oil and Grease, Fecal Coliform, pH, Phenolics, Total Suspended Solids	High	—

State	Facility Name	City	Watershed	Waterbody Name	Parameters of Concern	Priority for TMDL Development	Potential Sources of Impairment
West Virginia	Wheeling-Pittsburgh Steel Weirton Steel Wheeling-Pittsburgh Steel Wheeling-Nisshin	Wheeling Weirton Follansbee Follansbee	Upper Ohio 05030101	Ohio River	PCBs, Chlordane, Aluminum	Low/High	—

NOTE: Facilities may be located on waterbodies listed under Section 303(d) of CWA for other states (e.g., Ohio River). Listings are presented based on location (state) of facility.

Source: 1998 TMDL Tracking System Data, Version 1.1, July 1998.

Table 38. Modeled Direct Discharging Iron and Steel Facilities Located on Waterbodies with State/Tribal/Federal Fish Consumption Advisories[a]

Facility NPDES	Facility Name	City	Discharge Type	Receiving Stream	Advisory Area/No.[b]	Pollutant	Species	Population[c]	Comments
AL0055239	Gulf States Steel	Gadsden	Direct	Black Creek	Coosa River/2	PCBs	Spotted Bass, Catfish, Largemouth Bass, Striped Bass, White Bass	NCGP, RGP	Advisories within 50 miles downstream of discharge site
CA0005002	USS-Posco Industries (UPI)	Pittsburgh	Direct	New York Slough	Richmond Harbor	PCBs, DDT, Dieldrin	Croaker, Gobies, Shellfish, Surfperch, Bullheads	NCGP	Advisory within 50 miles downstream of discharge site
CT0003701	Allegheny Ludlum Steel	Wallingford	Direct	Quinnipiac River	Long Island Sound	PCBs	Bluefish >25", Striped Bass	NCSP, RGP	Advisory within 50 miles downstream of discharge site
					All CT Freshwaters Statewide	Mercury	All Fish, Trout >15"	RSP, RGP	
DE0051021	Citisteel USA Incorporated	Claymont	Direct	Delaware River	Delaware Estuary/2	PCBs	Striped Bass, White Catfish, Channel Catfish	RSP, NCGP, RGP	
IL0000612	Laclede Steel	Alton	Direct	Mississippi River	Mississippi River	Chlordane	Shovelnose Sturgeon (fish and eggs)	NCGP	
IL0001309	Austeel Lemont Company Inc.	Lemont	Direct	Chicago Ship Canal	Des Plaines River	PCBs	Smallmouth Buffalo, Common Carp >15", Channel Catfish, Freshwater Drum	NCSP, RGP, NCGP	Advisory within 50 miles downstream of discharge site
					Illinois River	PCBs	Common Carp>15", Channel Catfish	NCGP	Advisory within 50 miles downstream of discharge site
IL0002631	LTV Steel	Hennepin	Direct	Illinois River	Illinois River	PCBs	Common Carp >15", Channel Catfish	NCGP	
IL0000329	National Steel	Granite City	Direct	Horseshoe Lake	Mississippi River	Chlordane	Shovelnose Sturgeon (fish and eggs)	NCGP	Advisory within 50 miles downstream of discharge site
IN0000094	Inland Steel Flat Products	East Chicago	Direct	Indiana Harbor Ship Canal	All Indiana Rivers and Streams Statewide	Mercury, PCBs	Common Carp>15"	NCSP, RGP, NCGP	
IN0000205	LTV Steel Company	East Chicago	Direct	Indiana Harbor Ship Canal	Grand Calumet River and Indiana Harbor Ship Canal	Mercury, PCBs	All Fish	NCGP	
IN0000281	U.S. Steel	Gary	Direct	Grand Calumet River	Lake Michigan and tributaries	Mercury, PCBs	Chinook Salmon, Black Crappie>7", Brook Trout, Brown Trout, White Sucker>15", Longnose	NCSP, RGP, NCGP	

Table 38. Direct Discharging Iron and Steel Facilities Located on Waterbodies With State/Tribal/Federal Fish Consumption Advisories[a] (continued)

