

# UNIVERSITY OF MINNESOTA

---

*Twin Cities Campus*

*Office of the Dean  
School of Public Health*

*A302 Mayo Memorial Building  
Mayo Mail Code 197  
420 Delaware Street S.E.  
Minneapolis, MN 55455  
Office: 612-624-6669  
Fax: 612-626-6931  
<http://www.sph.umn.edu>*

## **ANNUAL REPORT TO THE LEGISLATURE** **MINNESOTA TACONITE WORKERS HEALTH STUDY**

**DATE:** February 21, 2011

**TO:** Sen. Geoff Michel, Chairman  
Senate Jobs and Economic Growth Committee  
208 Capitol

Sen. David Hann, Chairman  
Senate Health and Human Services Committee  
328 Capitol

Rep. Steve Gottwalt, Chairman  
House Health and Human Services Reform Committee  
485 State Office Building

Rep. Bob Gunther, Chairman  
House Jobs and Economic Development Finance Committee  
591 State Office Building

**FROM:** John R. Finnegan, Jr., Assistant Vice President for Public Health, Dean and  
Professor (E-mail: [finne001@umn.edu](mailto:finne001@umn.edu); Phone: 612 625 1179)

Jeffrey Mandel, Associate Professor, Principal Investigator (E-mail:  
[mand0125@umn.edu](mailto:mand0125@umn.edu); Phone: 612 626 9308)

**COPIES:** *Iron Range Legislative Delegation*  
Rep. Tom Anzelc  
Sen. Tom Bakk  
Rep. David Dill  
Rep. Carolyn McElfatrick  
Rep. Carly Melin  
Rep. Tom Rukavina  
Sen. Tom Saxhaug  
Sen. David Tomassoni

Dear Legislators,

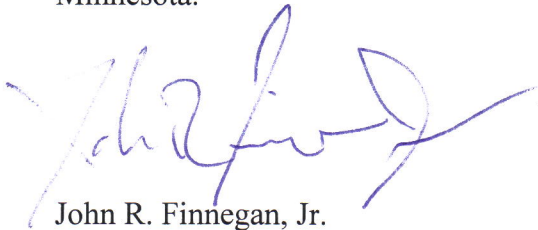
Per House File No. 3569 which states that the University of Minnesota must report annually to the committees of the legislature that are responsible for health and workers' safety, we are pleased to present the attached report on our research into the health status of Minnesota taconite mine workers.

In the report, you will find a progress report on the three main human health study areas (occupational exposure assessment, mortality and cancer incidence studies, taconite respiratory health survey) as well as a report from the National Resources Research Institute on its environmental exposure characterization study.

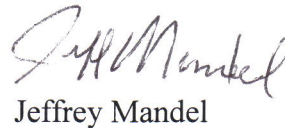
In addition to our scientific research efforts, we continue to make open communication and transparency fundamental objectives of our work. We regularly communicate about our work with the broader Iron Range community through the Minnesota Taconite Workers Lung Health Partnership which continues to meet regularly, via our Web Site (<http://www.taconiteworkers.umn.edu>), in our work with the news media in the Twin Cities that have statewide reach, as well as with media in northeastern Minnesota, and with various stakeholder groups.

We welcome your comments and suggestions, and would be delighted to present this report in person if you wish.

Thank you for the opportunity to advance scientific knowledge on this critical issue facing Minnesota.

A handwritten signature in blue ink, appearing to read "John R. Finnegan, Jr.", with a stylized, flowing script.

John R. Finnegan, Jr.

A handwritten signature in blue ink, appearing to read "Jeffrey Mandel", with a stylized, flowing script.

Jeffrey Mandel

## **Taconite Workers Health Study Progress Report to the Minnesota Legislature**

### **OVERALL SUMMARY**

We have continued to make progress on each of the component parts of the Taconite Workers Health Study. The occupational exposure assessment, mortality, cancer incidence studies, and the respiratory health survey have all moved forward in accomplishing key goals. Those are discussed in more detail within this report, along with a progress report from the Natural Resources Research Institute (NRRI).

We are also pleased with our communications efforts. The study website has been updated (<http://www.taconiteworkers.umn.edu>) and has had over 500 new visits in the past six months with over 900 visits total during that time period. We have continued interacting with the mining communities, unions and industry representatives. Our Stakeholder meetings have been held twice yearly and we are expecting this to continue through the next two years. We have had more interaction within the component study teams. An effort is currently underway to coordinate the reporting process, which will begin this year, for some of the early results. We have had excellent input from the external scientific advisory boards for the School of Public Health and NRRI studies.

