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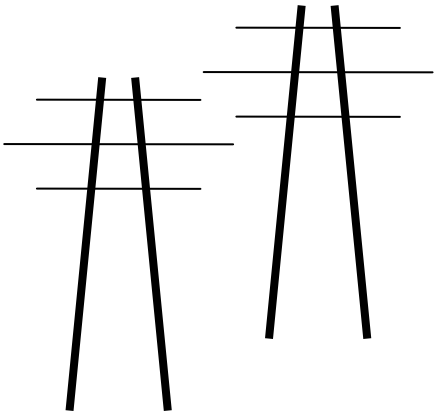


July 15, 2013

Kristi Gross
County Land Use Management Dept.
Goodhue County Land Use
509 W. 5th Street.
Red Wing, MN 55066

RE: Save the Bluffs Zoning Ordinance Amendment Application

Dear Ms. Gross:

Enclosed on behalf of Save the Bluffs please find filing fee of $546.00 and Application for creation of a Silica Sand and Natural Resources Overlay District and Amendments to Ordinance Article 14, together with supporting documents.

At this time, Save the Bluffs requests that the County:

- Extend the moratorium to establish a Silica Sand and Natural Resources Overlay District
- Develop a Silica Sand and Natural Resources Overlay District under Article 14.

Please let me know if you require anything further or if you have any questions or comments.

Very truly yours,

Carol A. Overland
Attorney at Law

Goodhue County Zoning Application

Zoning Ordinance Amendment

The following information is required before the application may be accepted and considered complete:

Applicant Name (if different than owner) Save the Bluffs c/o Keith Fossen **Parcel #** N/A

Date of Birth N/A **Phone #** (651) 388-9206 Keith Fossen
(651) 345-4779 Jody McIlrath for Save the Bluffs

1) Goodhue County Planning & Zoning form ☐

2) Fees paid in full ☐

3) Additional information as corresponds to request ☐

4) All necessary state and federal permits ☐

5) Applicant or representative is encouraged to attend the scheduled public hearings ☐

After preliminary review, additional information may be required before the application is considered complete and can be processed

Please note the Planning Advisory Commission Calendar for required submittal dates (*attached*)

Please mail application, payment and all supporting documents to:
Goodhue County Land Use Management
Attn: Kelly
509 West Fifth Street
Red Wing MN 55066

Fees:
General Application $ 546

Reciept Number _____
Date Paid _____

Office Use Only

Zoning District
- ☐ Residential
- ☐ Business B-1 B-1
- ☐ Industrial
- ☐ Agricultural A-1 A-2 A-3
- ☐ Shoreland
- ☐ Wild & Scenic
- ☐ Flood Fringe
- ☐ Floodway
- ☐ General Flood Plain
- ☐ Other: _____

Type of Request
- ☐ Conditional Use Permit
- ☐ Variance/Appeal
- ☐ Zoning District Change
- ☐ Preliminary/Final Plat
- ☑ Ordinance Amendment
- ☐ Land Use Permit
- ☐ Land Alteration Permit
- ☐ Other (specify Below)

Shoreland Management Data
Lake/Stream Name:
ID Number:
Classification: NE RE GD Other____

Tracking Summary
Date Received : _____
Application number: _____
Date of Hearing Notice: _____
Date of Public Hearing: _____
DNR Notice?
City Notice?

PAC Recommendation: ☐ Approve ☐ with conditions (attached)
☐ Deny

Final Action (brief explanation of decision): _____

by: [ ] County Board [ ] Board of Adjustment
Date of Action:

Goodhue County Planning & Zoning
Zoning Ordinance Amendment *(attach separate sheet if necessary)*

Date 7/15/2013 Application Number _____

Applicant Name Save the Bluffs c/o Keith Fossen and Jody McIlrath

Mailing Address P.O. Box 296 Red Wing, MN 55066

~~Daytime~~ Phone (651)388-9206 Keith Fossen ~~Evening~~ Phone (651)345-4779 Jody McIlrath

Stated Reason for change requested: (see attached)

Statement on compatibility with the Comprehensive Plan: (see attached)

Text of portion of the existing ordinance to be amended: (see attached)

Proposed amended text and statements outlining any other effects that the amendment may have on other areas of this ordinance:

(see attached)

Applicant's Signature: Carol A Overland

Keith Fossen

Carol A. Overland

********** County Section **********

Planning Advisory Commission

The Planning Advisory Commission recommends to the Goodhue County Board of Commissioners to
☐ Approve ☐ Deny the application for a zoning ordinance amendment

Date of Hearing _____

Recommended Wording of Amendment: _____

_____

_____

_____

_____

_____

_____

Chairman: _____

Zoning Administrator: _____
Michael Wozniak, AICP

Goodhue County Board of Commissioners

The Goodhue County Board of Commissioners votes to ☐ Approve ☐ Deny the zoning ordinance amendment

Date of Decision: _____

Amended Ordinance Wording: _____

_____

_____

_____

_____

_____

_____

Chairman: _____

County Administrator: _____
Scott Arneson

Stated Reason for change requested:

Save the Bluffs is requesting development of a Silica Sand and Resource Protection Overlay District and an extension of the Moratorium while the Overlay District and Best Practices are established, and while an economic cost/benefit analysis is completed.

In anticipation of silica sand mining permit applications, Goodhue County has amended its Comprehensive Plan and Article 14 ordinance. In May, the legislature made several changes that affect silica sand mining in Minnesota, and directed the Environmental Quality Board to develop standards and criteria, in consultation with local government. Minn. Stat. §116C.99, Subd. 2.

> The standards and criteria must include:
>
> (1) recommendations for setbacks or buffers for mining operation and processing, including:
> (i) any residence or residential zoning district boundary;
> (ii) any property line or right-of-way line of any existing or proposed street or highway;
> (iii) ordinary high water levels of public waters;
> (iv) bluffs;
> (v) designated trout streams, Class 2A water as designated in the rules of the Pollution Control Agency, or any perennially flowing tributary of a designated trout stream or Class 2A water;
> (vi) calcareous fens;
> (vii) wellhead protection areas as defined in section 103I.005;
> (viii) critical natural habitat acquired by the commissioner of natural resources under section 84.944; and
> (ix) a natural resource easement paid wholly or in part by public funds;
> (2) standards for hours of operation;
> (3) groundwater and surface water quality and quantity monitoring and mitigation plan requirements, including:
> (i) applicable groundwater and surface water appropriation permit requirements;
> (ii) well sealing requirements;
> (iii) annual submission of monitoring well data; and
> (iv) storm water runoff rate limits not to exceed two-, ten-, and 100-year storm events;
> (4) air monitoring and data submission requirements;

(5) dust control requirements;
(6) noise testing and mitigation plan requirements;
(7) blast monitoring plan requirements;
(8) lighting requirements;
(9) inspection requirements;
(10) containment requirements for silica sand in temporary storage to protect air and water quality;
(11) containment requirements for chemicals used in processing;
(12) financial assurance requirements;
(13) road and bridge impacts and requirements; and
(14) reclamation plan requirements as required under the rules adopted by the commissioner of natural resources.

Minn. Stat. 116C.99. Many of these standards above are not addressed by the County, and require integration into Article 14. The County has the opportunity to consult with state agencies and utilize state technical assistance in setting up regulation of silica sand mining.

The County's amendments to Article 14 are not sufficient because mining of silica sand is fundamentally distinct from other mining in the county, with distinct issues that should be addressed in an Overlay District in conjunction with the County's Article 14. Silica sand mining and associated processing and transportation is a volatile process, with a high potential for significant impacts. There are conflicts in land uses between silica sand mining and residential, agricultural and public uses, and the Ordinance is insufficient to protect natural, ecological and cultural resources that must be addressed by identifying the areas where mining could be permitted or should be restricted.

An Overlay District was proposed by the County's consultant as a means to regulate silica sand mining and protect the health and safety of the county's residents and natural resources. Save the Bluffs requests the County extend the Moratorium and adopt a Silica Sand Mining and Resource Protection Overlay District as recommended, which could address these regulatory issues, help protect natural resources, and set out those areas in the County where mining could potentially confer benefits greater than costs.

A Silica Sand and Natural Resources Overlay District would more adequately protect the County's resources

The County's Article 14 does not adequately protect our water sources and resources, our air, our health, our bluff lands, residences, trout streams, roads and railroads, our economic base, our wells, and we as "receptors" of noise, light and carcinogenic dust, nor does the Ordinance protect us from the cumulative impacts of mines that could apply for permits in the County.

An Overlay District would do a better job because it would simultaneously locate the Silica Sand resource and locate those Natural Resources in need of protection. A repeated question of parties involved, ranging from Commissioners to landowners, was "where would mining be allowed?" This fundamental question has not yet been answered by the County's process, despite the charge from the County Board to address inappropriate locations for mining and the MSC "consolidation" to "location restrictions." The Overlay District map would show these inappropriate locations and location restrictions.

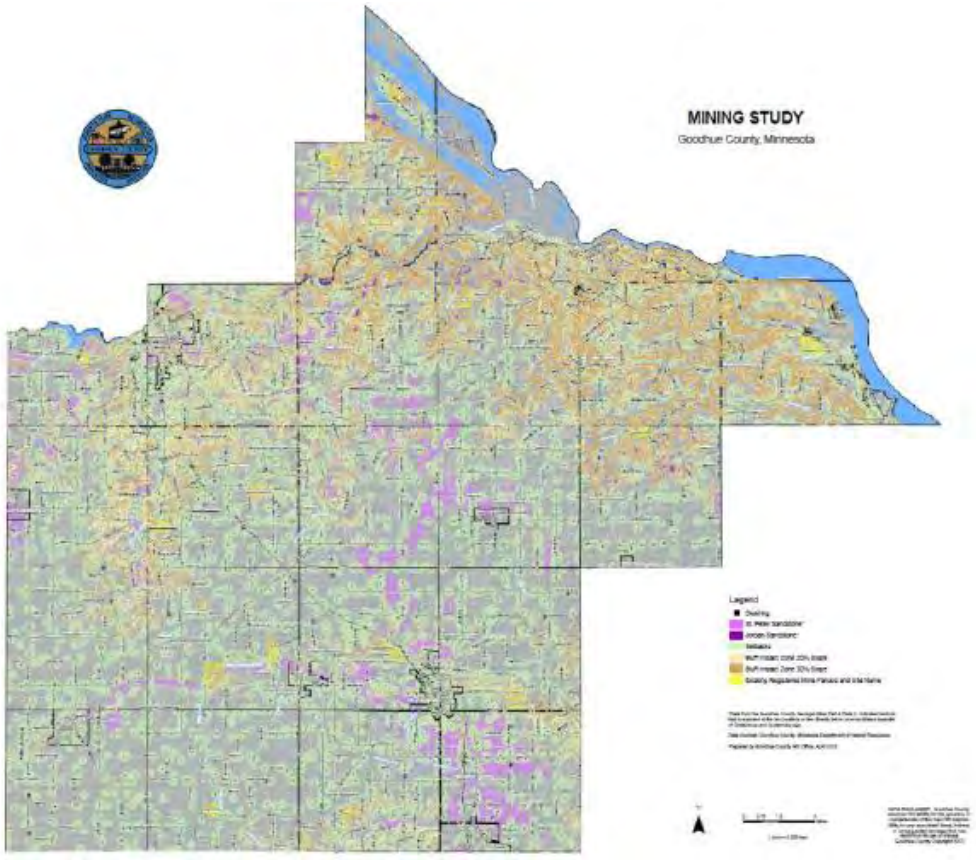
The County's consultant, John Dustman, addressed the role of such districts, and of maps in developing them, in his report:

> *The mapping completed by the County, the ECLUE project, and this project may provide enough specific information for the County to designate specific Mining District(s) in Goodhue County.*
>
> *This designation could have a variety of impacts, such as those listed below.*
>
> • *The identification of specific mining districts on zoning maps would provide specific information to surrounding landowners and project proposers about where this use will be allowed in the County.*
>
> • *Designation of specific mining districts would help to implement the Comprehensive Plan goal of discouraging mining in environmentally sensitive areas, in prime farmable agricultural areas, and in areas where it is not compatible with current or future residential uses.*
>
> • *The requirement to re-zone to allow mining outside of specific mining districts may increase the length of approval time for new mining activity and make it more difficult for project proposers to obtain approvals.*

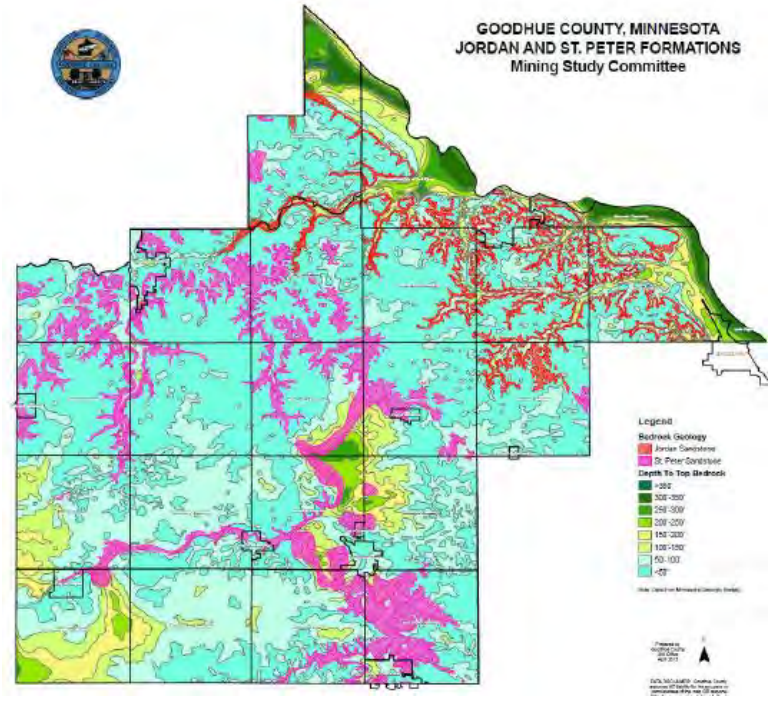
Supplemental Information Regarding Non-Metallic Mining in Goodhue County, Minnesota, p. 17, Dustman, Summit Envirosolutions, Inc (2013).

Three maps are included at the end of the May, 2013 MSC Report which, when combined, would represent many, if not most, of the areas inappropriate for mining or locations where mining would be restricted. These maps were discussed in the MSC meetings and should be utilized to convey the silica sand resources and important natural resources that should be protected.

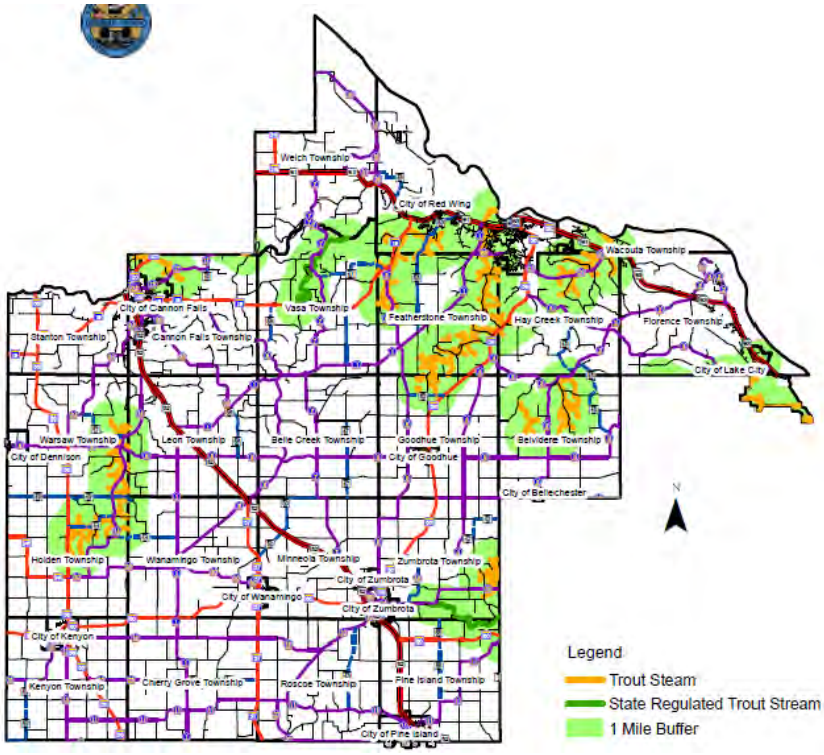
The first shows St. Peter and Jordan sandstone in purple, and existing mine parcels in yellow. The map also shows setbacks in green, bluff impact zones 20-30% in shades of tan and brown, all areas where mining would not be allowed (please see pdf of report for more legible copy):



The next map of the series, on the next to the last page in the MSC Report, shows the Jordan and St. Peter formations and overburden depth, with blue representing the most accessible:



The final map shows trout streams and the requisite buffer:



Development of the Silica Sand and Natural Resources Overlay District could be quickly accomplished by County staff. Additional information about protected resources should be added, such as the MCBS[1] layer showing sites of biological significance, which is also readily available to the County, building on the Overlay of the three maps in the MSC May 2013 report.

Save the Bluffs seeks protection of the County's resources through a Silica Sand and Natural Resource Overlay District, utilizing available information from the Mining Subcommittee and in the County's GIS system.

<u>An economic cost/benefit analysis must be done -- the County has yet to address economic impacts</u>

A primary reason for this request is that the County's process has missed a key component of the County Board's charge, and a key component to an adequate permit application review and decision – there is essentially no record on economic impacts of sand mining development, no cost/benefit analysis has been completed and considered – there is nothing in the record to support a Finding regarding the economic impacts of frac sand mining in Goodhue County. Save the Bluffs requests that the costs and benefits be evaluated to inform the record regarding potential economic impacts of sand mining development. Often economic evaluations consider

[1] Minnesota County Biological Survey, at http://www.dnr.state.mn.us/eco/mcbs/procedures_sites.html

only the "benefits" and not the costs, therefore Save the Bluffs seeks a symmetrical and balanced evaluation of the impacts and implications of large-scale silica sand mining.

One of the charges to the Mining Committee was to address economic impacts, although it was characterized as "Relationship between economic and recreational value," just one aspect of economic impacts. This issue of "economic impacts" never received serious review. It was put on the agenda of the Mining Subcommittee, as "Review Economic Report," and was put off to January 4, 2012, February 1, 2012, and March 14, 2012 (where there was some discussion but no review of "Economic Report." From the Minutes of the April 11, 2012 meeting:

> ***Economic/Social Impact***
>
> *Lisa presented several discussion items. Do we want site screening from rivers and roads? Bernie said homes were more important that (sic) roads. Screen less for tourists and more for those living in vicinity. Screen from "tourist attractions."*
> *Discussion on what does no mining in bluffs mean. Needs clarity.*
>
> *Audience asked about property. Explained what was discussed last month with property values.*

Site screening is not economic impact. This discussion does not constitute review of an Economic Report, nor does the narrative in the Subcommittee reports of July, 2012 or March, 2013 constitute economic analysis. Presumably, this "Economic Report" reference is for a report addressing benefits and costs in Goodhue County, and it appears that no "Economic Report" was completed, entered into the record, appended to the report or reference in it, or reviewed by the Committee. Further, the focus is flawed -- there is more to an economic analysis or cost/benefit analysis than "Relationship between economic and recreational value."

A report has been released by Tom Power regarding the economic impacts of frac sand mining, and a similar report should be done on the Minnesota side of the river. Exhibit A, The Economic Benefits and Costs of Frac-Sand Mining in West Central Wisconsin. This report is an overview of economic considerations, including the anomaly of high pay and great wealth but not sustained prosperity, explanations for poor economic performance of mining communities, a comparison of sand mining to other mineral extraction, evaluation of economic impacts of sand production, the local economy, and a holistic view of economies of the Wisconsin frac-sand region. The Power report also specifies "Questions to be asked and answered before approving expansions of frac-sand productions," specifically:

1. *What will the pay levels associated with the projected new jobs be?*
    a. *Direct mining and processing jobs may or may not be quite high.*
    b. *Transportation jobs may or may not be quite high.*
    c. *"Induced" jobs tied to workers spending their paychecks are likely to be low.*

d. Exactly what will be the mix of high and low paid jobs.

2. Who will get each type of job?

a. National studies do not show faster job growth in more mining reliant communities.

b. Can unemployed and under-employed existing residents fill the jobs or will in-commuters and in-migrants take the jobs?

3. Will frac-sand production be relatively stable?

a. As natural gas and oil prices fluctuate, will the demand for frac-sand fluctuate?

b. Is the recent frac-sand retrenchment and production declines a sign of the fluctuations the industry will have going forward?

c. As more firms seek to enter the Wisconsin frac-sand market and large national firms seek to "integrate" frac-sand production with oil and gas developing companies and transportation companies, what will be the impact on small local operations?

d. As frac-sand production gets consolidated into the hands of a smaller number of large national firms, how will that impact local employment and businesses? E.g. will there be a shift to national trucking firms, railroads displacing trucking, deployment of more capital-intensive, labor-displacing technologies, the flow of profits and wages out of the community, etc.?

e. Will the damage and disruption in the downturn or "bust" be greater than the benefits of the initial growth or "boom" in sand production?

4. How big will the frac-sand production "footprint" ultimately be?

a. The area of operating and abandoned mines?

b. Intensity of haul truck traffic on local roads?

c. The number and location of processing plants?

d. Unit train loading facilities, rail spur extensions, rail heads, storage piles?

5. What will be the environmental impacts of these activities?

a. Fine silica particulate from sand mining, handling, trucking, processing, and railroad hauling? Diesel and other emissions from all of these?

b. The likelihood of more extensive chemical treatment and/or coating of the sand and resulting pollution associated with those chemicals?

c. Likelihood of abandoned pits, storage piles, rail spurs and rail heads, etc.?

d. What level of bonding will be required to assure complete reclamation? Are frac-mine operations willing to put up such guaranteed bonds?

6. What will be the costs to other economic activities?

a. Impact on the visitor economy from pollution, congestion, and industrialization of small towns and rural areas?

b. Impact on holding and attracting new residents and businesses including retirees and other amenity in-migrants.

c. Impact on agricultural productivity of the land?

d. Will frac-sand producers bid workers away from local businesses and/or drive the cost of labor to local businesses upward?

7. How important will the economic impact of frac-sand production be to the local economy?

a. What will be the growth in percentage terms of the jobs, total income, and population?

b. How does the frac-sand production impact compare, for instance, to the on-going growth in the other sectors of the economy?

c. How short- or long-term will the impact be?

d. Will there be a sustained, long-term, positive impact on the local economy from frac-sand mining?

8. How desperate is the current and near term economic situation in potential frac-sand counties?

a. Is it unbearable, calling for significant sacrifices of other community objectives and attractive characteristics right now?

b. Is the longer term trajectory of the community relatively attractive despite the short term disruptions associated with the national Great Recession?

c. How could frac-sand production actually contribute to the pursuit of the community's primary long-term objectives?

Id., The Economic Benefits and Costs of Frac-Sand Mining in West Central Wisconsin, p. 5-6.

These are the issues that should be addressed by the County's evaluation of economic impacts, examples of questions that should both form and inform the County's review and comprise information that silica sand mining operators should provide in an application.

The economic impacts of sand mining development are long term, and changes to the County could be irreparable. The industry is fraught with environmental issues, non-compliance, and flagrant disregard for regulations, such as the impoundment breach leaking into the St. Croix River, the mine waste pile flows onto neighboring land, and opening and operation of a transportation facility without securing necessary permits. See Exhibit B, Containment Berm at Frac Mine Fails; Exhibit C, Pollution worries abound in frac sand waste streams; Exhibit D, MN town voices opposition to frac sand operation.[2]

The likelihood of pollution also raises the specter of health impacts, such as silicosis, lung cancer, chronic obstructive pulmonary disease (COPD), renal disease and kidney cancer, and several diseases of the immune system. Disease risk is related to levels and duration of exposure to silica, and may occur a long time after exposure to silica has ceased. These impacts of silica have been addressed in the context of silica sand mining by Dr. Hilary Carpenter. Exhibit E, Silica Toxicity, Hillary M. Carpenter, Minnesota Department of Health.