Facility NPDES	Facility Name	City	Discharge Type	Receiving Stream	Advisory Area/No.[b]	Pollutant	Species	Population[c]	Comments
IN0000337	National Steel	Portage	Direct	Burns Ditch	All Indiana Rivers and Streams Statewide	Mercury, PCBs	Common Carp>15"	NCSP, RGP, NCGP	
IN0000175	Bethlehem Steel Corp.	Chesterton	Direct	Little Calumet River	Lake Michigan and Tributaries	Mercury, PCBs	Chinook Salmon, Black Crappie>7", Brook Trout, Brown Trout, White Sucker>15", Longnose Sucker 14-23", Walleye>17", Whitefish, Lake Trout, Rainbow Trout, Largemouth Bass>4", Common Carp, All Catfish Species, Coho Salmon>17", Pink Salmon, Northern Pike>10", Longnose Sucker>23", Goldfish>4", Golden Shiner 3-6"	NCSP, RGP, NCGP	
IN0004847	Plymouth Tube Co.	Winamac	Direct	Sigerson Ditch	All Indiana Rivers and Streams Statewide	Mercury, PCBs	Common Carp>15"	NCSP, RGP, NCGP	
					Tippecanoe River-Pulaski Co.	Mercury, PCBs	Longear Sunfish 3-5", Channel Catfish >11", Black Redhorse >16", Northern Hogsucker >13"	RSP, RGP, NCSP	
					Wabash River-Tippecanoe Co.	Mercury, PCBs	Quillback 13"-19", Channel Catfish >13", Sauger >13", Bigmouth Buffalo >19", Paddlefish >34", Freshwater Drum >12", White Bass, River Redhorse >16", Flathead Catfish >15", Largemouth Bass 9-14", Smallmouth Bass >9", Blue Sucker >21", Smallmouth Buffalo >25", Shorthead Redhorse 15-17"	RGP, RSP, NCSP, NCGP	Advisory within 50 miles downstream of discharge site

Table 38. Direct Discharging Iron and Steel Facilities Located on Waterbodies With State/Tribal/Federal Fish Consumption Advisories[a] (continued)

Facility NPDES	Facility Name	City	Discharge Type	Receiving Stream	Advisory Area/No.[b]	Pollutant	Species	Population[c]	Comments
IN0045284	Allegheny Ludlum Steel	New Castle	Direct	Big Blue River	All Indiana Rivers and Streams Statewide	Mercury, PCBs	Common Carp>15"	NCSP, RGP, NCGP	
					Big Blue River, Henry Co.	PCBs	White Sucker>8", Creek Chub>6", Rock Bass>4"	NCSP, RGP	
					Big Blue River, Rush Co.	PCBs	Creek Chub >6"	NCSP, RGP	Advisory within 50 miles downstream of discharge site
					Big Blue River, Shelby Co.	PCBs	Northern Hogsucker >9", Golden Redhorse >18", Rock Bass >4"	NCSP, RGP	Advisory within 50 miles downstream of discharge site
					Big Blue River, Johnson Co.	PCBs	Longear Sunfish >5", Rock Bass >7", Smallmouth Bass >5", Northern Hogsucker >8"	NCSP, RGP	Advisory within 50 miles downstream of discharge site
KY0000558 KY0001571 KY0095877 KY0098221	AK Steel Corp Green River Steel North American Stainless Gallatin Steel Co.	Ashland Owensboro Carrollton Warsaw	Direct Direct Direct Direct	Ohio River	Ohio River	Chlordane, PCBs	Paddlefish (fish and eggs), Channel Catfish, Common Carp, White Bass	NCGP	
KY0033979	KY Electric Steel Inc	Coalton	Direct	Williams Creek	Ohio River	Chlordane, PCBs	Paddlefish (fish and eggs), Channel Catfish, Common Carp, White Bass	NCGP	Advisory within 50 miles downstream of discharge site
MI0002313	National Steel Corp.	Ecorse	Direct	Detroit River	Detroit River	Mercury, PCBs	Freshwater Drum >14", Common Carp	RSP, NCGP, RGP	
					Lake Erie/2	PCBs	Common Carp, Catfish, White Bass 6-22", Coho Salmon >10", Rainbow Trout >10', Smallmouth Bass 14-30", White Perch >6", Walleye >14", Lake Trout >10", Lake Whitefish>6", Freshwater Drum >6"	NCGP, RGP	Advisories within 50 miles downstream of discharge site