We have completed the respiratory health survey at the Virginia Regional Medical Center. This past fall, we also tested additional individuals on the eastern end of the range, in Silver Bay. We are pleased with the turnout from this part of the study, which will make the study findings more relevant. We are also pleased with our dedicated testing team, who helped provide the highest quality possible in clinical testing. Each of the participants has received a letter that reviews their findings and provides guidance as to follow-up with their personal physicians. A digital copy of their x-ray (provided at no cost on a CD) was also included in this communication. We've had many gratified participants and an extremely small number of dissatisfied individuals who went through this testing process.

Our exposure assessment process is in the final stages of on-site testing. Each of the active mines has allowed us access to their facilities. They have provided the opportunity for our exposure experts to gather air and personal samples during the processing of iron ore. This information will be combined with historical sampling information and will provide the foundation of exposure data, to be used in each of the health study components.

Our epidemiology studies are nearing the completion in the identification in causes of death for tens of thousands of individuals. Likewise, we have identified additional mesothelioma cases, which, with the inclusion of cases from outside of Minnesota, now number 77. The causes of death and the mesothelioma and lung cancer cases will be linked to the exposure information during the remainder of 2011.

Geologic work from NRRI is also progressing on schedule. Community air sampling information has been collected and sent for analysis. Initial reports from NRRI will occur over the first half of 2011.

## **STUDY COMPONENTS**

### **I. Occupational Exposure Assessment**

There are three main goals for the exposure assessment component of this research:

1. Assess historical exposures of workers to health-relevant components of dust from taconite operations (asbestos and non-asbestos fibers, respirable dust, and respirable silica) in the taconite industry for the time period 1955-present to evaluate the relationship between exposures and health effects.
2. Assess current exposures of workers to the health-relevant components of dust from taconite operations in relation to current occupational exposure limits.
3. Evaluate existing practices and methods to reduce worker exposures in this industry and, where appropriate, suggest improvements in these methods.

The following tasks have been accomplished to date:

1. We have obtained primary exposure monitoring measurements made in the taconite industry for the time period 1955-present that were abstracted by Dr. John Sheehy in 1986, and data from the Mine Safety and Health Administration.
2. We have obtained data on historical exposure monitoring measurements from Cliffs Natural Resources, US Steel, and Arcelor Mittal. These data have been entered into a database for further statistical analysis. This analysis will be carried out during the coming year. Based on this, we have started preliminary analysis to classify the workers into 30 similarly exposed groups (SEGs).
3. The six mines have been divided into two zones (eastern and western) based on their geographical location on the Iron Range. Five of the mines are in the western zone and one in the eastern zone. Each zone's workforce has been divided into 30 SEGs. We have finished our assessment of current exposures at Northshore mining in Silver Bay and Babbitt, US Steel operations at Minntac and Keetac mines, and at Cliffs Natural Resources Hibbtac mine. We are in the process of starting our assessments at UTac mine, which is the last mine that will be assessed. Two workers from each SEG are sampled three times each for fibers (NIOSH 7400 method) and respirable dust and silica. Table 1 shows the total number of personal samples obtained. We expect that the monitoring of current exposures at the six mines will be concluded by Summer 2011.
4. At the same time, we are also obtaining area samples for more detailed microscopic analysis by transmission electron microscopy (TEM) that can be used to adjust the personal samples. Area samples also include real-time monitoring for particle number, surface area, and mass

concentrations. Table 2 shows the total number of area samples obtained. We expect that the monitoring of current exposures at the six mines will be concluded by Summer 2011.

5. In these surveys, we are also conducting a detailed study of the efficacy of existing exposure control measures including engineering controls, work practice and administrative controls, and personal protective equipment. We have finished this activity for 3 out of the 6 mines.

**Table 1:** Total number of **personal samples** obtained to date.

| <b>Zone</b>    | <b>Mine</b>   | <b>Workers</b> | <b>PCM*</b> | <b>TEM*</b> | <b>RD*</b> | <b>RS*</b>  |
|----------------|---------------|----------------|-------------|-------------|------------|-------------|
| <b>Eastern</b> | Northshore    | 56             | 332         | 131         | 218        | 218         |
| <b>Western</b> | Keetac        | 34             | 220         | 38          | 127        | 127         |
|                | Minntac       | 46             | 325         | 58          | 182        | 182         |
|                | ArcelarMittal | 22             | 143         | 27          | 86         | 86          |
|                | Hibbtac       | 34             | 244         | 47          | 119        | 119         |
|                | Utac          | 46             | 325**       | 58**        | 182**      | 182**       |
| <b>Total</b>   |               | <b>238</b>     | <b>1589</b> | <b>301</b>  | <b>732</b> | <b>732</b>  |
|                |               |                |             |             |            | <b>3354</b> |

\* The number of total samples includes blanks.

