INDEX TO THE

MINNESOTA REGIONAL COPPER-NICKEL STUDY

Prepared by:

Susan M. Tertell
Environmental Conservation Library
Minneapolis Public Library
and Information Center
300 Nicollet Mall
Minneapolis, Minnesota 55401

November 24, 1980
# CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>i</td>
</tr>
<tr>
<td>Report Organization</td>
<td>ii</td>
</tr>
<tr>
<td>Subject Index</td>
<td>1</td>
</tr>
<tr>
<td>Author Index</td>
<td>68</td>
</tr>
<tr>
<td>Abbreviations</td>
<td>72</td>
</tr>
</tbody>
</table>
The Minnesota Regional Copper-Nickel Study is a comprehensive examination of the potential cumulative environmental, social and economic impacts of copper-nickel development in northeastern Minnesota. It was conducted from 1976 through 1978 by a special study team assembled by the Minnesota Environmental Quality Board. Funding for the study was provided by the Legislative Commission on Minnesota Resources.

This index is intended to be a guide to this wide-ranging and detailed study, which encompasses approximately 3,790 pages in 5 volumes totalling 36 chapters. The index is detailed and comprehensive. Efforts have been made to standardize terminology where this is possible, and there are liberal cross-references. The reader also is encouraged to make use of the tables of contents included in each of the chapters, since these show more readily the hierarchical organization of the subject areas covered in the study.

Each chapter of volumes 2-5 was published separately, with separate paging. For this reason each index entry refers to both volume and chapter, as well as page.
# MINNESOTA REGIONAL COPPER-NICKEL STUDY

## Report Organization

### Volume 1 - Executive Summary
- Chapter 1: Historical Perspective
- Chapter 2: Study Goals and Objectives
- Chapter 3: Study Area and Mineral Resources
- Chapter 4: Copper-Nickel Alternatives
- Chapter 5: Environmental, Economics, Social, and Fiscal Impacts Issues
- Chapter 6: Major Trade Off Areas
- Chapter 7: Report Organization and Study Documentation (Appendix)

### Volume 2 - Technical Assessment
- Chapter 1: Exploration
- Chapter 2: Mineral Extraction (Mining)
- Chapter 3: Mineral Processing
- Chapter 4: Smelting and Refining
- Chapter 5: Integrated Development Models

### Volume 3 - Physical Environment
- Chapter 1: Geology and Mineralogy
- Chapter 2: Mineral Resources Potential
- Chapter 3: Air Resources
- Chapter 4: Water Resources
- Chapter 5: Noise

### Volume 4 - Biological Environment
- Chapter 1: Aquatic Biology
- Chapter 2: Terrestrial Biology

### Volume 5 - Human Environment
- Chapter 1: Human Populations
- Chapter 2: Public Health
- Chapter 3: Land Use Overview
- Chapter 4: Lands and Minerals Ownership
- Chapter 5: Mine Lands
- Chapter 6: Forest Lands and the Forest Products Industry
- Chapter 7: Residential Settlement Patterns
- Chapter 8: Transportation
- Chapter 9: Outdoor Recreation
- Chapter 10: Natural, Scientific, and Historical Areas
- Chapter 11: Regional Energy Systems
- Chapter 12: Government Taxes and Aids
- Chapter 13: Community Services, Costs and Revenue Projections
- Chapter 14: Characteristics of the Mineral Industry: Copper, Nickel, Cobalt
- Chapter 15: Regional Economics
- Chapter 16: Local Economic Analysis: A Case Study of Ely
- Chapter 17: State Mineral Policy and Copper-Nickel Mining Profitability

---

ii
SUBJECT INDEX

A -

Accidents, v. 5, ch. 2, pp. 46-49.
  chemical spills, v. 5, ch. 8, p. 22.
  rates, v. 5, ch. 2, pp. 5-6.
Acid mist, v. 2, ch. 4, pp. 70-71.
Acid plants, see Sulfuric acid plants.
Acid precipitation, v. 1, ch. 5, pp. 41-44; v. 3, ch. 4, pp. 13, 76-87; v. 4, ch. 1, pp. 82, 83.
  average pH of rain, v. 5, ch. 9, p. 19, figure 13.
  effect on natural and scientific areas, v. 5, ch. 10, p. 18.
  effect on recreation, v. 5, ch. 9, pp. 17, 19-20.
  effect on terrestrial ecosystems, v. 4, ch. 2, pp. 150-152.
  effect on vegetation, v. 4, ch. 2, table 25.
Acidity,
  and buffering of surface water, v. 3, ch. 4, pp. 57-60.
  of surface water, v. 4, ch. 1, pp. 81-87.
Acids, organic,
  effect on leaching, v. 3, ch. 4, p. 154.
Actinolite,
  fibers, v. 3, ch. 2, pp. 60-61.
  Actinolite-tremolite, v. 3, ch. 1, p. 68.
  asbestiform variety, v. 3, ch. 3, p. 106.
Adiabatic process, v. 2, ch. 4, pp. 21-22.
Age structure,
  of human populations, v. 5, ch. 1, pp. 5-6, table 2.
Agriculture,
Air, v. 3, ch. 3.
Air emissions, v. 2, ch. 4, pp. 65-66, 69-141; see also Nitrogen oxides; Particulates; Sulfur dioxides.
  ambient vs. occupational environment, v. 2, ch. 4, pp. 107-108.
  effect on water quality, v. 3, ch. 4, pp. 75-87.
  gaseous fugitives, v. 2, ch. 4, pp. 133-134.
  models, v. 2, ch. 4, pp. 82-84.
  particulate fugitives, v. 2, ch. 4, pp. 135-141.
  from refinery, v. 2, ch. 4, pp. 69-71.
  from smelter, v. 2, ch. 4, pp. 71-84.
  control devices for weak gas streams, v. 2, ch. 4, pp. 105-124.
  effect of upset conditions, v. 2, ch. 4, pp. 96-97.
  models, v. 2, ch. 4, pp. 121-123.
Air emissions (continued)
source simulation models, v. 3, ch. 3, pp. 11-13, 21-23, 146-175.
State Implementation Plan (SIP), v. 3, ch. 3, p. 32.
upset conditions,
weak gas streams, v. 2, ch. 4, p. 124.

Air pollution,
classes of effects on forested ecosystems, v. 4, ch. 2, p. 135.
effect on terrestrial ecosystems, v. 4, ch. 2, p. 10, 135-158.
mitigation and reclamation, v. 4, ch. 2, pp. 157-158.

Air quality,
av. 1, ch. 5, pp. 34-36.
emission standards, v. 3, ch. 3, pp. 36-37.

Alder, black (Ilex verticellata), v. 4, ch. 2, p. 46.
Alder, speckled (Alnus rugosa), v. 4, ch. 2, pp. 39, 46.
Alder carrs, see Carr, alder.
Algae, see Phytoplankton.
Alkalinity, of surface water, v. 3, ch. 4, pp. 57-58.
Alloys,
Alton Lock and Dam 26, v. 5, ch. 8, p. 12.
Alumina,
use in smelting, v. 2, ch. 4, pp. 16-17, 19.
Aluminum,
toxicity to vegetation, v. 4, ch. 2, p. 151.
AMAX,
bulk samples, v. 2, ch. 1, p. 20.
exploration in zone 4, v. 2, ch. 1, p. 10.
exploration on Bear Creek leases, v. 5, ch. 4, pp. 20, 21.
Minnesota surface lease, v. 5, ch. 4, p. 21.
operating plans, v. 5, ch. 5, pp. 20-21.
proposed capacity of operation, v. 2, ch. 5, p. 4.
Ambulance services, v. 5, ch. 2, p. 33.
American Metals Climax, see AMAX.
Minneapolis mineral lease, v. 5, ch. 4, p. 20.
operating problems, v. 2, ch. 4, p. 113.
Amoco, Minnesota pipeline, v. 5, ch. 11, p. 9.
Amphibole fibers, see Fibers.
Anemone, wood (Anemone quinquefolia), v. 4, ch. 2, p. 68.
Anorthositic series, v. 3, ch. 1, pp. 11, 41-43.
Aquatic biology, v. 4, ch. 1.
Aquatic biota, changes due to stress, v. 4, ch. 1, pp. 50-51.
diversity of communities, v. 4, ch. 1, pp. 51-52.
impacts of loss of terrestrial vegetation, v. 4, ch. 1, pp. 103-105.
recolonization, v. 4, ch. 1, pp. 53-55.
species composition, v. 4, ch. 1, p. 51.
Aquatic ecosystems, effect of acid precipitation, v. 4, ch. 1, pp. 84-85.
effect of physical changes, v. 4, ch. 1, pp. 87-105.
impact assessment, v. 4, ch. 1, pp. 49-60.
impact of metals pollution, v. 4, ch. 1, pp. 77-80.
of streams, v. 4, ch. 1, pp. 11-26.
recovery from stress, v. 4, ch. 1, p. 52.
sensitivity, v. 4, ch. 1, pp. 45-49.
seasonal variation, v. 4, ch. 1, pp. 48-49.
"significant impact," v. 4, ch. 1, pp. 52-54.
Aquatic plants, see Macrophytes.
Aquifers, v. 3, ch. 4, pp. 44-46.
Archeological sites, v. 5, ch. 10, pp. 3-4, table 1.
Arethusa (Arethusa bulbosa), v. 4, ch. 2, pp. 45, 52.
Arizona, tax revenues over life of mine, v. 5, ch. 17, appendix C.
taxation of mineral industries, v. 5, ch. 17, pp. 51-57, appendix A.
emissions from smelter, v. 2, ch. 4, p. 129.
NIOSH occupational standard for exposure, v. 5, ch. 2, p. 50.
toxicity, v. 2, ch. 4, p. 13; v. 5, ch. 2, p. 11.
toxicity to aquatic biota, v. 4, ch. 1, p. 70, figure 34.
Arsenolite, v. 2, ch. 4, p. 129.
Artesian (confined) aquifers, v. 3, ch. 4, pp. 44-45.
Asbestiform fibers, see Fibers.
Asbestos,
effect on health, v. 5, ch. 2, pp. 68-72.
Asbestosis, v. 5, ch. 2, pp. 7-8.
Ash, black (Fraxinus nigra), v. 4, ch. 2, pp. 39, 54-56.
Ash, mountain (Sorbus americana), v. 4, ch. 2, pp. 56, 75.
Aspect ratio, v. 3, ch. 1, pp. 67, 68.
Aspen,
commercial use, v. 5, ch. 6, p. 12.
Aspen, trembling (Populus tremuloides), v. 4, ch. 2, pp. 39, 68-75.
Aster, fringed blue (Aster ciliolatus), v. 4, ch. 2, p. 68.
Aster, large-leaved (Aster macrophyllus), v. 4, ch. 2, pp. 57, 59, 63, 68, 72, 75.
Aster, swamp blue (Aster puniceus), v. 4, ch. 2, p. 55.
Atikokan generating station,
effect on particulate concentrations, v. 3, ch. 3, p. 124.
Aurora (community),
economic importance of iron ore mining, v. 5, ch. 5, p. 10.
residential settlement, v. 5, ch. 7, pp. 16, 17.
Autogenous mills, see Grinding mills.

B -

Babbitt (community),
economic importance of iron ore mining, v. 5, ch. 5, p. 10.
projected city expenditures with copper-nickel development, v. 5, ch. 13, p. 28.
"taconite town," v. 5, ch. 7, p. 10; v. 5, ch. 15, pp. 4-5.
advantages and disadvantages, v. 2, ch. 2, pp. 28-29.
Baghouse,
Baird Sale, v. 4, ch. 2, pp. 91, 104.
Ball mills, see Grinding mills.
Base industry,
definition, v. 5, ch. 15, p. 20.
Bass-Dry Lakes National Natural Landmark (proposed), v. 5, ch. 10, p. 6.
Basswood, (Tilia americana), v. 4, ch. 2, pp. 68-69.
Bear, black (Ursus americanus), v. 4, ch. 2, pp. 28, 61, 86-87.
Bear Creek Mining Co.,
Bear Creek Mining Co. (continued)

Minnesota mineral lease, v. 5, ch. 4, p. 20.

Special Use Permit in SNF, v. 5, ch. 4, p. 19.

surface exploration in Gunflint area, v. 2, ch. 1, p. 6.

Bear Island Lake,

lakeshore development, v. 5, ch. 7, p. 11.


Beaver (Castor canadensis), v. 4, ch. 2, pp. 28, 43, 84.


Bedstraw, sweet (Galium triflorum), v. 4, ch. 2, p. 72.


reagents,
effect on aquatic biology, v. 4, ch. 1, pp. 60-81.

Benville (community),


Bicarbonate,
in surface water, v. 3, ch. 4, p. 58.

Birch,
commercial use, v. 5, ch. 6, p. 13.

Birch, dwarf (Betula pumila), v. 4, ch. 2, p. 48.

Birch, paper (Betula papyrifera), v. 4, ch. 2, pp. 39, 68-75.

Birds, see also Game birds; Raptors; Songbirds.

Birds,
of alder carrs, v. 4, ch. 2, p. 47.
of cedar bogs, v. 4, ch. 2, p. 54.
of conifer mature uplands, v. 4, ch. 2, pp. 63-64.
of deciduous clearcuts, v. 4, ch. 2, p. 70.
of deciduous mature uplands, v. 4, ch. 2, pp. 72-74.
of deciduous regenerating stands, v. 4, ch. 2, p. 71.
disruption of nesting behavior due to noise, v. 4, ch. 2,

pp. 164, 165, 166.
of mixed deciduous-coniferous uplands, v. 4, ch. 2, pp. 76-77.
of special interest in Study Area, v. 4, ch. 2, pp. 81-91.
of spruce bogs, v. 4, ch. 2, pp. 50-51.
of tamarack bogs, v. 4, ch. 2, p. 53.
waterfowl, v. 4, ch. 2, pp. 85-86.


Biwabik (community),

residential settlement, v. 5, ch. 7, pp. 16, 17.

Biwabik formation, v. 3, ch. 1, pp. 8, 9.

groundwater, v. 3, ch. 4, p. 7.


Blister copper, see Copper, blister.

Blueberry (Vaccinium augustifolium and Vaccinium myrtilloides),
v. 4, ch. 2, pp. 48, 57, 63.

Bobcat (Lynx rufus), v. 4, ch. 2, pp. 54, 90.

Bogs and swamps,

land cover, v. 5, ch. 3, p. 10.
Bogs and swamps (continued)

Land cover - year 2000, v. 5, ch. 3, p. 73.
Bogs, black spruce, v. 4, ch. 2, pp. 47-51.
Bogs, cedar, v. 4, ch. 2, pp. 53-54.
Bogs, heath, v. 4, ch. 2, pp. 44-46.
Bogs, tamarack, v. 4, ch. 2, pp. 51-53.
Bond Index, see Grinding, energy requirements.
"Boom town" phenomenon, v. 5, ch. 13, pp. 10-11.
Borrow, see Overburden.

Boundary Waters Canoe Area (BWCA), v. 5, ch. 5, p. 26.
- protection from mine development, v. 5, ch. 9, p. 14.
- tourism industry, v. 5, ch. 15, p. 7.


Bridges, crossing Duluth-Superior harbor, v. 5, ch. 8, p. 11.

Britt (community),

Budworm, spruce, v. 4, ch. 2, pp. 79, 104.

Building permits,
- number issued, v. 5, ch. 7, pp. 18-21; figure 4, 5, 6; table 3, 4, 5, 6.

Bulk flotation, see Flotation.

Bunchberry (Cornus canadensis), v. 4, ch. 2, pp. 48, 57, 63.

Burlington Northern, Inc. (BN), v. 5, ch. 8, pp. 6, 7, 8, 9.


Burntside Lake,
- lakeshore development, v. 5, ch. 7, pp. 11, 12.

C -

Caddisflies (Trichoptera), v. 4, ch. 1, p. 18.

Cadmium,
- damage to vegetation, v. 4, ch. 2, p. 139.
- effect on health, v. 5, ch. 2, p. 8; v. 5, ch. 2, pp. 72-74.
- emissions from smelter, v. 2, ch. 4, p. 129; v. 3, ch. 3,
  p. 160, table 68.
- in soils, v. 3, ch. 1, p. 32.
- toxicity to aquatic biota, v. 4, ch. 1, p. 69, figure 31.

Calcine, v. 2, ch. 4, p. 16.

Calcine saturation index (CST), v. 3, ch. 4, pp. 9, 59, table 14, 15.

Calcium,
- in surface water, v. 3, ch. 4, pp. 53-54.
- Calcium-based scrubbing systems, v. 2, ch. 4, pp. 116-120.
Cancer, v. 5, ch. 2, p. 28.
  arsenic-caused, v. 5, ch. 2, pp. 51-52.
  nickel caused, v. 5, ch. 2, pp. 55-56, 57.

Capacity demand,
  for forest products, v. 5, ch. 6, p. 10.

Capital costs,
  for forest products, v. 5, ch. 6, p. 10.
  for local government, v. 5, ch. 13, pp. 16, 17, 18.
  for mining operation, v. 5, ch. 15, p. 24, figure 5.
  for pollution control, v. 5, ch. 17, pp. 30-31, table 7, 8.
  for reclamation, v. 5, ch. 17, pp. 32-33.
  variables for models, v. 2, ch. 5, pp. 30-32.
  by year for integrated mine model, v. 2, ch. 5, table 15.

Capital facilities,
  repayment of cost, v. 5, ch. 13, p. 2.

  for forest products, v. 5, ch. 6, p. 10.

Carbon monoxide,
  effect on health, v. 5, ch. 2, pp. 53-54.

  toxicity to aquatic biota, v. 4, ch. 1, p. 72.

  and stream order, v. 4, ch. 1, p. 17, figure 9.

Cash flow,
  see discounted cash flow rate of return.

Cash flow, see discounted cash flow rate of return.

Cathode (Dumetella carolinensis), v. 4, ch. 2, p. 47.

Cave, v. 5, ch. 2, p. 38.
  commercial use, v. 5, ch. 6, p. 13.
  commercial use, v. 5, ch. 6, p. 13.

Cedar, v. 5, ch. 6, p. 13.
  northern white (Thuja occidentalis), v. 4, ch. 2, pp. 39, 53-54.
  Chickadee, black-capped (Parus atricapillus), v. 4, ch. 2, pp. 64, 73, 77.
  Chickadee, boreal (Parus hudsonicus), v. 4, ch. 2, p. 51.
  Chipmunk, eastern (Tamias striatus), v. 4, ch. 2, pp. 28, 74, 75.
  Chipmunk, least (Eutamias minimus), v. 4, ch. 2, pp. 28, 54, 60-61, 66, 71.
  Chironomids (Diptera), v. 4, ch. 1, p. 18.

Chloride,
  in surface water, v. 3, ch. 4, p. 54.
  in tailing basins, v. 3, ch. 4, p. 173.

Chlorine,
  emissions from smelter, v. 2, ch. 4, p. 130.

Chlorophyll a, v. 4, ch. 1, p. 17, figure 9.

Chromium,
  in soils, v. 3, ch. 1, p. 32.
Chrysotile, v. 3, ch. 3, p. 140; v. 3, ch. 1, p. 68.
CIPEC (Intergovernmental Council of Copper Exporting Countries), v. 5, ch. 14, pp. 7-8.
Cisco (Coregonus artedi), v. 4, ch. 1, p. 23.
Citrate,
effect on leaching, v. 3, ch. 4, p. 154.
Claus process, v. 2, ch. 4, p. 91.
Clay, v. 3, ch. 1, p. 20; see also Surficial materials.
Clean Air Act Amendments of 1977, v. 5, ch. 10, pp. 11-12.
  sky conditions, v. 3, ch. 3, pp. 41-47.
Climatological Dispersion Model (CDM), v. 3, ch. 3, p. 25.
Climax theory,
of forest types (Clements), v. 4, ch. 2, p. 19.
Clinical studies, v. 5, ch. 2, pp. 18-19.
Clinopyroxene, v. 3, ch. 1, p. 65, figure 29.
Cloudberry (Rubus chamaemorus), v. 4, ch. 2, pp. 97-98.
Clouds, v. 3, ch. 3, pp. 41-47.
Coal, v. 5, ch. 11, pp. 9-10.
  consumption, v. 5, ch. 11, pp. 9-10, figure 3.
  increased use, v. 3, ch. 3, p. 83.
Coal gasification, v. 5, ch. 11, pp. 7-8.
  experimental plant - Erie Mining Co., v. 5, ch. 11, pp. 2, 7.
  UMD plant for space heating, v. 5, ch. 11, p. 8.
Cobalt, v. 5, ch. 5, p. 19.
    Malenbaum forecasts, v. 5, ch. 14, p. 45.
  demand, price, production,
  emissions from smelter, v. 2, ch. 4, p. 129.
  forecasts of supply, demand, price, v. 5, ch. 14, pp. 44-45.
  from ocean mining, v. 5, ch. 14, p. 16.
  price, v. 5, ch. 14, pp. 43-44.
  recovery from electrorefining of nickel, v. 2, ch. 4, p. 59.
  recovery processes, v. 2, ch. 4, pp. 52-53.
  resource estimates, v. 1, ch. 3, pp. 6-12.
  toxicity to aquatic biota, v. 4, ch. 1, p. 68, figure 29.
Collectors, see Flotation, chemical reagents.
Collectors (Zooplankton)
in Kawishivi R., v. 4, ch. 1, p. 23
in mid-reach streams, v. 4, ch. 1, p. 21.