[2] Available online at: http://bcove.me/qeaxyqm3

The potential for costly impacts and irreparable harm are high. A Wisconsin state regulator has been quoted stating that "The industry just came on too fast," and "I wish we could turn back the clock a couple of years and start over." Exhibit C, quoting Ruth King, Wisconsin DNR. This is the County's opportunity to carefully establish sand mining regulation before it occurs. The County also has the opportunity to establish annual review prior to Interim Use permit renewal that provides incentive to permittees to comply with the permit's conditions and county regulation. The time to develop regulatory controls and processes is before the development occurs, before there's any irreparable harm and longing to "turn back the clock a couple of years."

Review of the economic cost/benefit analysis is not a burden or unreasonable delay. As the county noted in its charge to the Mining Subcommittee, it is a necessary part of evaluation of the impacts of mining. Silica sand mining is a multi-billion dollar industry with long term impacts. Review of this economic information gathered in anticipation and as a part of operation by mining companies, by regulators and consultants is reasonable.[3]

Save the Bluffs seeks a report on the cost/benefit analysis of the impacts of silica sand mining in Goodhue County as directed by the Board, entry of this economic analysis into the record, review by the Subcommittee, Planning Advisory Commission, the County Board, and an opening of the record for comment by the public on this economic report.

Statement on compatibility with the Comprehensive Plan:

A Silica Sand and Natural Resources Overlay District would be compatible with the Comprehensive Plan as amended. A Comprehensive Plan is a high level forward-looking land use scheme, and should contain land-use maps that show the appropriate locations for specific land uses as set forth in Zoning. The Goodhue County Comprehensive Plan contemplates mining, but has not designated the areas where silica sand operations are inappropriate or potentially appropriate. A Silica Sand and Resource Protection Overlay would do just that, and, in a public and transparent process, would provide notice to landowners of the areas where mining would be a permitted use.

The County consultant's report provided for update and amendment of the Comprehensive Plan, and an Overlay District. Supplemental Information Regarding Nonmetallic Mining, p. 16-17, July 2012.

Save the Bluffs requests the County, consistent with the Comprehensive Plan, develop a Silica Sand and Natural Resources Overlay District under Article 14 due to the unique characteristics

[3] Under the law passed this most recent session, the state also offers independent technical assistance and gives authority for assessment of costs from the project proposer. Minn. Stat. §116C.99, Subd. 3; Subd. 4(c). In the context of a permit application, the applicant can be assessed costs of review.

of mining, processing and transport of silica sand and the need for regulatory review, controls and enforcement, and extend the Moratorium as during development of the Overlay District.

Text of portions of the existing ordinance to be amended:

Save the Bluffs requests that the Moratorium be extended and a Silica Sand Mining and Natural Resource Overlay District be added to the existing Comprehensive Plan and Ordinance Article 14. In addition, the county should amend application requirements of Section 5 and Section 6:

SECTION 5 CONDITION/INTERIM USE PERMIT APPLICATION REQUIREMENTS FOR NEW MINERAL EXTRACTION FACILITIES

Subd. 1(A) I. Narrative of cost/benefit analysis

Subd. 2. Supporting Documentation:

G. Cost Benefit Analysis addressing economic impacts of the proposed project.

(renumber)

SECTION 6 **APPLICATION REQUIREMENTS FOR REGISTRATION/LAND USE PERMITS AND CONDITIONAL/INTERIM USE PERMITS**

Subd. 4 Mineral Extraction Facilities Performance Standards.
T. Best Practices. The County shall establish Best Practice standards that shall be incorporated into the design, operation, and reclamation of Mineral Extraction Facilities. A list of Best Practice documents is available through the Zoning Administrator. The County reserves the right to update Best Practices and the list as appropriate and shall rely on a balance of information sources.

Proposed amended text and statements outlining any other effects that the amendment may have on other areas of this ordinance:

Save the Bluffs requests that the Moratorium be extended while the Overlay District is developed and Ordinance amended. We offer this narrow language amendment to the County, below, intended for discussion and a starting point. We understand that Comprehensive Plan and Zoning Ordinance language is developed in an iterative process and we expect improvements in the public, Planning Advisory Commission and County Board review. The bulk of the work necessary to delineate a Silica Sand and Natural Resources Overlay District has already been completed, as maps were compiled by County staff that shows silica sand resources and other maps show some of the natural resources to be avoided and use circles to

represent setbacks from the resource. These maps could be combined and would then show the initial Silica Sand and Natural Resources Overlay District.

New Language:

ARTICLE 14. MINERAL EXTRACTION

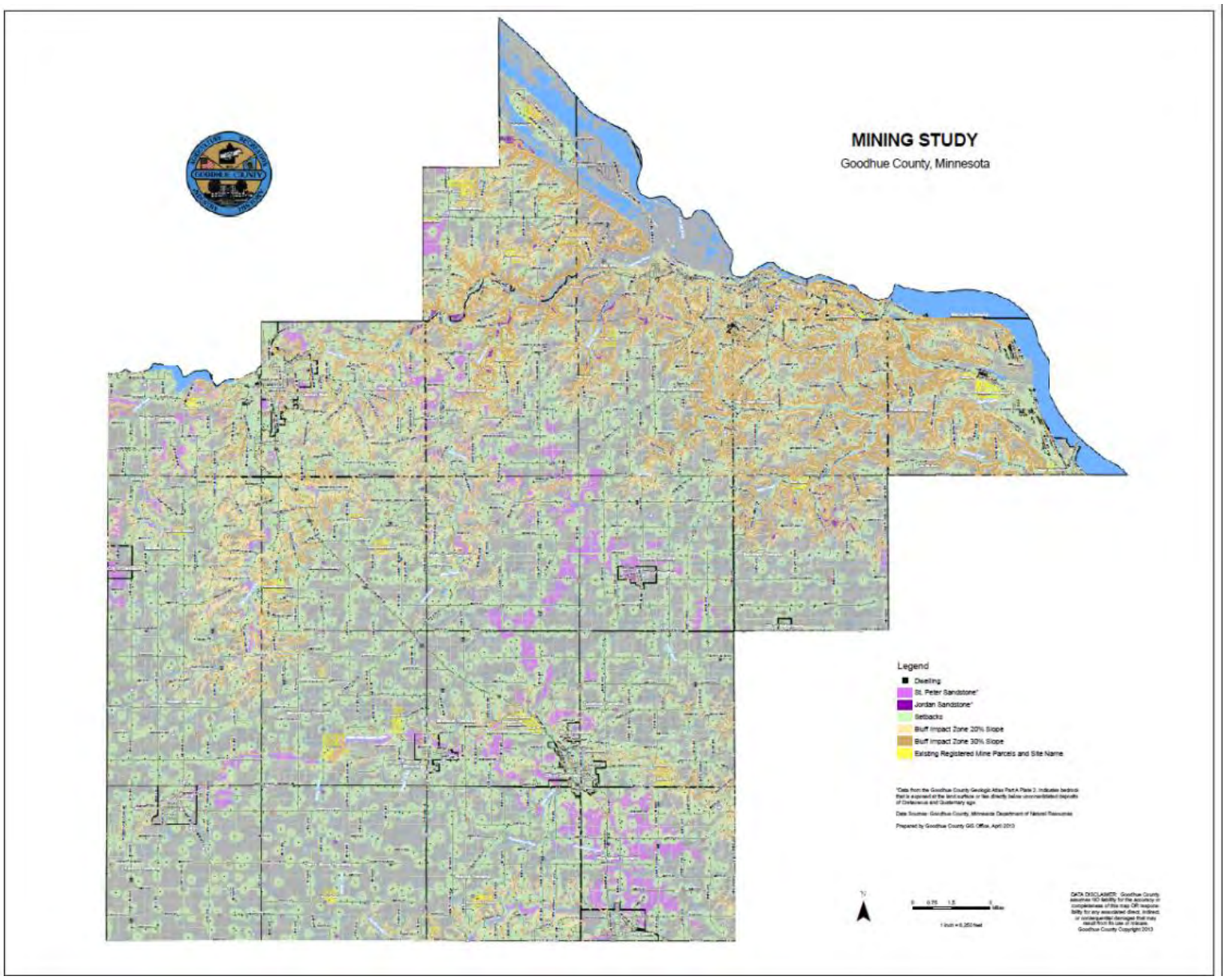
SECTION 1. PURPOSE

Subd. 5. The purpose of the Silica Sand and Natural Resources Overlay District is to delineate areas inappropriate and potentially appropriate for mining of silica sand in the county, and avoidance criteria and locations of areas to be avoided, which shall be identified within the Mineral Resources Overlay District boundaries as shown on the Official Zoning Map. The Silica Sand and Natural Resources Overlay District will protect the health, safety and welfare of the residents of Goodhue County, the economic health of the county, the sand resources and natural resources and protected areas within the Overlay District.

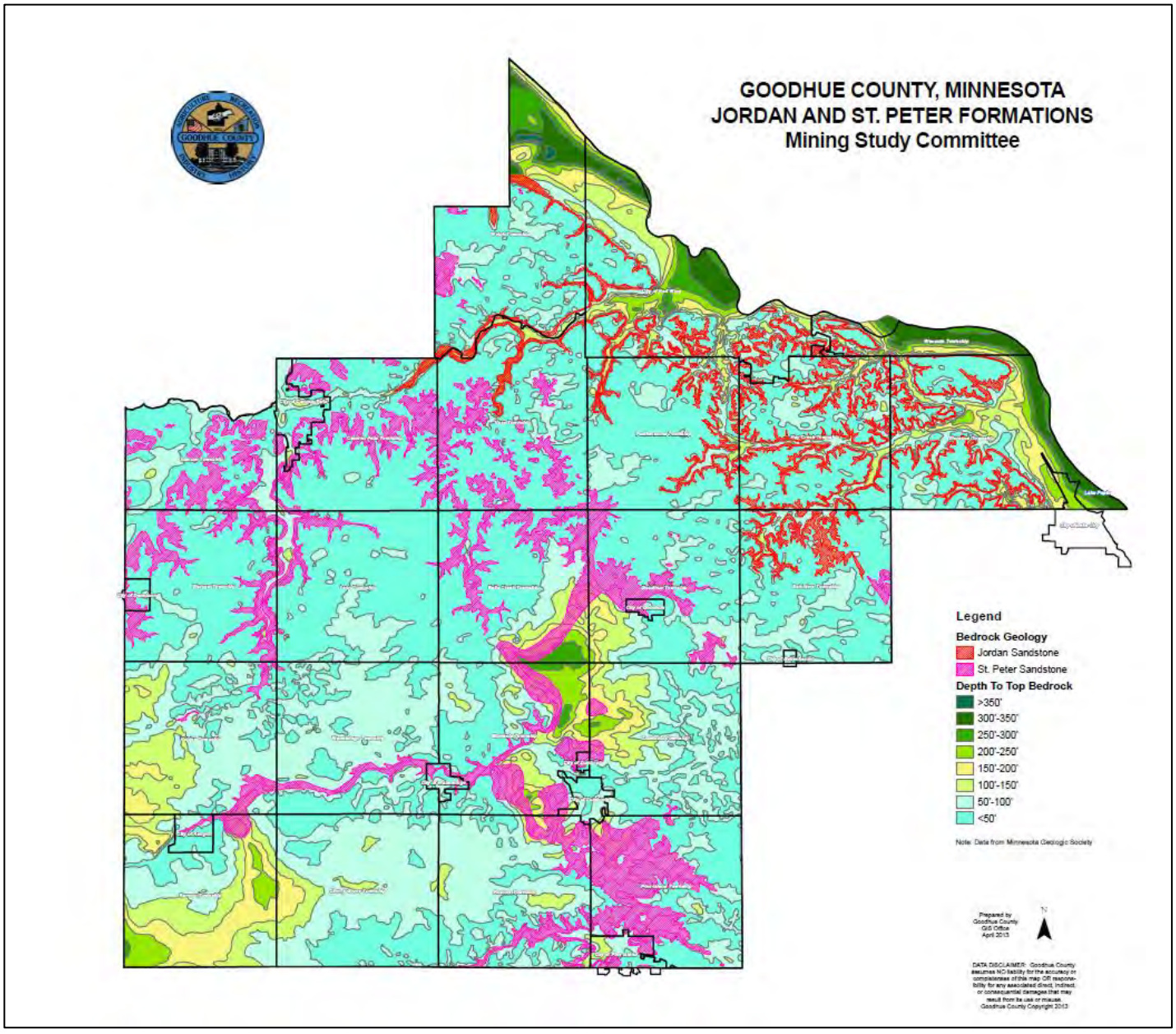
The County Mining Subcommittee, Planning Advisory Commission and the County Board would develop Permitting Procedures for applications for silica sand mining in the Overlay District.

Again, Save the Bluffs requests that the Moratorium be extended to provide time to develop a Silica Sand and Natural Resources Overlay District in Article 14.

Jordan and St. Peter resources with setbacks including property lines, dwellings, bluffs, platted property



Depth to Resource Map (Jordan and St. Peter layers). Data obtained from Summit EnviroSolutions



One mile buffer around designated Trout Streams in Goodhue County, MN

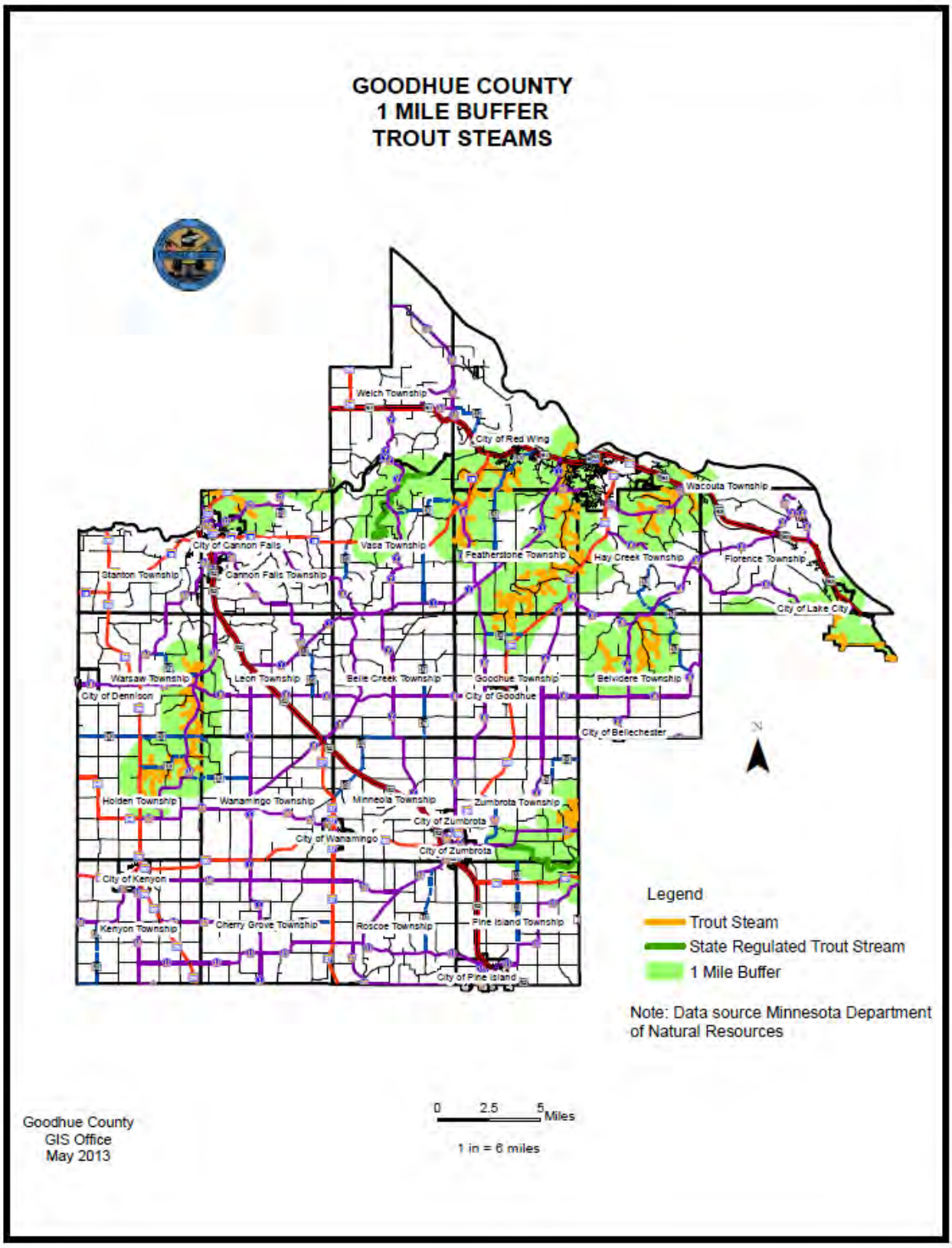


Exhibit A

The Economic Benefits and Costs of Frac-Sand Mining in West Central Wisconsin

Thomas Michael Power, Ph. D. and Donovan S. Power, MS

May 2013

INSTITUTE FOR AGRICULTURE AND TRADE POLICY

The Economic Benefits and Costs of Frac-Sand Mining in West Central Wisconsin

Phase One of Study – General Economic & Community Overview

By Thomas Michael Power, Ph.D. and Donovan S. Power, MS

A report prepared for Wisconsin Farmers Union, Wisconsin Towns Association and the Institute for Agriculture and Trade Policy

May 2013

The Economic Benefits and Costs of Frac-Sand Mining in West Central Wisconsin:
Phase One of Study – General Economic & Community Overview

By Thomas Michael Power, Ph.D. and Donovan S. Power, MS
Power Consulting, Inc

A report prepared for Wisconsin Farmers Union, Wisconsin Towns Association and the Institute for Agriculture and Trade Policy

About the Authors:

Thomas Michael Power is the Principal in Power Consulting, Inc. and a Research Professor and Professor Emeritus in the Economics Department at The University of Montana where he has been a researcher, teacher, and administrator for over 40 years. He received his undergraduate degree in Physics from Lehigh University and his MA and PhD in Economics from Princeton University. Dr. Power was born and raised in Wisconsin and spent his summers paddling on the Flambeau River.

Donovan S. Power received his undergraduate degree in Geosciences at the University of Montana and his M.S. in Geology from the University of Washington. He has been the principal scientist at Power Consulting, Inc. for the past five years.

Published May 2013

The Institute for Agriculture and Trade Policy works locally and globally
at the intersection of policy and practice to ensure fair and sustainable food, farm and trade systems.

More at iatp.org and powereconconsulting.com

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Executive summary

A new technology to extract oil and natural gas from geological formations that lack the porosity to allow the oil and natural gas to flow into drilled wells has dramatically increased oil and natural gas production in the United States. Horizontal drilling combined with hydraulic fracturing ("fracking") of the rock requires that material be injected into the fractured rock to "prop" it open. Sand of the right size, shape, and strength is one of the "proppants" used in oil and gas fracking. Wisconsin has substantial deposits of such "frac-sand." The boom in the fracking activity of oil and gas companies has created a boom in the demand for frac-sand, including Wisconsin's.

Frac-sand production, like almost all surface mining and ore processing, involves significant land disturbance and the potential to cause air and water pollution among other environmental problems. That has confronted citizens and local elected officials in west central Wisconsin with a familiar but difficult choice: mining, processing, and transporting the sand promises economic benefits for some parts of the population while imposing business, environmental, and social costs, on other parts of the population. Citizens and elected officials have to evaluate the mix of benefits and costs and their distribution over the short term and long term to make an informed decision as to what is best for their community.

The commercial businesses promoting frac-sand production typically commission *economic impact analyses* that purport to layout the "economics" of frac-sand production. These types of *impact studies*, however, almost always quantify only what are labeled benefits: additional jobs, payrolls, and tax revenues to governments. Costs associated with frac-sand production are rarely discussed in these studies. Since economic analysis, in general, involves the analysis of choices and tradeoffs where benefits and cost have to be weighed, the study of only benefits is difficult to label an economic analysis. As economists are fond of saying: "There is no such thing as a free lunch," meaning costs are almost always present and have to be considered in any rational decision.

This report seeks to look at both the benefits and the costs associated with frac-sand mining. The objective of the report is to lay the basis for more informed public discussions and improved decisions about how to manage the natural landscape in Wisconsin's frac-sand country. Based on our research on the impacts of mining activity across the nation and around the world, we will raise many questions about the benefits and costs associated with frac-sand mining. Some of those questions we will answer, some we will not. The intent is to lay out as clearly as possible the questions that each community needs to ask and answer, as best they can, before authorizing additional frac-sand production.

This study came to the following conclusions that are documented in the full report:

- The *promise* of mining is that it will remove from the earth minerals of substantial value. That value created by miners typically supports levels of pay that are far above the average pay level in the rest of the economy. That high pay and the creation of wealth are expected to have "ripple" effects that boost the economic vitality and wellbeing of the entire community.

- The promise that mining can lay the basis for prosperous, vital economies has not usually been fulfilled. Wisconsin has had a long history of mining that tells the same historical story found in other mining districts across the United States and around the world. Mining has rarely laid the basis for sustained prosperity. Often, as in Appalachia or the Ozarks or the Upper Peninsula of Michigan or the Iron Range of Minnesota, mining has been synonymous with economic depression, high rates of unemployment and poverty, or simply "ghost towns."

- This "economic anomaly of mining," the apparent contradiction between wealth creation and high wages not leading to community prosperity or often, even, community survival, needs to be recognized and understood if communities are going to manage their landscapes so as to sustain and increase local economic wellbeing.

- We discuss seven reasons for the frequent failure of mining to produce sustained prosperity:

    - Mining tends to be volatile, swinging through booms into busts. These fluctuations can be quite frequent and quite deep. This creates uncertainty about mining jobs and payroll that disrupts communities and depresses local economies.

    - Labor-saving technological change is constantly reducing the number of jobs associated with any given level of mine production. This causes an ongoing loss of jobs even when production is steady or rising.

    - Miners recognize this uncertainty about employment and choose to live away from mines, commuting long distances to work or leaving their families "at home" while they temporarily re-locate to work. This leads to substantial

leakage of the mining payroll out of the local community.

- Mines tend to have limited connections with the local economy, especially if the mine in located in a rural area. With limited commercial infrastructure, the local economy cannot provide the mine with either the equipment or supplies it needs and often cannot even provision the mining households. As a result, the income generated rapidly leaks out of the community.

- Mining is very landscape intensive and has often been associated with significant air and water pollution. That environmental degradation makes mining districts unattractive locations for both homes and non-mining businesses.

- Mining in a variety of ways can discourage or displace other economic activities. In that sense, the economic stimulus provided by the mine is offset by the economic losses also associated with the mine.

- Analysis of frac-sand production indicates that it is likely to have many of these same characteristics and economic problems that limit or offset the economic benefits associated with it.

- The *economic impact* of frac-sand production in west central Wisconsin is likely to be quite small. The jobs associated with it will make up only a fraction of one percent of total employment. Over the last twenty years, the Wisconsin economy has created about the same number of jobs every single month on average. Within the frac-sand region that number of jobs has been created about every two months. That level of job creation will have little impact region-wide.

- Using four quite different counties that are already significantly involved in frac-sand production, Trempealeau, Dunn, Eau Claire, and Chippewa, we explore the sources of their economic vitality over the last several decades. We document that land-based export activities such as mining, agriculture, forest products and other manufacturing have *not* been a source of economic vitality. The primary sources of job growth have been in the service sectors such as medical and other professional services.

- Those frac-sand counties, however, have shown considerable economic vitality over the last decade or so despite the fact that the national economy has stumbled through two recessions including the last "Great Recession." These counties should not think of themselves as so economically desperate that they cannot afford to make good long-run decisions for their communities.