Table 38. Direct Discharging Iron and Steel Facilities Located on Waterbodies With State/Tribal/Federal Fish Consumption Advisories[a] (continued)

Facility NPDES	Facility Name	City	Discharge Type	Receiving Stream	Advisory Area/No.[b]	Pollutant	Species	Population[c]	Comments
MI0044415	Double Eagle Steel Coating Co.	Dearborn	Direct	Rouge River	Detroit River	Mercury, PCBs	Freshwater Drum >14", Common Carp	RSP, NCGP, RGP	Advisory within 50 miles downstream of discharge site
MI0043524	Rouge Steel Corp.	Dearborn	Direct		Lake Erie/2	PCBs	Common Carp, Catfish, White Bass 6-22", Coho Salmon >10", Rainbow Trout >10" Smallmouth Bass 14-30", White Perch >6", Walleye >14", Lake Trout >10", Lake Whitefish>6", Freshwater Drum >6"	NCGP, RGP	Advisories within 50 miles downstream of discharge site
					Rouge River, Main Branch	PCBs	Northern Pike, White Sucker, Catfish, Common Carp, Smallmouth Bass, Largemouth Bass, All fish (RGP, NCSP)	NCGP, RGP, NCSP	
NC0045993	Teledyne Allvac	Monroe	Direct	Richardson Creek	All North Carolina Waters Statewide	Mercury	Bowfin	RGP, NCSP	
NE0111287	Nucor Steel	Norfolk	Direct	Spring Branch Creek	Elkhorn River	PCBs, Dieldrin	Common Carp	RGP	Advisory within 50 miles downstream of discharge site
NY0001368	Bethlehem Steel Corp.	Lackawanna	Direct	Smokes Creek	Niagara River/2	PCBs, Mirex, Dioxins	Coho Salmon, Chinook Salmon, American Eel, Channel Catfish, Common Carp, Lake Trout, Brown Trout, White Perch, Rainbow Trout, White Sucker, Smallmouth Bass, All fish (NCSP)	RGP, NCGP, NCSP	Advisories within 50 miles downstream of discharge site
OH0122386	North Star BHP Steel Inc.	Delta	Direct	Maumee River	All Ohio Waterbodies Statewide	Mercury	All Fish Species	RSP	
OH0122271	Worthington Steel	Delta	Direct		Maumee River/2	Mercury, PCBs	Common Carp, Smallmouth Bass, Channel Catfish	RSP, RGP	
					Lake Erie/2	PCBs	White Perch, Lake Trout, Channel Catfish, Common Carp, White Bass, Smallmouth Bass, Chinook Salmon >19", Steelhead Trout, Freshwater Drum,	RGP, NCGP	Advisories within 50 miles downstream of discharge site

Table 38. Direct Discharging Iron and Steel Facilities Located on Waterbodies With State/Tribal/Federal Fish Consumption Advisories[a] (continued)