Coltsfoot, early sweet (Petasites palma tus), v. 4, ch. 2, p. 68.
Comandra, northern (Geocaulon lividum), v. 4, ch. 2, p. 32, 49, 98.

Commercial services,

Commodities Research Unit (CRU),

Commuting, v. 5, ch. 1, p. 11.
distance to work (average), v. 5, ch. 7, pp. 35-36, table 24.
effect of distance to work on residential settlement, v. 5, ch. 7,

Conate water,
from drilling, v. 2, ch. 1, pp. 21-22.

Concentrate, v. 3, ch. 2, pp. 41-49.
additional facilities for filtration and drying, v. 2, ch. 3, p. 93.
chemical composition, v. 2, ch. 4, pp. 125-126, table 22; v. 3,
ch. 1, p. 4, table 1, 2.
chemistry, v. 3, ch. 2, pp. 41-47.
grade and recovery values, v. 2, ch. 5, pp. 24-25.
physical characteristics, v. 3, ch. 2, p. 49.
transportation, v. 5, ch. 8, p. 2.

Concentration, see Beneficiation.
Conifer uplands, v. 4, ch. 2, p. 5.
Conifer wetlands, v. 4, ch. 2, p. 6.

Conifers,
Conoco, see Continental Oil Co.

Construction,
impacts on population, v. 5, ch. 1, pp. 18-20.
indirect impacts on economy, v. 5, ch. 15, p. 29, figure 7.
transportation demands, v. 5, ch. 8, p. 13.
work force required, v. 5, ch. 15, p. 22.

Construction industry
Continental Oil Co., v. 5, ch. 11, p. 8.

Contouring
of waste rock piles, v. 2, ch. 2, pp. 52-53.

Converters, v. 2, ch. 4, pp. 34-37.
air emissions, v. 2, ch. 4, pp. 77-78.
capital costs, v. 2, ch. 4, pp. 35-36.
control of sulfur dioxide emissions, v. 2, ch. 4, pp. 34-35.
Hoboken, v. 2, ch. 4, figure 7, 24.
advantages, v. 2, ch. 4, pp. 34-35.
Pierce-Smith, v. 2, ch. 4, figure 6, 23.
top blown rotary, v. 2, ch. 4, pp. 34, 36-37, figure 27.
chemical formulas, v. 2, ch. 4, p. 33.
of nickel matte, v. 2, ch. 4, pp. 36-37.
Conveyors, v. 2, ch. 2, pp. 12, 16.
Copper,
amount lost in slag, v. 2, ch. 4, p. 20.
blister, v. 2, ch. 4, p. 54, table 5.
consumption,
A.D. Little forecasts, v. 5, ch. 14, p. 27.
cost of discovery, v. 2, ch. 1, p. 3.
effect of market conditions on dcfror, v. 5, ch. 17, pp. 21-22.
effect of mill recovery on dcfror, v. 5, ch. 17, p. 23.
effect of price, mill recovery and ore grade on dcfror, v. 5,
ch. 17, p. 2.
emissions from smelter, v. 2, ch. 4, p. 129.
end-use industries, v. 5, ch. 14, pp. 18-19.
forecasts of supply, demand, price, v. 5, ch. 14, pp. 21-32.
leading companies, v. 5, ch. 14, p. 6.
loadings in soil, v. 4, ch. 2, pp. 139-141.
price and dcfror, v. 5, ch. 17, pp. 2, 4, 60-63.
prices, v. 5, ch. 14, pp. 20-21, figure 2.
A.D. Little forecasts, v. 5, ch. 14, p. 28.
production, primary and secondary,
production and price,
resource estimates, v. 1, ch. 3, pp. 6-12; v. 2, ch. 2, p. 2,
v. 3, ch. 2, pp. 6-7, table 1, 2; v. 5, ch. 5, pp. 18-19.
resource estimates by zone, v. 5, ch. 5, table 9.
sensitivity of dcfror to price changes, v. 5, ch. 17, p. 22.
soils (copper in soils), v. 3, ch. 1, p. 31.
toxicity to aquatic biota, v. 4, ch. 1, pp. 63-65, 67, figure 27.
U.S. demand,
U.S. supply, primary & secondary,
Copper (continued)
world production capacities, v. 5, ch. 14, pp. 4-6, table 1.
world resources, v. 5, ch. 14, table 3.
Copper industry, v. 5, ch. 14, pp. 4-9.
Copper equivalent units (CEU), v. 3, ch. 4, p. 23, 186-187; v. 4,
ch. 1, pp. 74-75.
significance of CEU to toxicity, v. 4, ch. 1, pp. 75-77.
Copper-nickel ratio, v. 3, ch. 2, pp. 7-10, figure 6.
Copper-Nickel Study Area, v. 1, ch. 3, pp. 5-6.
bedrock geology (map), v. 3, ch. 1, figure 3, 4.
development zones, v. 3, ch. 2, pp. 2-3, figure 2.
development zones,
biological impacts, v. 4, ch. 2, pp. 102-111.
susceptibility to air pollution impacts, v. 4, ch. 2, 152-157.
susceptibility to leachate impacts, v. 4, ch. 2, pp. 162-163.
resource zones, v. 3, ch. 2, pp. 2-3, figure 2.
resource zones (map), v. 2, ch. 1, figure 1.
Coral root (Corallorhiza maculata), v. 4, ch. 2, p. 63.
Cougar, eastern (Felis concolor schorgeri), v. 4, ch. 2, p. 35.
Cranberry, bog (Vaccinium oxycoccos), v. 4, ch. 2, pp. 44, 51.
Creeper, brown (Certhia familiaris) v. 4, ch. 2, p. 64.
Critical temperatures,
for furnace operation, v. 2, ch. 4, p. 23.
Crocodolite, v. 3, ch. 1, p. 68.
cone crusher, v. 2, ch. 3, p. 16.
gyratory crusher, v. 2, ch. 3, p. 15, figure 5.
in underground mining, v. 2, ch. 2, p. 16.
secondary, v. 2, ch. 3, p. 16.
Cummingtonite,
fibers, v. 3, ch. 2, pp. 60-61.
Cut-and-fill method, see Ground support, in underground mining.
Cycloning, see Tailing, separation of sand fractions.
Cytospora canker, v. 4, ch. 2, p. 95.

D -
Dace, blacknose (Rhinichthys atratulus), v. 4, ch. 1, p. 19.
Dace, finescale (Chrosomus neogaeus), v. 4, ch. 1, p. 19.
Daphnia pulicaria,
toxicity of leachate, v. 4, ch. 1, pp. 71-72, table 23.
Davy Power Gas
scrubbing system, v. 2, ch. 4, p. 115, figure 50.
dcfro, see Discounted cash flow rate of return.
Death rate, see Mortality rate.
Debt,  
effect on dcfror, v. 5, ch. 17, pp. 33-34.  
Debt/equity ratio, v. 5, ch. 17, pp. 33-34.  
Debt service cost,  
for local government, v. 5, ch. 13, p. 15.  
Debt service multiplier, see Capital facilities, repayment of cost.  
Deciduous uplands, v. 4, ch. 2, pp. 4-5.  
Deer, white-tailed (Odocoileus virginianus) v. 4, ch. 2, pp. 28-29, 48, 76, 82-83.  
effects of snowmobiles, v. 4, ch. 2, pp. 164-165.  
Delaney clause, v. 5, ch. 2, p. 15.  
Demographics, see also Population.  
Demographics,  
health-related, v. 5, ch. 2, pp. 2-4, 26-27.  
historical, v. 5, ch. 1, pp. 3-6.  
population and households in Study Area, v. 5, ch. 7, table 2.  
projected population without copper-nickel development, v. 5, ch. 1, pp. 7-14.  
Density  
of rock, v. 3, ch. 1, p. 53.  
Dependancy ratios, v. 5, ch. 1, pp. 5-6, table 2.  
Depressants, see Flotation, chemical reagents.  
Dermatitis,  
arsenic-caused, v. 5, ch. 2, pp. 50, 51.  
nickel-caused, v. 5, ch. 2, pp. 56, 57.  
Development zones, see Copper-Nickel Study Area, development zones.  
Dewberry (Rubus pubescens), v. 4, ch. 2, pp. 55, 63, 71.  
Diatoms,  
in headwater streams, v. 4, ch. 1, figure 10.  
in Kawishiwi River, v. 4, ch. 1, p. 22.  
in mid-reach streams, v. 4, ch. 1, p. 20.  
sensitivity to metal pollution, v. 4, ch. 1, p. 73.  
in streams impacted by mining, v. 4, ch. 1, pp. 24-25.  
Differential flotation, see Flotation.  
Dimethylaniline, see DMA.  
Dip,  
of geological contact, v. 3, ch. 1, p. 52.  
Discounted cash flow rate of return (dcfror), v. 5, ch. 17, pp. 5-8.  
comparison of major cash flow variables, v. 5, ch. 17, pp. 57-59.  
effect of cash flow variables, v. 5, ch. 17, pp. 16-50.  
effect of operating costs, v. 5, ch. 17, pp. 35-38.  
metal prices required for 15% dcfror, v. 5, ch. 17, pp. 59-63.  
variables affecting dcfror, v. 5, ch. 17, pp. 9-11.
Disease, agent-host-environment relationships, v. 5, ch. 2, pp. 11-12.
causative agents, v. 5, ch. 2, pp. 15-17.
interactions, v. 5, ch. 2, pp. 13-14.
morbidity studies, v. 5, ch. 2, pp. 29-30.
DNA absorption system, v. 2, ch. 4, pp. 92-95.
possible operating problems, v. 2, ch. 4, pp. 94-95.
Dogbane (Apocynum androsaemifolium), v. 4, ch. 2, p. 59.
Dogwood, red osier (Cornus stolonifera), v. 4, ch. 2, p. 46.
definition, v. 2, ch. 1, pp. 16-17.
Drying, of concentrates, v. 2, ch. 4, p. 15.
Duluth Complex, v. 3, ch. 1, pp. 9, 10-13.
anorthositic series rocks, v. 3, ch. 1, pp. 41-43.
mineralogy and chemistry, v. 3, ch. 1, pp. 53-70.
Duluth, Missabe and Iron Range Railroad (DM & IR), v. 5, ch. 5, p. 12;
v. 5, ch. 8, pp. 6, 7, 8, 9.
terminus in Ely, v. 5, ch. 16, p. 6.
Duluth-Superior Harbor,
availability to copper-nickel companies, v. 5, ch. 8, p. 17.
capacity and channel depth, v. 5, ch. 8, p. 10.
shipping season, v. 5, ch. 8, p. 11.
tonnages handled, v. 5, ch. 8, p. 10, table 3.
Duluth, Winnipeg and Pacific Railway (DW & P), v. 5, ch. 8, pp. 6, 7, 8, 9.
Dust, v. 3, ch. 3, pp. 161-170; see also Particulates.
from construction activities, v. 3, ch. 3, p. 162.
effect on health, v. 5, ch. 2, pp. 84-86.
effect on natural and scientific areas, v. 5, ch. 10, pp. 16-17.
effect on recreation, v. 5, ch. 9, pp. 16-17.
Dust (continued)

from material handling and storage, v. 2, ch. 4, pp. 136-138.
from material transfer, v. 3, ch. 3, p. 163.
Midwest Research Institute,
    emission factors for area sources, v. 3, ch. 3, pp. 166-169,
table 69.
from open pit mines, v. 3, ch. 3, p. 162.
from ore storage, v. 3, ch. 3, p. 168.
from reverberatory furnaces, v. 2, ch. 4, p. 42.
from roads, v. 3, ch. 3, pp. 112-113.
silt content, v. 3, ch. 3, pp. 165-166.
    stabilization of haul roads, v. 2, ch. 2, p. 66.
from tailing basins, v. 2, ch. 2, p. 41; v. 2, ch. 3, pp. 54-59;
wind necessary for lift-off, v. 2, ch. 3, p. 54.
from trucks on unpaved roads, v. 2, ch. 2, pp. 11-12.
Duval Corp., v. 5, ch. 5, p. 21.
Minnesota mineral lease, v. 5, ch. 4, p. 20.
prospecting permit, v. 5, ch. 4, p. 20.
Special Use Permit in SNF, v. 5, ch. 4, p. 19.

E

Eagle, bald (Haliaeetus leucocephalus), v. 4, ch. 2, pp. 30, 34, 50,
76, 88-89.
possible disturbance of nesting by noise, v. 4, ch. 2, pp. 164, 166.
Eagles Nest Lakes,
lakeshore development, v. 5, ch. 7, pp. 11, 12.
Earnings, see Income.
Economic base theory, v. 5, ch. 15, p. 20; v. 5, ch. 16, pp. 10-11,
table 3.
    employment multipliers, v. 5, ch. 16, p. 15.
    interindustry multipliers, v. 5, ch. 16, pp. 13-14.
Economy, see Local economy; Regional economy.
Ecosystems, see Aquatic ecosystems; Terrestrial ecosystems.
Electricity, v. 5, ch. 11, pp. 10-11.
demand projections, v. 5, ch. 11, pp. 16-19.
    facility requirements, v. 5, ch. 11, pp. 23-27.
    requirements, v. 3, ch. 3, pp. 149-150.
type of fuel used, v. 5, ch. 11, p. 10.
Electrorefining, v. 2, ch. 4, pp. 56-61.
  of copper, v. 2, ch. 4, pp. 56-57.
  energy requirements, v. 2, ch. 4, p. 57.
  of nickel, v. 2, ch. 4, p. 59.
Electrostatic precipitators,
  for particulate removal, v. 2, ch. 4, pp. 101-103, table 14;
Electrowinning,
  of copper, v. 2, ch. 4, pp. 57-58.
  energy requirements, v. 2, ch. 4, p. 58.
  of nickel, v. 2, ch. 4, pp. 60-61.
Ely (community),
  available capacity in schools, v. 5, ch. 13, pp. 6-7.
  characteristics, v. 5, ch. 16, pp. 6-9.
  declining school enrollment, v. 5, ch. 13, p. 46.
  economic importance of iron ore mining, v. 5, ch. 5, p. 10.
  economic importance of recreation, v. 5, ch. 9, pp. 11-12.
  effect on recreation of copper-nickel development, v. 5, ch. 9,
    pp. 24-26.
  history of mining, v. 5, ch. 16, pp. 7-8.
  local economy, see Local economy (Ely).
  projected city expenditures with copper-nickel development, v. 5,
  as recreation center, v. 5, ch. 16, p. 7.
  school financing, v. 5, ch. 13, pp. 44-47.
  school revenues vs. costs, v. 5, ch. 13, p. 37.
Ely Lake,
  lakeshore development, v. 5, ch. 7, pp. 16-17.
Ely-Hinton (community), v. 5, ch. 7, pp. 11-12.
Emarrass (community),
Emarrass River Valley aquifer, v. 3, ch. 4, pp. 7, 8.
Emissions, see Air emissions; Water emissions.
Employment, see Personnel.
Endangered species, see Rare species.
Energy, v. 5, ch. 11; see also Coal; Electricity; Natural Gas; Peat;
  Petroleum.
  annual requirements for copper-nickel operation, v. 5, ch. 11,
    pp. 20-21, table 14.
  conservation,
  consumption, v. 5, ch. 11, pp. 11-13, table 1.
  impacts of copper-nickel development, v. 5, ch. 11, pp. 2-3,
    19-27.
  in industrial sector, v. 5, ch. 11, p. 2.
Energy (continued)
demand projections to 2000, v. 5, ch. 11, pp. 2-3.
industrial consumption, v. 5, ch. 11, pp. 12-13, table 3.
industrial use per employee, v. 5, ch. 11, p. 13, table 5.
projected industrial demands, v. 5, ch. 11, p. 15, table 7, 8, 9.
projected industrial demands and output, v. 5, ch. 11, table 7, 8, 9.
projected residential demands, v. 5, ch. 11, pp. 15-16, table 10.
required per pound of refined metal, v. 2, ch. 4, pp. 164-165.
requirements and supplies, v. 2, ch. 4, pp. 164-166.
requirements by year and type of fuel for integrated mine model,
v. 2, ch. 5, table 16.
requirements by year for integrated mine model, v. 2, ch. 5, table 18.
requirements for exploration and mining phase, v. 2, ch. 5, pp. 22-23.
residential consumption, v. 5, ch. 11, pp. 11-12, table 4.
use by end-use categories, v. 5, ch. 11, table 2.

Epidemiology, v. 5, ch. 2, pp. 18-19.
Erie Mining Co., v. 5, ch. 5, p. 3.
Minnesota lease, v. 5, ch. 4, p. 21.
Minnesota surface lease, v. 5, ch. 4, p. 21.
railroad, v. 5, ch. 8, pp. 6-7, 8.

Esquagama Lake
lakeshore development, v. 5, ch. 7, p. 16.

Eunotia, v. 4, ch. 1, p. 17.


Eveleth (community),
available capacity in schools, v. 5, ch. 13, pp. 6-7.
residential settlement, v. 5, ch. 7, pp. 16, 17.

Eveleth Hippodrome,
historic site, v. 5, ch. 10, p. 8.

Eveleth Taconite and Expansion Co., v. 5, ch. 5, p. 3.
Minnesota lease, v. 5, ch. 4, p. 21.
projected production, v. 5, ch. 5, p. 15.

Exploration, v. 1, ch. 4, pp. 27-28; v. 2, ch. 1.
cost, v. 2, ch. 1, p. 3.
deduction of costs for income tax purposes, v. 5, ch. 12, p. 42.
finding stage, v. 2, ch. 1, p. 9, 11-14.
history, v. 2, ch. 1, pp. 6-7.
proving stage, v. 2, ch. 1, p. 9.
regional appraisal, v. 2, ch. 1, p. 12.
regulation in Minnesota, v. 2, ch. 1, pp. 4-6.
stages, v. 2, ch. 1, pp. 8-10, figure 3.
Exploration (continued)


Exploration and mining,
equivalent years at full production, v. 2, ch. 5, p. 16.
mine life cycle, v. 2, ch. 5, p. 16.
production capacity, v. 2, ch. 5, pp. 15-16.

Explosives
effect on health, v. 5, ch. 2, pp. 54-55.

Export base logic, see Economic base theory.

Exxon Corp.,
Minnesota mineral lease, v. 5, ch. 4, p. 20.
operating plans, v. 5, ch. 5, p. 21.
Special Use permit in SNF, v. 5, ch. 4, p. 19.

F -

Fabric filters,

Falcon, peregrine (Falco peregrinus), v. 4, ch. 2, pp. 30, 34.
False lily-of-the-valley (Maianthemum canadense), v. 4, ch. 2, pp. 57, 68, 75.

False Solomon's seal (Smilacina trifolia), v. 4, ch. 2, pp. 48, 51.
Fathead minnow (Pimephales promelas),
metal toxicity tests, v. 4, ch. 1, p. 63.

Federal Archeological and Historical Preservation Act (P.L. 93-291),
v. 5, ch. 10, p. 3.

Felsic series, v. 3, ch. 1, pp. 11, 12, 41-43.

Fern, bracken (Pteridium aquilinum), v. 4, ch. 2, pp. 66, 72, 76.

Fern, sweet (Comptonia peregrina), v. 4, ch. 2, p. 63
Fibers, v. 1, ch. 5, pp. 65-66; v. 3, ch. 1, pp. 67-70; v. 3, ch. 2,
pp. 40, 56-65; v. 3, ch. 3, pp. 139-145, 227-229; v. 3,
ch. 4, p. 25; see also Particulates.


asbestos amphibole,
level of occurrence, v. 3, ch. 1, p. 70.
background concentrations, v. 3, ch. 3, pp. 11, 174-175.
definition, v. 3, ch. 1, p. 67.
effect of grinding on formation, v. 3, ch. 2, p. 61.
effect on health, v. 5, ch. 2, pp. 7-8, 68-72.
plagioclase, v. 3, ch. 2, pp. 59-60.
in water, v. 3, ch. 1, p. 3; v. 3, ch. 4, pp. 192-194.