- For at least the last two decades, despite the recessions and their lingering effects, west central Wisconsin, has shown impressive economic vitality as its economies have evolved away from land-based economic activities towards a more diverse professional services economy combined with manufacturing that is not land-based. The high quality of life of the region, buttressed by attractive natural and human-made landscapes, inviting small towns and cities as well as rural areas, diverse cultural opportunities, and outdoor recreation potential has been central to this ongoing economic vitality. The high quality of life allows the region to hold and attract residents and visitors and well as relatively "footloose" new business ventures. The potential impact of frac-sand mining on these existing positive economic trends needs to be carefully examined.

Questions to be asked and answered before approving expansions of frac-sand productions

1. What will the pay levels associated with the projected new jobs be?
    a. Direct mining and processing jobs may or may not be quite high.
    b. Transportation jobs may or may not be quite high.
    c. "Induced" jobs tied to workers spending their paychecks are likely to be low.
    d. Exactly what will be the mix of high and low paid jobs.
2. Who will get each type of job?
    a. National studies do not show faster job growth in more mining reliant communities.
    b. Can unemployed and under-employed existing residents fill the jobs or will in-commuters and in-migrants take the jobs?
3. Will frac-sand production be relatively stable?
    a. As natural gas and oil prices fluctuate, will the demand for frac-sand fluctuate?

b. Is the recent frac-sand retrenchment and production declines a sign of the fluctuations the industry will have going forward?

c. As more firms seek to enter the Wisconsin frac-sand market and large national firms seek to "integrate" frac-sand production with oil and gas developing companies and transportation companies, what will be the impact on small local operations?

d. As frac-sand production gets consolidated into the hands of a smaller number of large national firms, how will that impact local employment and businesses? E.g. will there be a shift to national trucking firms, railroads displacing trucking, deployment of more capital-intensive, labor-displacing technologies, the flow of profits and wages out of the community, etc.?

e. Will the damage and disruption in the downturn or "bust" be greater than the benefits of the initial growth or "boom" in sand production?

4. How big will the frac-sand production "footprint" ultimately be?

   a. The area of operating and abandoned mines?

   b. Intensity of haul truck traffic on local roads?

   c. The number and location of processing plants?

   d. Unit train loading facilities, rail spur extensions, rail heads, storage piles?

5. What will be the environmental impacts of these activities?

   a. Fine silica particulate from sand mining, handling, trucking, processing, and railroad hauling? Diesel and other emissions from all of these?

   b. The likelihood of more extensive chemical treatment and/or coating of the sand and resulting pollution associated with those chemicals?

   c. Likelihood of abandoned pits, storage piles, rail spurs and rail heads, etc.?

   d. What level of bonding will be required to assure complete reclamation? Are frac-mine operations willing to put up such guaranteed bonds?

6. What will be the costs to other economic activities?

   a. Impact on the visitor economy from pollution, congestion, and industrialization of small towns and rural areas?

   b. Impact on holding and attracting new residents and businesses including retirees and other amenity in-migrants.

   c. Impact on agricultural productivity of the land?

   d. Will frac-sand producers bid workers away from local businesses and/or drive the cost of labor to local businesses upward?

7. How important will the economic impact of frac-sand production be to the local economy?

   a. What will be the growth in percentage terms of the jobs, total income, and population?

   b. How does the frac-sand production impact compare, for instance, to the on-going growth in the other sectors of the economy?

   c. How short- or long-term will the impact be?

   d. Will there be a sustained, long-term, positive impact on the local economy from frac-sand mining?

8. How desperate is the current and near term economic situation in potential frac-sand counties?

   a. Is it unbearable, calling for significant sacrifices of other community objectives and attractive characteristics right now?

   b. Is the longer term trajectory of the community relatively attractive despite the short term disruptions associated with the national Great Recession?

   c. How could frac-sand production actually contribute to the pursuit of the community's primary long-term objectives?

1. THE PROMISE OF MINING

Mining projects are often presented by the mineral developer and perceived by residents of surrounding communities as "an offer that is too good to refuse" because the mines appear to offer access to needed minerals, the production of new wealth, and high wages for local workers. We begin with a discussion of those positive economic aspects of mining and then turn to some of the often ignored negative economic characteristics of mining.

Because mineral extraction involves removing valuable minerals from the earth, a capturing of a "gift of nature," it is commonly perceived to involve the "production" of substantial wealth. In both our history and folklore, mineral exploration, when successful, has been seen as discovering substantial "treasures." The mining of metals, gold, silver, copper, and iron provide some of the most colorful examples from our history as "rushes" of migrating miners moved long distances from one newly discovered "mother lode" to another, at least temporarily densely populating the areas around the mines.

Wisconsin is the "Badger State" because of the early mining settlements in southwestern Wisconsin's "lead belt" where miners built crude shelters into the hillsides, "badger holes." That Wisconsin lead "rush" ultimately brought 4,000 miners to the southwest corner of the state by 1829. An estimated 6,000 immigrants from the Cornwall region of Great Britain settled in southwestern Wisconsin's Grant, Iowa, and Lafayette Counties by 1850.[1] As the lead ores gave out, the zinc ores supported sporadic mining and ore processing in the region that lasted until 1980.

Later in the 19th century, the Gogebic Iron Range that stretches from northern Wisconsin into the Upper Peninsula of Michigan supported extensive iron ore mining from the mid-1880s to the mid-1960s. That mining led to the development of the twin cities of Hurley, WI, and Ironwood, MI. Iron ore was mined much earlier (1850s) and much later (through 1983) in the Black River Falls mining district in Jackson County in west central Wisconsin. With multiple iron mines and blast furnaces, the *Jackson County Banner* in 1856 projected that Black River Falls would become the "Pittsburgh of the West."[2]

Mining and processing *can* generate considerable wealth. The copper mines in the city of Butte, Montana, were referred to as "the richest hill on Earth" in the early 20th century. The State of Montana adopted the title of the "Treasure State" because of its early history in mining and like Wisconsin put symbols of that mining on its state flag. This "strike it rich" folk history of the European settlement of Wisconsin, Montana, and many other of the nation's mining states has colored our view of the nation's economic history and has led to a common association of almost any mining project with the production of considerable wealth ("treasure") which is expected to benefit both workers and local residents.

In fact, mineral extraction activities do pay among the highest wages available to blue collar workers. It is not just the mining of metals or energy minerals that pay unusually well. Over the last 40 years the pay for mining non-metallic, non-fuel, minerals such as sand was significantly higher than the average pay in the state. In fact, for the time period we have data on mining of sand, gravel, stone, and other non-metal and non-fuel minerals, the pay was almost 50 percent above the average annual pay across all Wisconsin jobs. See Figure A.[3]

The hope is that this higher pay will not only bring prosperity to households that have a member engaged in mining, but also that, as those mining families spend their income, it will circulate through local businesses putting even more people to work. In that way, economic development and prosperity will extend through the communities near the mine.

Wisconsin has had a diverse history in mining, both in terms of geography, the types of minerals mined, and the time periods over which they were mine. As mentioned above lead and zinc were produced in a few southwestern counties. Iron was produced both in the west central part of the state as well as in the far north in Iron and Florence Counties. Copper was briefly produced in Rusk County in the northwest corner of the state. Also, as mentioned above, this metal mining began long before Wisconsin became a state, beginning in the 1820s with lead. Iron mining in Jackson County started in the 1850s, while zinc mining took off in the early 1880s. As with all mining, Wisconsin's mines proceeded at an irregular pace with lots of expansions and contractions. But the metal mining slowly contracted with iron mining in the north ending in 1965 and lead and zinc mining ending in the late 1970s. Two relatively more recent mines operated for short periods: The Black River Falls taconite mine operated from 1970 to 1982 and the Flambeau copper mine near Ladysmith operated for four years between 1993 and 1997. But by the

1. Mining Artifacts & History, www.miningartifacts.org/Wisconsin-Mines.html .

2. *Our Story 'The Chippewa Valley and Beyond'*, Vol. 3, "Settlers Aware of Jackson Iron Ore," *Eau Claire Leader* Telegram, 1976. http://www.usgennet.org/usa/wi/county/eauclaire/history/ourstory/vol3/ironore.html

3. Most of our economic data for the counties in Wisconsin as well as the state as a whole come from the Regional Economic Information System (REIS) maintained by the Bureau of Economic Analysis which is located in the U.S. Department of Commerce. http://www.bea.gov/regional/index.htm If a specific citation to some other source is not provided, the state- and county-level data comes from the BEA-REIS.

early 1980s metal mining had largely ended in Wisconsin. In 1984 and 1985 there were no labor earnings reported for metal mining in Wisconsin.

Studying the economic impact that mining has had on the overall Wisconsin economy is difficult because the state economy diversified and grew so much faster than mining activity that for the last 80 years it has represented only a tiny sliver of the overall economy. Since 1929 the direct contribution of mining to personal income in the state has been in the 0.1 to 0.3 percent range, providing between one and three dollars out of every thousand dollars of income received by Wisconsin residents. Over the last twenty years it has been closer to the one dollar out of every thousand dollars. Metal mining jobs between 1987 and1999, when they were last reported separately from all mining jobs, averaged less than 100 jobs out of a total of 3.3 million jobs in Wisconsin. At this minuscule level of activity, it is difficult to analyze metal mining's impact on overall economic development of the state.

2. THE ANOMALY OF MINING: HIGH PAY AND GREAT WEALTH BUT NOT SUSTAINED PROSPERITY

A. Wisconsin's historical experience with mining

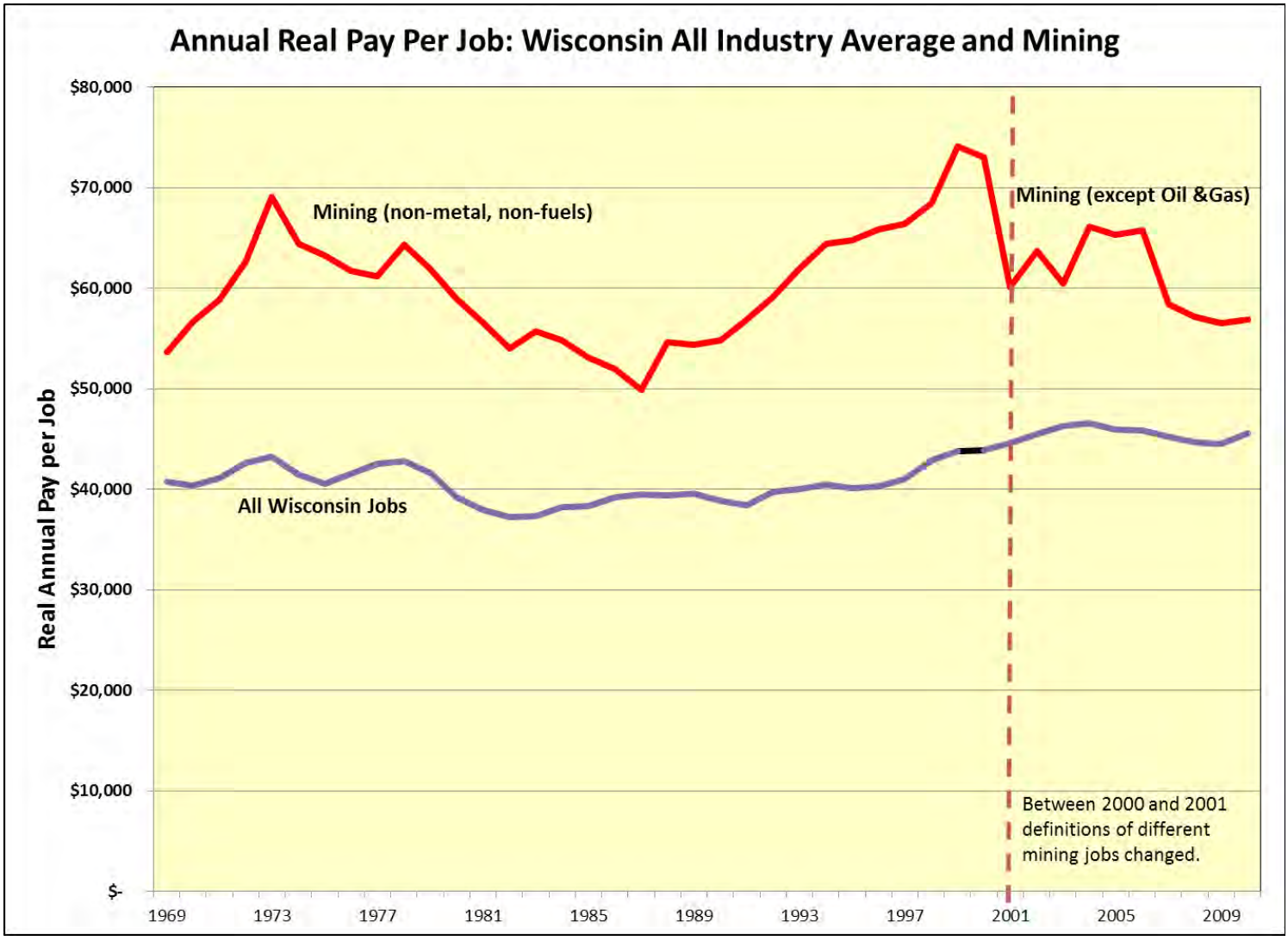
Given the high wages associated with mining, one would expect communities that rely on mining to be unusually prosperous. That, in general, is not the case. If we use population growth as an indication of an areas ability to attract and hold economic activity and the people who energize it, mining regions in Wisconsin have not done very well.

The oldest mining region in Wisconsin is the lead and zinc belt in the southwest corner of the state: Crawford, Grant, Iowa, and Lafayette Counties. Mining of lead began in the 1820s but was declining by the late1840s. It was later revived by the mining and processing of the zinc ore that was associated with many of the lead deposits. Zinc and lead mines and processing plants operated from the 1880s until the 1940s. The last operation shut down in 1979. Figure B below shows population trends for 110 years between 1900 and 2010 in each of the four lead-zinc mining counties in southwestern Wisconsin.

The population of all four of the counties either trended downward during the 1900 to 1945 period while the mines and metal processing plants were still in operation. That decline continued into 1970 for three of the four counties. For Lafayette the population decline continued through 2000. Only one of the counties, Grant, had a population in 2000 that was larger than it was in 1900. Clearly the early commitment to mining in these counties did not assure prosperity in future years.

Iron and Ashland Counties began mining iron ore from the Gogebic Range in northern Wisconsin in the mid-1880s. That mining continued until 1965. The city of Ashland also

Figure A



provided the port facilities for the shipment of the iron ore to Great Lakes industrial centers. After the iron mining ceased in 1965, copper mining was expanding just across the border in White Pine, MI, providing some ongoing mining jobs. After 1920, however, both counties saw their populations drop even as mining continued for another 45 years. That decline in population continued through 2010 at which time the population in Iron County was 10 percent below its 1900 level and the population of Ashland County was 20 percent below what it was at the beginning of the 20th century. See Figure C. Eighty years of iron ore mining in the Gogebic Range did not allow these counties to either stabilize their population or grow it.

The center of earlier iron ore mining (1850s to 1892) was in Jackson County in the west central part of the state. Black River Falls was promoted as the "Pittsburg of the West." After the iron ore mining ceased at the end of the 19th century, the population of Jackson County slowly declined so that by 1960 it was about 15 percent below its 1900 level. In 1970 open pit mining of lower grade taconite ore and processing it into high iron content pellets began in Jackson County. That mining operation lasted only 13 years. During that renewed mining, the population increased by about 10 percent but remained below the population in the first two decades of the 20th century. After the taconite operation shut down, the population growth ceased and declined slightly. By 1990, however, after mining had ended, the population grew at a faster rate than at any time since 1900. See Figure D.

Figure B

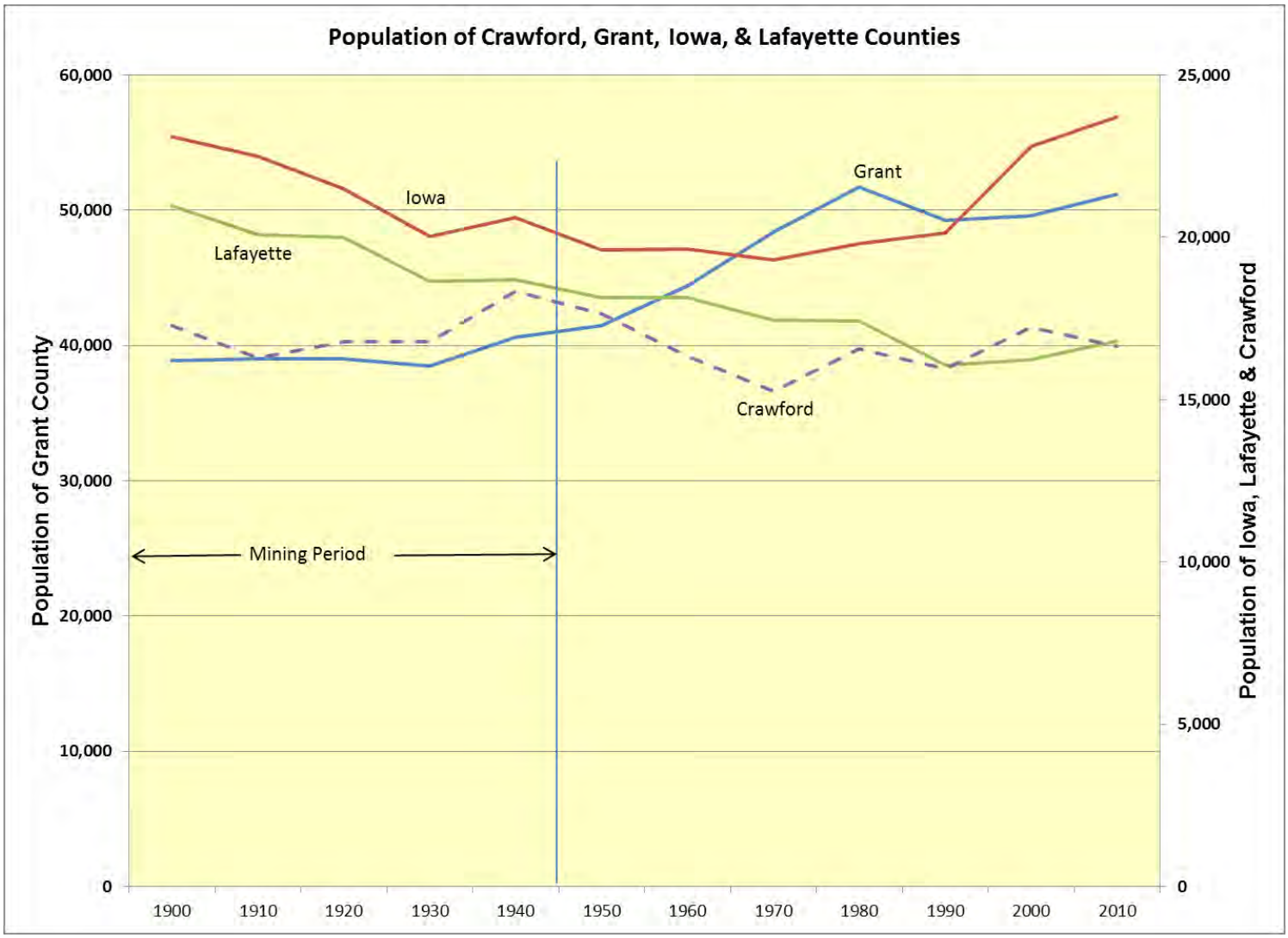
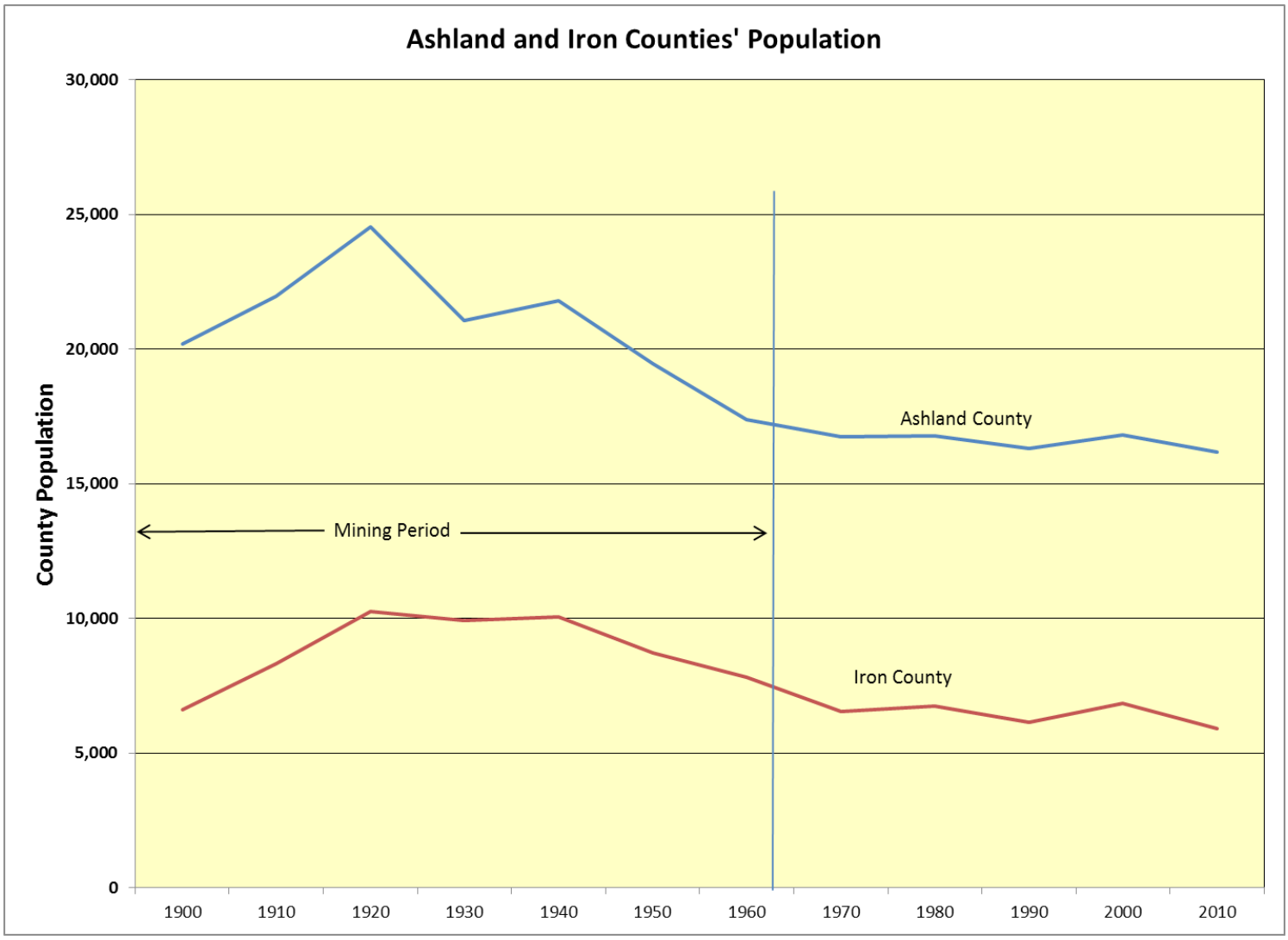


Figure C

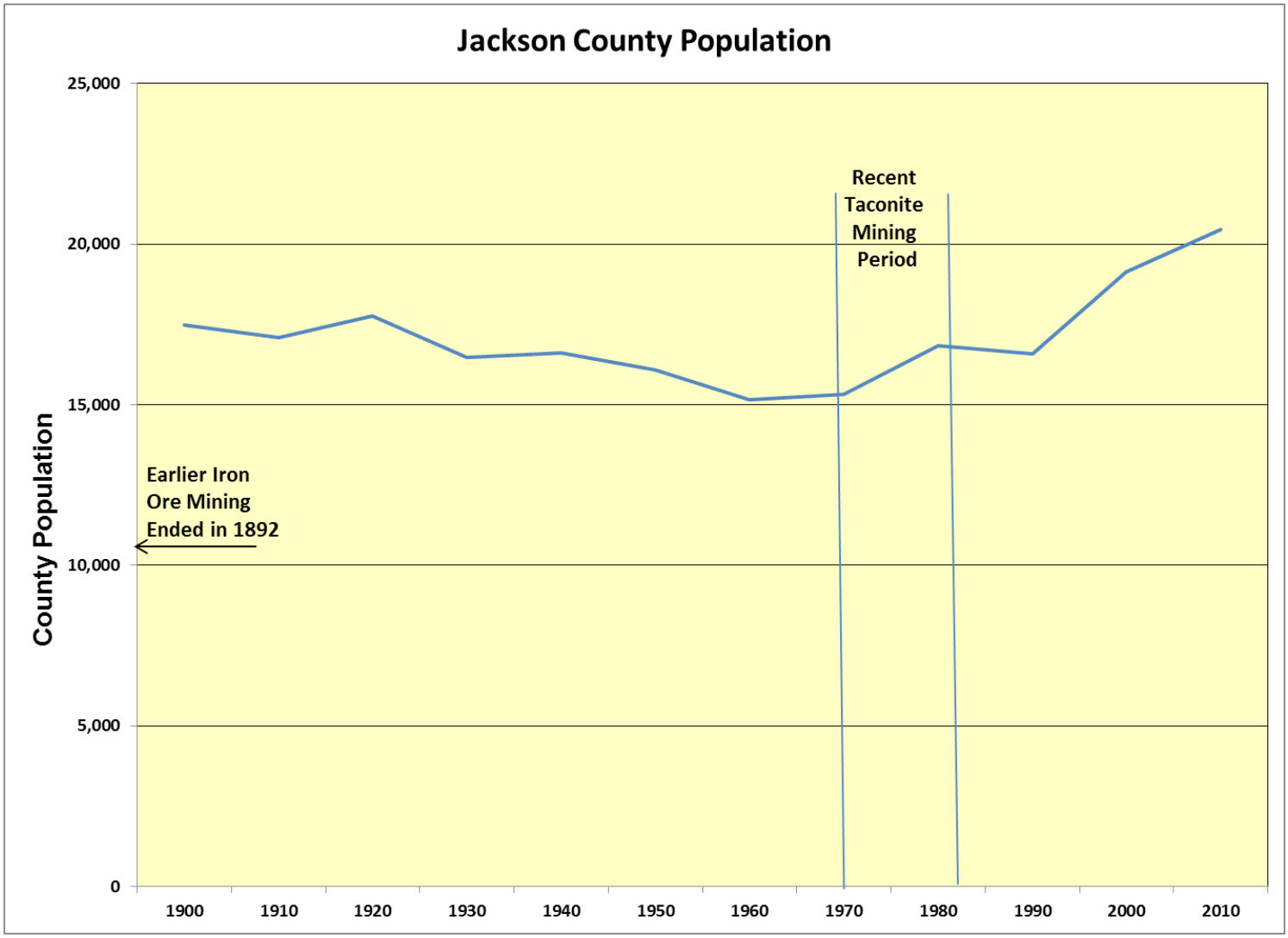


Iron mining also took place in the Wisconsin part of the Menominee Iron Range in Florence County along the Wisconsin-Michigan border in eastern Wisconsin. That mining began in the 1870s and ended in the 1940s. The population of the county grew consistently during the 20th century part of the mining period. When the mining ceased, 90 percent of that population growth was lost as the population in 1970 fell to approximately what it had been in 1900. A quarter of a century after mining ceased, population growth returned to Florence County. Between 1970 and 2000 the population increased by almost 55 percent. See Figure E.