Facility NPDES	Facility Name	City	Discharge Type	Receiving Stream	Advisory Area/No.[b]	Pollutant	Species	Population[c]	Comments
OH0001562	Republic Engineered Steel	Lorain	Direct	Black River	All Ohio Waterbodies Statewide	Mercury	All Fish	RSP	
					Lake Erie	PCBs	White Perch, Lake Trout, Channel Catfish, Common Carp, White Bass, Smallmouth Bass, Chinook Salmon >19", Steelhead Trout, Freshwater Drum, Walleye, Coho Salmon	RGP	Advisory within 50 miles downstream of discharge site
					Black River	PCBs	Common Carp, Freshwater Drum, Brown Bullhead Catfish	RGP	
OH0000957	LTV Steel Company Inc.	Cleveland	Direct	Cuyahoga River	All Ohio Waterbodies Statewide	Mercury	All Fish	RSP	
OH0002160	American Steel And Wire Corp.	Cuyahoga Hts.	Direct		Lake Erie	PCBs	White Perch, Lake Trout, Channel Catfish, Common Carp, White Bass, Smallmouth Bass, Chinook Salmon >19", Steelhead Trout, Freshwater Drum, Walleye, Coho Salmon	RGP	Advisory within 50 miles downstream of discharge site
					Cuyahoga River	Mercury, PCBs	White Sucker, Common Carp, Brown Bullhead Catfish, Yellow Bullhead Catfish, Largemouth Bass	RSP, RGP	
OH0101079	Warren Consolidated Industry	Warren	Direct	Mahoning River	All Ohio Waterbodies Statewide	Mercury	All Fish	RSP	
OH0011207	CSC Industries Incorporated	Warren	Direct		Mahoning River	Mercury, PCBs	Smallmouth Bass, White Crappie, Channel Catfish, Common Carp, Walleye	RSP, RGP, NCGP	
OH0011363	Thomas Steel Strip Corp.	Warren	Direct						
OH0011878	Babcox and Wilcox	Alliance	Direct	Ryans Run	All Ohio Waterbodies Statewide	Mercury	All Fish	RSP	
					Mahoning River	Mercury, PCBs	Smallmouth Bass, White Crappie, Channel Catfish, Common Carp, Walleye	RSP, RGP, NCGP	Advisory within 50 miles downstream of discharge site

Table 38. Direct Discharging Iron and Steel Facilities Located on Waterbodies With State/Tribal/Federal Fish Consumption Advisories[a] (continued)

Facility NPDES	Facility Name	City	Discharge Type	Receiving Stream	Advisory Area/No.[b]	Pollutant	Species	Population[c]	Comments
OH0120588	Ohio Coatings Co.	Yorkville	Direct	Ohio River[d]	All Ohio Waterbodies Statewide	Mercury	All Fish	RSP	
OH0011371	Wheeling-Pittsburgh Steel	Yorkville	Direct		Ohio River/2	Chlordane, PCBs, Mercury	Common Carp, Flathead Catfish, Channel Catfish, Sauger, Hybrid Striped Bass, Spotted Bass, Smallmouth Bass, Largemouth Bass, Freshwater Drum	RGP, NCGP	
OH0011355	Wheeling-Pittsburgh Steel	Mingo Junction	Direct						
OH0011347	Wheeling-Pittsburgh Steel	Steubenville	Direct						
OH0092444	Lukens Inc.	Massillon	Direct	Tuscarawas River	All Ohio Waterbodies Statewide	Mercury	All Fish	RSP	
OH0006939	Republic Engineered Steel	Massillon	Direct						
					Tuscarawas River	PCBs, Hexachloro-benzene	Rock Bass, Common Carp, Smallmouth Bass, Channel Catfish, Yellow Bullhead Catfish, Largemouth Bass	RGP	
OH0005606	Greer Steel Co.	Dover	Direct						
OH0004910	Armco Inc.	Dover	Direct						
OH0004219	Timken Company	Canton	Direct	Hurford	All Ohio Waterbodies Statewide	Mercury	All Fish	RSP	
OH0006921	Republic Engineered Steel	Canton	Direct	East Branch Nimishillen River	Tuscarawas River	PCBs, Hexachloro-benzene	Rock Bass, Common Carp, Smallmouth Bass, Channel Catfish, Yellow Bullhead Catfish, Largemouth Bass	RGP	Advisory within 50 miles downstream of discharge site
OH0007188	J&L Speciality Steel Inc.	Louisville	Direct	East Branch Nimishillen River					
OH0008338	Copperweld Corp.	Shelby	Direct	Black Fork, Mohican River (Tuby Run)	All Ohio Waterbodies Statewide	Mercury	All Fish	RSP	
OH0006858	Armco Inc.	Zanesville	Direct	Muskingum River	All Ohio Waterbodies Statewide	Mercury	All Fish	RSP	
OH0004260	Armco Inc.	Coshocton	Direct						
OH0009997	AK Steel Corporation	Middletown	Direct	Great Miami River	All Ohio Waterbodies Statewide	Mercury	All Fish	RSP	
					Great Miami River/2	Mercury, Lead, PCBs	Channel Catfish, Smallmouth Bass, Common Carp, White Bass, Largemouth Bass, Rock	RGP, RSP, NCGP	