Filson Creek,
elevated metal values, v. 3, ch. 4, p. 12.
Filson Creek (continued)
sulfate concentrations, v. 3, ch. 4, pp. 84-85.
Filter-feeders, v. 4, ch. 1, p. 21.
Fir, balsam (Abies balsamea), v. 4, ch. 2, pp. 40, 68, 69.
commercial use, v. 5, ch. 6, p. 13.
Fire,
in pine stands, v. 4, ch. 2, p. 36.
Fire protection, see Public protection.
Fireweed (Epilobium augustifolium), v. 4, ch. 2, p. 59.
Fish,
as source of mercury in diet, v. 5, ch. 2, pp. 78, 79.
detection of temperature gradients, v. 4, ch. 1, p. 96.
frequency in lakes, v. 4, ch. 1, p. 38, table 12.
in mid-reach streams, v. 4, ch. 1, p. 21.
reproduction, v. 4, ch. 1, pp. 88-89.
sensitivity to metal pollution, v. 4, ch. 1, pp. 73-74.
Fisher (Martes pennanti), v. 4, ch. 2, pp. 49-50, 65, 76, 90-91.
Flocculants, see Flotation, chemical reagents.
Florenton (community),
adaptation for Minnesota ores, v. 2, ch. 3, p. 3.
flowsheet, v. 2, ch. 3, figure 3.
smelting techniques, v. 2, ch. 4, pp. 52-53.
addition levels, v. 2, ch. 3, p. 34.
collectors, definition, v. 2, ch. 3, p. 29.
decomposition, v. 2, ch. 3, pp. 31-33.
levels in recycle water, v. 2, ch. 3, p. 34.
nickel depressants, v. 2, ch. 3, p. 27.
toxicity, v. 3, ch. 4, p. 190, table 89; v. 2, ch. 3, p. 35.
in water, v. 3, ch. 4, pp. 190-192.
toxicity to aquatic biota, v. 4, ch. 1, p. 72, figure 35.
flowsheet, v. 2, ch. 3, figure 11.
flowsheet, v. 2, ch. 3, figure 12.
selective or differential smelting techniques, v. 2, ch. 4, p. 53.
system design, v. 2, ch. 3, pp. 36-38.
type used determines smelter metallurgy, v. 2, ch. 4, pp. 2-3.
Fluorine,
Flushing rate, of lakes, v. 3, ch. 4, p. 206, table 93.
Flycatcher, alder (Empidonax trailli), v. 4, ch. 2, p. 47.
Flycatcher, yellow-bellied (Empidonax flaviventeris), v. 4, ch. 2, p. 50.
Forest, see also Timber.
   classifications, v. 5, ch. 6, p. 6.
   cover types, v. 5, ch. 6, pp. 2-3.
   distribution of cover types, v. 5, ch. 6, pp. 7-8, table 1.
   land cover, v. 5, ch. 3, pp. 5-6.
   productivity, v. 5, ch. 6, pp. 8-9, figure 4, table 3.
Forest fires,
   jack pine adaptation, v. 4, ch. 2, pp. 57-58.
   red pine adaptation, v. 4, ch. 2, p. 65.
Forest Highway 11, v. 5, ch. 8, p. 4, figure 3.
Forest lands, v. 5, ch. 6.
   commercial,
      volume of timber, v. 5, ch. 6, p. 8, table 2.
      consumption for residential settlement, v. 5, ch. 6, p. 5, 28-29.
      direct consumption for copper-nickel development, v. 5, ch. 6, pp. 18-20.
      impact mitigation, v. 5, ch. 6, pp. 24-27.
      impact of copper-nickel development, v. 5, ch. 6, pp. 17-29.
      impact of copper-nickel development, summary, v. 5, ch. 6, pp. 4-5.
      productivity, v. 5, ch. 6, pp. 20-23.
      suitability for commercial forestry, v. 5, ch. 6, pp. 10-11.
Forest products industry, v. 5, ch. 6, pp. 11-12.
   gross output, v. 5, ch. 6, p. 2.
   impacts of copper-nickel development, v. 5, ch. 6, pp. 17-29.
Foundation aid, see Schools, Foundation aid.
Frothers, see Flotation, Chemical reagents.
Fuel, see Energy; also specific type of fuel, i.e., Coal.
Fumigation,
Furnaces, see also Refining furnaces.
   anode,
      air emissions, v. 2, ch. 4, p. 79.
      continuous, v. 2, ch. 4, pp. 48-51.
      Mitsubishi, v. 2, ch. 4, pp. 50-51, figure 26.
      electric, v. 2, ch. 4, pp. 43-44, figure 20.
      reduction of effluent gases, v. 2, ch. 4, p. 44.
      Outokumpu, v. 2, ch. 4, pp. 46-47, figure 22.
      smelting process, v. 2, ch. 4, pp. 45-46.
      slag cleaning,
      air emissions, v. 2, ch. 4, p. 79.
Gabbro, see also Duluth complex.

anorthositic, v. 3, ch. 1, p. 43.
contact zone,
South Kawishiwi intrusion, v. 3, ch. 1, p. 45.
typical grades of copper content, v. 3, ch. 1, p. 55, table 18.

Game birds,
seasonal patterns, v. 4, ch. 2, pp. 29-30.

Gangue, see Waste rock.

Garbage collection, see sanitation.


Geology, v. 3, ch. 1; see also Bedrock geology; Surficial geology.


Geomorphology, see also Surficial geology.

regions, v. 4, ch. 2, pp. 20-22, figure 2.
relationship to vegetation communities, v. 4, ch. 2, figure 9A-E.

Germination,
impacts of heavy metals, v. 4, ch. 2, pp. 138-139.


Giants Range State Park (proposed), v. 5, ch. 9, p. 5; v. 5, ch. 10, pp. 7, 8-9.

Gilbert (community),
residential settlement, v. 5, ch. 7, p. 16.

Ginger, wild (Asarum canadense), v. 4, ch. 2, p. 72.

Glacial drift, see Overburden.


Glacial Lake Upham (I and II), v. 3, ch. 1, p. 18.

Glacial till,
thickness in Study Area, v. 3, ch. 1, p. 2.

map of phases, v. 3, ch. 1, figure 7.
Pleistocene, v. 3, ch. 1, p. 5.


Gooseberry (Ribes spp.),
alternate host for white pine blister rust, v. 4, ch. 2, p. 96.

Goshawk (Accipiter gentilis), v. 4, ch. 2, pp. 30, 88, 89.

Gossan, v. 3, ch. 1, p. 45.

Granivores,
habitats, v. 4, ch. 2, p. 41.

Granophyre, v. 3, ch. 1, p. 11, 43.

Graphite,
from tailings, v. 2, ch. 3, p. 88.

Grass (family Gramineae), v. 4, ch. 2, p. 63.

Grazers,
habitats, v. 4, ch. 2, p. 41.
Great Lakes Gas Transmission Co., v. 5, ch. 11, p. 4.
Great Lakes Waterway System, see Waterways.
   definition, v. 2, ch. 3, pp. 16-17.
   energy requirements, v. 2, ch. 3, p. 17.
   gabbro, v. 3, ch. 1, p. 53.
Grosbeak, rose-breasted (Pheucticus ludovicianus), v. 4, ch. 2, pp. 70, 73.
Gross output,
   from copper-nickel development,
      direct and indirect, v. 5, ch. 15, pp. 2-3.
   of mining companies, v. 5, ch. 15, p. 25.
Ground support,
      cost and safety of various methods, v. 2, ch. 2, pp. 21-22, table 8.
Groundwater, v. 3, ch. 4, pp. 7-8.
   bedrock aquifers,
      water quality, v. 3, ch. 4, pp. 70-71.
   bedrock seepage into open mines, v. 3, ch. 4, pp. 158-159.
   hydrology, v. 3, ch. 4, pp. 43-49.
   quality, v. 3, ch. 4, p. 11.
   regional variation of availability, v. 3, ch. 4, pp. 46-49.
   resources in Superior National Forest, v. 3, ch. 4, p. 43.
   saline water from bedrock, v. 3, ch. 4, p. 159.
   seepage into tailing basins, v. 3, ch. 4, p. 179.
   surficial aquifers,
      water quality, v. 3, ch. 4, pp. 68-69.
Grouse, ruffed (Bonasa umbellus), v. 4, ch. 2, pp. 14, 29, 47, 74, 76, 84-85.
Grouse, spruce (Canachites canadensis), v. 4, ch. 2, pp. 29, 50, 68, 76, 85.

H-
Habitats,
   distribution, v. 4, ch. 2, pp. 77-81.
   ranking by relative importance, v. 4, ch. 2, pp. 7-8, table 4A.
Hanna Mining Co.,
   federal mineral lease, v. 5, ch. 4, p. 20.
Hare, snowshoe (*Lepus americanus*), v. 4, ch. 2, pp. 49, 52, 83-84.

predators, v. 4, ch. 2, p. 84.

Hawk, broad-winged (*Buteo platypterus*), v. 4, ch. 2, pp. 30, 88, 89.

Hawk, Cooper's (*Accipiter cooperi*), v. 4, ch. 2, p. 34.

Hawk, marsh (*Circus cyaneus*), v. 4, ch. 2, pp. 34, 89.

Hawk, red-tailed (*Buteo jamaicensis*), v. 4, ch. 2, p. 89.

Hawk, sparrow (*Falco sparverius*), v. 4, ch. 2, pp. 59, 89.


Hazel (*Corylus cornuta*), v. 4, ch. 2, pp. 56, 62-63, 66, 72, 74, 75.

Headwater streams,

- biological characteristics, v. 4, ch. 1, pp. 16-20.
- canopy cover, v. 4, ch. 1, pp. 16-17.
- fish communities, v. 4, ch. 1, p. 19, table 4, figure 15.

Health, v. 5, ch. 2.

- impacts.
- priority classification, v. 5, ch. 2, pp. 41-45.
- impacts of population pressures, v. 5, ch. 2, pp. 86-89.
- potential impacts of mining, v. 5, ch. 2, pp. 4-5, table 1.

Health facilities, v. 5, ch. 2, pp. 5-6, 31-33.


Health manpower, v. 5, ch. 2, pp. 3, 5-6, 30-31.


Heart Lake Associates,

- federal mineral lease, v. 5, ch. 4, p. 20.

Heat,

- gross available in smelting process, v. 2, ch. 4, pp. 24-25.
- net available heat to metallurgical process, v. 2, ch. 4, p. 25.
- recovery from smelting, v. 2, ch. 4, pp. 31-32.
- used in smelting process, v. 2, ch. 4, pp. 21-32.

Heath (Family Ericaceae),

- in bogs, v. 4, ch. 2, pp. 44-46.

Heavy metals, see Metals.

Height of Land Portage,

- consideration for National Register of Historical Places, v. 5, ch. 10, p. 3.

Hepatica (*Hepatica americana*), v. 4, ch. 2, p. 72.

Herbivores,

- of special interest in Study Area, v. 4, ch. 2, pp. 82-86.

Hibernation, v. 4, ch. 2, p. 28.

Highways, see Roads.

Historical areas, v. 5, ch. 10; v. 5, ch. 10, p. 3-4, table 1.

Hoboken converter, see Converters.

Honeysuckle (*Lonicera canadensis*), v. 4, ch. 2, p. 72.

Honeysuckle, bush (*Diervilla lonicera*), v. 4, ch. 2, p. 68.

Hoods,

- to reduce fugitive air emissions, v. 2, ch. 4, pp. 139-140.

Horehound water (*Lycopus uniflorus*), v. 4, ch. 2, pp. 46, 53, 55.
Hoskold formula, v. 5, ch. 12, pp. 13, 55, 60-61.
Hospitals, see Health facilities.
Housing, see Residential settlement.
Hoyt Lakes (community),
  economic importance of iron ore mining, v. 5, ch. 5, p. 10.
  projected city expenditures with copper-nickel development,
    v. 5, ch. 13, pp. 30-31, 33.
  residential settlement, v. 5, ch. 7, p. 16.
  "taconite town," v. 5, ch. 7, p. 10; v. 5, ch. 15, pp. 4-5.
Human populations, v. 5, ch. 1; see also Demographics.
Hunting,
  maps of activity, v. 5, ch. 9, figure 5, 6.
Hydraulic backfilling, see Backfilling.
Hydrogen fluoride,
  damage to vegetation, v. 4, ch. 2, pp. 144-145, 146.
  elevated levels in zone 6, v. 4, ch. 2, p. 156.
Hydrograph, v. 3, ch. 4, p. 33, figure 9.
Hydrology, v. 3, ch. 4, pp. 5-8, 27-50.
  hydrologic cycle, v. 3, ch. 4, pp. 29-30.
  impacts, v. 3, ch. 4, pp. 18-21, 120-149.
    factors affecting, v. 3, ch. 4, pp. 120-122.
  mitigation, v. 3, ch. 4, pp. 127-128.
  post-operational phase of mining, v. 3, ch. 4, pp. 143-144.
Hydrometallurgy, v. 2, ch. 4, pp. 62-64; see also Metallurgy;
  Pyrometallurgy.
  advantages and disadvantages, v. 2, ch. 4, pp. 63-64.
  for sulfides, v. 2, ch. 4, p. 7.
  summary of systems, v. 2, ch. 4, tables 7, 8.
Hypoxylon canker, v. 4, ch. 2, p. 95.

I -
Ilmenite, v. 3, ch. 1, p. 64, figure 26.
  from tailings, v. 2, ch. 3, p. 88.
Inclusions,
INCO,
  bulk samples, v. 2, ch. 1, p. 20.
  exploration in zones 1 & 2, v. 2, ch. 1, p. 10.
  federal lease terms, v. 5, ch. 12, pp. 86-87.
  federal mineral lease, v. 5, ch. 4, p. 20.
  Maturi shaft, v. 3, ch. 1, pp. 44.
  mining lease signed, v. 2, ch. 1, p. 6.
  Minnesota surface lease, v. 5, ch. 4, p. 21.
INCO (continued)
operating plans, v. 5, ch. 5, p. 20.
proposed capacity of operation, v. 2, ch. 5, p. 4.
Shebandowan Mine,
Spruce Road pit, v. 3, ch. 1, p. 44.
Income,
corporate,
effect on dcf fror, v. 5, ch. 17, pp. 20-27.
disposable,
generated by tourist sales in Ely, v. 5, ch. 16, p. 19.
individual, v. 5, ch. 15, pp. 9-10, table 2.
derect impact of copper-nickel development, v. 5, ch. 15,
pp. 21-24.
per employee with copper-nickel development, v. 5, ch. 15, p. 3.
Income tax, see also Net proceeds tax; Occupation tax.
deductions, v. 5, ch. 15, pp. 39, 40.
effect on dcf fror, v. 5, ch. 17, p. 43.
individual, v. 5, ch. 12, pp. 50-51.
Indians, see Native Americans.
Inflation,
possible in Ely during "boom" cycle, v. 5, ch. 16, pp. 26, 27.
Inland Steel Mining Co., v. 5, ch. 5, p. 3.
Minnesota lease, v. 5, ch. 4, p. 21.
projected production of Minorca operation, v. 5, ch. 5, p. 15.
Inland Waterway System, see Waterways.
Input/output, v. 5, ch. 15, pp. 14-17, table 3.
Inter-city Minnesota Pipelines, Ltd., v. 5, ch. 11, p. 4.
International Gas Ltd., Inc., v. 5, ch. 11, p. 4.
International Nickel Company, see INCO.
Inter-Provincial-Lakehead Pipeline System, v. 5, ch. 11, p. 8.
Intrusions,
South Kawishiwi, v. 3, ch. 1, pp. 44-49.
Invertebrates,
in lakes, v. 4, ch. 1, pp. 36-37.
Iron,
effect on health, v. 5, ch. 2, pp. 74-76.
in particulates, v. 3, ch. 3, p. 130, figure 70, table 52.
deposition, v. 3, ch. 3, p. 137.
removal from concentrate in smelting process, v. 2, ch. 4, p. 16.
in soils, v. 3, ch. 1, p. 31.
Iron ore,
magnetite, v. 3, ch. 1, p. 64, figure 26.
problem in smelting, v. 2, ch. 4, p. 17.
from tailings, v. 2, ch. 3, pp. 88, 89.
magnetite silicious taconite, v. 5, ch. 5, pp. 9-10.
magnetite taconite ore reserves, v. 5, ch. 5, p. 9, table 2.
production capacities by company, v. 5, ch. 5, table 4.
Iron ore (continued)
reserves, v. 5, ch. 5, pp. 5, 8-9, table 1, 2.
shipment of taconite pellets, v. 5, ch. 8, p. 9.
taconite,
production, v. 5, ch. 5, pp. 9-10.
reserves, v. 5, ch. 5, p. 13.
taconite pellets transported by rail, v. 5, ch. 8, pp. 7-8.
Iron ore mines and mining, v. 5, ch. 5, pp. 5-17.
capital and operating costs, v. 2, ch. 3, p. 12.
companies with state leases, v. 5, ch. 4, p. 21.
current operations, v. 5, ch. 5, p. 7.
in economy of Study Area, v. 5, ch. 15, pp. 5-6.
effect on historical residential settlement patterns, v. 5, ch. 7,
pp. 8-10.
effect on population, v. 5, ch. 1, pp. 3-4.
energy requirements, v. 2, ch. 3, pp. 11-12.
exemption of taconite operations from corporate income tax, v. 5,
ch. 12, pp. 43-44.
extension, 
effect on historic sites, v. 5, ch. 10, pp. 8-9.
effect on recreation, v. 5, ch. 9, pp. 26-30, figure 16,
table 3.
flooded pits, v. 5, ch. 5, pp. 6-7.
future production, v. 5, ch. 5, pp. 12-17.
history in Ely, v. 5, ch. 16, pp. 7-8.
natural ore, v. 5, ch. 5, pp. 5-7.
possible conflicts with copper-nickel development, v. 5, ch. 5,
p. 28.
potential taconite facility area, v. 5, ch. 5, pp. 16-17.
projected electricity consumption, v. 5, ch. 11, pp. 17-18,
table 11.
projected production capacities, v. 5, ch. 1, table 3.
supplying water needs for copper-nickel mining, v. 3, ch. 4, p. 130.
taconite, v. 5, ch. 5, pp. 8-17.
underground potential, v. 5, ch. 5, pp. 15-16.
water use, v. 5, ch. 5, p. 11.
Iron ore processing,

J -
Jay, blue (*Cyanocitta cristata*), v. 4, ch. 2, pp. 62, 73.
Jay, gray (*Perisoreus canadensis*), v. 4, ch. 2, p. 6, 51, 77.
Johnson, Lloyd K.,
federal mineral lease, v. 5, ch. 4, p. 20.
prospecting permit, v. 5, ch. 4, p. 20.
Johnson Lake,

Jones & Laughlin,
taconite production facilities, v. 5, ch. 5, pp. 16-17.

Junco, dark-eyed (Junco hyemalis), v. 4, ch. 2, p. 50.

Juneberry (Amelanchier spp.), v. 4, ch. 2, pp. 56, 65, 66, 69, 75.


K -

Kawishiwi River, v. 4, ch. 1, pp. 22-23.
sensitivity, v. 4, ch. 1, p. 47.

KAX (potassium amyl xanthate), see Flotation, chemical reagents, xanthates.

Keeley Creek National Natural Landmark (proposed), v. 5, ch. 5, p. 27; v. 5, ch. 10, p. 6.
possible displacement by mining activity, v. 5, ch. 10, pp. 10-11.

Keeley Creek Research Natural Area, v. 4, ch. 2, p. 104; v. 5, ch. 5, p. 27; v. 5, ch. 10, p. 5.

protection from mine development, v. 5, ch. 9, p. 14.


Kennecott Copper Corp., see Bear Creek Mining Co.

Kinglet, ruby crowned (Regulus calendula), v. 4, ch. 2, p. 6.

Knife Lake Group, v. 3, ch. 1, p. 6.

L -

Labor force, see Personnel.

Ladels,
air emissions, v. 2, ch. 4, pp. 79-80.

Ladyslipper (Cypripedium acaule), v. 4, ch. 2, p. 57.

Lagoons,
for treatment of sludge, v. 2, ch. 4, pp. 146-147.

Lake County,

Lake Vermilion formation, v. 3, ch. 1, p. 6.

Lakeland (community),
residential settlement, v. 5, ch. 7, p. 17.