Copper sulfide ore was mined in northern Wisconsin briefly between 1993 and 1997. The Flambeau copper mine was located outside of Ladysmith in Rusk County. In the decade before it opened, Rusk County population had declined slightly. During the Flambeau Mine's operation the population grew very slightly, by about 250 people or a little less than two percent. After the close of the mine and the completion of the required reclamation, however, the population dropped to below what it was when the mine opened. In 2010 the population was below its 1960 level. See Figure F.

Several important conclusions can be drawn from this brief review of Wisconsin's historical experience with mining. First, the mining activity has a relatively modest impact on local economic vitality during the period of active mining. That is followed by a loss of population. It is only a considerable time after mining has ended that new economic activities become the source of economic vitality. The mining itself does not lay the basis for sustained economic vitality. In fact, economic depression tends to follow mining.

Figure D

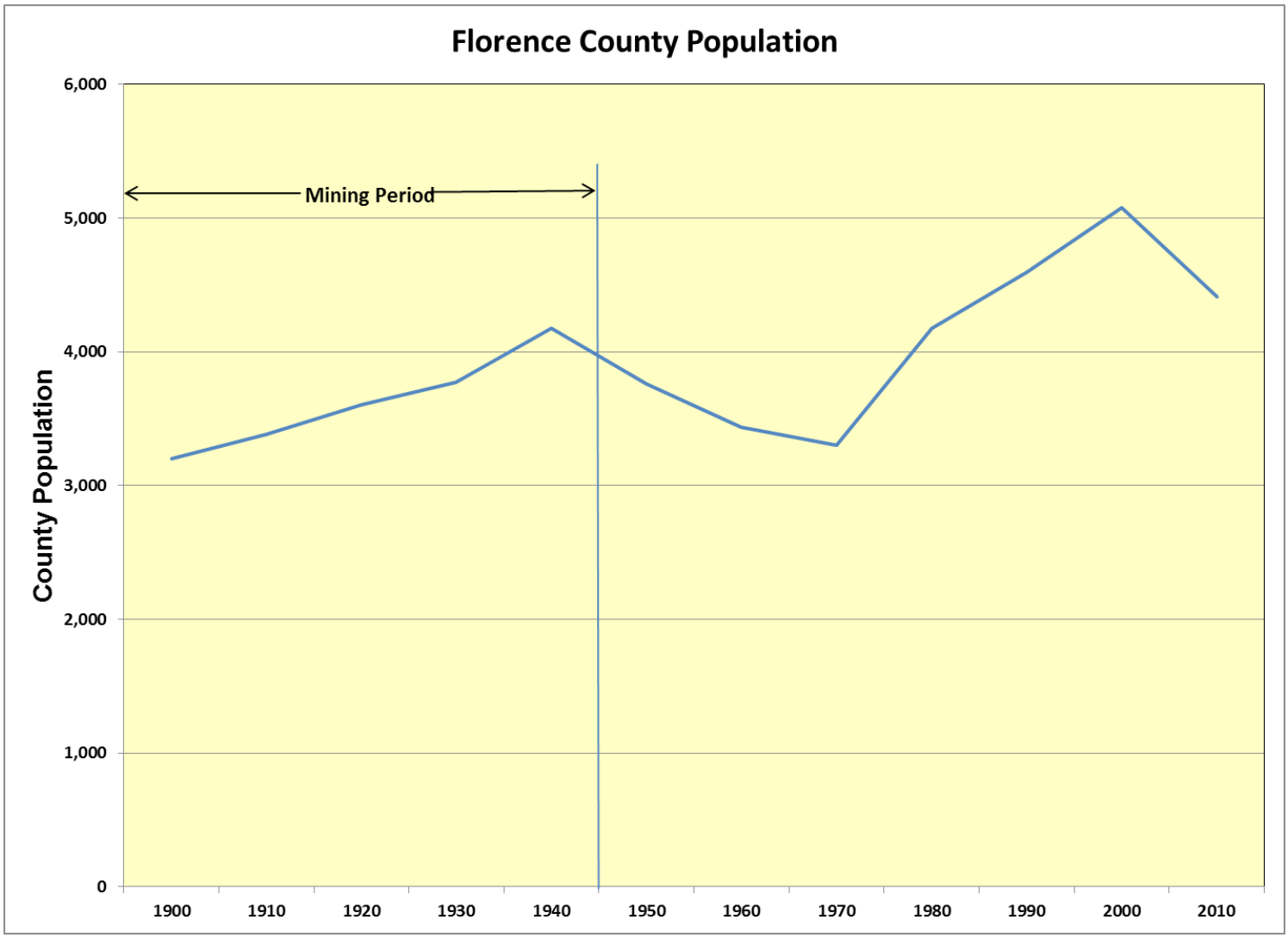


B. The broader American experience with mining and economic development

There is nothing unusual or surprising about mining in Wisconsin not bringing sustained economic prosperity and vitality. Across the United States, mining dependent communities are noted for high levels of unemployment, slow rates of growth of income and employment, high poverty rates, and stagnant or declining populations. In fact, our historic mining regions have become synonymous with persistent poverty, not prosperity: Appalachia (coal), the Ozarks (lead), the Four Corners (coal), and the Upper Peninsula of Michigan (copper and iron) are the most prominent of these.[4] Federal efforts have focused considerable resources on overcoming the poverty and unemployment found in these historic mining districts. In addition, the copper towns of Arizona, New Mexico, Montana, and Michigan and the Iron Range in Minnesota, the Silver Valley of Idaho, the gold mining towns of Lead and Deadwood, South Dakota, the "Uranium Capitol" of the nation in the Grants area of New Mexico and the Uravan Belt in western Colorado, etc. are also not prosperous, vital communities. Over the last several decades some of these areas have begun to recover either as a result of hundreds

4. Outside of the rural US Deep South where a long history of racial inequality has led to persistent poverty, mining and other natural resource counties are prominent among the persistently poor non-metropolitan counties. "Mining the Data: Analyzing the Economic Implications of Mining for Non-metropolitan Regions," William R. Freudenburg and Lisa J. Wilson, Sociological Inquiry, 72(4), Fall 2002. Also the Revised ERS County Typology: An Overview, 1994, Peggy J. Cook and Karen L. Mizer, Economic Research Service, Rural Development Research Report Number 89, US Department of Agriculture. Compare the mining counties with the persistent poverty counties, pp. 8 and 24.

Figure E



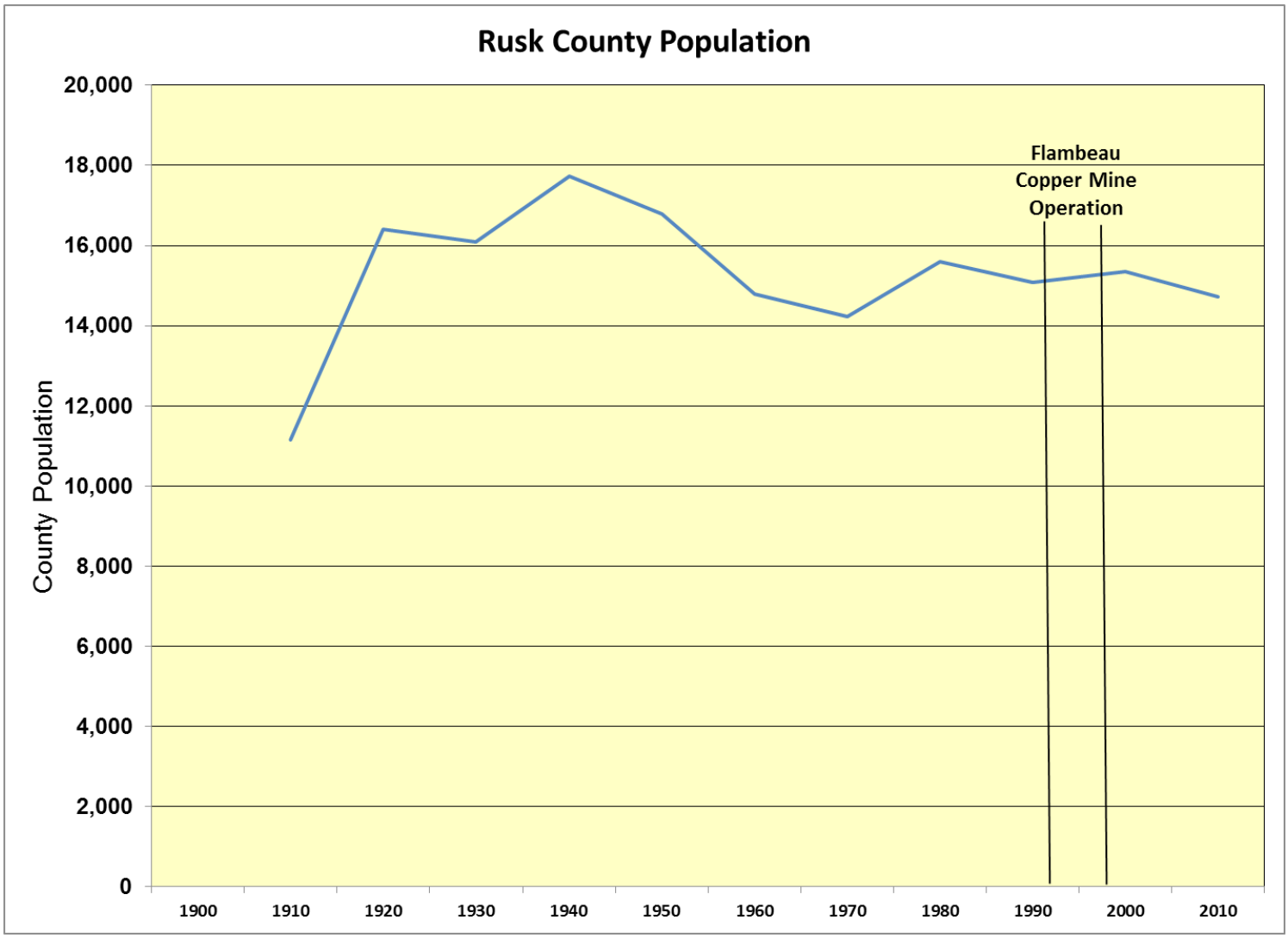
of millions of dollars of Super Fund expenditure and/or as a result of the in-migration of new, relatively foot-loose residents and economic activities, but that recovery is usually not tied to ongoing mining.

The dramatic contrast between the wealth created and the high wages paid in mining and the poor economic performance of mining communities needs to be understood before expanded mineral extraction activities can be safely promoted as a local economic development strategy. Below we take a brief look at the actual performance of mineral communities over the last thirty years and then turn to an explanation for that relatively poor economic performance.

In order to explore the contemporary local impact of reliance on mining in the United States, we look at the economic performance of all US counties where mining (excluding oil and gas extraction) was the source of 20 percent or more of labor earnings at some time in the 1980s and then follow those counties through 2008. There are about 100 such counties that could be identified out of the 3,100 counties in the U.S.[5] Data disclosure problems prevented the identification of

5. The Regional Economic Information System 1969-2000 CD-ROM (Bureau of Economic Analysis, US Department of Commerce) was the source of the data. A county was included as "mining-dependent" if the data indicated that for at least one year in the 1970-1979 or 1980-1989 period "mining" less "oil and gas" earnings were 20 percent or more of total earnings by place of work.

Figure F



some mine dependent counties.[6]

The US mining-dependent counties are spread out over half of the American states but are geographically clustered in the Appalachian (Pennsylvania, West Virginia, Tennessee, Kentucky, and Virginia) and Mountain West states. The century-old copper mines of Arizona, New Mexico, Montana, Utah, and Upper Michigan are included as are the new gold mines in Nevada. The older coal mines in the southern regions of the Great Lakes states (Illinois, Indiana, and Ohio) are included as are the new open pit coal mines of Wyoming, Montana, Utah, Colorado, and New Mexico. The lead mines of the Ozarks in Missouri, the precious metal mines in the Black Hills of South Dakota and the Silver Valley of Idaho, and the iron fields of Minnesota and Upper Michigan are also included. There were no Wisconsin counties that met our criteria as specializing in mining activities in the 1980s.

The question we seek to answer is whether a high degree of reliance on mining allowed these counties to out-perform counties that did not specialize in mining. Economic performance was measured in terms of the growth in the total income received by residents, the aggregate labor earnings of residents of the county, per capita income, and population. In addition, the level of per capita income at the beginning and end of the periods was analyzed.

6. If a few firms dominated local mining, federal regulations prevent the release of the mining data for that county. This is often a problem in any given year, but it is less of a problem when looking at 20 years of data since mining data often will be available for at least one of those years and thus qualify it as "mining-dependent." The number of counties that would have been labeled mining-dependent if it were not for these data disclosure restrictions is unknown. However, our analysis identified about the same number of mining-dependent counties as other studies, about 100 counties dependent on solid minerals and another hundred dependent on oil and gas extraction. Kenneth Deavers and David Brown in a 1985 study identified a total of 199 counties in these two categories (Natural Resource Dependence, Rural Development, and Rural Poverty, Economic Research Service, US Department of Agriculture. Rural Development Research Report No. 48). A 1994 study identified only 146 mining-dependent counties (including oil and gas counties) (Peggy Cook and Karen Mizer, The Revised ERS County Typology, Economic Research Service, Rural Development Research Report Number 89, US Department of Agriculture).

The decade of the 1980s was not good for mining-dependent counties. Aggregate labor earnings in those counties grew much more slowly than in other counties, almost 60 percent slower. During the 1990s earnings were still growing more slowly in mining-dependent counties, 25 to 30 percent slower. In the 2001-2008 period[7], however, rising metal and coal prices led to a recovery of some mining counties after 20 years of depressed economic vitality. During that period, although mining counties saw much slower population growth, the earnings and per capital income of the residents of mining counties grew faster than in other counties for the first time in 20 years. Per capita income and residents' labor earnings grew 13 percent faster in mining-dependent counties while total income grew 9 percent faster. For the whole period 1980-2008, despite the resurgence of mining activity in the most recent period, however, aggregate earnings and per capita income still grew significantly more slowly. Mining-dependent county earnings grew over a third slower, personal income almost a quarter slower, and population and per capita income about an eighth slower.

Given this poor economic performance in US mining-dependent counties despite the high wages paid by mining, it is not surprising to find that population growth in these counties was negative during the 1980s and significantly slower than in the rest of the nation in the 1990s. Population growth continues to be significantly slower during the 2001-2008 period too. See Table A below.

Table A

Ratios of Growth in Economic Vitality Indicators Growth in Mining Dependent Growth in Non-mining Dependent				
	1980-1990	1990-2000	2001-2008	1980-2008
Personal Income	0.59	0.82	1.09	0.76
Population	-0.85	0.50	0.65	0.87
Per Capita Income	0.72	0.95	1.13	0.88
Earnings	0.41	0.69	1.13	0.64
Source: U.S. Dept. Comm., BEA, REIS Local Area Income				

Despite the high wages paid in mining, the level (as opposed to the growth rate) of per capita income was also lower in the mining-dependent counties and, given the slower growth, the gap increased relative to the rest of the nation between 1980 and 2000. The gap grew to $9,500 per person by 2000. In 2008 there was still a gap in per capita incomes in the mining counties, but the gap had narrowed to $3,000.[8] See Table B below.

Table B

Level of Per Capita Income: Mining Dependent and Non-Mining Dependent Counties				
	1980	1990	2000	2008
Mining-Dependent	$8,390	$13,754	$20,099	$30,240
Non-Mining Dependent	$10,201	$19,622	$29,548	$33,191
Difference	-$1,811	-$5,868	-$9,449	-$2,951
Source: U.S. Dept. Comm., BEA, REIS Local Area Income, and author's calculations				

It is clear that over the last several decades, dependence on mining did not provide a reliable path to prosperity that allowed mining communities to perform better than other American communities. In fact, mining-dependent communities lagged significantly behind the average for the rest of the nation.

These are not new results. US Department of Agriculture analyses of mining-dependent counties have also pointed out the slower economic growth and lower per capita incomes in mining-dependent counties.[9] In addition recent reports by the US Census Bureau providing Profiles of Poor Counties showed, when counties are classified by the type of industry that dominates the local area, mining counties had the highest poverty rates of any industrial group and that poverty rate increased systematically between 1989 and 1996.[10]

7. In 2001 the U.S. Department of Commerce shifted is industrial categories from the Standard Industrial Classification to the North American Industrial Classification. Instead of reporting on total mining and the sub-categories of metal mining, coal mining, oil and gas, and other mining, it reported only on the sub-categories of "oil and gas extraction" and "mining except oil and gas." The 2000 and 2001 data cannot be directly compared, hence our use of the 2001-2008 period. For the 1980 to 2000 period we approximated the "mining except oil and gas" by subtracting "oil and gas" from total mining.

8. Most mining operations are located in non-metropolitan areas where average incomes, in general, are lower. If the mining-dependent counties are compared only to other non-metropolitan areas as opposed to all counties, both metropolitan and non-metropolitan, it is still true that the mining-dependent counties have lower per capita incomes and that they lost ground relative to other non-metropolitan counties during the 1980-2000 period. This is also true for most mining regions even if the mining-dependent counties are compared only with the other non-metropolitan counties within the same state. Of the 24 states with mining-dependent counties, only 5 (MT, MN, MI, GA, and SD) had per capita incomes above the state's non-metropolitan average in 1990 and per capita incomes in the mining communities within those five states were only 4 to 9 percent higher. In 2000 the per capita incomes of mining-dependent counties exceeded that of the state's non-metro areas in only 3 states. In 2008, despite the expansion of mining, 17 of the mining states still had non-metro per capita income above that in the mining-dependent counties. The average per capita income in the mining-dependent counties remained below the per capita income in the non-metropolitan areas for 1970, 1990, 2000, and 2008. In 1980 the per capita income in mining-dependent counties was 5 percent above the national non-metropolitan per capita income.

9. See the studies cited in footnote 37 above.

10. Profiles of Poor Counties: Some Empirical Evidence, Patrick Cardiff, US Census Bureau, Small Area Income and Poverty Estimates, FB3-1065, Washington, DC 20233, 1999. http://www.census.gov/hhes/www/saipe/asapaper/Cardiff99.pdf

Unemployment is also higher in mining-dependent counties in the US. For instance, unemployment rates in coal mining counties[11] are significantly above the average unemployment rate in the state where the county is located. Averaged over the 1990-2000 period and across all coal-mining counties, the unemployment rate in those counties was 55 percent above the state average rates. For some states such as Arizona and Virginia, the coal county unemployment rates are two to three times higher than the state unemployment rates. See Table C below. Given the ongoing job losses in most coal mining counties due largely to labor-displacing technological change, these high unemployment rates might be expected. During the 1980s, for instance, the layoff rate in the mining industry was the highest of all the major industrial groups in the US and the rate of job displacement in coal mining was much higher than in mining as a whole.[12]

Table C

Ratio of the Unemployment Rates in U.S. Coal Counties to the State-wide Average Unemployment Rate, 1990-2000								
AL	AZ	CO	IL	IN	KY	MT	NM	ND
1.05	2.64	1.31	1.50	1.38	1.64	1.76	1.38	1.82
OH	PA	TX	UT	VA	WV	WY	All U.S. Coal Counties	
1.75	1.44	1.23	1.73	2.95	1.27	1.02	1.55	
Source: U.S. Department of Labor; author's calculations								

The important point to be drawn from all of these statistical results is that these mining activities, in general, have not triggered sustained growth and development in the local regions were the mining took place. Closure of mines in the late 19th and the first half of the 20th centuries often led to "ghost towns" and abandonment of a mining region. Where mining persisted over longer periods, it did not trigger a diversification of the economy. Instead, as labor saving technologies reduced employment opportunities, the region around the mines became distressed with high unemployment and poverty rates.[13] As mining again began to expand in the 2001-2008 period, counties that depended on mining made up some of the losses over the previous twenty years, but still lagged behind other counties that were not mining-dependent and remained vulnerable to downturns in the mineral economy such as happened in 2009 and almost certainly will take place again.

A recent analysis of the impact of mining activity on rural counties between 2000 and 2007 confirms the results of earlier studies indicating that reliance on mining activity does not add to local economic vitality measured in terms of either population growth or job growth.[14] That study of all U.S. non-metropolitan counties found that increased dependence on mining was associated with slower population growth in the 2000 to 2007 period. It also found that increased reliance on mining had no positive impact on employment growth. On the other hand, the more reliant a rural county was on mining, the higher was the growth rate in per capita income in that most recent period.[15]

The authors explained these mixed results in terms of the characteristics of contemporary mining operations that we will also discuss below. The increased capital intensive character of mining has reduce the labor intensity of mining operations, significantly reducing the size of the necessary workforce but increasing the skill and pay level of that smaller work force. In addition, because of the uncertainty about the duration of mining employment (the "flickering" of the industry), miners have become more mobile, commuting long distances to mining jobs or locating temporarily away from their families to work at a mine. The result is that the local multiplier impacts associated with miners spending their pay are quite small because that payroll rapidly "leaks out" of the local economy.[16]

11. A US country was categorized as being a "coal mining county" if it had 200 or more coal miners in its work force. There were 99 such counties out of America's 3,100 counties. The Regional Economic Information System (US Bureau of Economic Analysis) was the source of the employment data; US Department of Labor the source of the unemployment data for the yeas 1990-2000.