Table 38. Direct Discharging Iron and Steel Facilities Located on Waterbodies With State/Tribal/Federal Fish Consumption Advisories[a] (continued)

Facility NPDES	Facility Name	City	Discharge Type	Receiving Stream	Advisory Area/No.[b]	Pollutant	Species	Population[c]	Comments
OH0006068	New Boston Coke Corp.	New Boston/ Portsmouth	Direct	Ohio River	All Ohio Waterbodies Statewide	Mercury	All Fish	RSP	
					Ohio River	Chlordane, PCBs, Mercury	Common Carp, Flathead Catfish, Channel Catfish, Sauger, Hybrid Striped Bass, Spotted Bass, Smallmouth Bass, Largemouth Bass, Freshwater Drum	RGP, NCGP	
OR0027260	Cascade Steel Rolling Mills	McMinnville	Direct	Trib of South Yamhill River	Willamette River	Mercury	Smallmouth Bass, Largemouth Bass, Squawfish	RGP, RSP	Advisory within 50 miles downstream of discharge site
OR0000469	Oregon Steel Mills Inc.	Portland	Direct	Willamette River	Willamette River	Mercury	Smallmouth Bass, Largemouth Bass, Squawfish	RGP, RSP	
PA0013463	United States Steel Group-USX	Fairless Hills	Direct	Central Canal	Delaware River and Estuary	Chlordane, PCBs	Channel Catfish, American Eel, White Perch	NCGP	Advisory within 50 miles downstream of discharge site
PA0013129	Carpenter Technology Corp	Berks County	Direct	Schuylkill River	Schuylkill River	Chlordane, PCBs	American Eel, Common Carp, White Sucker	NCGP	
PA0011568	Lukens Steel Corp.	Coatesville	Direct	W. Branch Brandywine Creek	Brandywine Creek	Chlordane, PCBs	American Eel	NCGP	Advisory within 50 miles downstream of discharge site
					Brandywine Creek, West Branch	Chlordane, PCBs	American Eel	NCGP	
PA0006327	Allegheny Ludlum Corp	Brackenridge	Direct	Kiskiminetas River	Allegheny River	Chlordane, PCBs	Common Carp, Channel Catfish	NCGP	Advisory within 50 miles downstream of discharge site
					Ohio River	Chlordane, PCBs	Common Carp, Channel Catfish	NCGP	Advisory within 50 miles downstream of discharge site
PA0001996	Standard Steel	Burnham	Direct	Loyalhanna Creek	Allegheny River	Chlordane, PCBs	Common Carp, Channel Catfish	NCGP	Advisory within 50 miles downstream of discharge site
PA0013820	Allegheny Ludlum Steel	Brackenridge	Direct	Allegheny River	Allegheny River	Chlordane, PCBs	Common Carp, Channel Catfish	NCGP	
PA0001406	Braeburn Alloy Steel	Lower Burrell	Direct		Ohio River	Chlordane, PCBS	Common Carp, Channel Catfish	NCGP	Advisory within 50 miles downstream of discharge site
PA0003620	Pittsburgh Flatroll Co.	Pittsburgh	Direct						

Table 38. Direct Discharging Iron and Steel Facilities Located on Waterbodies With State/Tribal/Federal Fish Consumption Advisories[a] (continued)