Lakes, see also under names of specific lakes, i.e., Vermilion Lake.
aquatic organisms, v. 4, ch. 1, pp. 7-8, 10-11.
biological characteristics, v. 4, ch. 1, pp. 34-43.
buffering, v. 3, ch. 4, p. 9, 57-60.
buffering effect of lake volume on mining discharge, v. 3, ch. 4, p. 205.
currently impacted by mining, v. 4, ch. 1, pp. 42-43.

Ice cover, v. 3, ch. 3, p. 49, table 12.
impacts of mining on water quality, v. 3, ch. 4, p. 207.
impacts of secondary development on trophic levels, v. 4, ch. 1, pp. 107-108.
Lakes (continued)
likely to be affected by acid precipitation, v. 4, ch. 1, p. 85.
MDNR Fisheries classification, v. 4, ch. 1, p. 38, figure 24.
nutrients, v. 4, ch. 1, pp. 32-34.
physical and chemical conditions, v. 4, ch. 1, pp. 31-34.
possible level changes, v. 3, ch. 4, p. 126.
relationship to streams, v. 4, ch. 1, pp. 43-45.
supplying water for mining operation, v. 3, ch. 4, pp. 133-134.
trophic status, v. 4, ch. 1, pp. 28-29, 32-34.
trophic status and MDNR fisheries classifications, v. 4, ch. 1,
pp. 40-41.
water quality impacts of mining, v. 3, ch. 4, pp. 204-207.
Lakeshore property,
effect of increase on aquatic biota, v. 4, ch. 1, p. 106.
Land,
available for copper-nickel development, v. 5, ch. 5, p. 29, table 8.
available for residential growth, v. 5, ch. 7, figure 1.
impacts of land appropriation on terrestrial ecosystems, v. 4, ch. 2,
pp. 118-134.
requirements for copper-nickel development, v. 5, ch. 5, pp. 24-25.
requirements for different development models, v. 4, ch. 2, pp. 119-
121, table 19.
requirements for mining operation, v. 2, ch. 4, p. 167.
relationship to mine production, v. 4, ch. 2, pp. 2-3, figure 11.
requirements for new residential settlement, v. 5, ch. 7, pp. 51-
52, table 31, 32.
requirements for waste rock piles, v. 2, ch. 5, pp. 51-52, table
27, figure 28.
Land cover, see also Land use-land cover.
Land ownership, v. 5, ch. 3, pp. 11-13; v. 5, ch. 4.
disputes, v. 5, ch. 4, pp. 7-8.
public and private, v. 5, ch. 4, pp. 3-5, table 2.
Land use, v. 1, ch. 5, pp. 31-33.
changes due to increased traffic, v. 5, ch. 8, p. 21.
impacts of direct land use, v. 4, ch. 2, pp. 121-134.
impacts of residential settlement, v. 5, ch. 7, pp. 49-52.
increase in minelands, v. 5, ch. 5, pp. 2-3.
minelands, v. 2, ch. 2, pp. 36-38, table 16.
policy makers, v. 5, ch. 3, p. 11.
projected for mining, v. 5, ch. 5, p. 17.
residential use vs. mining use, v. 5, ch. 7, pp. 5-6, 49-52.
taconite processing, v. 5, ch. 5, p. 10, table 3.
Land use (continued)
types, v. 2, ch. 2, pp. 35-36, table 15; v. 5, ch. 3, pp. 3-4.
and vegetation communities, v. 4, ch. 2, pp. 35-37.
Land use-land cover, v. 5, ch. 3.
correlations, v. 5, ch. 3, p. 4, figure 2.
Lattice leaf (Goodyera spp.), v. 4, ch. 2, p. 63.
Laurel, bog (Kalmia polifolia), v. 4, ch. 2, p. 44.
Laws,
Leachate, see Runoff water.
dump,
in metal recovery, v. 2, ch. 4, p. 62.
effect on water quality, v. 3, ch. 4, p. 17.
heap,
increased by acid precipitation, v. 4, ch. 2, pp. 150, 151.
possible increase from revegetation, v. 2, ch. 2, pp. 51-52.
of sludge, v. 2, ch. 4, p. 147.
Lead,
effect on health, v. 5, ch. 2, p. 8, 76-78.
in particulates, v. 3, ch. 3, p. 130, figure 69, table 52.
in soils, v. 3, ch. 1, p. 32.
toxicity to aquatic biota, v. 4, ch. 1, p. 69, figure 32.
Lean ore, v. 3, ch. 2, pp. 35-38.
chemistry, v. 3, ch. 2, pp. 36-37.
mineralogy, v. 3, ch. 2, pp. 35-36.
physical characteristics, v. 3, ch. 2, pp. 37-38.
Lean ore piles,
differences from waste rock piles, v. 2, ch. 2, p. 50.
reclamation, v. 2, ch. 2, pp. 49-59; see also Waste rock piles,
reclamation.
Leases and leasing, see also under specific companies; i.e., INCO,
AMAX.
current status, v. 5, ch. 4, pp. 18-21.
federal, v. 5, ch. 12, pp. 84-87.
federal mineral leases,
federal process vs. state process, v. 5, ch. 12, pp. 78-79.
federal regulations, v. 5, ch. 12, pp. 84-87.
Leases and leasing (continued)

Minnesota mineral leases,
and permitting procedures,
state regulations, v. 5, ch. 12, pp. 79-84.
state rental rate, v. 5, ch. 12, p. 81.
of surface and mineral rights on public lands, v. 5, ch. 4, pp. 1-3.

Leatherleaf (Chamaedaphne calyculata), v. 4, ch. 2, pp. 44, 48.

Lemming, southern bog (Synaptomys cooperi), v. 4, ch. 2, p. 34.


LHD units, see Machinery, load-haul-dump (LHD) units.


Lignon sulfonate,
as dust retardant on roads, v. 2, ch. 2, p. 66.

Lily, bluebead (Clintonia borealis), v. 4, ch. 2, p. 48, 53, 75.

Lime,
use in smelting, v. 2, ch. 4, pp. 16-17, 19.
Limestone slurry scrubbing system, v. 2, ch. 4, p. 116, figure 51.

Liming,
of acid tailing, v. 2, ch. 2, p. 47.
to ameliorate affects of acid precipitation, v. 2, ch. 2, p. 56.

slowed due to heavy metal loading, v. 4, ch. 2, pp. 139-144.

Little, A.D., Co.,

Local economy (Ely), v. 5, ch. 16.
firms, employment and sales for economic sectors, v. 5, ch. 16,
table 1.
sales to tourists, v. 5, ch. 16, pp. 17-20.
tourist-related economic sectors, v. 5, ch. 16, pp. 4-5.

Local government,
comparison of state tax revenues to aid payments, v. 5, ch. 12,
pp. 72-74, table 16, 17.
cost of administration, v. 5, ch. 13, p. 19, table 1.
cost projections, v. 5, ch. 13, pp. 24-34.
debt policy, v. 5, ch. 13, p. 15.
increase in expenditures due to increase in population, v. 5, ch. 13,
pp. 3-4.
projected expenditures with copper-nickel development, v. 5, ch. 13,
tables 9, 10, 11, 12.
revenue shortfall, v. 5, ch. 13, pp. 36-40.
revenue sources, v. 5, ch. 12, pp. 7-9.
service costs and revenue projections, v. 5, ch. 13.
Local government (continued)
- 30 -
service costs vs. tax revenues, v. 5, ch. 17, pp. 40-41.
service functions and cost multipliers, v. 5, ch. 13, pp. 19-23.
taconite municipal aid, v. 5, ch. 12, p. 72.
taxes and state aids, v. 5, ch. 12, pp. 67-72.
Lock and Dam 26, see Alton Lock and Dam 26.
Long Lake,
lakeshore development, v. 5, ch. 7, p. 17.
Lowlands, see Wetlands.
Lynx (Lynx lynx), v. 4, ch. 2, pp. 54, 90.

M -
Machinery,
- 30 -
electric shovels, v. 2, ch. 2, p. 10.
load-haul-dump (LHD) units, v. 2, ch. 2, p. 15.
trucks,
noise impacts, v. 3, ch. 5, pp. 29-36.
McKinley (community),
residential settlement, v. 5, ch. 7, p. 16.
Macrophytes,
in lakes, v. 4, ch. 1, pp. 35-36.
Magnesium,
in surface water, v. 3, ch. 4, p. 54.
Magnetic separation,
Magnetite, see Iron ore.
Malaxis green (Malaxis unifolia), v. 4, ch. 2, p. 68.
Malenbaum, Wilfred,
cobalt forecasts, v. 5, ch. 14, p. 45.
copper forecasts, v. 5, ch. 14, pp. 24-25.
Mammals,
of alder carrs, v. 4, ch. 2, pp. 46-47.
of cedar bogs, v. 4, ch. 2, p. 54.
of deciduous mature stands, v. 4, ch. 2, pp. 74-75.
habitat groupings, v. 4, ch. 2, p. 41, table 7B.
of jack pine mature stands, v. 4, ch. 2, pp. 64-65.
of mixed deciduous-coniferous uplands, v. 4, ch. 2, p. 76.
rare species, v. 4, ch. 2, pp. 34-35.
seasonal patterns, v. 4, ch. 2, pp. 28-29.
of special interest in Study Area, v. 4, ch. 2, pp. 81-91.
of spruce bogs, v. 4, ch. 2, pp. 49-50.
of tamarack bogs, v. 4, ch. 2, p. 52.
of white spruce uplands, v. 4, ch. 2, p. 68.
Manganese, from ocean mining, v. 5, ch. 14, p. 16.
in soil, v. 3, ch. 1, p. 31.
Manpower, see Personnel.
Maple, mountain (Acer spicatum), v. 4, ch. 2, p. 72.
Maple, silver (Acer saccharinum), v. 4, ch. 2, p. 55.
Maple, sugar (Acer saccharum), v. 4, ch. 2, p. 68.
Martes (Martes americana), v. 4, ch. 2, pp. 49-50, 90-91, 103, 29.
Materials handling, see Transportation.
Matter,
mineral content, v. 2, ch. 4, table 2.
Maximum containment levels, v. 5, ch. 2, pp. 20-21.
Mayflies (Ephemeroptera), v. 4, ch. 1, p. 21.
Mercury,
effect on health, v. 5, ch. 2, pp. 8-9, 78-80.
in water, v. 3, ch. 4, p. 11.
Mesabi Mountain Pit, v. 5, ch. 5, p. 7.
geologic map, v. 3, ch. 1, figure 5.
Mesothelioma, v. 5, ch. 2, pp. 7-8.
Metal and Nonmetallic Mine Safety Act (PL 89-577), v. 5, ch. 2, p. 47.
Metal fume fever, v. 5, ch. 2, pp. 90-91.
Metal toxicity,
seed germination tests, v. 2, ch. 2, p. 45.
Metallurgy, see also Hydrometallurgy; Pyrometallurgy.
Metals, v. 3, ch. 2, pp. 64-65.
affinity for sulfur and oxygen, v. 2, ch. 4, pp. 18-19.
assessment of aquatic impacts, v. 4, ch. 1, pp. 74-75.
bio-accumulation as hazard to wildlife, v. 4, ch. 2, p. 99.
concentrate analysis, v. 2, ch. 4, table 1.
concentration in discharge water, v. 2, ch. 4, p. 156.
effect on aquatic biology, v. 4, ch. 1, pp. 60-81.
effect on aquatic ecosystems, v. 4, ch. 1, pp. 72-81.
fungitoxicity and reduced litter decomposition, v. 4, ch. 2, p. 137.
indicator species showing pollution, v. 4, ch. 1, pp. 73-74.
loadings in soils, v. 4, ch. 2, pp. 139-144.
loss from discarded slags, v. 2, ch. 4, pp. 6-7.
as pollutants, v. 1, ch. 5, pp. 57-65.
pollution mitigation, v. 4, ch. 1, p. 80.
precious, v. 3, ch. 2, pp. 16-17, 65, table 28.
effect of sale on dcfro, v. 5, ch. 17, pp. 26-27.
prices needed for economically feasible operation, v. 5, ch. 17,
pp. 59-63.
protection limits for aquatic biota, v. 4, ch. 1, pp. 66-70,
figure 34, table 22.
recovery from concentrate, v. 2, ch. 5, p. 27.
removal from aqueous mine waste, v. 3, ch. 4, pp. 211-212.
toxicity in waters in Study Area, v. 4, ch. 1, pp. 63-66.
Metals (continued)
  toxicity to aquatic biota in combination, v. 4, ch. 1, p. 70.
  in water, v. 3, ch. 4, pp. 185-187.
Meteorology, see Climate.
Mid-reach streams, v. 4, ch. 1, pp. 20-22.
  canopy cover, v. 4, ch. 1, p. 20.
  sensitivity, v. 4, ch. 1, p. 47.
Mills, see Grinding mills.
Mine/mill operation,
  post-production water budget, v. 3, ch. 4, pp. 117-118.
Mine water, v. 3, ch. 4, pp. 157-165.
  factors influencing quality, v. 4, ch. 1, p. 60.
Minelands, v. 5, ch. 5.
  effect on residential settlement, v. 5, ch. 7, p. 22.
  taconite and copper-nickel, v. 5, ch. 5, pp. 31-33.
Mineral Interest Taxation Law, v. 5, ch. 12, p. 50.
Mineral ownership, v. 5, ch. 4.
  public and private, v. 5, ch. 4, pp. 5-7.
  severed mineral interests, v. 5, ch. 4, p. 8; v. 5, ch. 12, pp. 49-50.
  taxation of severed mineral interests, v. 5, ch. 17, pp. 61-62.
Mineralization,
  classification, v. 3, ch. 2, pp. 10-11, figure 7.
Mineralogy, v. 3, ch. 1.
  sulfide, v. 3, ch. 1, pp. 54-64.
Minerals,
  non-sulfide,
    recovery, v. 3, ch. 2, pp. 6-11.
    reserved minerals, v. 5, ch. 4, p. 13.
    resource estimates, v. 1, ch. 3, pp. 6-12.
    resource potential, v. 3, ch. 2.
    resources, v. 3, ch. 2, pp. 3-11; v. 5, ch. 5, pp. 29-31.
    table 9, 10.
    chemistry, v. 3, ch. 1, pp. 61-64.
    elemental & chemical analysis, v. 3, ch. 1, p. 61, table 23, 25.
Mines and mining, v. 1, ch. 4, pp. 16-18; v. 2, ch. 2; see also
  Iron ore mines and mining; Open pit mines and mining;
    Underground mines and mining;
    alternatives, v. 1, ch. 6, pp. 84-93.
Mines and mining (continued)
capital and operating costs for integrated model, v. 2, ch. 5, table 15.
combination open pit and underground, v. 2, ch. 2, pp. 22-23.
Mines and mining,
data summary, v. 2, ch. 5, table 11.
deduction of development costs for income tax purposes, v. 5, ch. 12, p. 42.
development models, v. 5, ch. 7, pp. 46-47, figure 21-34, table 29, 30.
effect of capital and operating costs on dcfror, v. 5, ch. 17, p. 2.
effect of fluctuating production on tax revenues, v. 5, ch. 12, pp. 44-46, 52-54.
effect of time to full production and life of mine on dcfror, v. 5, ch. 17, pp. 18-20.
effect on terrestrial ecosystems, v. 4, ch. 2, pp. 118-134.
factors influencing impacts, v. 4, ch. 2, pp. 119-121.
noise impacts, v. 3, ch. 5, pp. 28-36.
open pit model, v. 2, ch. 5, pp. 35-36, 38.
open pit vs. underground, v. 1, ch. 6, pp. 87-89; v. 2, ch. 2, pp. 3-6.
capital and operating costs, v. 2, ch. 5, p. 7, figure 3, 4.
environmental considerations, v. 2, ch. 5, pp. 6-8, figure 2.
possible capacities, v. 2, ch. 5, pp. 3-5.
profitability, v. 5, ch. 17.
resource recovery,
open pit vs. underground mines, v. 3, ch. 2, p. 6.
underground model, v. 2, ch. 5, pp. 36-38.
MINESTM-4 computer program, v. 5, ch. 17, pp. 11-16.
Mining Protection Area, v. 5, ch. 10, p. 6.
Mink (Mustela vison), v. 4, ch. 2, p. 29.
Minnamax, see AMAX.
Minnegasco,
demonstration peat gasification plant, v. 5, ch. 11, p. 8.
Minnesota Compensation Rating Bureau, v. 5, ch. 12, p. 49.
Minnesota Employment Services Law, v. 5, ch. 12, pp. 48-49.
Minnesota Power and Light (MP&L), v. 5, ch. 11, p. 11, 16-17, 23, 27.
Minnesota Severed Minerals Act (M.S. 93.52-93.58), v. 5, ch. 4, p. 8.
Minnesota State Historic Preservation Office, inventory, v. 5, ch. 10, p. 3.
Mint, sweet (*Mentha arvensis*), v. 4, ch. 2, p. 55.

Mississippi River,

Models,
air emissions, v. 3, ch. 3, pp. 11-13, 146-175.
cash flow (*MINESIM-4*), v. 5, ch. 17, pp. 11-16.
development, v. 2, ch. 5; v. 3, ch. 2, pp. 54-56.
variables, v. 2, ch. 5, pp. 10-32.
economic (*SIMLAB*), v. 5, ch. 15, pp. 10-18.
illustrative variables, v. 2, ch. 5, pp. 11-12, 15-19.
mining, v. 1, ch. 4, pp. 22-27.
operating variables, v. 2, ch. 5, pp. 13, 21-29.
representative vs. predictive, v. 2, ch. 5, p. 2
residential settlement, v. 5, ch. 7, pp. 30-37.
water quality, v. 3, ch. 4, pp. 149-183.

Molluscs,
sensitivity to metal pollution, v. 4, ch. 1, p. 73.

Montana,
tax revenues over life of mine, v. 5, ch. 17, appendix C.
taxation of mineral industries, v. 5, ch. 17, pp. 51-57,
appendix A.


Moore, Warren S., Co.,
federal mineral lease, v. 5, ch. 4, p. 20.

Moose (*Alces alces*), v. 4, ch. 2, pp. 14, 28-29, 45, 76, 83.

in areas of previous copper-nickel development, v. 5, ch. 2,
pp. 36-39.

Mortality rate, v. 5, ch. 1, p. 8; v. 5, ch. 2, pp. 3, 4-5, 24-25,
27-30, table 2, 4.
in areas of previous copper-nickel development, v. 5, ch. 2,
pp. 36-39.

Mortgage financing,
in Ely, v. 5, ch. 16, pp. 22-23.

Mosses,
rare species, v. 4, ch. 2, p. 33.

*Sphagnum*, v. 4, ch. 2, p. 45.

Mosses, feather, v. 4, ch. 2, p. 53.

Mouse, meadow jumping (*Zapus hudsonicus*), v. 4, ch. 2, pp. 28, 55,
61, 66.

Mouse, woodland deer (*Peromyscus maniculatus*), v. 4, ch. 2, pp. 41,
54, 55, 60-61, 64, 71.

Mouse, woodland jumping (*Napaeozapus insignis*), v. 4, ch. 2, pp. 28,
55, 74.

Mud sumps,

Mudminnow, central (*Umbra limi*), v. 4, ch. 1, p. 19.
Multipliers, see Economic base theory.
Municipal government, see Local government.
Munsell color scale, v. 3, ch. 1, p. 19.
Murphy Oil Co., v. 5, ch. 11, p. 8.
Muskrat (Ondatra zibethicus), v. 4, ch. 2, p. 28.