\*\* In progress

**Table 2:** Total number of **area samples** obtained to date.

| <b>Zone</b>    | <b>Mine</b>   | <b>AeroTrak<br/>9000</b> | <b>DustTrak<br/>RPM</b> | <b>DustTrak<br/>PM2.5</b> | <b>DustTrak<br/>PM1.0</b> | <b>AeroTrak<br/>9306</b> | <b>Ptrak</b> | <b>MOUDI</b>  |
|----------------|---------------|--------------------------|-------------------------|---------------------------|---------------------------|--------------------------|--------------|---------------|
| <b>Eastern</b> | Northshore    | 22                       | 22                      | 22                        | 22                        | 22                       | 22           | 286           |
| <b>Western</b> | Keetac        | 12                       | 12                      | 12                        | 12                        | 12                       | 12           | 156           |
|                | Minntac       | 15                       | 15                      | 15                        | 15                        | 15                       | 15           | 195           |
|                | ArcelarMittal | 8                        | 8                       | 8                         | 8                         | 8                        | 8            | 104           |
|                | Hibbtac       | 12                       | 12                      | 12                        | 12                        | 12                       | 12           | 156           |
|                | Utac          | 28*                      | 28*                     | 28*                       | 28*                       | 28*                      | 28*          | 364*          |
| <b>Total</b>   |               | <b>97</b>                | <b>97</b>               | <b>97</b>                 | <b>97</b>                 | <b>97</b>                | <b>97</b>    | <b>1261</b>   |
|                |               |                          |                         |                           |                           |                          |              | <b>2134**</b> |

\* In progress

\*\* Includes CO2, temperature, and RH.

## II. Mortality and Cancer Incidence Studies

The overall objective of this part of the study is to determine whether employment in the taconite industry, and more specifically exposure to dust from taconite mining and processing, is related to developing certain cancers or dying from specific diseases. In consultation with the study's external Scientific Advisory Board, the specific hypotheses for this study have been narrowed to determine whether employment in the taconite industry and the attendant dust and fiber exposures are associated with: mesothelioma, lung cancer, and non-malignant respiratory disease. These selected conditions are believed to be most relevant to exposure to asbestos, asbestos-like fibers, and silica that would be encountered in taconite mining and processing.

To address these hypotheses, the existing cohort of taconite industry workers will be linked to mortality records and the Minnesota Cancer Surveillance System to identify the cases of cancer and deaths arising from these conditions. Each disease will be evaluated in nested case-control studies in which detailed work history and exposure information is abstracted from all individuals identified as having died or developed the diseases of interest and a representative sample of taconite workers who did not develop this disease. This approach will yield scientifically valid results but will be less labor intensive and more cost effective.

The following tasks were accomplished in the last year:

- An update to the methods was reviewed with the Scientific Advisory Board. It was recommended that the study focus on the three diseases of primary interest. It was also decided to focus on workers who were born in 1920 or later to concentrate on workers who spent a significant proportion of their career working when taconite was being mined and processed.
- The vital status was determined for those born 1920 or later. Of the 45,532 workers, vital status could not be established for only 197 (0.4%) of the population.
- Causes of death were identified from vital records. Through 2007, 13,658 deaths were classified by cause with another 266 presumed deceased where a death certificate is not yet located. Another 868 were presumed to have died in 2008 or 2009. These causes of death will be identified in the future.
- The cohort has been linked to the Minnesota Cancer Surveillance system. From this resource, a total of 63 cases of mesothelioma and 1,025 cases of lung cancer have been identified. MCSS records all cases confirmed with pathology that were diagnosed in Minnesota residents from 1988 onward.
- The mortality records have identified an additional 386 lung cancer cases. Death records from states other than Minnesota have identified an additional 14 potential cases of mesothelioma. These cases do not have the same level of certainty as the cases from MCSS, but will be treated as presumptive cases in the analysis.
- The historical work history records have been abstracted for the mesothelioma and lung cancer cases and their respective control populations.
- Systematic review and coding of the abstracted jobs is underway to standardize the exposure assessment.
- The analysis, comparing the general mortality rates of taconite workers to that of the rest of Minnesota (without exposure information) will be completed in the first half of 2011.