Facility NPDES	Facility Name	City	Discharge Type	Receiving Stream	Advisory Area/No.[b]	Pollutant	Species	Population[c]	Comments
PA0217034	USX Corp U.S.S. Division	Dravosburg	Direct	Monongahela River	Ohio River	Chlordane, PCBs	Common Carp, Channel Catfish	NCGP	Advisory within 50 miles downstream of discharge site
PA0004073	USS Irvin Plant	Dravosburg	Direct		Monongahela River	Chlordane, PCBs	Common Carp, Channel Catfish	NCGP	
PA0217034	Koppers Industries	Monessen	Direct						
PA0002437	Shenango Inc.- Neville Coke & Iron	Pittsburgh/ Neville Island	Direct	Ohio River	Ohio River	Chlordane, PCBs	Common Carp, Channel Catfish	NCGP	
PA0005754	J & L Specialty Steel Inc.	Midland	Direct						
PA0006335	Koppel Steel Corp	Beaver Falls	Direct						
PA0204315	J & L Structual Inc.	Aliquippa	Direct	Logstown Run	Ohio River	Chlordane, PCBs	Common Carp, Channel Catfish	NCGP	Advisory within 50 miles downstream of discharge site
PA0002721	Washington Steel Corp	Washington	Direct	Chartiers Creek	Ohio River	Chlordane, PCBs	Common Carp, Channel Catfish	NCGP	Advisory within 50 miles downstream of discharge site
PA0002739	Lukens Steel Company	Washington	Direct	Chartiers Run	Chartiers Creek	Chlordane, PCBs	Largemouth Bass, Common Carp	NCGP	Advisory within 50 miles downstream of discharge site
PA0000868	Wheatland Tube Co.	Wheatland	Direct	Shenango River	Shenango River	Chlordane, PCBs	Common Carp	NCGP	
PA0103781	Sharon Tube Company	Sharon	Direct		Ohio River	Chlordane, PCBs	Common Carp, Channel Catfish	NCGP	Advisory within 50 miles downstream of discharge site
PA0002429	Caparo Steel Company Inc.	Farrell	Direct		Beaver River	Chlordane, PCBs	Common Carp, Channel Catfish	NCGP	Advisory within 50 miles downstream of discharge site
PA0205222	Koppel Steel Corp.	Koppel	Direct	Trib. To Beaver River	Beaver River	Chlordane, PCBs	Common Carp, Channel Catfish	NCGP	Advisory within 50 miles downstream of discharge site
					Ohio River	Chlordane, PCBs	Common Carp, Channel Catfish	NCGP	Advisory within 50 miles downstream of discharge site

Table 38. Direct Discharging Iron and Steel Facilities Located on Waterbodies With State/Tribal/Federal Fish Consumption Advisories[a] (continued)

Facility NPDES	Facility Name	City	Discharge Type	Receiving Stream	Advisory Area/No.[b]	Pollutant	Species	Population[c]	Comments
PA0006343	Armco Inc.	Butler	Direct	Connoquen-essing Creek	Beaver River	Chlordane, PCBs	Common Carp, Channel Catfish	NCGP	Advisory within 50 miles downstream of discharge site
					Ohio River	Chlordane, PCBs	Common Carp, Channel Catfish	NCGP	Advisory within 50 miles downstream of discharge site
TX0000027	Lone Star Steel Company	Lone Star	Direct	Ellison Creek, Big Cypress Creek	Big Cypress Creek	Mercury	Freshwater Drum, Largemouth Bass	RSP, RGP	Advisory within 50 miles downstream of one discharge site for 1 outfall and on receiving stream for another outfall
TX0067695	N. Star Steel Texas Inc.	Rose City	Direct	Trib. To Neches River	Gulf of Mexico	Mercury	King Mackerel	RSP, RGP	Advisory within 50 miles downstream of discharge site
TX0007706	USS Ce-Tex Center	Baytown	Direct	East Ditch	Houston Ship Channel and Contiguous Waters	Dioxins	Catfish, Blue Crab	RGP	Advisory within 50 miles downstream of discharge site
					Gulf of Mexico	Mercury	King Mackerel	RSP, RGP	Advisory within 50 miles downstream of discharge site
WV0004499 WV0004502 WV0023281	Wheeling-Pittsburgh Steel Wheeling-Nisshin Inc. Wheeling-Pittsburgh Steel	Follansbee Follansbee Wheeling	Direct Direct Direct	Ohio River	Ohio River	Chlordane, PCBs, Dioxins	Common Carp, Channel Catfish, Smallmouth Bass, Largemouth Bass, White Bass, Freshwater Drum, Flathead Catfish, Hybrid Striped Bass, Sauger	NCGP, RGP	
WV0003336	Weirton Steel Corporation	Weirton	Direct	Harmon Creek/Ohio River	Ohio River	Chlordane, PCBs, Dioxins	Common Carp, Channel Catfish, Smallmouth Bass, Largemouth Bass, White Bass, Freshwater Drum, Flathead Catfish, Hybrid Striped Bass, Sauger	NCGP, RGP	Advisory within 50 miles downstream of discharge site for 3 outfalls and on receiving stream for 3 additional outfalls

Table 38. Direct Discharging Iron and Steel Facilities Located on Waterbodies With State/Tribal/Federal Fish Consumption Advisories[a] (continued)

Footnotes:

NOTE: Facilities may be located on waterbodies with fish consumption advisories issued by other states (e.g., Ohio River - PA, OH, KY). Advisories are listed based on location (state) of facility.
Based on facilities (sample set) included in environmental assessment.