N -

National Forests,
  law relating to leasing of lands, v. 5, ch. 12, p. 85.
  protection by law, v. 5, ch. 4, pp. 10-11.
National Register of Historic Places, v. 5, ch. 10, p. 3.
National Register of Natural Landmarks, v. 5, ch. 10, pp. 5-6.
Native Americans,
  use of tax on severed mineral interests for loans, v. 5, ch. 12, p. 50.
Natural and scientific areas, v. 5, ch. 10; v. 5, ch. 10, pp. 4-8.
  impact of copper-nickel development, v. 5, ch. 10, pp. 9-20.
Natural gas, v. 5, ch. 11, pp. 4-8.
  curtailment of Canadian supplies, v. 5, ch. 11, pp. 5-6.
  distributors, v. 5, ch. 11, p. 4.
  industrial consumption, v. 5, ch. 11, pp. 5-6.
  potential new sources, v. 5, ch. 11, pp. 7-8.
  supply and consumption, v. 5, ch. 11, pp. 5-6.
Net proceeds tax, v. 5, ch. 12, p. 18.
Neumont Exploration, Ltd.,
New Jersey Zinc Co.,
New Mexico,
  tax revenues over life of mine, v. 5, ch. 17, appendix C.
  taxation of mineral industries, v. 5, ch. 17, pp. 51-57, appendix A.
Nickel,
  anodes,
    composition, v. 2, ch. 4, p. 54.
    as cause of cancer, v. 5, ch. 2, p. 6.
    concentrations in foliage, v. 4, ch. 2, pp. 160-161.
    consumption and price,
      tied to national economy, v. 5, ch. 14, pp. 36, 37.
    effect of market conditions on dcfro, v. 5, ch. 17, p. 24.
    effect of price, mill recovery and ore grade on dcfro, v. 5, ch.
    17, p. 2.
Nickel (continued)
effect on health, v. 5, ch. 2, pp. 55-57, 80-82.
effect on water quality of natural and scientific areas, v. 5,
emissions from smelter, v. 2, ch. 4, p. 130.
income elasticity of demand, v. 5, ch. 14, p. 36.
leading companies, v. 5, ch. 14, p. 11.
loadings in soil, v. 4, ch. 2, pp. 139-140.
NIOSH standards, v. 5, ch. 2, p. 56.
price, v. 5, ch. 14, p. 36, table 27.
price and defro, v. 5, ch. 17, pp. 2, 4.
recovery processes, v. 2, ch. 4, pp. 52-53.
resource estimates, v. 1, ch. 3, pp. 6-12; v. 3, ch. 2, pp. 7-10,
table 3; v. 5, ch. 5, pp. 18-19.
in soils, v. 3, ch. 1, p. 32.
sensitivity of defro to price changes, v. 5, ch. 17, p. 25.
summary of forecasts, v. 5, ch. 14, pp. 41-42.
toxicity to aquatic biota, v. 4, ch. 1, pp. 67-68, figure 28.
toxicity to aquatic biota in Study Area, v. 4, ch. 1, pp. 63-65.
U.S. demand,
U.S. supply, v. 5, ch. 14, pp. 33-34.
uses, v. 5, ch. 14, p. 11.
Nickel carbonyl (Ni(Co)4),
as carcinogen, v. 5, ch. 2, p. 6.
Nickel sulfide (Ni3 S2),
as carcinogen, v. 5, ch. 2, p. 6.
Nitrification,
reduction due to acid precipitation, v. 4, ch. 2, p. 151.
Nitrogen,
deposition, v. 3, ch. 4, pp. 79-80.
as nutrient in water, v. 3, ch. 4, pp. 9-10.
Nitrogen oxides,
damage to vegetation, v. 4, ch. 2, pp. 144, 146.
effect on health, v. 5, ch. 2, pp. 82-84.
emissions from smelter, v. 2, ch. 4, pp. 72-74, table 10.
formula for formation rate and concentrations, v. 2, ch. 4, pp.
72-73.
Nitrogen: Phosphorus ratios, v. 3, ch. 4, p. 61, table 17.
Nodule mining, see Ocean mining.
Noise, v. 1, ch. 5, pp. 66-67; v. 3, ch. 5; see also Sound.
audibility contours, v. 3, ch. 5, figure 9-20, 22-23.
Noise (continued)
changes due to increased traffic, v. 5, ch. 8, p. 22.
common sounds in decibels, v. 3, ch. 5, figure 2.
effect on BWCA, v. 3, ch. 5, pp. 41-42.
effect on health, v. 5, ch. 2, pp. 57-58.
effect on recreation, v. 5, ch. 9, pp. 20-22.
effect on terrestrial ecosystems, v. 4, ch. 2, pp. 11, 163-166.
existing man-made sources, v. 3, ch. 5, pp. 5-7.
factors affecting audibility, v. 5, ch. 9, p. 21.
map of audibility contours, v. 5, ch. 9, figure 14.
models, v. 3, ch. 5, pp. 20-45.
parameters affecting sound propagation, v. 3, ch. 5, pp. 21-22.
spectral characterization of Study Area, v. 3, ch. 5, pp. 7-9.
ventilation fans as source, v. 2, ch. 2, p. 17.
Norite, v. 3, ch. 1, pp. 41-42.
North Shore volcanic group, v. 3, ch. 1, pp. 9, 10, 11.
Northeastern Minnesota,
geological map, v. 3, ch. 1, figure 2.
Northern Natural Gas Co., v. 5, ch. 11, p. 4.
Nursing homes, see Health facilities.
Nuthatch, red-breasted (Sitta canadensis), v. 4, ch. 2, p. 64.
Nutrients,
	loss due to acid precipitation, v. 4, ch. 2, p. 151.
	reduced recycling due to presence of heavy metals, v. 4, ch. 2, p. 138.

- 37 -

Occupation tax, v. 5, ch. 12, pp. 18, 25-26, 32-36.

credits, v. 5, ch. 12, pp. 32-33, 36.
distribution of proceeds, v. 5, ch. 12, p. 33.
effect on dfcror, v. 5, ch. 17, p. 46.
Oglebay-Norton, v. 5, ch. 5, p. 15.
Oikocrysts, v. 3, ch. 1, p. 43.
Oil,
as dust retardant on roads, v. 2, ch. 2, p. 66.
Oil companies,
	acquiring copper interests, v. 5, ch. 14, pp. 6-7.
	from tailings, v. 2, ch. 3, p. 88.
Omnivores,
of special interest in Study Area, v. 4, ch. 2, pp. 86-87.
One Pine Lake,
conversion of pit to lake, v. 2, ch. 2, pp. 38-40.
disseminated ore model, v. 3, ch. 2, pp. 18-19.
importance, v. 2, ch. 2, pp. 4-5, table 2.
operating costs, v. 2, ch. 2, p. 9, table 5.
rate of filling with water, v. 2, ch. 2, p. 33.
water appropriation needs during drought, v. 3, ch. 4, pp. 129-130.
water quality, v. 3, ch. 4, pp. 163-165.
Operating costs,
distribution, v. 5, ch. 17, p. 36.
effects on dfcror, v. 5, ch. 17, pp. 35-38.
for pollution control, v. 5, ch. 17, pp. 36-37.
variables for models, v. 2, ch. 5, pp. 30-32.
by year for integrated mine model, v. 2, ch. 5, table 15.
Orchids, v. 4, ch. 2, p. 45.
rare species, v. 4, ch. 2, pp. 49, 52.
Ore,
chemical composition, v. 3, ch. 1, p. 4, table 1, 2; v. 3, ch. 2,
pp. 15-17, table 6.
chemistry, v. 3, ch. 2, pp. 13-17.
cutoff grade, v. 2, ch. 2, p. 3; v. 3, ch. 2, pp. 5-6, 25-27.
effect on dfcror, v. 5, ch. 17, p. 62.
produced over life of mine, v. 2, ch. 5, p. 16.
value,
Commissioner of Revenue, v. 5, ch. 12, pp. 34-35.
Orthopyroxene, v. 3, ch. 1, p. 65.
Osprey (Pandion helaetus), v. 4, ch. 2, pp. 30, 34, 50, 88-89.
disturbances of nesting by noise, v. 4, ch. 2, pp. 164, 166.
Otter (Lontra canadensis), v. 4, ch. 2, pp. 29, 89.
Outdoor recreation, see Recreation.
Output, see Gross output.
Ovenbird (Seiurus aurocapillus), v. 4, ch. 2, p. 73.
Overburden, v. 2, ch. 2, pp. 27-28, table 11; v. 3, ch. 2, pp. 25,
28-31.
depth in Study Area, v. 2, ch. 2, p. 64.
leaching from stockpiles, v. 2, ch. 2, pp. 64-65.
pile construction, v. 2, ch. 2, p. 64.
Overburden (continued)

- supply and demand, v. 3, ch. 2, pp. 29-31, table 10, 11, figure 9.
- use in topdressing, v. 2, ch. 2, pp. 46-47, 63-64.

Owl, barred (Strix varia), v. 4, ch. 2, p. 30.

Owl, great horned (Bubo virginianus), v. 4, ch. 2, pp. 30, 64, 88, 89.

Owl, saw-whet (Aegolius acadicus), v. 4, ch. 2, p. 30.

Oxygen,

- energy required in production, v. 2, ch. 4, p. 29.
- energy savings from use in smelting, v. 2, ch. 4, p. 29.
- for enrichment of combustion air, v. 2, ch. 4, pp. 27-29.

P-

Palladium, v. 5, ch. 5, p. 19.

Palo (community), v. 5, ch. 7, p. 7.


Particulates, v. 1, ch. 5, p. 57; v. 3, ch. 3, pp. 100-145, 156-175;

- see also Air emissions; Dust; Fibers.
- area sources, see Dust.
- as cause of chronic respiratory diseases, v. 5, ch. 2, p. 6.
- concentrations dependent on weather, v. 3, ch. 3, pp. 116-117.
- control devices,
  - capital costs, v. 2, ch. 4, table 15, figure 46.
  - efficiency, v. 2, ch. 4, pp. 99-100, figure 45.
- control devices for strong gas streams, v. 2, ch. 4, pp. 98-105.
- control devices for weak gas streams, v. 2, ch. 4, pp. 120-121.
- current levels in Study Area, v. 3, ch. 3, pp. 9-11.
- deposited,
- effect on health, v. 5, ch. 2, pp. 59-62, 84-86.
- effect on terrestrial ecosystems, v. 4, ch. 2, pp. 136-144.
- emission from dryers, v. 2, ch. 4, p. 75.
- fugitive emissions, v. 2, ch. 4, pp. 135-141.
  - control, v. 2, ch. 4, pp. 136-137, 138-140.
- important characteristics, v. 2, ch. 4, pp. 98-99.
- levels on mine sites, v. 3, ch. 3, pp. 110-112.
- major source categories, v. 3, ch. 3, p. 120.
Particulates (continued)

- nonattainment areas, v. 3, ch. 3, figure 12.
- from roaster, v. 2, ch. 4, p. 75.
- smelter as point source, v. 3, ch. 3, pp. 156-158.
- summary by source category, v. 3, ch. 3, table 42.
- summary of emissions from smelter operations, v. 2, ch. 4, pp. 81-82.
- transport distances, v. 4, ch. 2, pp. 136-137.
- Pasture,
- Pearly everlasting (Anaphalis margaritacea), v. 4, ch. 2, pp. 59, 68.
- Peat,
  - amount and types in Study Area, v. 3, ch. 1, p. 21.
- Peat gasification, v. 5, ch. 11, p. 8.
- Pebble mills, see Grinding mills.
- Pentlandite, v. 3, ch. 1, p. 60, figure 21.
- Peoples Natural Gas, v. 5, ch. 11, p. 4.
- Perch, yellow (Perca flavescens), v. 4, ch. 1, p. 21.
- Peridotite, v. 3, ch. 1, p. 42.
- Personnel,
  - construction requirements,
    - for exploration and mining phase, v. 2, ch. 5, p. 16.
    - for processing phase, v. 2, ch. 5, p. 17.
    - for smelter/refinery phase, v. 2, ch. 5, p. 18.
- employment,
  - effects outside Study Area, v. 5, ch. 15, pp. 37-38.
  - employment in Ely resulting from tourist sales, v. 5, ch. 16, p. 18.
  - employment levels for open pit mining, v. 2, ch. 2, pp. 8-9.
  - impacts of copper-nickel development on employment, v. 1, ch. 5, pp. 74-76.
  - impacts of workforce type on residential settlement, v. 5, ch. 7, pp. 41-42.
  - indirect employment from copper-nickel development, v. 5, ch. 15, p. 2.
  - operating requirements for
    - exploration and mining phase, v. 2, ch. 5, pp. 21-22.
    - processing phase, v. 2, ch. 5, p. 25.
    - smelter/refinery, v. 2, ch. 5, p. 27.
Personnel (continued)

professional employment, v. 5, ch. 15, p. 5.
requirements by year,
for integrated mine model, v. 2, ch. 5, table 17.
for smelter/refinery, v. 2, ch. 4, pp. 10-11, 166-167, table 42.


Pewee, eastern wood (Contopus virens), v. 4, ch. 2, pp. 63, 70.
Phelps Dodge Corp.,
Phosphatases,
Phosphorus,
as nutrient in water, v. 3, ch. 4, pp. 9-10.
Phthallic acid,
effect on leaching, v. 3, ch. 4, p. 154.
Physicians, see Health manpower.
Physiography, see Geomorphology.
Phytoplankton,
Pickands-Mather and Co., v. 5, ch. 5, p. 3.
Pierce-Smith converter, see Converters.
Piezometric surface, v. 3, ch. 4, p. 44.
Pike, northern (Esox lucius), v. 4, ch. 1, pp. 19, 21.
in lakes, v. 4, ch. 1, p. 40.
Pike, walleye (Stizostedion vitreum), v. 4, ch. 1, pp. 22, 39.
Pine, ground (Lycopodium obscurum), v. 4, ch. 2, p. 72.
Pine, jack (Pinus banksiana), v. 4, ch. 2, pp. 39, 56-65.
adaptation to forest fires, v. 4, ch. 2, pp. 57-58.
commercial use, v. 5, ch. 6, p. 13.
adaptation to forest fires, v. 4, ch. 2, p. 65.
commercial use, v. 5, ch. 6, p. 13.
Pine, white (Pinus strobus), v. 4, ch. 2, p. 69.
blister rust, see White pine blister rust.
commercial use, v. 5, ch. 6, p. 13.
pollution damage from sulfur dioxide, v. 4, ch. 2, pp. 148-150.
Pineville (community),
residential settlement, v. 5, ch. 7, p. 16.
Pink, grass (Calopogon pulchellus), v. 4, ch. 2, pp. 45, 52.
Pioneer Mine (Ely), v. 5, ch. 16, p. 7.
Piping,
Pitcher plant (Sarracenia purpurea), v. 4, ch. 2, pp. 15, 44-45.
Pittsburgh Pacific Co., v. 5, ch. 5, p. 7.
Pittsburgh Pacific Co. (continued)

Minnesota lease, v. 5, ch. 4, p. 21.
Plagioclase, v. 3, ch. 1, pp. 64-65, figure 27.
Plants, see Macrophytes; Vegetation.

Pogonia, rose (Pogonia ophioglossoides), v. 4, ch. 2, pp. 45, 52.

Police, see Public protection.

Pollutants.
maximum containment levels, v. 5, ch. 2, pp. 20-21.
priority 1, v. 2, ch. 4, p. 128, table 26, 27, 28.
priority 2, v. 2, ch. 4, pp. 128, 130, table 27, 28.
threshold limit values, v. 5, ch. 2, p. 20.

Pollution,

Pollution abatement equipment,
exemption from property tax, v. 5, ch. 12, p. 5.

Pollution control, v. 2, ch. 5, pp. 9-10.
capital costs and dcrfor, v. 5, ch. 17, pp. 30-31.
in mining operations, v. 2, ch. 2, pp. 31-32, table 12, 13.
in processing operations, v. 2, ch. 3, pp. 98-100.
in smelting and refining operations, v. 2, ch. 4, pp. 64-162.

Population, v. 1, ch. 5, pp. 33-34; v. 5, ch. 2, p. 23; see also
Demographics.
effect of increase on health, v. 5, ch. 2, pp. 86-89.
growth,
effect on recreation, v. 5, ch. 9, pp. 5, 22-23.
impacts of copper-nickel development, v. 1, ch. 5, pp. 76-77;
v. 5, ch. 1, pp. 16-28.
impacts of single mine/mill with smelter/refinery, v. 5,
ch. 1, pp. 17-22.

increase due to taconite mining expansion,
effect on recreation, v. 5, ch. 9, pp. 29-30.
projected out migration, v. 5, ch. 7, pp. 36-37.

Porcupine (Erithizon dorsatum), v. 4, ch. 2, pp. 28, 64-65.

Porphyry copper, see Copper.

Potassium,
in surface water, v. 3, ch. 4, p. 54.
Potassium amyl xanthate, see Flotation, chemical reagents, xanthates.


Precambrian rocks, v. 3, ch. 1, pp. 5-6, table 3.
Precipitation, v. 3, ch. 3, pp. 50, 64-75; v. 3, ch. 4, pp. 30-31,
figure 8.

average monthly and annual for cities in Study Area, v. 3, ch. 3,
table 21, figure 29.
Precipitation (continued)

influence of Lake Superior, v. 3, ch. 3, pp. 77-78.
snowfall, v. 3, ch. 3, pp. 72-75.
depth on ground, v. 3, ch. 3, pp. 74-75.

Prevention of significant deterioration (PSD), see Air Quality,
prevention of significant deterioration (PSD).

Processing, v. 1, ch. 4, pp. 18-20; v. 2, ch. 3.
chemicals,
effect on health, v. 5, ch. 2, pp. 89-90.
fresh (make-up) water requirements, v. 3, ch. 4, p. 16.
plant production capacity, v. 2, ch. 5, p. 17.
potential areas for cost improvement, v. 2, ch. 3, p. 98.

Processing facilities,
capital investment required, v. 2, ch. 3, p. 10.
operating costs, v. 2, ch. 3, p. 11.
production capacities, v. 2, ch. 3, pp. 5-6.
site layout and areal requirements, v. 2, ch. 3, pp. 94-96.
soil compaction and heavy metal contamination, v. 2, ch. 2, p. 61.
visual impacts, v. 2, ch. 2, p. 60, figure 19, 20; v. 2, ch. 3,
pp. 95-96.

Production tax, see Severance tax.

Productivity,
projected increases, v. 5, ch. 15, pp. 30, 32-33.
of workers, v. 5, ch. 1, pp. 11-12.

Profitability, see Discounted cash flow rate of return.

Propagation loss (of sound), see Sound propagation.

Propene, v. 5, ch. 11, p. 9.

determining taxable valuation, v. 5, ch. 12, pp. 55-56.
effect on dcfror, v. 5, ch. 17, p. 42.
homestead credits, v. 5, ch. 12, p. 62.
revenues to counties, v. 5, ch. 12, pp. 60-61.
revenues to local governments, v. 5, ch. 12, pp. 67-68.
revenues to school districts, v. 5, ch. 12, p. 64.
state reimbursement for homestead credits, v. 5, ch. 12, p. 68.

Prospecting permits, v. 2, ch. 1, p. 5; v. 5, ch. 4, pp. 10-12.
regulation and cost, v. 5, ch. 12, pp. 85-86.

PSD (Prevention of Significant Deterioration), see Air quality,
prevention of significant deterioration (PSD).

Public Health, see Health.
Public protection,  
Pulpwood,  
value of production, v. 5, ch. 15, pp. 6-7.  

Purcel, J.,  
Special Use Permit in SNF, v. 5, ch. 4, p. 19.  

Purvis Lake-Ober Foundation, Scientific and Natural Area, v. 5, ch. 10, pp. 7.  

Pyrometallurgy, v. 2, ch. 4, pp. 15-37; see also Hydrometallurgy;  
Metallurgy.  
applications to Minnesota copper-nickel, v. 2, ch. 4, pp. 52-53.  
equipment and apparatus, v. 2, ch. 4, table 4.  
equipment features and design, v. 2, ch. 4, table 4, figure 16-27.  

Pyrrhotite, v. 3, ch. 1, p. 60, figure 22; v. 3, ch. 2, p. 46.  

R -  

Raccoon (*Procyon lotor*), v. 4, ch. 2, p. 28.  

Rain, see Precipitation.  
Rainy River Watershed, v. 3, ch. 4, p. 5.  

Raptors, v. 4, ch. 2, pp. 88-89.  
rare species, v. 4, ch. 2, p. 34.  
seasonal patterns, v. 4, ch. 2, pp. 29-30.  

Raspberry (*Rubus idaeus*), v. 4, ch. 2, pp. 59, 63, 66.  

Raspberry, arctic (*Rubus acaulis*), v. 4, ch. 2, pp. 52, 98.  

Raven (*Corvus corax*), v. 4, ch. 2, pp. 64, 73, 77.  

Reclamation, v. 1, ch. 5, pp. 47-48; v. 2, ch. 2, pp. 33-67;  
of areas impacted by air pollution, v. 4, ch. 2, pp. 157-158.  
capital costs and deffor, v. 5, ch. 17, pp. 32-33.  
of drill site, v. 2, ch. 1, p. 22.  
of iron ore mines, v. 5, ch. 5, p. 7.  
Reclamation (continued)
for potential wilderness areas, v. 2, ch. 2, pp. 33-34.

Recreation, v. 5, ch. 9.
activities, v. 5, ch. 9, pp. 8-9.
cost, v. 5, ch. 13, p. 21, table 5.
economic importance, v. 5, ch. 9, pp. 11-12.
facilities, v. 5, ch. 9, pp. 2-3, 6, 7-8.
map, v. 5, ch. 9, figure 2, 3.
features inhibiting use, v. 5, ch. 9, p. 10.
features promoting use, v. 5, ch. 9, p. 10.
impacts of copper-nickel development, v. 5, ch. 9, pp. 4-5, 12-30.
land-based, v. 5, ch. 9, p. 9.
potential decrease due to taconite industry expansion, v. 5, ch. 9, pp. 27-29.
public lands in Study Area, v. 5, ch. 9, p. 8, figure 4.
use patterns, v. 5, ch. 9, pp. 9-10.
maps, v. 5, ch. 9, figure 5-10.
water-based, v. 5, ch. 9, p. 9.