12. "The Industrial structure of job displacement, 1979-88, Monthly Labor Review, September 1992, pp. 17-25.

13. A 2002 review of the literature dealing with the economic characteristics of mining-dependent rural communities in the US confirms these results. Of the 301 quantitative economic findings in scholarly studies about how mining-dependent communities fared relative to other communities, there were almost two (1.9) negative impacts reported for every positive finding. See "Mining the Data: Analyzing the Economic Implications of Mining for Non-metropolitan Regions," William R. Freudenburg and Lisa J. Wilson, Sociological Inquiry 72(4):549-75. "Rural" is used loosely here to refer to non-metropolitan areas that can have urban areas with populations of up to 50,000.

14. Mining except oil and gas development was the industrial classification. That includes metal, coal, sand and gravel, and other non-metallic mineral mining.

15. Deller, Steven C and Andrew Schreiber. 2012. "Mining and Community Economic Growth."The Review of Regional Studies, 42(2):121-141.

16. Ibid. p. 136.

C. The international experience with mining: The "resource curse" literature

The experience of developing countries around the world also raises questions about the impact of specialization in mineral development on sustained community development over the last 30 or 40 years. The empirical results of many studies cast doubts about whether a focus on mineral development can boost local economic well-being. The evidence over the last several decades has been that the more a developing country has depended on mineral development, the slower its rate of growth in per capita income has been. In general, reliance on mineral development has not been consistent with sustained economic development. In recent years, for instance, international studies have been published with titles such as:

- "Treasure or Trouble? Mining in Developing Countries,"[17]
- "Natural Resources: A Blessing or a Curse?"[18]
- "Resource Impact: A Curse or a Blessing,"[19]
- "The Curse of Natural Resources,"[20] and
- "Oil Windfalls: Blessing or Curse?"[21]

Clearly these international economic analyses do not see natural resource development as a simple and certain way for developing countries to derive substantial and sustained net benefits. Despite the conventional view of mineral deposits as easy "treasure," mining is actually a complex and risky undertaking in the context of sustained economic development.

17 Mining Department, World Bank Group, World Bank and International Finance Corporation, Washington, DC, 2002.

18 Elissaios Papvrakis and Rever Gerlagh, Institute for Environmental Studies, Vrije Universiteit, Amsterdam, The Netherlands. January 2003.

19 "Paul Stevens, 2003, Resource Impact: A Curse or a Blessing?—A Literature Survey, Journal of Energy Literature 9(1), June. Also see the statistical analysis of similar title by the same author: Resource Impact: A Curse or a Blessing?, Center for Energy, Petroleum and Mineral Law and Policy, University of Dundee, Scotland, UK, April 2003, CEPMLP Internet Journal, Vol 13, Article 14, www.dundee.ac.uk/cepmlp/journal/html/Vol14/Vol14_1.pdf .

20 Jeffrey D. Sachs and Andrew M. Warner, *European Economic Review*, 45(2001):827-838.

21 Alan Gelb and Associates, published for the World Bank by Oxford University Press, New York, 1988.

3. EXPLANATIONS FOR THE POOR ECONOMIC PERFORMANCE OF MINING COMMUNITIES

There are many related explanations for the poor economic performance of mining communities despite the high wages paid in and the wealth produced by those industries:

- The instability of mine production, employment, and payroll due to the fluctuations in supply and demand in national and international markets. Mining jobs and payroll "flicker" over time, coming and going in deep cycles that cause economic disruption in the surrounding area.

- The impact of ongoing labor-displacing technological change that constantly reduces the workforce required for any given level of mine production. Even if mine production and employment does not fluctuate, the number of employees required steadily declines over time. There are fewer and fewer jobs associated with modern mines.

- Mines, ultimately, always deplete their economically viable ore deposits and shut down. The average life of a metal mine has declined significantly in recent decades. For instance, the copper mining activities in Butte, Montana, have lasted 125 years, albeit, with periodic busts and now employing a drastically reduced workforce. The White Pine Mine across the Wisconsin-Michigan border operated for almost 45 years. But the proposed Copperwood project adjacent to White Pine is estimated to last 13 years. The Flambeau Mine near Ladysmith lasted only a little over four years. The Black River Falls taconite mine lasted 13 years.

- Mine employees are very mobile, commuting long distance to work while maintaining their residences outside of the area immediately impacted by the mining and milling. This leads much of the mining payroll to "leak" out of the region immediately around the mine.

- Mines often have very limited connections with the local economy. The specialized machinery, chemicals, vehicles, etc. have to be imported from outside the local economy. As a result the "spillover" or "ripple" effects that can "multiply" impacts in other settings are often small.

- Mining is land intensive and as a result has nearly permanent impacts on the natural environment. Environmental degradation can significantly reduce the attractiveness of a mining area as a place to live, work, raise a family, or visit.

- Because of the high wages mining pays and because to the impact it can have on the livability of communities, mining can displace or discourage other economic activities.

In separate brief sections below we will discuss each of these in more detail below.

A. Riding the mining roller coaster: The uncertainty about jobs and pay checks

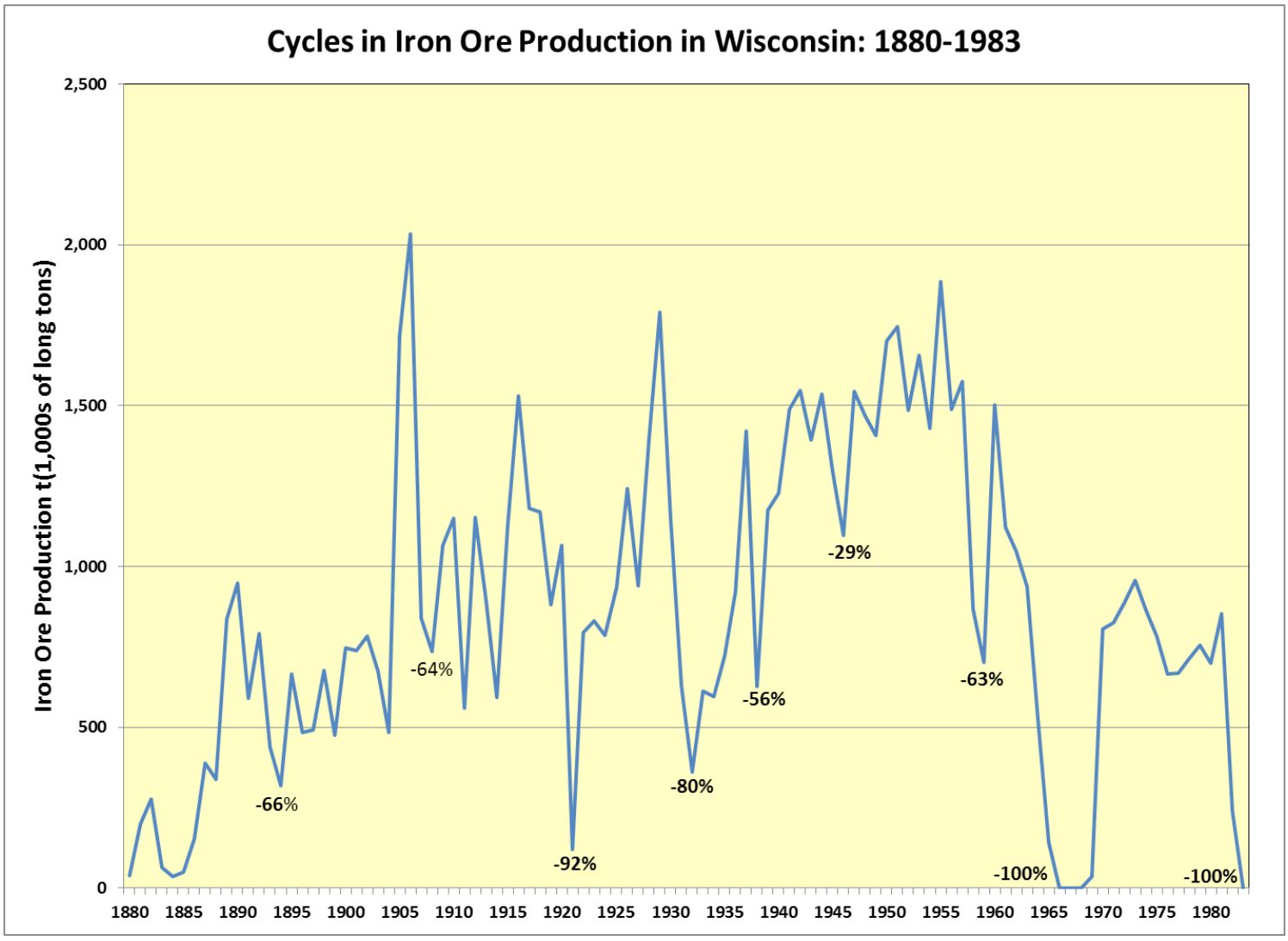
One important explanation for this poor economic performance of local economies specializing in mining despite the very high wage characteristics of that industry is the instability of employment and income associated with mineral development activity. The experience of Wisconsin mining communities, whether it was lead, zinc, iron, or copper, dramatizes this.

Wisconsin has had almost two centuries' experience with the mining and processing minerals. That history was one of spectacular expansions of mining, booms, followed by contractions, the inevitable busts that tend to follow the booms. Iron ore production from Wisconsin mines provides a good example.

As shown in Figure G on the following page, iron ore production was very unstable, increasing dramatically over a few years and then tumbling downward just as dramatically. One can count nine significant collapses in iron ore production with an average time period of about 8 years from one bust to another. But there were significant fluctuations up and down on a much more regular basis. Since employment and payrolls are linked to the actual mining and processing of the ore, employment and payrolls fluctuated too. This creates considerable uncertainty about how many high-paid jobs there will be in any given year and how large the payroll will be that circulates through the communities in which the workers live.

Part of that uncertainty is associated with the fluctuations in iron ore prices that vary with market condition. Iron ore is sold into national and international markets. When prices are low, mines cut back on production at their most costly units. As the supply of iron ore falls, ultimately supply and demand come into balance and prices stabilize. But often the cutbacks in production overshoot what is necessary and prices start to rise. If prices rise enough both existing mines where production has been reduced and new known deposits can move

Figure G



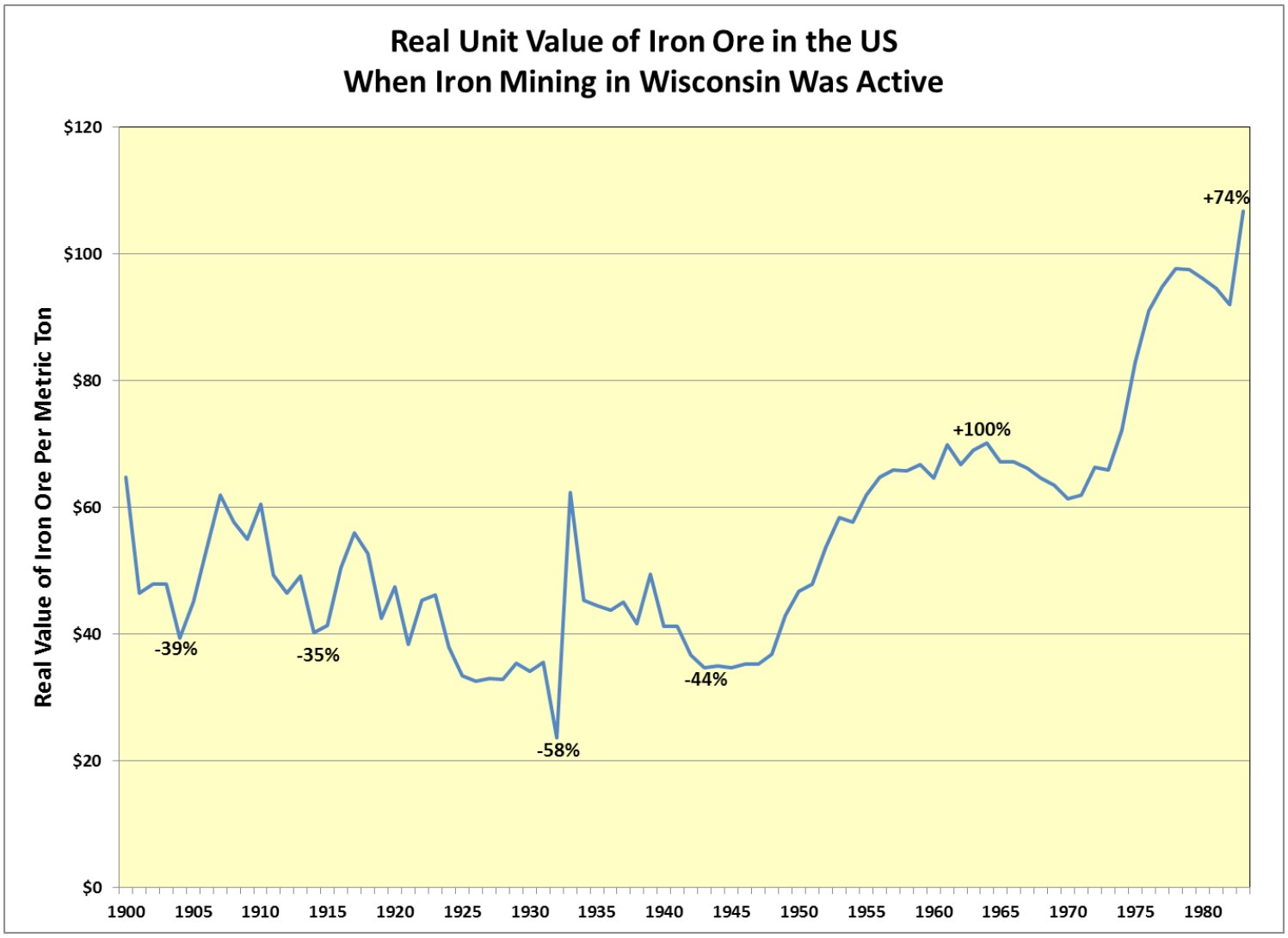
into production. The increased supply can also overshoot the demand, stabilizing and then driving iron ore prices back down again. This can be seen in the average value of a metric tonne of iron ore produced in the U.S. over the last century shown in Figure H on the following page. Note the regular declines in iron ore prices of about 40 to 60 percent. Such price declines can lead mining companies to shut down their more costly operations or shut down completely.

Fluctuations in the national and international economies can also cause fluctuations in iron ore demand and its price. Expanding economies need more iron ore; economies in recession use less iron. Most recently, the expanding Chinese economy's demand for iron ore has led to relatively high world iron ore prices largely set by the Chinese market. But those prices also fluctuate significantly. Figure I shows those iron ore market price fluctuations over the 2009 through 2012 period. The price rose through a series of fluctuations during 2009 and 2011, increasing by almost 50 percent. But along the way there were declines including a 27 percent decline beginning in April of 2010. After the peak in February 2011 the price then tumbled downward first by 29 percent and then after a modest recovery by 33 percent. From February 2011 through September 2012 iron ore prices tumbled 49 percent. There are few business operations that can avoid drastic cutbacks in production and workforce when faced with a fifty percent decline in the price they can receive for their product.

B. The impact of technological change on mining employment

Technological change in mining activities tends to systematically reduce the number of jobs associated with any given level of production. Larger earth moving equipment and more automated processing of the raw material has reduced employment per unit of output dramatically. In many mining industries the shift from underground to open pit mining has also allowed the same mineral production with a smaller workforce. The replacement of thermal processing of ores

Figure H



Sources: Mineral and Water Resources of Wisconsin, Report prepared by the US Geological Survey in collaboration with the Wisconsin Geological and Natural History Survey, Committee on Interior and Insular Affairs, US Senate, 94th Congress, 2nd Session, US Government Printing Office, November 1976. 1975-1983 data from USGS Mineral Yearbook for those years.

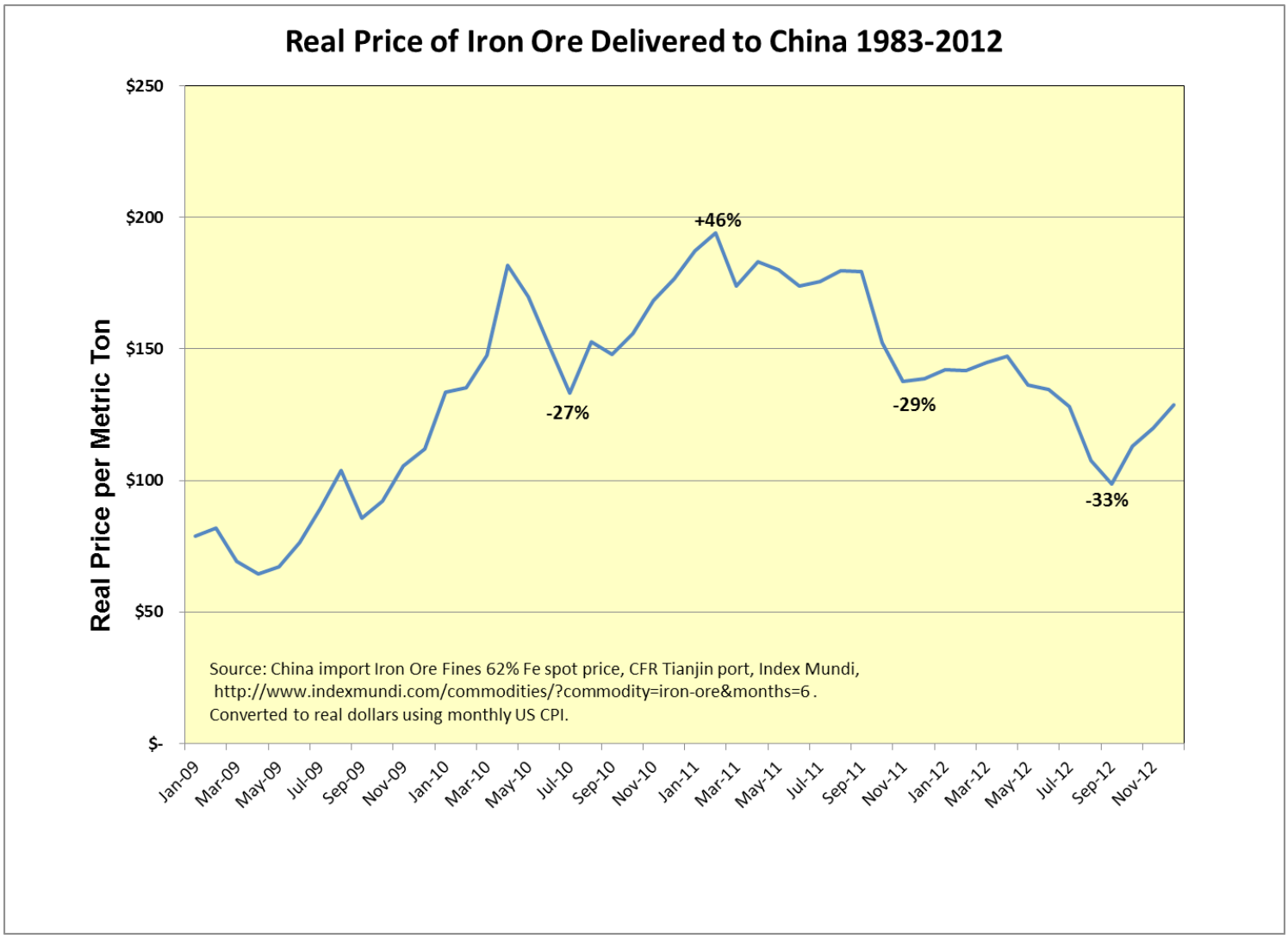
with chemical processing and, even, the use of chemical extraction of ores in place has also reduced the size of the necessary workforce.

If one looks across all mineral extraction industries, including fossil fuels, metals, sand, gravel, and rock, and other minerals, over the 1987 to 2003 period, labor productivity has increased by 37 percent. Put the other way around, the labor requirements of produced minerals has fallen by 27 percent. If we do not include oil and gas exploration and development in "mining", labor productivity approximately doubled or labor requirements were cut in half between the 1987 and about 2005. That was largely due to substantial gains in coal and metal mining productivity.[22]

This labor-displacing technological change has helped mining companies control costs and remain competitive while processing lower and lower grade ores. The higher labor productivity also supports the high wages paid in mining. The downside of this growth in labor productivity for workers and communities is that the labor required per unit of production has continued to fall, reducing the number of jobs associated with most mining operations. Thus even if production is stable,

22. The readily available federal data series begins in 1987, well past when most of the major gains in mineral extraction productivity had already been realized. As the Great Recession came 2006-2007 labor productivity declined as mining and mineral processing activities were cut back.

Figure I



employment continuously falls. Only constantly expanding mineral development can maintain stable employment, and this is rarely possible over the long run in any particular area.

C. Depletion of mineral deposits

Another obvious characteristic of mining limits the contribution it can make to sustained economic development of an area: mineral deposits are always, ultimately, exhausted, and the industry has to shift to new geographic areas.

As northern Wisconsin learned from the Flambeau Mine near Ladysmith in Rusk County, even without fluctuating commodity prices, the impact of a mine can be a short-run, one-time-only, pulse that is quickly gone. The Flambeau Mine operated only for a little over four years. The construction of the mine and the reclamation of the site after it shut down extend the period during which it was providing local jobs for several more years. But it is hard to imagine any continuing economic development impacts from such a short-run venture.

The Black River Falls taconite mine and processing facility in Jackson County lasted for about 13 years. The proposed Copperwood mine on the shore of Lake Superior across the Wisconsin border in Gogebic County is also planned to last 13 years.[23] These short mine life spans represents a dramatic change from the earlier periods when mines often operated, albeit off and on, for many decades. Mining operations with short lives add to the "flicker" associated with the local economic activity, as a result of mine production repeatedly cycling up and down over the years.

23. Feasibility Study of the Copperwood Project, Upper Peninsula, Michigan, USA," prepared by Joseph M. Keane, et al. for Orvana Resource US Corporation. March 21, 2012.

There may be some interplay with the previous three characteristics of mining we have discussed: the "flickering" or "boom and bust" fluctuations, the labor-displacing technological change, and the more rapid depletion of mineral deposits. As more and more labor-saving investments have been made in mining and mineral processing activities, mining has become more capital and less labor intensive. Fewer workers are associated with mining. This may lower the variable costs of mining while increasing the fixed capital costs associated with the mine. This could encourage mines to continue to operate through low mineral price periods because more of the costs are sunk costs that cannot be avoided by cutting back production. Given those high capital costs, however, mines are likely to be designed to extract the economically feasible minerals in as short a period of time as possible so as to recover the capital investment sooner. This could reduce the "flicker" but amplify the short-run "pulse" characteristic of the construction and brief operation of mines.

D. The mobility of miners and income leakage out of the mining area

Partly because of the uncertainty about the duration of employment in a mining operation, the mining workforce tends to be very mobile, moving from one mining operation to another as opportunities come and go. Mine workers are paid as well as they are because they have specialized skills that allow them to operate very expensive equipment in relatively dangerous settings. These jobs require skills that existing residents in a rural area are not likely to have.

When relatively high-paid jobs are created, the high pay justifies long commutes and applicants from a large surrounding area will compete for the jobs. In general, the mine is likely to hire the most qualified of those who apply. As a result, mining jobs typically are filled by workers who commute long distances to the mine or locate only temporarily in the vicinity of the mine.

This means that the economic benefits of the mining and milling become relatively widely dispersed throughout the region and do not primarily flow to local residents. This partially explains why mining towns often are not as prosperous as the high wages and payroll would suggest.