- The analysis of mesothelioma, lung cancer, and nonmalignant respiratory disease with respect to work history and time working in the industry will be completed towards the end of 2011 or early 2012.
- The analyses of risk of mesothelioma, lung cancer, and nonmalignant respiratory disease with respect to specific exposure concentrations of silica and fibers will be completed in 2012.

**Summary of vital status and diseases of interest in Taconite Worker Cohort for workers born in 1920 and later**

| <b>Vital Status</b>                      |       |
|--|-------|
| Alive                                    | 29792 |
| Deceased as of December 31, 2007         | 13658 |
| Presumed Dead (Year of Death 2008/2009)* | 868   |
| Presumed Dead                            | 266   |
| Presumed Alive                           | 751   |
| Unknown                                  | 197   |
| Total                                    | 45532 |

**Mesothelioma**

|                      |    |
|----------------------|----|
| MCSS**               | 63 |
| Non-Minnesota Deaths | 14 |

**Lung Cancer**

|  |       |
|--|-------|
| MCSS cases                                   | 1,025 |
| Deaths (includes Minnesota and other states) | 1,411 |

**Nonmalignant Respiratory Disease**

|  |     |
|--|-----|
| Deaths (includes Minnesota and other states) | 645 |
|--|-----|

\*Cohort members who died in 2008 or 2009 have been identified as deceased, but their causes of death will be obtained at a later date.

\*\*Includes 12 cases of mesothelioma in workers born before 1920. Because mesothelioma is a rare cancer and of particular interest in this population all cases were included.

### **III. Respiratory Health Survey**

Since we last reported in February 2010, the Respiratory Health Survey of Taconite Workers and Spouses has progressed as follows:

The research clinic operated in the Virginia Regional Medical Center from August 2009 to August 2010 and tested 1638 participants. After the clinic was closed in Virginia, it was moved to the Bay Area Health Center in Silver Bay. The research clinic operated in Silver Bay for four weeks from mid-September to mid-October, 2010 and tested 48 participants. There were 134 workers who participated in the survey by completing the questionnaire, but did not attend the clinic appointment. The total response number for the Respiratory Health Survey was 1820.

Since February 2010, following approval by the University of Minnesota's Institutional Review Board, a significant effort was undertaken to telephone approximately 1900 individuals who were sent a request to participate in the study but had not responded to us, (non-responders). Through this effort we were able to schedule and test an additional 10% and were able to obtain further insights into the response rate. This information will be important when we start to interpret the findings of the study. Overall, considering the distances traveled, the inconvenience of participating and the fact that participants were not remunerated, we are pleased with the number of people who agreed to be part of this effort.

Each participant in the research study has been mailed a letter with their individual results from the testing along with a copy of their X-ray for their personal records. In addition to the clinical report, each X-ray has been evaluated by radiologists trained to look for occupational exposure related abnormalities.

#### **Public Meetings:**

The study team continued to hold informational community meetings regarding the Minnesota Taconite Workers Health Study. Over the past year, multiple meetings for each community were held in Virginia, Hibbing and Silver Bay.

#### **Scientific Reports:**

The research team has been and will continue to compile the data from the research clinic visits, the questionnaires and the X-rays. Summary reports for the Respiratory Health Survey will be produced in the coming months. The data from the survey will then be incorporated with the Exposure Assessment and the Epidemiologic Studies to produce the final report. A rough time line for reports from this part of the investigation for 2011 is as follows:

1. Spring, 2011-descriptive findings of pulmonary function testing
2. Summer, 2011-descriptive findings of chest x-rays
3. End of 2011 and early 2012-incorporation of exposure information into clinical testing

#### **IV. Environmental Study of Airborne Particulates – NRRI**

During 2010, the Natural Resources Research Institute (NRRI) Environmental Exposure Characterization Study completed numerous tasks including sampling, sample submission to external laboratories, sample analysis at the NRRI, lake sediment sample analysis, presentations at professional conferences, science advisory board meetings, and training. Several personnel changes also took place. Several reports are planned for 2011. These items are summarized below.