Recreational lands,
effect on residential settlement, v. 5, ch. 7, pp. 28-29.

Redpoll, common (Acanthis flammca), v. 4, ch. 2, p. 64.

Refinery, see also Smelter/refinery.

Refining, v. 1, ch. 4, pp. 21-22; v. 2, ch. 4; v. 2, ch. 4, pp. 54-61;
see also Electrorefining.
fire, v. 2, ch. 4, pp. 55-56.

Refining furnaces, see also Furnaces.
rotary-anode, v. 2, ch. 4, p. 55.

Regional economy,
base industries, v. 5, ch. 15, pp. 5-9.
benefits from mining companies' expenditures, v. 5, ch. 15, p. 25,
table 5.

characteristics, v. 5, ch. 15, pp. 4-10.
direct impacts of copper-nickel development, v. 5, ch. 15, pp. 21-27.

economic sectors, v. 5, ch. 15, pp. 33-36, table 7, 8.

impacts of copper-nickel development, v. 5, ch. 15.
impacts of copper-nickel development on region outside of Study
Area, v. 5, ch. 15, pp. 36-38.

indirect impacts of copper-nickel development, v. 5, ch. 15, pp. 28-33.

multiplier effect, v. 5, ch. 15, pp. 31-33.

Research Natural Areas, v. 5, ch. 10, pp. 4-5; see also Keeley Creek
Research Natural Area.

Reserve Mining Co., v. 5, ch. 5, p. 3.

Minnesota surface lease, v. 5, ch. 4, p. 21.

railroad, v. 5, ch. 8, pp. 6-7, 8.

Special Use Permit in SNF, v. 5, ch. 4, p. 19.

Reserves, see also Copper, resource estimates; Nickel, resource
estimates.
Reserves (continued)


Reservoirs,

Residential/commercial,

Residential settlement, v. 1, ch. 5, pp. 33-34; v. 5, ch. 7.
copper-nickel generated distribution, v. 5, ch. 7, pp. 37-38,
figure 10-20, table 25.

East Range sub-region, v. 5, ch. 7, pp. 16-17.
effect of growth on natural and scientific areas, v. 5, ch. 10,
pp. 19-20.


existing patterns, v. 5, ch. 7, pp. 6-29.
factors affecting location, v. 5, ch. 7, pp. 21-29.

history, v. 5, ch. 7, pp. 8-10.
housing construction in Ely, v. 5, ch. 16, p. 5.
housing types,
frequency in Ely, v. 5, ch. 16, p. 22.
housing values in Ely, v. 5, ch. 16, p. 22.
impacts of copper-nickel development, v. 5, ch. 7, pp. 29-52.
impacts of mine life, v. 5, ch. 7, pp. 48-49.
impacts of mine location, v. 5, ch. 7, pp. 38-41.
impacts of mine size and multiple mine development, v. 5, ch. 7,
pp. 46-47.

impacts of workforce type, v. 5, ch. 7, pp. 41-42.

increase due to taconite mining expansion,

effect on recreation, v. 5, ch. 9, pp. 29-30.
location, v. 5, ch. 7, pp. 3-4.
projected growth, v. 5, ch. 7, pp. 4-5.

projections, v. 5, ch. 7, pp. 43-49.
Southeastern sub-region, v. 5, ch. 7, p. 10.
sub-regions (five), v. 5, ch. 7, pp. 10-17.

types, v. 5, ch. 7, pp. 7-8.

v. 5, ch. 5, pp. 27-28.

Resources,

Restoration, v. 4, ch. 2, pp. 116-117.
of mature vegetation communities, v. 4, ch. 2, pp. 9-10.
necessary steps, v. 2, ch. 2, pp. 34-35.
Revegetation, v. 1, ch. 5, pp. 48-49.
desirable proportion of vegetative cover, v. 2, ch. 2, pp. 57-58.
levels depending on reclamation goal, v. 2, ch. 2, p. 34.
of tailings, v. 2, ch. 2, pp. 48-49.
species used, v. 2, ch. 2, pp. 48-49, table 27.
use of non-native species, v. 2, ch. 2, pp. 48-49.
undisturbed areas as seed source, v. 2, ch. 2, p. 63.
Revenue sharing, v. 5, ch. 12, pp. 70-72.
Rhude and Fryberger, Inc.,
Minnesota lease, v. 5, ch. 4, p. 21.
Rivers, see Streams; Waterways, Inland.
Roadless areas, v. 5, ch. 10, p. 6.
Roads, v. 5, ch. 8, pp. 3-6.
ability to handle projected demands, v. 5, ch. 8, pp. 19-21.
accessibility,
effect on residential settlement, v. 5, ch. 7, p. 25.
areas not accessible by public roads, v. 5, ch. 8, p. 3.
average daily traffic, v. 5, ch. 8, pp. 4-5, figure 6.
capacity, v. 5, ch. 8, pp. 5-6.
cost of construction and upgrading, v. 5, ch. 8, pp. 20-21, table 7.
projected average daily traffic (ADT), v. 3, ch. 8, figure 14-20.
proposed AMAX road, v. 5, ch. 7, pp. 38, 40; v. 5, ch. 8, p. 20.
proposed new roads, v. 5, ch. 8, p. 4.
reclamation as public or access roads, v. 2, ch. 2, p. 66.
volume to capacity ratio, v. 5, ch. 8, pp. 5-6, 19.
weight restriction, v. 5, ch. 8, p. 4, figure 4.
Roasting,
of concentrates to remove sulfur, v. 2, ch. 4, pp. 15-16.
Rod mills, see Grinding mills.
Rose, wild (Rose acicularis), v. 4, ch. 2, pp. 56, 63, 66.
Rosemary, bog (Andromeda glaucophylla), v. 4, ch. 2, p. 44.
Rove formation, v. 3, ch. 1, p. 10.
comparison of state and federal regulations, v. 5, ch. 12, table 21.
effect on dcfror, v. 5, ch. 17, pp. 46-47.
rates, v. 5, ch. 12, p. 80.
state revenues, v. 5, ch. 12, table 20.
effect on recreation, v. 5, ch. 9, p. 19.
effect on terrestrial ecosystems, v. 4, ch. 2, pp. 158-163.
Runoff water (continued)
factors affecting production, v. 3, ch. 4, p. 151.
heavy metal concentrations, v. 2, ch. 2, p. 52.
seasonal, v. 3, ch. 4, pp. 96-97.
toxicity to *Daphnia pulicaria*, v. 4, ch. 1, pp. 71-72.
vegetation damage, v. 4, ch. 2, pp. 10-11.
diversion to tailing basins, v. 2, ch. 2, p. 52.

S -

St. Louis County,
St. Louis River,
St. Louis River Watershed, v. 3, ch. 4, p. 5.
Sales tax, v. 5, ch. 12, pp. 25, 47-48.
effect on *dcefror*, v. 5, ch. 17, p. 42.
Salinity,
of tailings, v. 2, ch. 2, p. 44.
Sandwort, large leaved (*Arenaria macrophylla*), v. 4, ch. 2, pp. 32, 103.
Sanitation, v. 5, ch. 2, pp. 33-35.
effect of sewage treatment on aquatic biota, v. 4, ch. 1, p. 106.
effect of sewage treatment on water quality, v. 3, ch. 4, pp. 72-73.
effect on residential settlement, v. 5, ch. 7, p. 25.
sewage treatment, v. 5, ch. 2, pp. 34-35.
Sapsucker, yellow-bellied (*Sphyrapicus varius*), v. 4, ch. 2, p. 73.
Sarsaparilla, wild (*Aralia nudicaulis*), v. 4, ch. 2, pp. 57, 72.
Schindler's ratio, v. 4, ch. 1, pp. 33-34.
Schools,
cost multipliers for school districts, v. 5, ch. 13, pp. 23-24,
table 8.
fiscal disparity for school districts, v. 5, ch. 13, pp. 41-43.
general state aid to school districts, v. 5, ch. 12, pp. 64-65.
taxes and state aids to school districts, v. 5, ch. 12, pp. 63-67.
Scientific areas, see Natural and Scientific areas.
Sclerotoderris canker, v. 4, ch. 2, p. 96.
Scrubbers, see Wet scrubbers.
Seabed minings, see Ocean mining.
Secondary development,
effect on aquatic biota, v. 4, ch. 1, pp. 105-110.
Sedges (*Carex* spp.),
in heath bogs, v. 4, ch. 2, pp. 44, 45.
Seepage,
Seepage (continued)
rate of water seepage through tailing, v. 2, ch. 3, p. 61.
cost of control, v. 2, ch. 3, pp. 76-78.
Selective flotation, see Flotation.
aid to local government, v. 5, ch. 12, pp. 68-69.
effect on dcfrror, v. 5, ch. 17, pp. 44-46.
from mine/mill operation, v. 5, ch. 12, p. 8.
rate tied to wholesale price index, v. 5, ch. 12, pp. 40, 41-42.
revenues to counties, v. 5, ch. 12, pp. 62-63.
revenues to local governments, v. 5, ch. 12, pp. 55-57.
revenues to school districts, v. 5, ch. 12, pp. 64-65.
similarity to fiscal disparities law, v. 5, ch. 12, pp. 56-57.
use to support special funds, v. 5, ch. 12, pp. 39-41, 42.
Severed mineral interests, see Mineral ownership.
Sewage treatment, see Sanitation.
Shafts,
in underground mining, v. 2, ch. 2, pp. 16-17.
Shagawa Lake,
lakeshore development, v. 5, ch. 7, pp. 11, 12.
Shipstead-Nolan Act, v. 5, ch. 5, p. 27; v. 5, ch. 9, p. 14; v. 5,
ch. 10, p. 6.
Shoestring root-rot fungus (Armillaria mellea), v. 4, ch. 2, p. 156.
Shredders,
in mid-reach streams, v. 4, ch. 1, p. 21.
Shrew, American water (Sorex palustris), v. 4, ch. 2, p. 55.
Shrew, arctic (Sorex arcticus), v. 4, ch. 2, pp. 45, 46, 49, 68.
Shrew, masked (Sorex cinereus), v. 4, ch. 2, pp. 41, 45, 46, 49,
52, 64, 68, 71, 76.
Shrew, pigmy (Microsorex hoyi), v. 4, ch. 2, pp. 49, 52, 76.
Shrew, short-tailed (Blarina brevicauda), v. 4, ch. 2, pp. 49, 52,
74, 76.
Siderosis and siderosilicosis, v. 5, ch. 2, pp. 74-75.
Silica,
effect on health, v. 5, ch. 2, pp. 63-64.
to reduce copper and nickel contact of slag, v. 2, ch. 4, pp. 17,
19.
in surface water, v. 3, ch. 4, pp. 54-55.
Silicosis, v. 5, ch. 2, pp. 1, 63-64.
Silver, v. 5, ch. 5, p. 19.
toxicity to aquatic biota, v. 4, ch. 1, p. 69, figure 33.
Silver Bay, v. 5, ch. 8, p. 9.
SIMLAB computer program, v. 5, ch. 1, p. 7; v. 5, ch. 15, pp. 10-18.
modules, v. 5, ch. 15, pp. 11-12, figure 3.
Siren,
noise from mine warning siren, v. 3, ch. 5, p. 34.
Skunk, striped (Mephitis mephitis), v. 4, ch. 2, p. 28.
Slag, v. 2, ch. 4, pp. 14, 142-143; v. 3, ch. 2, p. 66.
   cleaning, v. 2, ch. 4, p. 20.
   granulation, v. 2, ch. 4, p. 142.
   iron content, v. 2, ch. 4, p. 143.
   from smelting operations, v. 2, ch. 4, p. 140.
   mineral content, v. 2, ch. 4, table 2.
   use in electric furnaces, v. 2, ch. 4, p. 43.
   uses, v. 2, ch. 2, p. 65; v. 2, ch. 4, pp. 142-143.

Slag piles,

Slaked lime scrubbing system, v. 2, ch. 4, pp. 116, 117, figure 51.

Slimes,
   hydraulic conductivity, v. 3, ch. 4, p. 105.

   amount generated, v. 4, ch. 2, pp. 145-146.

Smelter,
   effect of air quality criteria on siting, v. 3, ch. 3, pp. 13-14,
     figure 5.
   hypothetical site for point source emissions, v. 3, ch. 3, p. 178,
     figure 86.
   summary of physical parameters, v. 3, ch. 3, table 66.

Smelter/refinery, see also Refinery.
   capital costs, v. 1, ch. 4, pp. 24-25.
   contact water, v. 3, ch. 4, pp. 107-108.
   effect of location on local tax revenues, v. 5, ch. 12, pp. 8-9.
   effect of location on state occupation tax, v. 5, ch. 12, p. 36.
   effect on cost of local government, v. 5, ch. 13, pp. 48-50.
   effect on tax revenues, v. 5, ch. 12, pp. 29-31.
   land requirements, v. 2, ch. 4, pp. 8-9.
   location alternatives, v. 1, ch. 6, pp. 89-91.
   location in Duluth, v. 5, ch. 13, p. 32.
   materials required, v. 5, ch. 8, table 6.
   post-production water budget, v. 3, ch. 4, pp. 118-119.
   production capacity, v. 2, ch. 5, p. 18.
   siting flexibility, v. 2, ch. 4, p. 9.
   tax revenue generated, v. 5, ch. 12, p. 6.
   water inputs, v. 3, ch. 4, p. 181.
   water outputs, v. 3, ch. 4, pp. 182-183.
   water requirements, v. 3, ch. 4, pp. 16-17.

Smelter/refinery sites,
Smelter/refinery sites (continued)
Smelting, v. 1, ch. 4, pp. 20-22; v. 2, ch. 4; v. 2, ch. 4, pp. 16-32;
see also Pyrometallurgy.
chemical affinities, v. 2, ch. 4, p. 17.
combustion systems, v. 2, ch. 4, pp. 21-32.
continuous,
advantages, v. 2, ch. 4, p. 49.
heat requirements, v. 2, ch. 4, pp. 21-32.
INCO flash,
advantages, v. 2, ch. 4, p. 48.
Outokumpu flash,
advantages, v. 2, ch. 4, pp. 46-47.
sulfur dioxide emissions, v. 3, ch. 3, pp. 150-156.
temperatures,
adibatic process, v. 2, ch. 4, pp. 21-22.
Snow, see Precipitation.
Snowberry, creeping (Gaultheria hispidula), v. 4, ch. 2, pp. 48, 53.
Snowshoe hare (Lepus americanus), v. 4, ch. 2, pp. 28-29.
Sodium,
in surface water, v. 3, ch. 4, p. 55.
Sodium sulfate,
from DMA adsorption process, v. 2, ch. 4, p. 95.
Sodium sulfite-bisulfite,
Soil associations, v. 3, ch. 1, figure 11A, table 7, 8.
Soils, v. 3, ch. 1, pp. 26-39; v. 4, ch. 2, pp. 22-23; see also
Surficial materials.
base saturation index, v. 3, ch. 4, pp. 86-87.
buffering effect, v. 3, ch. 4, pp. 85-87.
chemical properties, v. 3, ch. 1, pp. 28-37, table 10.
effect of heavy metal loading in natural and scientific areas,
v. 5, ch. 10, p. 18.
effect on forest productivity, v. 5, ch. 6, pp. 8-9.
effect on residential settlement, v. 5, ch. 7, p. 23, table 11.
element concentration, v. 3, ch. 1, table 11.
mineral, v. 3, ch. 1, p. 34.
organic, v. 3, ch. 1, pp. 33-34.
ph, v. 3, ch. 1, pp. 27, 30.
ph and buffering capacities, v. 4, ch. 2, pp. 143-144.
susceptibility to impacts, v. 4, ch. 2, pp. 94-95.
from tailing basin sites, v. 2, ch. 2, p. 54.
for topdressing, v. 2, ch. 2, pp. 54-55.
Solid waste, see also Slag; Sludge.
production and control, v. 2, ch. 4, pp. 141-147.
from smelter/refinery, v. 2, ch. 4, p. 67.
Solids loading, v. 3, ch. 4, pp. 154-156.
Songbirds,
  habitat groupings, v. 4, ch. 2, pp. 41-43, table 7B.
  rare species, v. 4, ch. 2, pp. 33-34.
Soudan (community),
  on National Register of Historic Places, v. 5, ch. 10, p. 3.
Sound, see also Noise.
  natural sound sources, v. 3, ch. 5, p. 4.
  natural sound levels, v. 3, ch. 5, pp. 10-18.
    summer levels,
      by vegetation type, v. 3, ch. 5, table 2.
      winter levels, v. 3, ch. 5, table 1.
South Kawishiwi River Special Area, v. 5, ch. 5, pp. 27; v. 5, ch. 10, p. 5.
  possible displacement by mining activity, v. 5, ch. 10, pp. 10-11.
Sparrow, chipping (Spizella passerina), v. 4, ch. 2, p. 70.
Sparrow, Lincoln's (Melospiza lincolni), v. 4, ch. 2, p. 50.
Sparrow, song (Melospiza melodia), v. 4, ch. 2, p. 62.
Sparrow, swamp (Melospiza georgiana), v. 4, ch. 2, p. 47.
Sparrow, white-throated (Zonotrichia atricapilla), v. 4, ch. 2, pp. 60, 62, 77.
Sparta (community),
  residential settlement, v. 5, ch. 7, pp. 16, 17.
Special Use Permits, see U.S. Forest Service, Special Use Permits.
Spigotting, see Tailing, Separation of sand fractions.
Spring beauty (Claytonia caroliniana), v. 4, ch. 2, p. 72.
Spruce,
  commercial use, v. 5, ch. 6, p. 13.
  black (Picea mariana), v. 4, ch. 2, pp. 68, 69.
    in black spruce-jack pine uplands, v. 4, ch. 2, pp. 56-57.
    in spruce bogs, v. 4, ch. 2, pp. 39, 47-51.
  white (Picea glauca), v. 4, ch. 2, pp. 40, 67-68.
  Spruce Road (Superior National Forest),
    road work revealing copper, v. 2, ch. 1, p. 6.
Square set method, see Ground support, in underground mining.
Squirrel, Franklin's ground (Spermophilus franklinii), v. 4, ch. 2, p. 34.
Squirrel, red (Tamiasciurus hudsonicus), v. 4, ch. 2, pp. 28, 61.
Stack emissions, see Air emissions.
State mineral policy, v. 5, ch. 17.
  for six states, v. 5, ch. 17, pp. 51-57, appendix A.
State parks, v. 5, ch. 10, p. 7.
State Scientific and Natural Areas, v. 5, ch. 10, pp. 6-7.
Stickleback, brook (Culaea inconstans), v. 4, ch. 1, p. 19.
Stokes' Law, see Tailing basins, settling rates of particles.
Stoneflies (Plecoptera), v. 4, ch. 1, p. 18.
Stoping, see Ground support, in underground mining.
Stores, see Commercial services.
Strawberry (*Fragaria virginiana*), v. 4, ch. 2, pp. 63, 68.
Stream hydrology, v. 3, ch. 4, pp. 31-41.
Streamflow, v. 3, ch. 4, pp. 31-41.
  changes, v. 4, ch. 1, pp. 87-92.
  contribution from precipitation, v. 3, ch. 4, pp. 32-33.
  effect of changes on aquatic biota, v. 4, ch. 1, pp. 88-90.
  high flow periods, v. 3, ch. 4, pp. 36-37.
  impacts of mining during operation phase, v. 3, ch. 4,
    pp. 142-143, figure 56, 57.
  low flow periods, v. 3, ch. 4, pp. 35-36.
  mitigation of changes, v. 4, ch. 1, pp. 91-92.
  probable induced changes, v. 3, ch. 4, pp. 125-126.
Streams,
  aquatic organisms, v. 4, ch. 1, pp. 7, 9-10.
  biological characteristics, v. 4, ch. 1, pp. 16-23.
  channelization/diversion, v. 4, ch. 1, pp. 92-95.
    impacts on aquatic biota, v. 4, ch. 1, pp. 92-93.
    mitigation techniques, v. 4, ch. 1, p. 95.
  classification, v. 4, ch. 1, p. 16.
  currently showing biological effects from mining, v. 4, ch. 1,
  fifth order, see Kawishiwi River.
  first and second order, see Headwater streams.
  flow needed to dilute mine discharges, v. 3, ch. 4, pp. 199-200.
  orders and lengths in Study Area, v. 3, ch. 4, p. 34, table 6.
  physical and chemical conditions, v. 4, ch. 1, pp. 15-16.
  relationship to lakes, v. 4, ch. 1, pp. 43-45.
  sensitivity, v. 4, ch. 1, pp. 46-47.
  third and fourth order, see Mid-reach streams.
  water quality impacts of mining, v. 3, ch. 4, pp. 194-204.
Study Area, see Copper-Nickel Study Area.
Subsidence,
  of ground from underground mining, v. 2, ch. 2, p. 4.
Subsurface ownership, see Mineral ownership.
Succession,
  of vegetation communities, v. 4, ch. 2, pp. 19-20, 24-25.
Sucker, white (*Catostomus commersoni*), v. 4, ch. 1, p. 19.
  in lakes, v. 4, ch. 1, p. 40.
Sulfates, v. 3, ch. 3, pp. 147, 207-212.
  affecting water quality, v. 2, ch. 4, p. 156
  background concentrations, v. 3, ch. 3, pp. 93-100, 207-211.
  deposition, v. 3, ch. 3, pp. 95-100, 211-212; v. 3, ch. 4,
    pp. 79-80.
  annual averages for various communities, v. 3, ch. 3, table 80.
Sulfates (continued)

deposition,
predicted increase in rates, v. 3, ch. 3, pp. 99-100.
origin and transport from outside of region, v. 3, ch. 3, p. 97.
in particulates,
in surface water, v. 3, ch. 4, p. 58.
in water, v. 3, ch. 4, pp. 187-188.