In addition, most employees of mines usually do not live adjacent to the mine. This is rational behavior since miners know that mining employment is cyclical and potentially short-term in nature at any given mine location. If a mine closes down, home values in the area may fall. In addition mining creates environmental hazards and scars the landscape in an enduring way. To protect the investment miners have made in the value of their homes, miners tend to locate those homes at some distance from the immediate impact area of the mine and commute considerable distances to work.

Because of this worker mobility and avoidance of "mining towns" by miners, the impact of a new mine on the local area immediately around the mine will be much smaller than the employment and payroll associated with the mine suggests. That payroll will not flow primarily to local residents. Much of it will immediately "leak out" of the local economy to the towns and counties where the many in-commuting mine workers actually live. Some miners may move to the area without their families but commute "back home" periodically and send most of their paycheck to their family's place of residence.

This mobility of workers should also be kept in mind when thinking about the impact of a mining project on the closest town. Typically, if the mine and mill will employ 200 workers, it will be said that 200 new jobs will be created for residents of the town. But people who live in a town often do not work in that town and those that work in that town often do not live there. In addition, how much of residents' or workers' income actually gets spent in that town is largely determined by whether that town is a regional trade center or primarily a residential location.

E. Mines tend to have limited economic connections with the local economy

Mines can be linked to the local economy in two ways. First, the mine may purchase from local businesses some of the inputs it needs to operate. This is typically labeled the "indirect" impact. Second, when a mine pays its workers or earns a profit for its owners, that income may circulate within the local economy as households provision themselves. This is called the "induced" impact. It is these "spillover" or "ripple" effects that amplify or "multiply" the "direct" impact associated with the construction of the mine and the hiring of the workforce.

Mines typically are located in relatively rural areas. Depending on how rural the area is, it may have very limited commercial infrastructure providing goods and services to locals. Because of this one would not expect the mine to be able to purchase locally the specialized equipment and materials that it needs to operate. In addition, residents may have to purchase most household goods and services from a somewhat distant trade center. If, as suggested above, many of the workers are in-commuters or temporary residents, the paychecks from the mine are highly likely to be spent outside the local area. If, in addition, the "profits" associated with the

mining operation, including royalties to the land and mineral owners, flow to non-residents, that income will not circulate in the local economy either.

At the extreme, mines are operated by national or international companies with headquarters and stockholders in distant locations and the workforce lives in temporary man-camps or on drilling platforms close to where the mineral is being extracted. In that setting, there are no local economic impacts because there is really no local economy in which the income associated with the mineral extraction project can circulate. The important point is the likely impact on the local economy will depend on the economic connections between the mine and its workforce and the local economy. For mining in rural areas these connections can be quite limited as the income associated with the project rapidly flows out of the local area.

F. The economic implications of environmental degradation

As discussed in more detail elsewhere in this report, the quality of the local natural and social environments are crucial to supporting several important sources of local economic vitality: Holding and attracting new residents and businesses, attracting the foot-loose income associated with retirees and investors, attracting business activity linked to professional and technical services, high tech manufacturing, and information workers, and encouraging a diversified visitor economy. Mineral extraction tends to be land intensive, imposing a disruptive footprint on the natural landscape and contributing to significant environmental degradation. The industrialization of rural landscapes and the increase in mine-related transportation of minerals can also change the character of rural communities. This makes mining-dependent areas less attractive places to live, work, do business, and visit, depressing economic diversification and development.

G. Potential displacement of existing economic activities

As the previous paragraph suggests, all economic activities are not necessarily compatible with all other economic activities. That is why in urban areas zoning plays an important role in separating incompatible land uses. It is also why, in a voluntary and informal way, people and businesses, voting with their feet, seek to move away from locations that they perceive to have unattractive or noxious characteristics and towards locations where those "disamenities" are perceived to be absent or there are actually positive characteristics, and attractive social and natural amenities,present.

Mining necessarily modifies the natural landscape in ways that most people find unattractive. In addition, because of that modification of the landscape or because of emissions associated with the processing of the minerals, mining also tends to generate significant air, water, noise, and/or light pollution. This can discourage the in-migration of new residents and businesses as well as discourage visitors and undermine the local potential for an expanding visitor economy.

Mining can also compete with other land uses such as agriculture. Given the high mineral values that may be present while the mine is operating, mining often can easily out-compete agricultural land uses, converting farmland to a mining site. Reclamation back to previous agricultural used after mining ceases is often difficult especially re-creating crop land after the top soil has been scraped away and stored. It takes considerable time to reestablish soils that were as productive as they were pre-mining.

The high-wage jobs in mining and transportation are also likely to successfully compete for whatever local workers have the requisite skills for those jobs. While obviously beneficial for those workers who can shift to a higher skilled and higher paid job, other local businesses will find it more difficult and more costly to hire equally qualified workers. This could raise costs to local businesses, making it more difficult for them to earn a profit, potentially undermining the diversity and vitality of the local economy.

H. Policy implications of these negative economic characteristics of mining

These well-known sources of economic instability in mining-dependent economies lead businesses and households to be very cautious about the investments they make in areas dependent on mining.

Since workers, residents, businesses, and local governments do not know how long the employment and payrolls will last, they reduce their risk by avoiding fixed investments that may be lost if the mineral industry enters a period of decline. As a result, mineral workers commute long distances to jobs, maintaining residences at some distance from the mineral development.

Businesses are hesitant to develop local commercial infrastructure and local governments are hesitant to finance public infrastructure with debt. Entrepreneurial talent also tends to avoid or leave "company" towns because the mine tends to dominate the town economically and politically creating a culture of dependence rather than one of innovation.

The result is a less fully developed local economy and more income leakage out of the local economy. In short, dependence on mining tends to constrain local economic development, leading to the depressed economic conditions that have come to characterize many mining-dependent areas.

The policy implications of this description of the problem are straightforward:

a. A commitment to mining is probably not a good economic development strategy because of the instability it can bring to the local economy.

b. In addition, avoiding additional environmental damage associated with new mining and repairing the damage associated with past mining is important in making the community an attractive place for current and new residents and businesses which promotes long-term economic development and health.

c. Projecting that a mine will operate continuously for an indefinite period with more or less constant employment and payroll is unrealistic because it ignores the market cycles in mineral prices and production and the ongoing deployment of labor-saving technology. Throughout the history of mining in Wisconsin and elsewhere, mine production and employment have fluctuated widely, disrupting communities that depend on mining. It is a historical rarity to find a twenty- to thirty-year period when major mining expansions and then contractions did not take place. Recall Figure G above.

d. Assuming that all of the jobs associated with a mining project will be filled by local residents who will then continue to live in the area immediately around the mine and, therefore, that the mine payroll will primarily circulate within that local economy is unrealistic. Many of the jobs will go to in-migrating and in-commuting workers from a broad geographic area. As a result, that payroll and its impact on the economy will quickly leak out of the local area and be diffused across a broad geographic area.

4. IS SAND MINING SIMILAR TO METAL, COAL, AND OTHER TYPES OF MINERAL EXTRACTION?

Reviewing the economic characteristics and problems of other types of mineral extraction can provide insight into how widespread frac-sand mining and processing might impact the communities of western Wisconsin only if there are significant similarities between frac-sand mining and other types of past mineral extraction and processing. We explore those similarities and differences in this section.

A. The likely stability of frac-sand mining over time

Frac-sand mining is not only a mineral extraction activity itself, but it produces a product that is used to produce other minerals, namely oil and natural gas. This means that its production can fluctuate simply because of the fluctuations in the price of the sand itself, but also because of fluctuations in oil and natural gas prices.

Wisconsin frac-sand mining is currently in a typical mineral "rush" boom with a significant number of companies rushing to bring permitted facilities on line and many others hurriedly seeking to plan and permit additional facilities. Both shale gas and tight oil production, which make use of frac-sand, have been expanding rapidly and are projected to continue to expand.[24]

The price that frac-sand could bring in Wisconsin rose rapidly over the last several years. In 2010 uncoated sand was in the $40 to $45 per ton range. The cost of producing the sand was in the $20 to $30 range. So there were profits to be made. The price being paid for the sand rose rapidly to over $100 per ton in early 2012 and then settled down to about $80 per ton at the end of that year. Those prices and costs meant very high profits for those who could get mines and processing plants permitted, built, and operating. The "rush" was on.

However, there is no shortage of frac-sand in Wisconsin. Much of western Wisconsin is underlain with appropriate sand deposits. The same is true across the Mississippi in Minnesota. That means that large additional supplies of frac-sand can be brought onto the market relatively quickly, creating competition for sales and pushing the price for the sand back down toward the cost of producing it. Wisconsin sand production may already be moving into that over-supply phase. The investment advising firm, Seeking Alpha, published a warning to investors in August 2012 entitled "The Coming Tsunami of Frac Sand Supply."[25] Based on surveys of county permitting officials, the production capacities of frac-sand facilities under- construction and those that have been proposed were totaled. The new sand facilities under-construction would increase Wisconsin frac-sand production by almost 50 percent and those proposed would add another 40 percent, almost doubling the production of frac-sand in Wisconsin. At $80 per ton, it still appears very profitable to get into the frac-sand business. As a result, more and more supply will come on line, pushing the price down until marginal, high cost operations are squeezed out and the price is closer to the cost of production. Seeking Alpha projected that that would be in the $35-$40 per ton range.

The emerging competition is not just among the local potential supplying firms. Oil and gas exploration and development companies have begun to develop their own frac-sand supplies, integrating those activities into their oil and gas production activities. This allows them to avoid paying a high scarcity price and assure supply, quality, and delivery. That integration of frac-sand production into oil and gas development may squeeze out most small local operations.

In addition to the impact on sand prices of competition among the many potential frac-sand providers, there is also the impact on sand prices from the fluctuation in the demand for frac-sand as the profitability of shale natural gas and tight oil fields shifts with the market value of natural gas and oil. Natural gas prices have been highly volatile for almost two decades. In April 2012 natural gas wellhead prices fell to less than two dollars per thousand cubic feet (mcf). Four years earlier the price had been almost $11. See Figure J below. Note the wide swings in natural gas prices.[26] They fluctuated between about $1.60 and $10.80 per mcf. These types of price cycles are typical of many mineral markets.

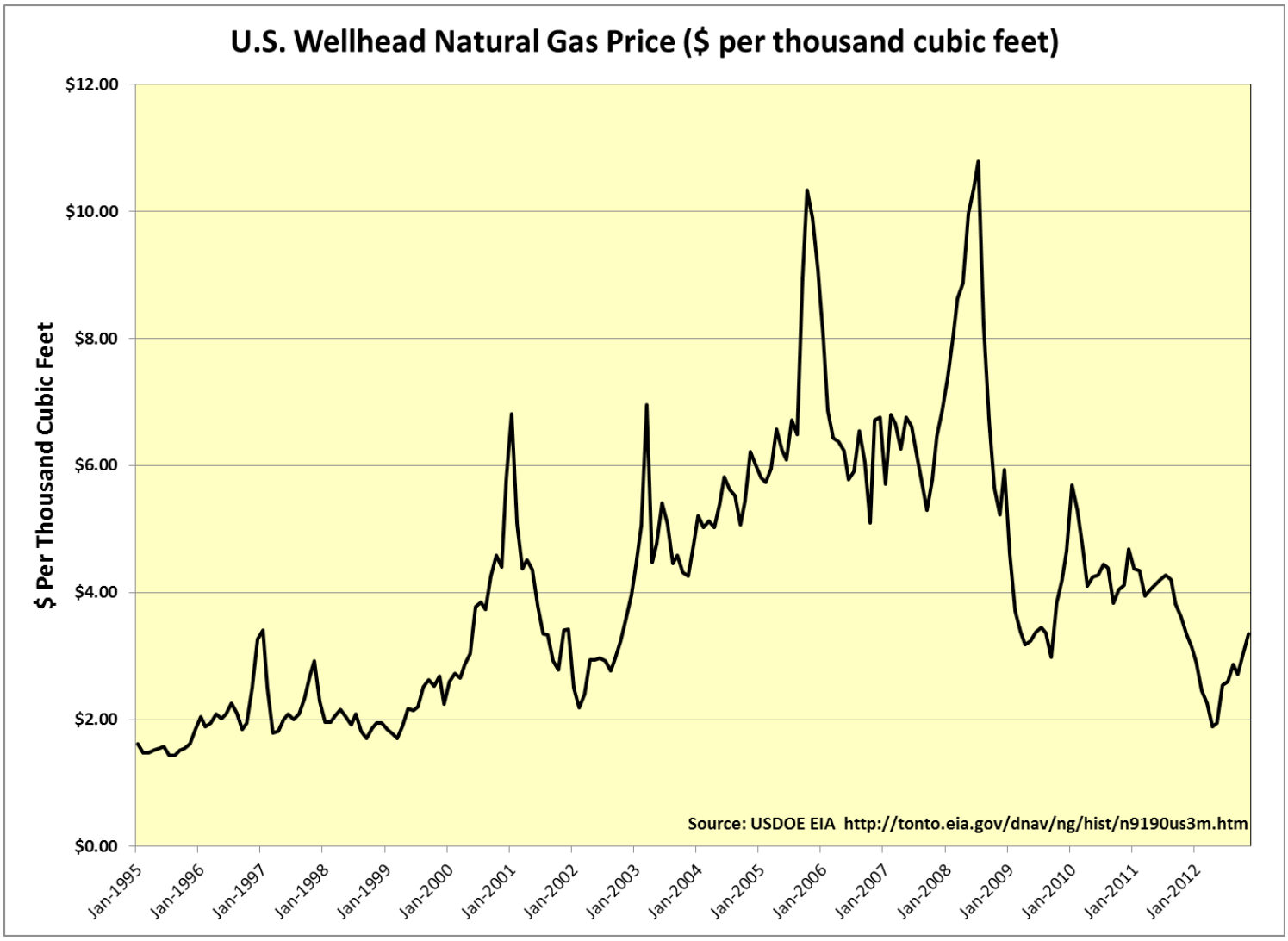
With the price of natural gas at extremely low levels, it is no longer financially feasible to pursue the more difficult and costly sources of supply that were profitable when the price of gas was 50 or 100 or 400 percent higher. The result has been a decrease in investment in natural gas exploration and development, including the higher cost shale gas developments that purchase frac-sand in the Marcellus shale gas area. With oil prices remaining relatively stable and high, the unconventional tight oil formations that requiring frac-sand have continued to be developed. As a result, one source of the demand for frac-sand, shale gas development, has weakened. That may already be having an impact on frac-sand prices in Wisconsin. If the past volatile history of natural gas prices continues, one can

24. *Annual Energy Outlook 2013 (Early Release)* and *Annual Energy Outlook 2012.*

25. August 23, 2012.

26 The prices are *not* adjusted for inflation. Doing so would not change the size of the fluctuation appreciably.

Figure J



expect the demand for frac-sand to fluctuate with the price of natural gas. In the latest decline in natural gas prices in 2012, total operating on-shore drilling rigs declined and the rail shipments of frac-sand ceased growing. Of course frac-sand prices in Wisconsin declined as well.

B. Labor-saving technological change in frac-sand mining and processing

While labor productivity in actual mining (i.e. excluding oil and gas development) doubled and the labor requirements per unit of production were cut in half between 1987 and 2004, the decline labor requirements in the mining category that contains sand mining was more modest. Sand mining has always tended to be a surface mining operation.[27] In addition, it is not an ore that is being extracted that has to be chemically converted into the desired product. It is the sand itself that is being mined. The processing involves a largely mechanical process of crushing sandstone, washing the sand, and then sorting it to the desired size grains, although chemical coating or treatment is sometimes desired. This reduces the number of processing steps where labor-saving technological change can be deployed. As a result, national data indicates that the increase in labor productivity in "non-metallic mineral mining and quarrying," which includes sand mining, has been slower than in metal ore mining and coal mining. As a result production that took 100 workers in 1987 required only about 70 workers in 2006.[28]

27. There are two underground sand mines on the eastern bank of the Mississippi River in Bay City and Maiden Rock east of Eau Claire, Wisconsin.

28. Industry Labor Productivity and Costs, Bureau of Labor Statistics, U.S. Department of Labor, http://www.bls.gov/lpc/iprprodydata.htm . This BLS data series begins in 1987. With the start of the Great Recession in 2007, labor productivity in most mining activities, including non-metallic minerals, fell as mining operations scale back production. Industry Labor Productivity and Costs, Bureau of Labor Statistics, U.S. Department of Labor, http://www.bls.gov/lpc/iprprodydata.htm . Productivity measured in terms of real output per labor hour.

The major costs associated with delivering frac-sand to oil and gas production sites are handling and transportation costs. They make up about 60 percent of the costs.[29] Reducing repeated handling and short distance shipping of small quantities of sand is important in keeping a frac-sand source competitive. Because of this, the location of frac-sand sources relative to processing plants and rail heads is important. The volume of sand available for shipment is also important since transport costs are much lower when unit trains are used. That can make mine location relative to the location of a unit train loading facility important. Clearly there are economies of scale to be realized in the mining, processing, and shipping of frac-sand that can boost labor productivity further.

C. The depletion of sand mines and the life of individual mines

Sand mines are similar to other relatively shallow open pit mineral extraction operations. Powder River Basin coal in Wyoming and Montana, for instance, lies close to the surface and the mining operations move through the leased coal horizontally to extract the coal. When the lease has been fully mined, the mine leases adjacent coal and continues with the mining. If there is a discontinuity in the coal seam, a natural feature in the way, or important infrastructure that cannot be moved, the coal mining company may have to open a new mine in the vicinity.

The logistics, transportation and handling costs, associated with sand mining are similar to those of any other open pit mining operation. It is important to reduce the number of times that the mineral has to be handled, loaded or unloaded, in the process of mining, processing, and delivering the sand to the long distance transportation that will carry the sand to the oil or gas production basin where it will be used. As discussed above this requires careful integration of the mining, the processing plant, and the transportation system that will be used. This is likely to lead to the development of relatively large sand mining and processing facilities located near unit train facilities or other rail heads. Over time as the sand within low cost haul distance of the processing plant and rail head are depleted, the existing mine will have to be abandoned and another economic unit developed. Given that only about a quarter of Wisconsin frac-sand mines, including proposed mines, have rail access at the mine site, there could be a significant shake out of the sand mining industry as competition, integration, and price instability continue.

Competition among frac-sand producers to minimize costs and exploit geographic and sand quality characteristics may also force some existing mines to close because they have higher cost characteristics. As a result, sand mines in the region will be periodically closing and new mines will be opening up. This will lead to a shifting of production from one location to another just as with mining operations in any mineral district. Some areas in the region will prosper for a while and then the lead is likely to be taken by other areas. The problem of the limited economic life of any particular mine will characterize sand mining as well.

D. The mobility of frac-sand mining and processing workers

As discussed above, the shape of frac-sand mining in western Wisconsin is still developing. Before the widespread deployment of horizontal drilling and hydraulic fracturing of oil and natural gas sources, Wisconsin's sand served more limited markets. The advantages of Wisconsin's sand for "propping" open fractured oil and gas deposits has opened a potential growing demand for these sands across the nation and possibly around the world. In this setting, it is unlikely that small single family sand mining operations will be able to compete. The pressure to minimize not only mining costs but also handling and transportation costs is leading to the consolidation and integration of mining, processing, and transporting the sand. Oil and gas development companies are investing in their own frac-sand supplies. In addition, railroads are forming alliances with frac-sand companies. Finally, trucking is being integrated with the transloading facilities that load the sand into rail cars as the owners of those facilities also develop their own trucking fleets.[30]

This integration of frac-sand mining, processing, and transporting is likely to lead to national firms coming to dominate the frac-sand operations in Wisconsin. Fairmount Minerals, which owns Wisconsin Industrial Sand Company, is an example of things to come. Fairmount has facilities in half the states and in Europe and China. Fairmount has three mines in Wisconsin as well as three rail terminals in each of Wisconsin and the Bakken oil fields of North Dakota and Montana.

We emphasize this integration of the different aspects of supplying frac-sand to natural gas and oil fields because it has implications for hiring. The informality of local residents mining sand and trucking it to processing facilities and on to rail heads is likely to be replaced by national firms paying relatively high wages but pursuing the best workers they can find. As will be discussed below, much of the frac-sand development in western Wisconsin is found in counties that are in

29. "Proppant Logistics: A Key Cost & Performance Driver," PLG Consulting, slide 10, 2nd Proppants Summit, December 2012, Huston,TX. http://www.slideshare.net/ewlamy/plg-2nd-proppants-summit .

30. Ibid.

or adjacent to metropolitan areas: Greater Minneapolis, Eau Claire, and La Crosse. This puts relatively large labor forces within commuting distance of even the more rural counties of the area. As with other mining and industrial developments around the nation, the relatively high wages paid to workers in the sand mines, sand processing mills, trucking firms, and railroad lines will attract qualified workers from the surrounding metropolitan areas. The more purely rural areas are unlikely to have a large reservoir of workers with these desired skills. As a result, most of the jobs will go to workers commuting in to the jobs or, if some of those commuting workers become relatively confident in the stability of the employment and prefer a more rural setting, to in-migrants.

For that reason, much of the income generated by the relatively high-paid jobs will "leak" out of the local areas surrounding the mines, processing mills, and rail loading facilities into the larger region.

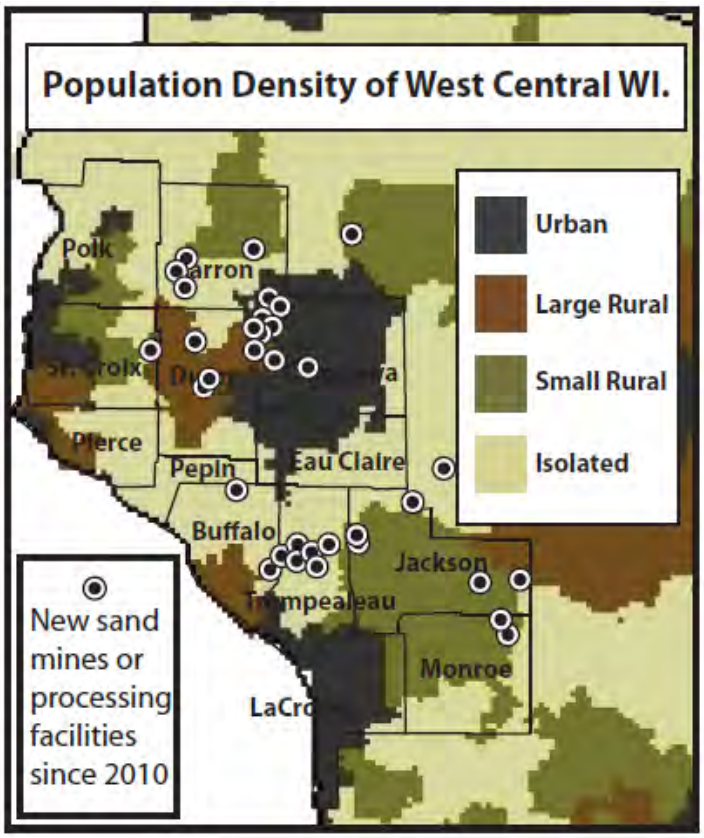
E. The likely economic connections between frac-sand mining operations and the local economy

The new frac-sand mining facilities that have developed in western Wisconsin since 2010 have been scattered across an area that varies from isolated rural areas, to rural areas with relatively small towns, to more densely settled rural areas, to heavily urbanized areas. See Figure K.

The 62 percent of new frac-sand facilities in isolated and small rural areas are unlikely to have any significant linkage to the local economy, either through providing supplies and services to the sand mining, processing, and transportation operations or as a result of workers spending their paycheck in the limited commercial infrastructure found in rural areas. The quarter of new frac-sand facilities in metropolitan areas will have greater economic links, especially in capturing the spending of people employed in the frac-sand related industries and the common purchases that the sand-related firms will make. However, much of the specialized equipment used in the sand-related activities will still be imported from the firms that manufacture that equipment. The current pattern of economic linkages between frac-sand mining facilities and local areas is likely to be similar the pattern associated with past mining activities and rural areas. It will be quite limited, with most of the impacts being felt at locations far removed from where the mining takes place.