**Sampling Events – Communities:** Community air sampling is now completed for this study, with each of the seven sites in northeastern Minnesota having a minimum of three winter sampling events (November – April) and three summer sampling events (May – October). During 2010, community sampling took place at Duluth (eight sampling events), Ely (one sampling event), Keewatin (one sampling event), and Silver Bay (two sampling events). A summary of NRRI community sampling conducted for the project is available at <http://taconiteworkers.umn.edu/news/pages/documents/120810-taconite-partnershipmtg.pdf>.

**Sampling Events – Taconite Operations:** Sampling at the six taconite processing facilities on the Mesabi Iron Range is now completed for this study. At each plant, four locations were sampled, including: 1) crusher; 2) magnetic separator; 3) agglomerator / ball drums; and 4) kiln pellet discharge area. During 2010, sampling occurred at Hibtac (one sampling event, plant operating), Keetac (one sampling event, plant operating), Minntac (one sampling event, plant operating), Minorca (three sampling events, plant operating), Northshore (two sampling events, plant operating), and United Taconite Forbes Plant (one sampling event, plant operating). A complete summary of sampling conducted at taconite processing facilities for the project is available at <http://taconiteworkers.umn.edu/news/pages/documents/120810-taconite-partnershipmtg.pdf>.

**Samples Submitted for Analysis (External Laboratories):**

378 samples were submitted for various analyses at external laboratories. These included: 1) 20 samples submitted to Braun Intertec Corporation (Bloomington, Minnesota) for Minnesota Department of Health transmission electron microscopy (TEM) analysis for mineral fibers in air (MDH 852 Method); 2) 178 samples were submitted to Elemental Analysis, Inc. (Lexington, Kentucky) for proton-induced X-ray emission (PIXE) analyses; and 3) 180 samples were submitted to EMSL Analytical (Minneapolis, MN) for TEM analysis of sub-micron particulate utilizing International Standards Organization (ISO) Method 13794.

**Samples Submitted for Analysis (NRRI):** Sample analyses performed by NRRI personnel included: 1) gravimetric analyses were completed on all particulate samples collected during the 2010 community and mining operation sampling events; and 2) scanning electron microscopy (SEM) analysis was completed on 20 samples, with several of these samples also undergoing energy dispersive spectrometry (EDS) analysis.

**Lake Sediment Samples (NRRI):** Lake sediment core samples collected at two sites (one site near the Northshore/Dunka Pit (“North of Snort” Lake) and the other site within the limits of the City of Virginia (Silver Lake) were processed and dated using Pb-210 and Cs-137

methodologies. Chemical, mineralogical, and microscopic analysis of dated sediment intervals will be conducted in 2011.

Conference Presentations: One poster was presented at a professional conference in 2010. This poster presentation is available on the NRRI website (<http://www.nrri.umn.edu/egg/presentations.html>).

- Hudak, G., Diedrich, T., Monson Geerts, S., Schreiber, M., Zanko, L., and Schwanke, A., 2010, Taconite-derived mineral dust in population centers on Mesabi Iron Range – an update: Institute on Lake Superior, Proceedings Volume 56, Part 1 – Program and Abstracts, p. 29-30.

#### Scientific Advisory Board Meetings

Two days of Scientific Advisory Board (SAB) meetings took place in Duluth, Minnesota in September 2011. On September 28, the NRRI SAB met to discuss progress on the Environmental Study of Airborne Particulates. On September 29, a joint meeting of the University of Minnesota School of Public Health SAB and NRRI SAB reviewed progress on the Taconite Workers Lung Health Study and made recommendations.

Training: All NRRI personnel involved in this project received Mine Safety and Health Administration (MSHA) annual update training during 2010.

Personnel Changes: Several personnel changes took place during 2010. These included: Megan Schreiber (Leave of Absence), Allison Severson (employed as Student Research Assistant), and April Severson (employed as Student Research Assistant).

#### Reports in Preparation

Several reports are currently in preparation or planned for 2011. These include:

- Summary of Gravimetric Data Collected During In-Plant Air Sampling (completion during first half of 2011)
- Summary of Gravimetric Data Collected During Community Air Sampling (completion during first half of 2011)
- Quality Assurance Project Plan (QAPP) (completion during first half of 2011)
- Minnesota Taconite Workers Health Study: Development of Standard Operating Procedures for Particle Collection and Gravimetric Analysis (first half of 2011)
- Glossary of Selected Terminology for the Environmental Study of Airborne Particulates for the Minnesota Taconite Workers Lung Health Partnership (first half of 2011)
- Final Report, Environmental Study of Airborne Particulates for the Minnesota Taconite Workers Lung Health Partnership (completion during second half of 2011)