Sulfides,
content in Duluth gabbro, v. 2, ch. 3, p. 7.
instability in presence of oxygen, v. 2, ch. 4, pp. 18-19.

Sulfur,
in particulates, v. 3, ch. 3, p. 130, figure 68, table 52.
removal during copper refining, v. 2, ch. 4, pp. 55-56.
Sulfur dioxide, v. 1, ch. 5, pp. 35, 51-57; v. 3, ch. 3, pp. 81-93, 147-156; see also Air emissions.
air quality impact analysis, v. 3, ch. 3, pp. 175-212.
annual average concentrations, v. 3, ch. 3, pp. 177-184, table 73.
background concentrations, v. 3, ch. 3, pp. 86-93.
control devices for weak gas streams, v. 2, ch. 4, pp. 109-120.
control of smelter emissions, v. 2, ch. 4, pp. 5-6.
conversion to sulfur trioxide, v. 2, ch. 4, pp. 86-87.
current levels in Study Area, v. 3, ch. 3, pp. 7-9, 8-10.
economic recovery, v. 2, ch. 4, pp. 75-78.
effect on health, v. 5, ch. 2, pp. 6-7.
effect on natural and scientific areas, v. 5, ch. 10, pp. 17-18.
effect on plant diseases, v. 4, ch. 2, p. 96.
effect on terrestrial ecosystems, v. 4, ch. 2, pp. 144-150.
emissions based on fuel usage, v. 3, ch. 3, pp. 87-88.
emissions from dryers, v. 2, ch. 4, pp. 74-75.
emissions from smelter, v. 2, ch. 4, pp. 5-6.
emissions from smelting furnaces, v. 2, ch. 4, pp. 75-77.
geographic comparisons of emissions, v. 3, ch. 3, pp. 84-86.
point sources, v. 3, ch. 3, pp. 81-84.
production of liquid sulfur dioxide from smelter air emissions, v. 2, ch. 4, pp. 92-95.
projected emissions, v. 3, ch. 3, pp. 81-84.
removal from emissions of reverberatory furnace, v. 2, ch. 4, p. 42.
from roaster, v. 2, ch. 4, p. 75.
scrubbing systems, v. 2, ch. 4, pp. 110-120.
summary of emissions from smelting operation, v. 2, ch. 4, pp. 80-81.

3-hour concentrations, v. 3, ch. 3, pp. 199-204.
Sulfur oxides, effect on health, v. 5, ch. 2, pp. 64-66.
Sulfuric acid, effect of sale on dcfror, v. 5, ch. 17, p. 27.
transportation, v. 5, ch. 8, p. 2.
transportation problems, v. 5, ch. 8, p. 16.
effect of blowdown on water quality, v. 2, ch. 4, p. 155.
operating costs, v. 2, ch. 4, pp. 89-90.
single contact and double contact, v. 2, ch. 4, pp. 87-88.
Sundew (Drosera rotundifolia), v. 4, ch. 2, pp. 15, 45.
Superior Light, Water, and Power Co., v. 5, ch. 11, p. 17.
Support, see Ground support.
Surface ownership, see Land ownership.
Surface water, v. 3, ch. 4, pp. 6-7.
factors governing pH, v. 3, ch. 4, p. 76; v. 4, ch. 1, pp. 81-83.
impacts of mining on BWCA, v. 3, ch. 4, p. 209.
nutrients, v. 3, ch. 4, pp. 60-62.
Surficial materials,
distribution and depth, v. 3, ch. 1, p. 25, figure 11.
Syphon converter, see Converters.

T -

Tabellaria, v. 4, ch. 1, p. 17.
Taconite, see Iron ore.
"Taconite amendment," v. 5, ch. 12, p. 23.
Taconite Area Environmental Protection and Economic Development Fund,
v. 5, ch. 12, pp. 39, 42; v. 5, ch. 13, pp. 6, 39, 52.
Taconite Harbor, v. 5, ch. 8, p. 9.
Tailing basins,
areal requirements and design, v. 2, ch. 3, pp. 45-46.
capital and operating costs, v. 2, ch. 3, pp. 69-80.
capital costs, v. 5, ch. 17, p. 31, table 8.
dust control, see Dust, from tailing basins.
effect of depth on area required, v. 2, ch. 3, p. 43, figure 17.
embankment height and basin configuration, v. 2, ch. 5, pp. 53-54,
table 28-34, figure 29, 30.
Tailing basins (continued)

- Embankments,
  - capital cost, v. 2, ch. 5, pp. 54-55.
  - functions, v. 2, ch. 3, pp. 81-82.
  - in iron ore mining, v. 5, ch. 5, p. 11.
  - multiple basins for dust control, v. 2, ch. 3, p. 58.
  - post-production water budget, v. 3, ch. 4, p. 118.
  - rate of increase of embankment height, v. 2, ch. 3, p. 45.
  - revegetation,
    - settling rates of particles, v. 2, ch. 3, p. 47.
    - starter dam, v. 2, ch. 3, p. 43.
  - toxicity of metals to plants, v. 2, ch. 2, p. 45.
  - as treatment facilities,
    - advantages and disadvantages, v. 2, ch. 3, pp. 82-84.
    - use of ponds for wildlife, v. 2, ch. 2, p. 49.
    - use to treat liquid wastes, v. 2, ch. 3, pp. 81-84.
    - water, v. 3, ch. 4, pp. 170-179.
    - water budget, v. 3, ch. 4, pp. 104-106.

**Tailings**, v. 3, ch. 2, pp. 49-54.

- chemical composition, v. 3, ch. 1, p. 4, table 1, 2.
- chemistry, v. 3, ch. 2, pp. 49-52.
- copper-nickel compared to taconite, v. 2, ch. 2, p. 44, figure 17.
  - central discharge system, v. 2, ch. 3, pp. 84-85, figure 29.
- effect of production on basin size, v. 2, ch. 3, pp. 43-44.
- metal ion solubility and pH, v. 2, ch. 2, pp. 43-44, figure 16.
- modification to resemble normal soil, v. 2, ch. 2, p. 46.
- physical characteristics, v. 3, ch. 2, p. 54.
- from processing, v. 2, ch. 3, pp. 7-8.
Tailings (continued)
sand characteristics, v. 2, ch. 3, pp. 51-52.
separation of sand fractions, v. 2, ch. 3, pp. 52-53.
stabilization methods, see Dust, from tailing basins.
trace element analyses, v. 2, ch. 3, pp. 35-36.
transportation cost, v. 2, ch. 5, pp. 54-56.
use in embankment construction, v. 2, ch. 3, pp. 70-75.

Tamarack (Larix laricina),
commercial use, v. 5, ch. 6, p. 13.

Tansley, A.G.,

Tax revenue, v. 1, ch. 5, pp. 80-81; v. 5, ch. 12; see also Royalties and Royalty tax.
comparison of six states, v. 5, ch. 17, pp. 54-56.
copper-nickel vs. taconite, v. 5, ch. 12, pp. 74-76.
county, v. 5, ch. 12, pp. 59-63.
direct and indirect, v. 5, ch. 12, pp. 2-3.
impacts of varying production, v. 5, ch. 12, p. 9.
lag behind expenditures, v. 5, ch. 13, pp. 7-10.
over life of mine for six states, v. 5, ch. 17, appendix C.
local,
from copper-nickel development, v. 5, ch. 12, pp. 54-58.
from mine/mill operation, v. 5, ch. 12, pp. 7-8.
to local government, v. 5, ch. 12, pp. 67-72.
from mining companies, v. 5, ch. 15, p. 25.
to school districts, v. 5, ch. 12, pp. 63-67.
sensitivity to changes in variables, v. 5, ch. 12, pp. 31-50.
from smelter/refinery, v. 5, ch. 12, pp. 8-9.
state revenues from copper-nickel development, v. 5, ch. 12, pp. 5-6, 23-31.

Taxation, v. 1, ch. 5, pp. 77-80; v. 5, ch. 12.
comparison of six states, v. 5, ch. 17, pp. 51-57, appendix A.
effect on dcfior, v. 5, ch. 17, pp. 2-3, 39-50, figure 12.
exemptions, v. 5, ch. 12, pp. 4-5.
impacts of policy on minerals development, v. 5, ch. 17, pp. 55-57.
of individuals, v. 5, ch. 12, pp. 50-51.
Minnesota taxes on copper-nickel mining industry, v. 5, ch. 12, pp. 3-6, table 1.
policies, v. 1, ch. 5, pp. 82-83.
sensitivity of dcfior to changes in rates, v. 5, ch. 17, pp. 41-42.
sensitivity to changes in variables, v. 5, ch. 12, pp. 31-50.
state,
of state-controlled minerals, v. 5, ch. 4, pp. 15-16.
state variations for mineral industries, v. 5, ch. 12, pp. 10-12.
taconite vs. copper-nickel,
effect on dcfior, v. 5, ch. 17, pp. 48-50, appendix A.
Tea, Labrador (Ledum groenlandicum), v. 4, ch. 2, pp. 48, 56.
Temperature,
flame temperature in smelting, v. 2, ch. 4, pp. 21-23.
necessary for furnace operation, v. 2, ch. 4, p. 23.
Temperature (Climate), v. 3, ch. 3, pp. 58-62.
mean temperatures by month for cities in Study Area, v. 3, ch. 3,
pp. 60-61, table 17.
Temperature (Water),
changes, v. 4, ch. 1, pp. 95-98.
impact of changes on aquatic biota, v. 4, ch. 1, pp. 96-98.
mitigation of changes, v. 4, ch. 1, p. 98.
Terrestrial ecosystems, v. 4, ch. 2.
impact assessment, v. 4, ch. 2, pp. 111-117.
impacts of copper-nickel development, v. 4, ch. 2, pp. 8-13,
167-175.
impacts of mining land use, v. 4, ch. 2, pp. 118-134.
interactions of organisms, v. 4, ch. 2, pp. 13-16.
susceptibility, v. 4, ch. 2, pp. 93-111.
Threatened species, see Rare species.
Threshold limit values, v. 5, ch. 2, p. 20.
Thrush, hermit (Hylocichla guttata), v. 4, ch. 2, p. 63.
Thrush, Swainson's (Catharus usulatua), v. 4, ch. 2, p. 6.
Timber, see also Forest.

harvested in 1975, v. 5, ch. 6, p. 2.
loss of production, v. 5, ch. 6, p. 4.
projected supply and demand, v. 5, ch. 6, pp. 13-14.
resource use, v. 5, ch. 6, pp. 11-17.
value of production, v. 5, ch. 6, table 7.
Timber industry,
in economy of Study Area, v. 5, ch. 15, pp. 6-7.
employees and payroll, v. 5, ch. 15, p. 7.
Timber management, v. 4, ch. 2, pp. 5, 36, 79, 91-93, 175.
allowable cut effect, v. 5, ch. 6, p. 16.
current policies, v. 5, ch. 6, pp. 14-17.
"softwood deficit," v. 5, ch. 6, p. 16.
Titanium, v. 3, ch. 1, p. 64.
Titanium dioxide (TiO₂),
as iron impurity, v. 2, ch. 3, p. 89.
Toimi (community),
Top-blown rotary converter, see Converters.
Topdressing,
amount and choice of material, v. 2, ch. 2, pp. 53-54.
Topdressing (continued)
organic material disrupting flotation process, v. 2, ch. 2, p. 56.
for revegetation of metalliferous wastes, v. 2, ch. 2, pp. 53-56.
for stabilization in revegetation, v. 2, ch. 2, pp. 46-47.

Topography,
effect on residential settlement, v. 5, ch. 7, pp. 22-23.
table 10.
Total dissolved solids (TDS), v. 3, ch. 4, pp. 187-189.
Total suspended particulates (TSP), v. 3, ch. 3, pp. 101-128.
Total suspended solids (TSS), v. 3, ch. 4, pp. 189-190; v. 4, ch. 1,
pp. 98-102.

Tourism,
contribution to total export sales in Ely, v. 5, ch. 16, p. 3.
economic role in Ely, v. 5, ch. 16, pp. 15-20.
economic sectors affected, v. 5, ch. 16, p. 16, table 5.
in economy of Study Area, v. 5, ch. 15, pp. 7-9.
effect on Ely sales activity, v. 5, ch. 9, p. 11.
in Ely,

Tower (community),

Tower-Soudan,

Toxicology, v. 5, ch. 2, pp. 18-19.

Trace elements,
effect of pH on mobility, v. 3, ch. 4, p. 25.
smelter model, v. 2, ch. 4, pp. 131-132.
in water, v. 3, ch. 4, pp. 185-187.

Transmission lines,

Transportation, v. 2, ch. 4, pp. 162-164; v. 5, ch. 8; see also
Railroads; Roads; Waterways.
of concentrate, v. 2, ch. 3, pp. 92, 93.
cost for tailing disposal and recycle water, v. 2, ch. 3, pp. 78-80.
of forest products, v. 5, ch. 6, p. 10.
impact of copper-nickel development, v. 5, ch. 8, pp. 13-22.
for iron ore mining companies, v. 5, ch. 5, p. 12.
land cover, v. 5, ch. 3, p. 10.
land needs, v. 5, ch. 5, pp. 24-25.
materials handling costs, v. 2, ch. 2, figure 5.
noise impacts, v. 3, ch. 5, pp. 36-39.
of ore, lean ore and waste rock, v. 2, ch. 2, pp. 7-8.
residential,
increased demands, v. 5, ch. 8, pp. 18-19.
Transportation (continued)
of taconite pellets, v. 5, ch. 8, p. 1.

Trapping

Trillium, nodding (Trillium cernuum), v. 4, ch. 2, p. 72.

Troctolite,
low augite, v. 3, ch. 1, p. 46.

Troctolitic series, v. 3, ch. 1, pp. 11-12, 44-48.

Trophic levels, v. 4, ch. 1, p. 6.

Trophic state index (TSI), v. 3, ch. 4, p. 61, table 18.

Trout, v. 4, ch. 1, p. 19.
in lakes,
relationship to trophic status, v. 4, ch. 1, p. 40.

Trout, brook (Salvelinus fontinalis), v. 4, ch. 1, p. 19.
copper toxicity, v. 4, ch. 1, p. 64.

Twayblade, Lister's (Listera cordata), v. 4, ch. 2, pp. 45, 52.

Twinflower (Linnaea borealis), v. 4, ch. 2, pp. 75.

Twisted stalk (Streptopus roseus), v. 4, ch. 2, p. 72.

Two Harbors, v. 5, ch. 8, pp. 9, 10.
availability to copper-nickel mining companies, v. 5, ch. 8, p. 17.


U -

Ultimate pit limit, v. 5, ch. 5, pp. 3, 4, 8.
for taconite mining, v. 5, ch. 5, p. 31.

effect on water quality, v. 3, ch. 4, pp. 162-163.
environmental impacts compared to open pit mining, v. 2, ch. 2,
p. 4.
groundwater inputs, v. 3, ch. 4, pp. 102-103.

Undisturbed watersheds,

Undulations,
of geological contact, v. 3, ch. 1, pp. 52-53.

Unemployment insurance, v. 5, ch. 12, pp. 26, 48-49.


U.S. Bureau of Mines,
cash flow model (MINESIM-4), v. 5, ch. 17, pp. 11-16.

U.S. Forest Service,
U.S. Forest Service (continued)

special areas, v. 5, ch. 10, p. 5.
Special Use Permits,
current status, v. 5, ch. 4, p. 18.
for surface activities, v. 5, ch. 4, pp. 11-12.

U.S. Steel Corporation, v. 5, ch. 5, p. 3.
bulk samples, v. 2, ch. 1, p. 20.
Minnesota lease, v. 5, ch. 4, p. 21.
projected production of Minntac facility, v. 5, ch. 5, p. 15.
Special Use Permit in SNF, v. 5, ch. 4, p. 19.

Unnamed Creek,
biological effects of current mining operation, v. 4, ch. 1,
pp. 24-25.

Upgrading,
of roads, v. 5, ch. 8, pp. 20-21.

Uplands, v. 4, ch. 2, pp. 56-77.
black spruce-jack pine, v. 4, ch. 2, pp. 56-57.
recent clearcuts, v. 4, ch. 2, pp. 58-61.
successional classes, v. 4, ch. 2, p. 58.
young plantations, v. 4, ch. 2, pp. 61-62.

Upset conditions, v. 2, ch. 2, pp. 30-31; v. 2, ch. 4, pp. 158-161.
air emissions, v. 2, ch. 4, pp. 96-97.
air emissions from smelter, v. 3, ch. 3, p. 155.
in smelter/refinery, v. 2, ch. 4, p. 11.
sulfur dioxide emissions, v. 3, ch. 3, pp. 201-204.
types of failures, v. 2, ch. 4, pp. 159-160.

Utah,
tax revenues over life of mine, v. 5, ch. 17, appendix C.
taxation of mineral industries, v. 5, ch. 17, pp. 51-57,
appendix A.

Veery (Hylocichla fuscescens), v. 4, ch. 2, pp. 47, 73.
Vegetation,
in cedar bogs,
diversity, v. 4, ch. 2, pp. 53, 54.
effect of loss on aquatic organisms, v. 4, ch. 1, pp. 103-105.
effect of pollutants on diseases, v. 4, ch. 2, pp. 95-97.
growth reduction due to acid precipitation, v. 4, ch. 2, p. 152.
loss, v. 4, ch. 1, pp. 102-105.
maps of development zones, v. 4, ch. 2, figure 38-44.
rare species, v. 4, ch. 2, pp. 32-33, 63, 68.
of spruce bogs, v. 4, ch. 2, p. 49.
of tamarack bogs, v. 4, ch. 2, p. 52.
sensitivity to sulfur dioxide, v. 4, ch. 2, figure 49.
Vegetation (continued)
susceptibility to impacts, v. 4, ch. 2, pp. 95-98.
type,
affect on sound levels, v. 3, ch. 5, pp. 10-18.
Vegetation communities, v. 4, ch. 2, pp. 4-7, 24-25, 39-41, figure 4-7A-C, table 7, 8.

alder carrs, v. 4, ch. 2, pp. 46-47.
aspen-birch uplands, v. 4, ch. 2, pp. 68-75.
and associated animal populations, v. 4, ch. 2, pp. 43-93.
black ash lowlands, v. 4, ch. 2, pp. 54-56.
black spruce bogs, v. 4, ch. 2, pp. 47-51.
black spruce-jack pine uplands, v. 4, ch. 2, pp. 56-57.
boundaries and interactions, v. 4, ch. 2, pp. 18-20.

cedar bogs, v. 4, ch. 2, pp. 53-54.
deciduous uplands, v. 4, ch. 2, pp. 68-75.
in development zones, v. 4, ch. 2, pp. 101-111.
habitat types, v. 4, ch. 2, pp. 37-38.
heath bogs, v. 4, ch. 2, pp. 44-46.
jack pine uplands, v. 4, ch. 2, pp. 57-65.
mixed deciduous-coniferous uplands, v. 4, ch. 2, pp. 75-77.
shrub carr, v. 4, ch. 2, pp. 44-47.
tamarack bogs, v. 4, ch. 2, pp. 51-53.

white spruce uplands, v. 4, ch. 2, pp. 67-68.
Vermilion Lake,
Vireo, red-eyed (Vireo olivaceus), v. 4, ch. 2, pp. 70, 71, 73.
Virgin lands,
in Study Area, v. 4, ch. 2, pp. 6, 7.
Virginia (community),
commercial services, v. 5, ch. 7, pp. 27-28, table 16.