As discussed earlier, outside ownership of frac-sand related facilities will also reduce the linkages to the local economy as the profits associated with the production of frac-sands flow out of the local area. The integration of frac-sand mining activities by large national firms, e.g. oil and gas companies, railroads, national mining companies, and national trucking firms, will also reduce the linkages to the local economy.

Figure K



Sources: Wisconsin Geological & Natural History Survey; WWAMI Rural Health Research Center, University of WA.

F. Environmental damage associated with frac-sand mining, processing, and transportation

Frac sand mines pose a potential threat to the physical and social environments as well as potential threats to human health. The sheer size of many of the frac-sand mines separates them from the typical sand and gravel mine. Frac-sand mine sites often include sprawling open pits, storage areas, and various supporting facilities including, possibly, a processing plant, covering hundreds to thousands of acres of land in west central Wisconsin. When the sand that is being extracted from the mine is crushed and processed there is a strong potential to fracture the individual grains of sand shattering them like glass and producing a plume of small particles in the air that is hazardous to the human respiratory system when inhaled. There is also potential air pollution associated with blasting, mining, moving, processing and trucking the sand.

As discussed above, transportation of the sand is a significant part of the cost of developing frac-sand. Transportation can involve the use of large numbers of heavy trucks moving the sand to processing facilities and rail heads. This can lead to significant road congestion, road safety hazards, air pollution, and damage to local public roads. It can also lead to the extension of rail spurs to processing plants and associated mines. Finally, given that unit trains containing only cars loaded with frac-sand is the cheapest way to ship coal, large unit-train loading facilities and their associated storage piles will have to be constructed.

In 2012 the Concerned Chippewa Citizens set up an air quality monitoring system for the EOG Resources sand processing facility outside of Chippewa Falls.[31] The air quality monitoring found that when the wind blew in specific directions (toward the monitoring equipment), there was a statistically significant increase in the particulate pollution in the air at the monitoring sites that were more than a mile from the processing facility. On 51 percent of the days that were monitored, the particulate pollution "possibly exceeded the air quality standards" as specified by the Wisconsin Department of Natural Resources. On 37 percent of the days, the monitors showed "possible exceedances of this standard on an average hourly basis." The monitoring also found silica levels that "exceed various state benchmark levels for silicosis." This study suggests that health-threatening air quality problems can develop at significant distances from the frac-sand processing plants.

The Occupational Health and Safety Administration (OSHA) looked into "Worker Exposure to Silica during Hydraulic Fracturing" in a 2012 report.[32] Although this study did not look specifically at the extraction or processing of frac-sand, it did look at the health and safety implications of the workers who used the frac-sand during hydraulic fracturing in gas and oil extraction. Of the 116 samples that OSHA collected and analyzed from 11 different hydraulic fracturing sites in 5 states, over a full worker's shift, 47 percent showed silica exposure greater than the OSHA standard. Silica exposure that was 10 times the recommended exposure limit was found in 31percent of the samples. Although the OSHA study did not specifically study frac-sand mines and mills, many of the sources of the worker exposure are analogous including but not limited to

- Dust ejected from thief hatches (access ports) on top of the sand movers during refilling operations while the machines are running (hot loading).
- Dust ejected and pulsed through open side fill ports on the sand movers during refilling operations.
- Dust generated by on-site vehicle traffic.
- Dust released from the transfer belt under the sand movers.
- Dust created as sand drops into, or is agitated in, the blender hopper and on transfer belts.
- Dust released from operations of transfer belts between the sand mover and the blender.
- Dust released from the top of the end of the sand transfer belt (dragon's tail) on sand movers.

According to the National Center for Health Statistics and Crispin Pierce of the University of Wisconsin- Eau Claire, 200 people in the U.S. will die this year because of work place exposure to silica and between 8 to 18 people in Wisconsin will die from workplace silicosis.[33] Clearly there are potential health risks associated with mining, processing, and the handling of frac-sand.

The potential problems associated with silica mines are not limited to human contact with silica. Of great concern to residents near the frac-sand mines is the increased congestion on the roads from haul trucks moving the sand to processing facilities and hauling depots, diesel emissions from the mining and moving equipment, the noise and light pollution associated with the frac-sand mines and the building of new railroad facilities. The truck haul operations can also cause costly damage to local roads, highways, and bridges. For example the EOG Resources sand processing facility "plans to transport 2.6 million tons of sand per year into the city plant from distant quarries for processing...as they enter and leave the plant as many as 500 times per day."[34] This volume of heavy truck traffic represents a potential hazard as a result of the exposure of the general population to the diesel emissions which are known to be hazardous to human health.[35].

31. http://www.sandpointtimes.com/pdf/Air-Monitoring-Analysis-Chippewa-Falls-WI.pdf

32. http://www.osha.gov/dts/hazardalerts/hydraulic_frac_hazard_alert.pdf

33. http://stcroixriverassociation.org/wp-content/uploads/2012/11/Crispin-Hayes-Pierce-Particulate-Health-Risks-12-12.pptx.pdf (slide 7)

34. http://wisair.wordpress.com/

35. http://ntp.niehs.nih.gov/ntp/roc/twelfth/profiles/DieselExhaustParticulates.pdf

Although frac-sand mining and processing could cause significant environmental problems, the frac-sand industry does not appear to be the source of the types of risks of long term pollution that can be associated with the metal mining industry, e.g. acid mine drainage requiring perpetual treatment.

Widespread frac-sand mining can also impact local quality of life with important implications for both the well-being of residents and the future economic vitality of the region. Frac-sand mining industrializes relatively rural areas imposing:

- Higher levels of noise from blasting, industrial processing equipment, and heavy trucks, possibly 24 hours a day.
- Increased traffic congestion from heavy trucks.
- Scarring of the landscape with open pits, storage piles, etc.
- Potentially damaging ground and surface water resources.
- Degrading dark, starry nights with industrial lighting of mines and processing facilities.
- Extensions of rail lines and train loading facilities.

Along with health concerns, all of these could discourage amenity-led in-migration of new families and businesses and undermine the growth of the visitor economy.

To say that frac-sand mining and processing *may* damage human health while also damaging the physical and social environment, does not imply that such mining *always* causes these problems. In the recent past, careful regulation of the metal mining industry in Wisconsin sought to avoid or mitigate such problems. Similar careful regulation of frac-sand mining and processing, choosing the most appropriate sites and technologies, imposing strict emission limits, and mandating state-of-the art reclamation could also reduce the environmental risks of frac-sand production too.

5. EVALUATING THE ECONOMIC IMPACTS OF FRAC-SAND PRODUCTION

In the public dialogue about frac-sand production in western Wisconsin, the dominant *benefits* that the sand mining and processing are projected to bring to local communities are the impacts on local employment, personal income, and tax revenues. Those local *economic impacts* are projected to be positive and large.

It should be pointed out that *economic impact analysis* is a peculiar type of economic analysis in that it is primarily used for public relations purposes, and in that type of use, it focuses exclusively on perceived benefits. That is, economic impact analysis only asks "how large are the likely benefits" in terms of jobs, incomes, and tax revenues. There is no discussion of costs. Economics as a social science focuses on rational choice in situations where both costs and benefits and trade-offs have to be weighed. Economists are fond of saying "there is no such things as a free lunch," meaning there are always costs associated with any choice we make. In that sense, *economic impact analysis* is not really economic analysis since it imagines that there are "free lunches" associated with almost any commercial business proposal. It is in that sense that *economic impact analysis* is primarily a public relations effort, not serious economic analysis.

One of the more obvious examples of the one-sided "benefits-only" nature of most *economic impact analysis* is the handling of projected tax revenues. It is rare for the taxes levied by various branches of government to be treated as an economic *benefit*. The individuals paying the taxes certainly do not enjoy paying taxes. Conservatives insist that taxation actually damages the economy, reducing the level of economic activity. Most economists would agree that a tax that does not fund any public services or other benefits *is* likely to damage the economy. The more interesting economic question is what the *net* impact of taxes and the public services they fund on the overall economy? That reminds us that taxes, in general, are the payments we make to assure a stream of important public services.

New business activities not only pay taxes, but they also increase the demand for public services, from the need for roads, police protection, schools for the children of employees, etc. Frac-sand production, for instance, places heavy demands on public roads because of the large and numerous haul trucks. That is why more and more local governments have been asking the frac-sand producers to pay special fees to cover the damage done to the roads. This is just one small reminder that new economic activity not only increases the tax base and the flow of tax revenues to governments but also increases the demand for public services. A *real* economic analysis would not just total the expected additional tax revenues. It would also carefully analyze the additional public costs in order to arrive at a conclusion about whether there are *net fiscal benefits* or not. *Economic impact analysis* rarely does that. Instead it misleads the public by suggesting that there are only benefits associated with almost any commercial business proposal.

As discussed in some detail in earlier sections, mining activities present a challenging mix of costs and benefits. Even in a purely *economic impact analysis* context, the potential for mining activity to displace other sources of economic activity and damage valuable environmental goods and services indicates that it is necessary to look at the *net* economic impacts after accounting for the negative impacts or costs. The discussion in previous sections also pointed out that because of the limited economic connections between mining activities and the local economy, the local economic impacts of mining activity are likely to be much smaller than other economic activities as well as smaller than what is typically projected by the advocates of a mining proposal.

In this section we evaluate the likely economic impacts of frac-sand mining solely within its own context. That is, we ignore the anti-economic aspects of impact analyses' efforts to focus on pure benefits and imagine away all costs.

A. The IHS, Inc. projections of the economic impacts of Wisconsin supplying oil and gas fracking operations with sand

The American Petroleum Institute and the Natural Gas Supply Association hired the consulting firm IHS Inc. to estimate the current and future economic impacts that hydraulic fracturing of tight oil and shale natural gas formations on the American economy and the economy of each state. In late 2012 IHS released *America's New Energy Future: The Unconventional Oil and Gas Revolution and the US Economy.*[36] As the title makes clear, IHS found that fracking had dramatically increased the oil and natural gas resources available to the nation and would continue to expand, causing large positive changes in the economy in terms of employment, income, and tax revenues for governments. One purpose of the study was to show that not only states where fracking was developing new energy resources would benefit, but that the nation as a whole and many states where there was no unconventional oil and gas production would also benefit substantially. That is, the benefits of fracking would flow to almost all states. Given the increasing concern across the nation with the impacts of fracking on water quality and domestic water supplies and a

36. http://www.ihs.com/info/ecc/a/americas-new-energy-future.aspx

growing public demand that fracking be more closely regulated, this was a useful public relations message for the oil and gas industry.

The IHS analysis of the impact of fracking on the Wisconsin economy came to startling conclusions. Despite the fact that the use of fracking for oil and gas production was not expected in Wisconsin, IHS estimated that in 2012 fracking activities in other states would cause almost 20,000 addition jobs **in Wisconsin**. This Wisconsin employment impact was projected to grow to almost 36,000 jobs by 2035.[37] Since a frac-sand mining and processing boom has been developing in Wisconsin, one would expect that impact to be picked up in the IHS analysis. IHS actually uses Wisconsin and other frac-sand states as a prime example of how fracking is having impacts in other, non-fracking states. Some of that economic activity associated with developing the frac-sands was therefore directly assigned to the state of Wisconsin in the IHS analysis, and the economic impacts of that industry on the Wisconsin economy were calculated.

IHS estimated that about 2,300 Wisconsin workers were directly engaged in frac-sand mining, processing, and transportation. This estimate more or less matches others that have been made.[38] In that sense, the estimate of 2,300 direct jobs is plausible. To this IHS adds the additional jobs associated with Wisconsin businesses that support the frac-sand industry in Wisconsin, the *indirect* jobs, and the additional jobs created when the employees associated with frac-sand mining and processing in Wisconsin spend their income, the *induced* jobs. IHS's total Wisconsin jobs associated with fracking, however, was 20,000 in 2012. That is, IHS appears to estimate that for each actual job *in* frac-sand production there are nearly 7 additional other jobs created. For the year 2035, the projected direct employment in fracking-related jobs in Wisconsin is projected to be about 2,700 but the total jobs, including the indirect and induced jobs, were projected to be about 36,000. Almost 13 additional jobs are created for each direct job in frac-sand production.

These numbers have been interpreted as indicating that frac-sand mining in Wisconsin is having a very dramatic impact on the state economy. That is a misreading of the IHS results. According to IHS, the primary impact of oil and gas fracking on the state of Wisconsin is not the impact associated with frac-sand mining. That currently represents only a quarter of the impact of fracking that IHS calculates for Wisconsin. In the future, frac-sand mining will be responsible for only about a sixth of the IHS projected impact of fracking on Wisconsin.

The bulk of the Wisconsin jobs that IHS estimates are created by fracking are associated with Wisconsin manufacturing that, in more or less round-about ways, supports the construction of the equipment used in horizontal drilling and hydraulic fracturing. For instance, electric motors, pumps, and diesel engines and much more mechanical equipment are combined in the complex process of drilling and fracturing oil and gas fields. Wisconsin firms have long provided metal parts for large machinery and earthmoving equipment as well as smaller mechanical devices. IHS started with all of the equipment needed to engage in horizontal drilling and hydraulic fracturing and attempted to trace that equipment back to the various manufacturing firms that produced that equipment or produced parts for it. Wisconsin was found to contribute significantly to that.

Although this is interesting information and demonstrates the long supply lines that link our national economy together, this is not relevant information when estimating the likely economic impact of frac-sand mining. If no frac-sand came from Wisconsin, it could still be supplied by Minnesota, Iowa, Illinois, Ohio, Oklahoma, Missouri, Arizona, Nebraska, South Dakota and Texas.[39] There are also sources outside the United States that could provide it or ceramic substitutes for it. That is, if no frac-sand was mined in Wisconsin, hydraulic fracturing of oil and gas formations would continue and Wisconsin would continue to provide equipment for those operations in a round-about manner. The jobs associated with this manufacturing activity are **not** related to Wisconsin frac-sand production.

IHS *does* estimate the impact on Wisconsin of just its frac-sand production.[40] That Wisconsin economic impact analysis estimates that the 2,300 direct jobs in producing frac-sand generates a total of about 5,100 jobs when the indirect and induced jobs are taken into account. That is, each direct job

37. Ibid. Volume 2, Appendix A.

38. Neither the federal nor state government currently publishes data on the number of people employed in the production of frac-sand. This is too narrow an industrial category and there are too few operations in rural counties to allow data on this industry to be released without violating confidentiality protection. The Wisconsin Center for Investigative Journalism using job-site estimates developed by the Wisconsin Economic Development Corporation estimated in August 2012 that when frac-sand mines and processing plants under-construction are fully operating, about 2,800 people will be employed. Kate Prengaman, August 19, 2012. http://www.wisconsinwatch.org/2012/08/19/sand-boom-creates-jobs/ If there are 500 jobs associated with the facilities under construction, this estimate would be consistent with the IHS frac-sand direct employment estimate.

39. **Industrial Minerals**, *Frac Sand Frenzy: Focus on Supply & Demand for Hydraulic Fracturing Sand*, Mike O'Driscoll, Silica Arabia 2012, Jeddah, SA, March 12-14, 2012. http://www.indmin.com/downloads/MODFracSand-FrenzySilicaArabia201213312.pdf

40. Op. Cit. Vol. 2, Appendix C, "Economic Contributions Excluding Cross-State Contributions by State and Year. This reports the impact of supplies provided directly to oil and gas fracking activities.

in frac-sand production generates 1.2 additional jobs elsewhere in Wisconsin. Note that this estimate takes into account "ripple" effects even if they are felt far outside of western Wisconsin in more industrialized areas such as the Milwaukee urban area. In western Wisconsin the "multiplier" impact would be smaller and in rural counties in western Wisconsin the "multiplier" would be much smaller.

The IHS estimate of the employment impact of frac-sand production in Wisconsin now and in the future provides one reference point that allows us to evaluate the potential overall economic impact. IHS estimates 2,281 Wisconsin jobs directly related to frac-sand production in 2012. This is projected to grow modestly to 2,662. In 2011 the total number of jobs in Wisconsin was about 3.5 million. The 2,281 direct jobs in frac-sand production represented 7/100ths of one percent of all jobs, one out of every 1,500 jobs.

When we include the indirect and induced jobs associated with frac-sand production, the 5,100 jobs represent about 1/10th of one percent of total Wisconsin jobs, about one out of every 700 jobs.

IHS projects that these jobs related to frac-sand production will increase in Wisconsin by a total of 17 percent over the next 20 years or so, an annual growth rate of about 0.7 percent. The Wisconsin economy will also expand over that time period. Between 1969 and 2011, employment has grown by 1.4 percent per year. This period includes six recessions including the recent Great Recession. If, conservatively, we assume that the future growth of jobs in Wisconsin will be only half of its historical rate, only 0.7 percent, frac-sand mining will never become more than a tiny sliver in overall state employment. If state-wide job growth is higher, closer to its historical growth rate, jobs associated with frac-sand production will become even less important as a source of jobs in Wisconsin. In any case, this relatively small number of jobs is unlikely to have any impact on the overall trajectory of the Wisconsin economy.

If one also takes into consideration the expected periodic declines in frac-sand mining due to periodic over-supply of sand or the decline in the price of natural gas and oil, the actual level of employment and earnings will be even smaller. Finally, it is not clear that IHS has taken into account the impact of labor-saving technological change in frac-sand production which would lower future employment levels still further. When all of these pieces are put together, it is clear that frac-sand production is not going to have a significant positive impact on the Wisconsin economy.

B. Other Wisconsin estimates of the local economic impacts of frac-sand mining and processing

There have been a few local economic impact studies of frac-sand mining and processing in particular Wisconsin counties. We review them here to see what the impacts might be at the county level, especially within a rural county. One would expect the "multiplier" or "ripple" effects to be smaller at the county level than at the state level because most counties will not be able to provide specialized goods and services required by frac-sand producers. In largely rural counties, the commercial infrastructure even to "provision" households may not be present and the incomes earned in frac-sand production will leak out to regional trade centers, reducing the rural county multiplier impacts even further.

i. Wood County, WI, frac-sand mining impact study

The economic development agency serving a multi-county area of central Wisconsin, Centergy, Inc., funded a study of the impact of new frac-sand mining, processing, and transportation facilities in Wood County.[41] The proposed frac-sand production complex involved extended investments in developing the mine, the processing plant, and the necessary loading and shipping complex. That construction activity would be extended over a seven-year period before the operating mine and processing facility would reach its design output. At that point employment directly associated with the frac-sand complex would be approximately 600 with annual pay about $75,000 per worker. The estimated earnings multiplier was 1.31. That is, for each $1,000 in labor earnings at the frac-sand production complex, another $310 would be generated within the county economy. Because of the high pay associated with these jobs, the employment multiplier was higher 1.55. For every two frac-sand production jobs, another job would be created within the county. These "multiplier" jobs would pay much less, about half as much as the frac-sand jobs, $42,000 per year. Employment is counted on the basis of where the work is done. Thus the projected number of jobs does not imply that those jobs would be filled by Wood County residents. A worker who lives in another county and commutes into Wood County is counted as one of the people directly or indirectly employed by the frac-sand industry even though he is not a resident and his pay check may flow to another county.

Wood County is classified as a "micropolitan" area because it has a significant urban population and small trade centers (Marshfield and Wisconsin Rapids), is close to the college town of Stevens Point, and is adjacent to the Wausau metropolitan

41. The Economic Impact of Frac Sand Mining: A Look at Jobs and Earnings in Wood County, Wisconsin," Economic Modeling Specialists Inc. (EMSI), 2012.

area to the north. As a result, Wood County can be expected to capture and recirculate more of the dollars associated with the expenditures of employees associated with frac-sand production. The multiplier impacts, however, are projected to be relatively modest.

ii. Buffalo County, WI, frac-sand mining impacts

Buffalo County, WI, is located in western Wisconsin along the Mississippi River. It is largely a rural county with about two-thirds of it labeled "Isolated Rural." The part of the county just north of the La Crosse metropolitan area is somewhat more urbanized. The Buffalo County Board requested that the University of Wisconsin-Cooperative Extension undertake a study of the economic impact of the sand mining industry on Buffalo County. The result was a report: "The Economics of Sand Mining and Buffalo County."[42]

In that study, both a sand processing operation and a sand mining operation were modeled. Because the detail of how the sand processing plant would operate was considered proprietary, the analysis of how that mill would link into the local economy was incomplete since the analysts did not know what materials used in the operation of the mill might be purchased locally. This was not true of the sand mine itself since sand mining has been taking place in Buffalo County for quite some time.

This impact analysis projected much lower pay for frac-sand production, about $40,000 per year. The pay associated with the induced jobs was only half that, $20,000 per year. Pay in the indirect jobs was in-between, about $30,000 per year. The employment multiplier was such that for every three jobs in frac-sand production, there would be one job elsewhere in the local economy and for every four dollars of labor income in frac-sand production another dollar of labor income was earned in Buffalo County. These multipliers were somewhat lower than those estimated for Wood County: The labor earnings multiplier was about 7 percent lower and the employment multiplier was about a third lower. The more urbanized character of Wood County would be expected to support a more extensive business infrastructure to help the county capture and hold more of the purchases associate with frac-sand production. These low earnings and employment multipliers significantly constrain the employment and earnings impacts frac-sand mining and processing can have on the local economy. As the study's authors put it: "In essence, the lack of retail and service industries within [Buffalo] County will necessarily dictate that the economic impacts of the mining operations will be relatively modest."[43]

42. Carl Duley and Steven Deller, 2012.

43. Ibid. p. 19.

C. Putting the job impacts into the context of the Wisconsin frac-sand counties

In 2012 there were 17 Wisconsin counties with frac-sand production facilities.[44] Another seven counties have significant frac-sand deposits but have not yet begun developing them. See Figure L on the following page. The 2011 population of the 17 counties that have already begun producing frac-sands was 504,000. The population of all 24 Wisconsin frac-sand counties was 989,000.