Source: 1997 Update of Listing of Fish and Wildlife Advisories (LFWA), March 1998.

NCGP	=	No consumption advisory for general population
NCSP	=	No consumption advisory for sensitive subpopulations (e.g., pregnant women, nursing mothers, children)
RGP	=	Restrict consumption of specific species for general population
RSP	=	Restrict consumption of specific species for sensitive subpopulations
CFP	=	Commercial fishing ban

a	=	Includes advisories within 50 miles downstream of discharge site as noted.
b	=	Multiple advisories have been combined.
c	=	Consumption of specific species by specific populations not noted. See LFWA for this information.
d	=	See WV0004499/WV0004502/WV0023281.

Table 39. Significant Noncompliance (SNC) Rates for Iron and Steel Mills

Industry	Number of Facilities	Percentage of Facilities in Significant Noncompliance as of June 1998			Historical Noncompliance*				Key Compliance and Environmental Problems
		Air	Water	RCRA	Air	Water	RCRA	Total	
Integrated Mills	23	72.7%	39.1%	30.4%	5.0	5.4	5.7	7.9	Groundwater slag contamination, contaminated sediment, arc furnace dust, unregulated sources, SNCs from reoccurring and single peak violations, no baseline testing
Mini Mills	91	21.2%	2.7%	4.5%	1.5	2.7	1.7	3.9	

Note: SNC data are based on inspected facilities. SNC refers to the most egregious violations under each program or statute.
* Average number of quarterly periods, June 1996 - June 1998, with one or more violations or noncompliance events.

Source: *Enforcement and Compliance Assurance, FY 98 Accomplishments Report*, USEPA Office of Enforcement and Compliance Assurance, June 1999.

Table 40. Summary of Environmental Effects/Benefits of the Proposed Effluent Guidelines and Standards for the Iron and Steel Industry [a]

	Current	Proposed Rule	Summary of Benefits
Loadings (million lb/yr) [b, c]	253	198	22 percent reduction
Number of Instream Excursions for Pollutants That Exceed AWQC	269 at 55 streams	175 at 51 streams	4 streams become "contaminant-free" [d] Monetized benefits (recreational/nonuse) = $0.38 to $1.35 million
Excess Annual Cancer Cases [e]	0.31	0.29	Reduction of 0.02 cases each year Monetized benefits = $0.05 to $0.25 million
Population Potentially at Risk to Lead Exposure [e]	948,000	948,000	Annual benefits: • Reduction of 0.036 cases of adult and neonatal premature mortality • Prevention of aggregate loss of 57 IQ points in children Monetized benefits = $0.64 to $1.01 million
Population Potentially Exposed to Other Noncarcinogenic Health Risks [e]	900	none	Health effects to exposed population eliminated Benefits not quantifiable
POTWs Experiencing Inhibition	none of 61	none of 61	No baseline impacts
Improved POTW Biosolid Quality	0 metric tons	0 metric tons	No baseline impacts
Total Monetized Benefits			**$1.07 to 2.61 million** (1997 dollars)

a. Modeled results from 103 direct and 47 indirect facilities were extrapolated to represent 198 iron and steel facilities.
b. Loadings are representative of 60 priority and nonconventional pollutants evaluated; 4 conventional pollutants and 6 nonconventional pollutants are not included.
c. Loadings account for POTW removals.
d. "Contaminant-free" from iron and steel discharges; however, potential contamination from other point source discharges and nonpoint sources is still possible.
e. Through consumption of contaminated fish.

5. REFERENCES

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NOTE: Most of these references are available in the Environmental Assessment/Benefits Docket (W-99-24).