Residential settlement, v. 5, ch. 7, p. 15.
Visual screening,
effectiveness, v. 2, ch. 2, pp. 60-61, figure 21.
Vole, heather (Phenacomys intermedius), v. 4, ch. 2, p. 34.
Vole, meadow (Microtus pennsylvanicus), v. 4, ch. 2, pp. 49, 52.
Vole, red-backed (Clethrionomys gapperi), v. 4, ch. 2, pp. 41, 49, 52, 58, 61, 64, 68, 71, 76.
Vole, rock (Microtus chrotorrhinus), v. 4, ch. 2, p. 34.
Voyageurs National Park, v. 5, ch. 9, p. 5.
and tourism industry, v. 5, ch. 15, p. 7.

W -

Walleye pike, see Pike, walleye.
Warbler, black-and-white (Mniotella varia), v. 4, ch. 2, p. 73.
Warbler, Blackburnian (Dendroica fusca), v. 4, ch. 2, p. 64.
Warbler, Canada (Wilsonia canadensis), v. 4, ch. 2, p. 73.
Warbler, Cape May (Dendroica tigrina), v. 4, ch. 2, p. 6, 34.
Warbler, chestnut-sided (Dendroica pensylvanica), v. 4, ch. 2, pp. 60, 62, 71, 77.
Warbler, Connecticut (Oporornis agilis), v. 4, ch. 2, p. 50.
Warbler, golden-winged (Vermivora chrysoptera), v. 4, ch. 2, pp. 33, 47.
Warbler, magnolia (Dendroica magnolia), v. 4, ch. 2, pp. 73, 77.
Warbler, mourning (Oporornis philadelphia), v. 4, ch. 2, pp. 60, 71, 74.
Warbler, Nashville (Vermivora ruficapilla), v. 4, ch. 2, pp. 50-51.
Warbler, Tennessee (Vermivora peregrina), v. 4, ch. 2, pp. 6, 34, 50.
Warbler, yellow-rumped (Dendroica coronata), v. 4, ch. 2, pp. 63-64, 77.

diagram of stockpile, v. 2, ch. 2, figure 9.
mineralogy, v. 3, ch. 2, pp. 32-33, table 12.
physical characteristics, v. 3, ch. 2, pp. 34-35.

Waste rock piles,
design, v. 2, ch. 5, pp. 50-51, table 25, 26, figure 26.
leaching, v. 2, ch. 2, pp. 50-51.
revegetation,
AMAX pilot studies, v. 2, ch. 2, pp. 56-57.
runoff, v. 3, ch. 4, pp. 165-170.

Waste-heat boilers, v. 2, ch. 4, p. 32.
Wastewater treatment, see Sanitation.

Water, v. 3, ch. 4; see also Groundwater; Surface water.
amenity areas,
anual outputs from mine/mill, v. 3, ch. 4, table 47.
color due to organic material, v. 3, ch. 4, p. 54.
consumption for smelter/refinery, v. 2, ch. 4, pp. 148-150.
discharges from smelter/refinery, v. 2, ch. 4, pp. 147-148, figure 59.
distribution by year for integrated mine model, v. 2, ch. 5, table 19.
effect on residential settlement, v. 5, ch. 7, pp. 21-22.
hardness, v. 3, ch. 4, p. 55.
impacts of copper-nickel development on consumption, v. 1, ch. 5, pp. 50-51.
inflow into mines, v. 2, ch. 5, p. 23.
ionic strength,
land cover, v. 5, ch. 3, pp. 6-7.
makeup requirements for smelter/refinery, v. 2, ch. 4, pp. 150-152.
municipal and industrial discharges, v. 3, ch. 4, pp. 72-74.
pH, v. 2, ch. 4, p. 156; v. 3, ch. 4, p. 189.
Water (continued)

- pH,
  - for processing, v. 2, ch. 3, pp. 3, 9-10, 90-91, figure 30;
  - recycling from tailing basin, v. 2, ch. 3, p. 10.
  - siting constraints for mining development, v. 5, ch. 5, p. 27.
  - sources in copper-nickel development zones, v. 3, ch. 4, pp. 146-149.
  - specific conductance, v. 3, ch. 4, p. 55.
  - stream appropriation for water needs, v. 3, ch. 4, pp. 18-19.
  - supply in copper-nickel development zones, v. 3, ch. 4, pp. 145-149.
  - from tailing basins,
  - total balance in integrated operation, v. 2, ch. 5, figure 11, 12, 13.
  - total organic content (TOC), v. 3, ch. 4, p. 56.
  - use, v. 3, ch. 4, pp. 49-50.
  - use and discharge,

Water and sewer systems, see Sanitation.

Water budget, v. 3, ch. 4, pp. 15-18, 87-119, 210-211.
  - collection of runoff, v. 3, ch. 4, pp. 135-139.
  - for mill and tailing basins, v. 3, ch. 4, pp. 111-112, table 52.
  - mine/mill operation, v. 3, ch. 4, pp. 110, 128-139, table 48.
  - multiple year, v. 3, ch. 4, pp. 115-117.
  - for smelter/refinery, v. 3, ch. 4, pp. 112-114, 139-142.

Water emissions, v. 2, ch. 4, pp. 67-68.
  - area sources, v. 3, ch. 4, pp. 74-75.


Water quality, v. 1, ch. 5, pp. 38-45; v. 2, ch. 4, pp. 152-158;
  - v. 3, ch. 4, pp. 8-14, 50-87.
  - acid plant blowdown, v. 2, ch. 4, p. 155, table 36.
  - anode casting water, v. 2, ch. 4, p. 154, table 34.
  - concentrations of chemicals,
  - copper refinery, v. 2, ch. 4, p. 155, table 37.
  - effect on heavy metal,
    - toxicity to aquatic biota, v. 4, ch. 1, p. 50.
  - effect on natural and scientific areas, v. 5, ch. 10, pp. 11-15.
  - effect on recreation, v. 5, ch. 9, pp. 17-20.
  - existing impacts, v. 3, ch. 4, pp. 71-75.
Water quality (continued)
impacts, v. 3, ch. 4, pp. 22-27.
impacts of atmospheric deposition, v. 3, ch. 4, pp. 80-85.
impacts of copper-nickel mining, v. 3, ch. 4, pp. 184-212.
models, v. 3, ch. 4, pp. 149-183.
nickel refinery, v. 2, ch. 4, p. 156.
post-operational phase, v. 3, ch. 4, pp. 164-165.
potable water, v. 2, ch. 4, p. 155.
slag granulation water, v. 2, ch. 4, pp. 154-155, table 35.
smelter/refinery, v. 3, ch. 4, pp. 179-183, table 85, 86.
source models, v. 3, ch. 4, pp. 21-22.
of streams in Study Area, v. 2, ch. 4, p. 154, table 32.
Water quality regulations, v. 3, ch. 4, pp. 10-11.
Water Quality Research Area, v. 1, ch. 3, p. 5; v. 3, ch. 4, p. 5,
figure 1, 2.
Water system,
for mill and tailing basins, v. 3, ch. 4, pp. 103-106.
for mine/mill operation, v. 3, ch. 4, pp. 90-103.
Watersheds,
in Copper-Nickel Study Area, v. 3, ch. 4, p. 28, table 4.
drainage area affecting streamflow, v. 3, ch. 4, pp. 33-34,
figure 10.
lake watershed area and dilutional flow formula, v. 3, ch. 4,
p. 205.
sensitivity, v. 4, ch. 1, p. 47.
size necessary to dilute mine discharges, v. 3, ch. 4, pp. 199-204.
by vegetation and soil characteristics, v. 4, ch. 2, pp. 108-111.
Great Lakes, v. 5, ch. 8, pp. 9-11.
ability to handle projected demands, v. 5, ch. 8, p. 17.
capacity, v. 5, ch. 8, pp. 10-11.
Inland, v. 5, ch. 8, pp. 11-13.
ability to handle projected demands, v. 5, ch. 8, pp. 17-18.
Wessel (Mustela spp.), v. 4, ch. 2, p. 29.
Weather, see Climate.
Wetlands, v. 4, ch. 2, pp. 6-7, 43-56.
black ash, v. 4, ch. 2, pp. 54-56.
effect on residential settlement, v. 5, ch. 7, pp. 21-22.
White pine blister rust (Cronartium ribicola), v. 4, ch. 2, pp. 79, 96.
White Pine Jordan National Natural Landmark (proposed), v. 5, ch. 10, p. 6.
Whitefish (Coregonus clupeaformis), v. 4, ch. 1, p. 23.
Wildlife, contribution to sound levels, v. 3, ch. 5, pp. 18-19.
impacts of noise, v. 4, ch. 2, pp. 163-166.
susceptibility to impacts, v. 4, ch. 2, pp. 98-101.
Williams Pipeline Co., v. 5, ch. 11, pp. 8, 9.
Willow, Bebb's (Salix bebbiana), v. 4, ch. 2, pp. 62-63, 66, 68.
patterns,
sound levels, v. 3, ch. 5, pp. 10-18.
sound levels for different vegetation types, v. 3, ch. 5, p. 14, table 5.
Winter dormant mammals, v. 4, ch. 2, p. 28.
Winton, see Ely-Winton.
Wisconsin,
tax revenues over life of mine, v. 5, ch. 17, appendix C.
taxation of mineral industries, v. 5, ch. 17, pp. 51-57, appendix A.
Wolf, easter timber (Canis lupus lycaeon), v. 4, ch. 2, pp. 29, 34-35, 87-88.
destruction of habitat, v. 4, ch. 2, p. 100.
influence of social patterns on habitat use, v. 4, ch. 2, p. 168.
Woodcock (Philohela minor), v. 4, ch. 2, pp. 30, 47, 60, 71.
Woodpecker, black-backed three-toed (Picoides arcticus), v. 4, ch. 2, p. 64.
Woodpecker, downy (Dendrocopos pubescens), v. 4, ch. 2, pp. 60, 64.
Woodpecker, hairy (Dendrocopos villosus), v. 4, ch. 2, pp. 60, 64, 73.
Woodpecker, northern three-toed (Picoides tridactylus), v. 4, ch. 2, p. 51.
Worker's compensation, v. 5, ch. 12, pp. 48-49.
Wren, winter (Troglodytes troglodytes), v. 4, ch. 2, pp. 50, 77.

X -

Xanthates, see Flotation, chemical reagents.

Y -

Yellowthroat, common (Geothlypis trichas), v. 4, ch. 2, p. 47.

Z -

Zinc,
damage to vegetation, v. 4, ch. 2, p. 139.
Zinc (continued)
   effect on health, v. 5, ch. 2, pp. 90-91.
   emissions from smelter, v. 2, ch. 4, p. 130.
   in soils, v. 3, ch. 1, p. 31.
   toxicity to aquatic biota, v. 4, ch. 1, pp. 68-69, figure 30.
Zoning,
   effect on government service costs, v. 5, ch. 13, pp. 15-16.
   effect on residential settlement, v. 5, ch. 7, pp. 23-24, table 12.
Zooplankton, v. 4, ch. 1, p. 36.
   heavy metal toxicity tests, v. 4, ch. 1, p. 63.
AUTHOR INDEX

Ashbrook, Peter
Public health, v. 5, ch. 2.

Bauman, Eric H.
Mine lands, v. 5, ch. 5.
Outdoor recreation, v. 5, ch. 9.

Donaldson, Mark
Community government service cost and revenue projections, v. 5, ch. 13.
Government taxes and aids and estimated government revenue, v. 5, ch. 12.
Human populations, v. 5, ch. 1.
Local economic analysis: a case study of Ely, Minnesota, v. 5, ch. 16.
Regional economic impacts, v. 5, ch. 15.
Regional energy systems, v. 5, ch. 11.

Eger, Paul
Water resources, v. 3, ch. 4.

Hewett, Martha
Water resources, v. 3, ch. 4.

Honetschlager, Beth
Water resources, v. 3, ch. 4.

Johnson, Mark D.
Aquatic biology resources, v. 4, ch. 1.
Kreisman, Peter J.
Air resources, v. 3, ch. 3.
Geology and mineralogy, v. 3, ch. 1.
Integrated development models, v. 2, ch. 5.
Mineral resource potential, v. 3, ch. 2.
Smelting and refining, v. 2, ch. 4.

Lapakko, Kim
Water resources, v. 3, ch. 4.

Lentz, Charles O.
Forest lands and the forest products industry, v. 5, ch. 6.
Land use-land cover overview, v. 5, ch. 3.
Outdoor recreation, v. 5, ch. 9.
Residential settlement patterns, v. 5, ch. 7.

Lichty, Richard
Local economic analysis: a study of Ely, Minnesota, v. 5, ch. 16.

Lieberman, Gerald A.
Aquatic biology resources, v. 4, ch. 1.
Public health, v. 5, ch. 2.
Terrestrial ecosystems, v. 4, ch. 2.

Maki, Wilbur
Regional economic impacts, v. 5, ch. 15.

Meagher, Patrick D.
Human populations, v. 5, ch. 1.
Regional economic impacts, v. 5, ch. 15.
Mustalish, Roger
   Water resources, v. 3, ch. 4.

Nelson, Barbara
   Lands and minerals ownership, v. 5, ch. 4.
   Mine lands, v. 5, ch. 5.
   Outdoor recreation, v. 5, ch. 9.

Oman, Steven P.
   Mineral extraction (Mining), v. 2, ch. 2.

Patterson, William A.
   Terrestrial ecosystems, v. 4, ch. 2.

Pojar, Michael J.
   Smelting and refining, v. 2, ch. 4.

Poppe, Robert H.
   Integrated development models, v. 2, ch. 5.

Ritchie, Ingrid
   Air resources, v. 3, ch. 3.

Sather, Nancy
   Forest lands and the forest products industry, v. 5, ch. 6.
   Geology and mineralogy, v. 3, ch. 1.
   Mineral extraction (Mining), v. 2, ch. 2.
   Mineral resource potential, v. 3, ch. 2.
   Terrestrial ecosystems, v. 4, ch. 2.

Sipson, Roger F.
   Noise in the environment, v. 3, ch. 5.
Stevenson, Robert J.
Geology and mineralogy, v. 3, ch. 1.
Mineral resource potential, v. 3, ch. 2.

Thingvold, Daryle
Water resources, v. 3, ch. 4.

Tull, Royden E.
State mineral policy and copper-nickel mining profitability,
v. 5, ch. 17.

Veith, David L.
Integrated development models, v. 2, ch. 5.
Mineral processing, v. 2, ch. 3.

Waldum, Marit
Lands and minerals ownership, v. 5, ch. 4.
Mine lands, v. 5, ch. 5.
Natural, scientific, and historical areas, v. 5, ch. 10.
Transportation, v. 5, ch. 8.

Webb, Sara
Outdoor recreation, v. 5, ch. 9.
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACE</td>
<td>allowable cut effect</td>
</tr>
<tr>
<td>ACGIH</td>
<td>American Conference of Governmental Industrial Hygienists</td>
</tr>
<tr>
<td>ADT</td>
<td>average daily traffic</td>
</tr>
<tr>
<td>ANFO</td>
<td>Ammonium nitrate fuel oil</td>
</tr>
<tr>
<td>BLM</td>
<td>Bureau of Land Management</td>
</tr>
<tr>
<td>CDM</td>
<td>Climatological Dispersion Model</td>
</tr>
<tr>
<td>CEU</td>
<td>copper equivalent units</td>
</tr>
<tr>
<td>CIPEC</td>
<td>Intergovernmental Council of Copper Exporting Countries</td>
</tr>
<tr>
<td>COMEX</td>
<td>New York Commodity Exchange</td>
</tr>
<tr>
<td>CPOM</td>
<td>coarse particles of organic matter</td>
</tr>
<tr>
<td>CSAH</td>
<td>County State Aid Highways</td>
</tr>
<tr>
<td>CSI</td>
<td>Calcite saturation index</td>
</tr>
<tr>
<td>CTC</td>
<td>centralized traffic control</td>
</tr>
<tr>
<td>dBA</td>
<td>decibels, adjusted</td>
</tr>
<tr>
<td>dcfnor</td>
<td>discounted cash flow rate of return</td>
</tr>
<tr>
<td>DMA</td>
<td>Dimethylaniline</td>
</tr>
<tr>
<td>DO</td>
<td>dissolved oxygen</td>
</tr>
<tr>
<td>EDS</td>
<td>X-ray spectroscopy</td>
</tr>
<tr>
<td>ELA</td>
<td>Experimental Lakes Area (in northwestern Ontario)</td>
</tr>
<tr>
<td>FPOM</td>
<td>fine particles of organic matter</td>
</tr>
<tr>
<td>Hz</td>
<td>hertz</td>
</tr>
<tr>
<td>KAX</td>
<td>Potassium amyl xanthate</td>
</tr>
<tr>
<td>KVA</td>
<td>Kilovolt-ampere</td>
</tr>
<tr>
<td>LHD</td>
<td>Load-haul-dump units</td>
</tr>
<tr>
<td>LME</td>
<td>London Metal Exchange</td>
</tr>
<tr>
<td>Acronym</td>
<td>Description</td>
</tr>
<tr>
<td>---------</td>
<td>-------------</td>
</tr>
<tr>
<td>M</td>
<td>mesh (refers to Tyler mesh size)</td>
</tr>
<tr>
<td>MCL</td>
<td>Maximum contaminant level</td>
</tr>
<tr>
<td>MDH</td>
<td>Minnesota Department of Health</td>
</tr>
<tr>
<td>MDNR</td>
<td>Minnesota Department of Natural Resources</td>
</tr>
<tr>
<td>MGS</td>
<td>Minnesota Geological Survey</td>
</tr>
<tr>
<td>MIBC</td>
<td>methyl isobutyl carbinol</td>
</tr>
<tr>
<td>MRRC</td>
<td>Minnesota Mineral Resources Research Center</td>
</tr>
<tr>
<td>MSHA</td>
<td>Mine Safety and Health Administration</td>
</tr>
<tr>
<td>MTPY</td>
<td>metric tons per year</td>
</tr>
<tr>
<td>NAA</td>
<td>neutron activation analysis</td>
</tr>
<tr>
<td>NCFES</td>
<td>North Central Forest Experiment Station</td>
</tr>
<tr>
<td>NIOSH</td>
<td>National Institute of Occupational Safety and Health</td>
</tr>
<tr>
<td>NSPS</td>
<td>new source performance standards</td>
</tr>
<tr>
<td>ORTRAN</td>
<td>Superior Coal Transshipment Facility</td>
</tr>
<tr>
<td>PSD</td>
<td>Prevention of Significant Deterioration</td>
</tr>
<tr>
<td>RARE</td>
<td>Roadless area review and evaluation</td>
</tr>
<tr>
<td>RIM</td>
<td>Recreation Information Management</td>
</tr>
<tr>
<td>RNA</td>
<td>Research Natural Area</td>
</tr>
<tr>
<td>RQD</td>
<td>rock quality designation</td>
</tr>
<tr>
<td>SAF</td>
<td>Society of American Foresters</td>
</tr>
<tr>
<td>SCORP</td>
<td>State Comprehensive Outdoor Recreation Plan</td>
</tr>
<tr>
<td>SCS</td>
<td>Soil Conservation Service</td>
</tr>
<tr>
<td>SIP</td>
<td>State implementation plan</td>
</tr>
<tr>
<td>SKRSA</td>
<td>South Kawishiwi River Special Area</td>
</tr>
<tr>
<td>SNF</td>
<td>Superior National Forest</td>
</tr>
<tr>
<td>TBRC</td>
<td>top-blown rotary converter</td>
</tr>
<tr>
<td>TDS</td>
<td>total dissolved solids</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>TEM</td>
<td>Texas Episodic Model</td>
</tr>
<tr>
<td>TEM</td>
<td>transmission electron microscopy</td>
</tr>
<tr>
<td>TH</td>
<td>trunk highways</td>
</tr>
<tr>
<td>TLV</td>
<td>threshold limit value</td>
</tr>
<tr>
<td>TOC</td>
<td>total organic carbon</td>
</tr>
<tr>
<td>TSI</td>
<td>trophic state index</td>
</tr>
<tr>
<td>TSP</td>
<td>total suspended particulates</td>
</tr>
<tr>
<td>TSS</td>
<td>total suspended solids</td>
</tr>
<tr>
<td>UPL</td>
<td>ultimate pit limit</td>
</tr>
</tbody>
</table>