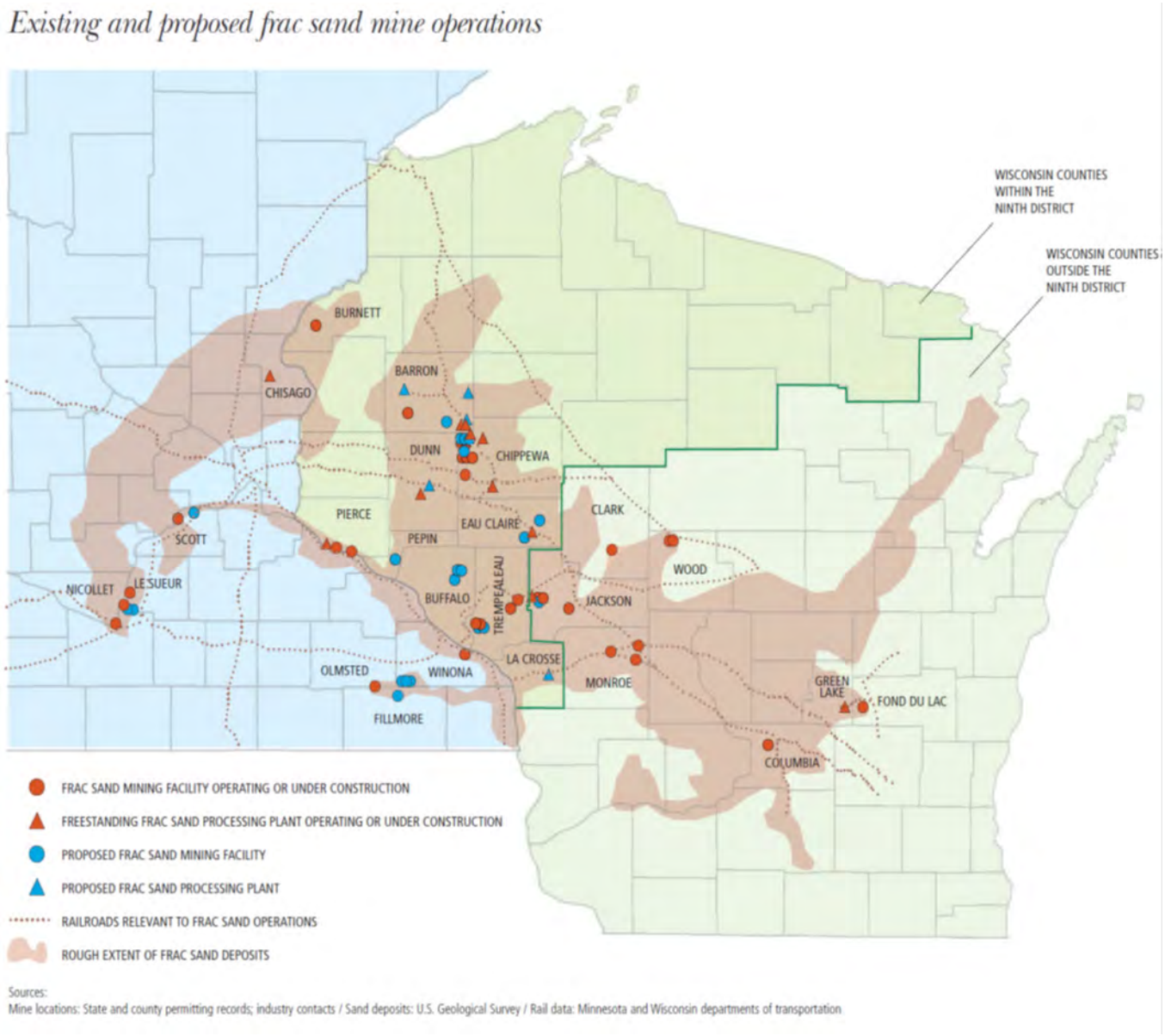
The IHS estimate of the direct employment in frac-sand production facilities in Wisconsin was 2,281. We have discussed frac-sand industry employment multipliers from three different sources: in a very rural county, Buffalo, the estimate was 1.37; in a *micropolitan* county, Wood, it was 1.55; for the state as a whole it was 2.22. The middle estimate, 1.55 is probably appropriate to represent the relatively rural areas where frac-sand mining is taking place. Applying that employment multiplier to the direct jobs in frac-sand production results in a total estimated employment due to frac-sand mining of 3,536. This represents about four-tenths of one percent (0.004) of the total number of jobs in those Wisconsin frac-sand counties in 2011. If we use only the counties where there are currently frac-sand production facilities as our reference, those frac-sand jobs represent seven-tenths of one percent (0.007) of total jobs.

It is clear that the employment in frac-sand production is unlikely to fundamentally change the county economies where this production takes place. It is highly likely to remain a small sliver of the overall economy that is unlikely to trigger a significant improvement in economic well- being.

The west central counties currently facing frac-sand development represent a very broad range of urban and rural counties. Two of the counties (Pierce and St. Croix) are classified as part of the Minneapolis-St. Paul metropolitan region. Three others are classified as metropolitan counties in their own right (Eau Claire-Chippewa, and La Cross). Two have relatively large urban centers, greater than 10,000, and are classified as micropolitan areas (Dunn and Wood). The remaining counties are largely rural, but can be broken into two categories: Those that are completely rural or have fewer than 2,500 living in urban areas (Buffalo, Clark, Pepin, and Trempealeau) and those with more than 2,500 but less than 10,000 living in urban areas (Barron, Jackson, Monroe, and Rusk). See Table D below.

44. **Fedgazette**, July 2012, "Sand surge," Phil Davies, p. 11, Minneapolis Federal Reserve Bank.

Figure L



It is highly unlikely that the diversified metropolitan and micropolitan counties will be significantly impacted by frac-sand employment. A few hundred additional jobs in that industry will represent a relatively small change in total jobs in those counties.

Table D

Urban-Rural Status of West Central Wisconsin Frac-Sand Counties			
Metropolitan	Non-Metropolitan		
~100,000+ population in urban area	Metropolitan Urban Center >10,000	Rural Less Than 10,000 in Urban	All Rural or Less Than 2,500 in Urban
Chippewa Eau Claire La Crosse Pierce St. Croix	Dunn Wood	Barron Jackson Monroe Rusk	Buffalo Clark Pepin Trempealeau
Source: USDA Economic Research Service, 2003 Urban-Rural Continuum			

6. THE ECONOMY OF WEST CENTRAL WISCONSIN: SHIFTING OUR FOCUS FROM THE PAST TO THE PRESENT

A. The view from the past

One of the chief attractions of frac-sand mining as a way to boost the economies of west central Wisconsin is that such land-based production for export fits the popular stories about how the state of Wisconsin was originally settled by European-Americans. Those stories focus on mining (the "Badger State"), forest products (tales of Paul Bunyan), and agriculture (including dairy products and the cheese as in "cheese heads"). Each region of the nation has similar historical tales of land-based livelihoods that allowed an economy to develop there.

These historical *folk tales* of early settlement tend to focus on the past. They provide a rear view mirror view of the local economy and the livelihoods that supported settlement. Such stories, while culturally important, may not be the best guide for a future-oriented economic development strategy.

The *export base* or *economic base* view of the local economy is one of the most widely shared pieces of popular economic understanding. Most of us learned this way of understanding our local economies from our parents, grandparents, elementary school teachers, and neighbors. The traditional economic base of an area is usually associated with folk tales of how European-Americans came to inhabit any particular area and built a successful and thriving economy.

This view is called an export base view because it focuses on the economic activities in which the local population specializes, producing more than it needs for its own consumption, and then *exports* the surplus to the rest of the national or international economy. Those exports are seen as bringing money into the local economy from outside. That money then can circulate within the local economy putting people to work in locally-oriented economic activities and allow the importing of vital goods and services that could not easily or economically be produced locally.

Unless the local residents want to live a self-sufficient non-monetary, subsistence way of life, those exports and the resulting income flows into the economy from outside sources are necessary for a modern, vital economy. In that sense, those export-oriented activities are seen as the region's *economic base*: the economic energy driving the local economy.

No widely held popular understanding of this sort could have become established and persisted for so long unless it had an important element of truth to it. In the context of the European-American settlement of a continent depopulated of its indigenous population by disease and warfare, the export base view was largely accurate in depicting how settlers were able to move from subsistence homesteads on a wilderness frontier to a prosperous commercial economy. Whatever its historical accuracy, however, it is important to ask whether that original 19th and early 20th century economic insight is a sufficient guide for understanding a modern 21st century economy. As we will explain below, that the export base view of the local economy is now seriously incomplete and needs to be supplemented in several ways that allow us to accurately look at the *total* economy and all the sources of local economic well-being when making public economic policy decisions.

B. Completing our analytical view of the local economy: The total economy

As we will develop in more detail below, there are three other important economic insights that have to be integrated with the export base view to complete our view of the local economy:

i. The export base view focuses only on what creates a local demand for workers. In that sense it ignores the other half of the twin supply-demand blades of the "economic scissors," the important role of the local supply of labor in encouraging the expansion of local economic activity.

ii. The export base view focuses only on commercial goods and services sold in markets in exchange for money. It ignores non-commercial, non-market sources of scarce and valuable goods and services that support and facilitate commercial activities and contribute to local economic well- being such as clean air and water, scenic landscapes, wildlife, crime-free neighborhoods, comfortable climatic conditions, etc.

iii. The export base view, as the name makes clear, focuses on exports as the sole determinant of local economic vitality. Its message is that "only exports matter." We need to understand that locally-oriented economic activity is not a passive, unimportant or "secondary" aspect of the local economy. By capturing, holding, and re-circulating income that comes into the local economy, the web of locally-oriented economic activities creates the "multiplier" impacts associated with exports and other sources of income injected into the local economy.

C. Incorporating labor supply into our view of the local economy

The export base view focuses on the commercial forces that draw workers and population to a particular area. What are the export-oriented activities the local area can support and thus create a local demand for workers? In a frontier economy these are likely to be land-based economic activities, hence the focus on ranching, farming, mineral extraction, and forest products.

That narrative has a compelling historical ring to it. But most economic activities in the 21st century are not land-based. The total of all jobs in agriculture, mineral extraction, and forest products represents only about three percent of total jobs in the American economy in 2011.[45] Clearly we cannot explain the location of economic activity across the American landscape on the basis of this tiny part of the total economy. We have to be able to explain why non-land-based economic activity locates where it does independent of this tiny sliver of land-based economic activity in the overall economy.

Even if we stick with a focus on export-oriented economic activities as the engine driving a local economy, we are still left with the question of why a particular export-oriented firm chose to locate where it did. If we cannot explain that, we have not really explained what the economic forces are supporting the local economy. For instance, much of light manufacturing (furniture, computer assembly, chip manufacturing, appliance assembly, etc.) as well as export-oriented services (publishers, information businesses, financial services, technical support, professional services, etc.) are relatively "foot-loose" in terms of where they locate. The fertility of the land, minerals in the ground, commercially valuable natural vegetation including livestock forage and timber are unlikely to provide an explanation for why most of the firms found in the Eau Claire-Chippewa or La Crosse metropolitan areas or even in rural Trempealeau County chose to locate there. For that reason, the export base view of the economy provides only limited insight into the local sources of economic vitality.

Businesses locate in particular areas for a wide variety of reasons, but two considerations are almost always important:

- the availability of a sufficiently skilled workforce at an affordable cost, and;
- access at an affordable cost to the markets for the firm's products.

The geographic distribution of the population and people's preferences for where they would like to live influence both of these important economic considerations. Businesses cannot afford to ignore either of these: Markets and the cost of reaching them and an adequate labor supply at a reasonable cost are central to any business location decision.

The export base view of the world implicitly assumes that *people do not care where they live*. People are assumed to passively go to where the jobs are because they have no choice if they want to be employed and their families to prosper. But in the 21st century continent-wide American economy, individuals and families do have a choice as to where they live. They face a broad range of economic opportunities mixed with an equally broad range of regions and communities that have diverse sets of attractive and unattractive characteristics that are unrelated to job availability and pay. Individuals and families can make tradeoffs and choices that mix labor market opportunities and the level of pay with other local characteristics such as cost of living, quality of schools, crime rates, levels of congestion and commuting time, intensity of social conflict, pace of life, neighborliness, cultural variety, recreation and cultural opportunities, climate, etc.

Areas that have mixes of qualities that make it easy for those areas to attract and hold residents will have a relatively large, diverse and skilled workforce available at a somewhat lower price. Alternatively, such areas can get workers to move to the area without wages being bid up significantly. That makes such areas attractive to businesses. The fact that businesses are run by people who also have preferences about where they and their families live only adds to the economic importance of a community's attractive qualities. To the extent the dynamic between the attractiveness of a community to new residents and businesses has triggered ongoing economic development, local markets for goods and services will also be expanding, increasing the economic attractiveness of the area to firms.

In brief, labor supply and its cost and the location of population concentrations matter to businesses. Areas that attract high quality workers at a relatively low price will, in turn, be attractive to business firms. Ignoring labor supply and focusing only on labor demand, as the export base view does, is inappropriate economic analysis. As in most components of a market economy, both supply and demand matter.

It is important to keep in mind that conceptually, we do not have to choose between the export base view of the economy and the residential location choice view. These two views encompass between them the two primary market forces of supply and demand. We should be careful to consider both. The relative importance of labor supply and labor demand can be expected to shift over time and vary across geographic

45. Agriculture, agricultural services, fishing, forestry, mining (including oil and gas), wood products, paper, and primary metals. U.S. Department of Commerce, BEA, REIS data base. http://www.bea.gov/regional/spi/default.cfm?selTable=SA25N&selSeries=NAICS

areas. At any particular location at a given time, the relative importance of these two sets of forces is an empirical matter to be determined. Local economic development policy, however, may choose to focus strategically on some elements of one or both of these sets of economic forces.

D. Looking at all sources of economic value including non-market economic values

The economic dynamic described above has been called *amenity-supported local economic development*. This economic potential in some ways is the opposite of the economic force that the export base view of the economy emphasizes. Within the export base view, people move to where the jobs are. Within the amenity-supported economic development model, economic activity follows the residential preferences of the population. Economic activity shifts in this way because the existence of local amenities provides businesses with access to a lower cost skilled labor force and to markets for their goods and services. In essence, because workers and families value local amenities, they are willing to sacrifice a certain amount of income to gain access to those site-specific qualities. They accept lower wages than they could earn in less attractive locations as an effective "price of admission" to what potential residents judge to be a more valuable set of local qualities. The *total real income* being received by residents comes in two parts: The value of the conventional paycheck and the value of the site specific amenities to which living in that location provides access. The value of those local amenities provides residents with a "second paycheck." [46]

This is not a new way of looking at the local economy. Since the mid-1950s, economists have emphasized the importance of residential location decisions as a powerful economic force. They focused on the role of local environmental "amenities" such as climate and natural landscapes in the settlement of areas such as the desert Southwest (Arizona, New Mexico, and Southern California), Florida, and the Pacific Northwest.[47]

Tiebout underlined the fact that people "shop around" for the social amenities produced by different levels of local government taxation and different public spending patterns such as on schools, parks, and roads.[48] Borts and Stein argued that in a mobile, open economy, it would be an area's ability to attract and hold a labor force without bidding up labor costs that would determine the geographic distribution of economic activity.[49]

But these economic forces tied to local amenities have transformed many parts of the nation's economic geography and help to explain the above average economic performance across most of the Mountain West, as well as in the Southeast and the Pacific Northwest over the last two decades before the Great Recession struck.[50] Many areas of Wisconsin have also experienced significant population growth during the 1990s and on into the 2000s despite a weak national economy. Many of the same Wisconsin counties experiencing that growth were also counties labeled "Retirement Destination Counties" and "Recreation Counties" by the Economic Research Service of the U.S. Department of Agriculture. Natural and social amenities drew both new, "footloose," permanent residents and recreational visitors.

This half-century of economic research simply underlines the important role that non-commercial, non-market goods and services can play both in contributing to the economic well-being of individuals and households as well as the economic vitality of communities. Some of these non-market economic values are human-created; others are gifts of nature, flowing as they do from well-functioning natural systems. All of them are often encompassed in the larger concept of "quality of life" or "local amenities."

E. Capturing, holding, and circulating income in the local economy

Our thinking about the local economy has to move beyond an "only exports matter" point of view. The export base view of the economy implicitly takes that point of view, effectively dismissing the bulk of local economic activity as "secondary" or "passive." This is an important error. As we will show below, a traditional export base view of the economy cannot explain the

46. Ed Whitelaw at the University of Oregon and with ECONorthwest coined that phrase. Local economies can be a bit more complicated than this. As the local economy expands, limited supplies of land for commercial and residential development can lead to land values rising, increasing both the cost of living and the cost of doing business. This can ultimately work to stabilize community size, limiting that location to those for whom it is the most productive site for a business and to those residents who most highly value the qualities of that location. The higher cost of living will reduce the purchasing power of local wages and residents will pay an effective access fee in the form of lower real (cost of living adjusted) wages. To the extent that the available land base is not a serious constrain on ongoing development, the effective price residents pay to gain access to the qualities associated with that location **are** likely to be reflected in the lower pay they accept compared to what they could earn in less attractive locations.

47. Ullman, Edward, 1954, "Amenities As a Factor in Regional Growth, ***Geographic Review***, 44(1):119-132.

48. Tiebout, Charles, 1956, "A Pure Theory of Local Expenditures, ***Journal of Political Economy***, 64(2):160-164.

49. Borts, G.H., and J.L. Stein, 1964, ***Economic Growth in a Free Market***, New York: Columbia University Press.

50. Thomas M. Power and Richard Barrett, ***Post Cowboy Economics: Pay and Prosperity in the New American West***, Island Press, Spring 2000; Power, Thomas M., 1995, editor, "Economic Well-Being and Environmental Protection in the Pacific Northwest: A Consensus Report by Pacific Northwest Economists", Department of Economics, University of Montana, Missoula, MT, December.

actual economic vitality of much of the northern and central Wisconsin. Here we focus on the important economic role of locally-oriented economic activity in boosting the local economy.

Exports by themselves do not create a local economy. On the North Slope of Alaska billions of dollars' worth of oil has been produced, but there is almost no "local economy" on the North Slope. The value of that oil and the wages earned producing it all flow to other areas a great distance from the North Slope where people are willing to actually live and where there is the commercial infrastructure in which that income can be spent. This is an extreme example, but the mining, timber, cattle, and farm towns that grew up around a primary export often had similar limiting characteristics: the income generated by the exports primarily went to fund imports. That is, the income from the exports almost immediately "leaked out" of the region. That is why many of the mining and mill towns became the equivalent of ghost towns as demand for the exports declined or technological change reduced the size of the workforce needed to produce the exports. Empirical economic analysis of the impact of natural resource activities in rural areas confirms that the multiplier impacts associated with natural resource extraction activities in contemporary rural areas can also be nearly zero.[51]

The actual size of the impact of an export activity on the local economy is determined by the interaction of two sets of local economic characteristics: The size of the flow of income into the local economy from the outside and the web of local economic interconnections among residents that captures and circulates that income among businesses and households. The "multiplier" impacts associated with export income is determined by that ability of the local commercial infrastructure to capture and circulate income locally. It is the local web of specialized and interdependent businesses and households that actually make up the local economy. Without those locally-oriented businesses, there can be enormous export flows but only a primitive, under-developed local economy.

Both export-oriented and locally-oriented businesses contribute to the vitality of the local economy. It can be a serious economic error to ignore either of these two sides of the local economy.

F. Conclusions on the limits of the export base view of the local economy

The importance of amenity supported local economic vitality in transforming the economic geography of much of the United States including many non-metropolitan and rural areas cannot be safely ignored when evaluating the likely economic impacts of frac-sand production. Local economic vitality and local economic well-being are not primarily determined by the same land-based economic activities that facilitated the original European-American settlement of Wisconsin in the nineteenth century. Although those traditional economic activities remain significant to some local economies, in general they have not been the source of new jobs and income for the region. The economic impacts of frac-sand mining and milling operations need to be put into a long-run economic development context: What are these mining activities likely to contribute to the sustained economic development of the region?

In answering that question, the importance of the attractiveness of a region to new residents and businesses has to be considered alongside any particular proposal to boost the region's exports. To the extent that re-industrialization of the region around frac-sand production damages the region's attractiveness as a place to live, work, raise a family, visit and do business, it may undermine future economic vitality rather than stimulate it. To the extent that those mineral extraction activities are also unstable, generating booms and busts that weaken communities and economies rather than strengthen them, there is even more reason to be concerned about what frac-sand mining in the region can actually contribute to local economic vitality and well-being.

51. "A Test of the Economic Base Hypothesis in the Small Forest Communities of Southeast Alaska," Guy C. Robertson, U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, General Technical Report, PNW-GTR-592, December 2003. http://www.fs.fed.us/pnw/pubs/pnw_gtr592.pdf

7. A HOLISTIC VIEW OF THE ECONOMIES OF THE FRAC-SAND REGION OF WISCONSIN

A. Indicators of economic vitality

The most serious problem with the conventional view that land-based economic activities such as mineral extraction and processing, forest products, and agriculture are the engines that drive local, especially rural, economies is that that assumption fails to explain the **actual** performance of most of the economies facing frac-sand production decisions. While the traditional export activities have offered little or no stimulus to the regional economy over the last 40 years, the rest of the economy has expanded nonetheless.

The Wisconsin counties currently being affected by frac-sand production and others likely to be affected in the future are too varied in terms of population density, the diversity of their economies, and the current sources of economic vitality to be simply combined into an aggregate "regional economy." Recall Table D above. Such a grouping of counties would hide more than it reveals. On the other hand, analyzing and discussing dozens of separate county economies are far beyond the scope of this study. In this report we will focus on three different economies, all of which have already been affected by frac-sand production and face expansion of that production. To cover the diversity of counties, we will use Trempealeau to represent a rural county, Dunn County to represent a more urbanized "micropolitan" (small city) economy, and the Eau Claire metropolitan area (which includes Eau Claire County and Chippewa County) to represent the more urbanized counties.

Consider Dunn County: While the traditional export base provided the same job opportunities in 2011 as it did over 30 years earlier in 1979, employment outside of that traditional export base increased by 80 percent. See Figure M below.

Figure M

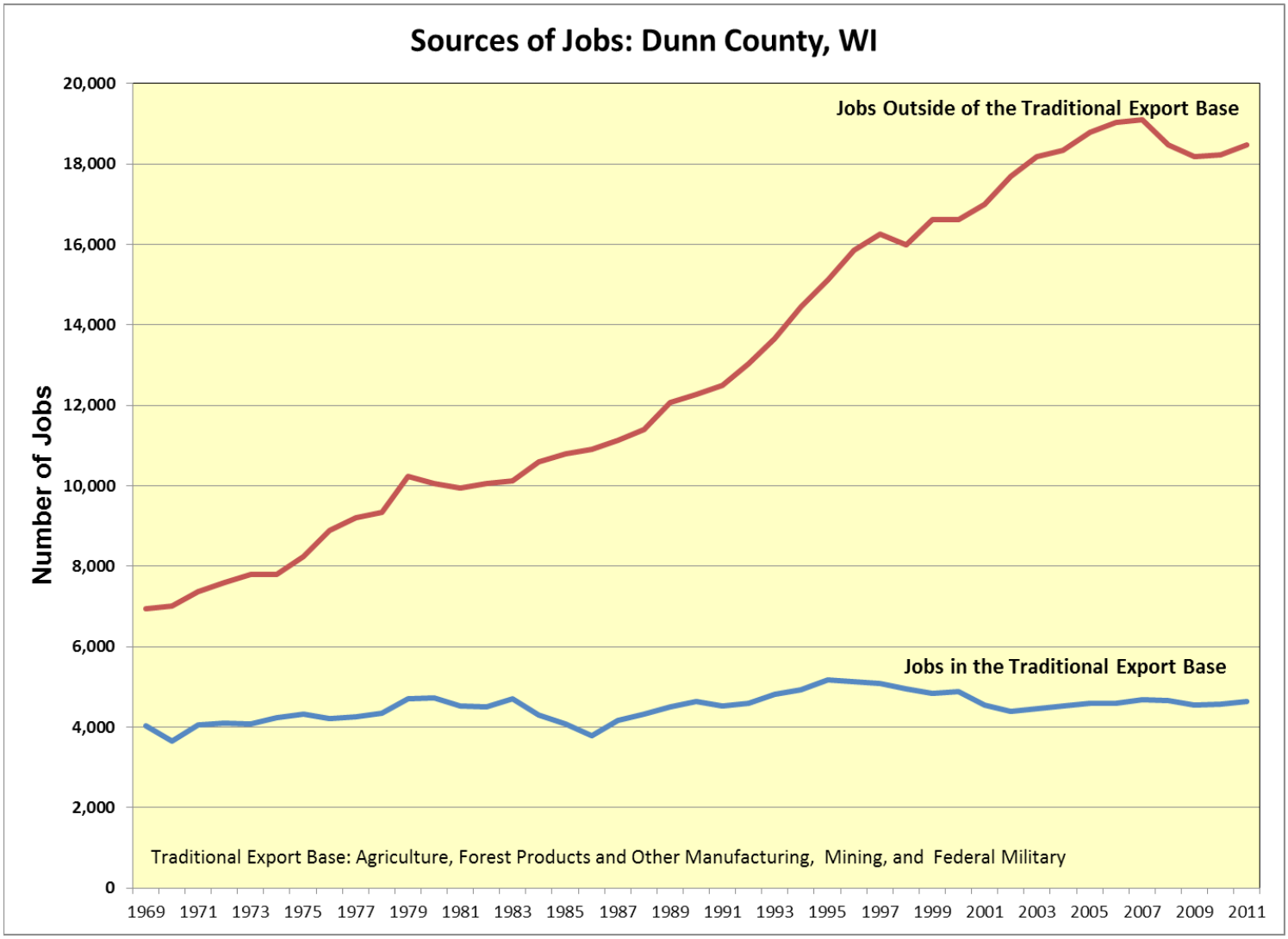
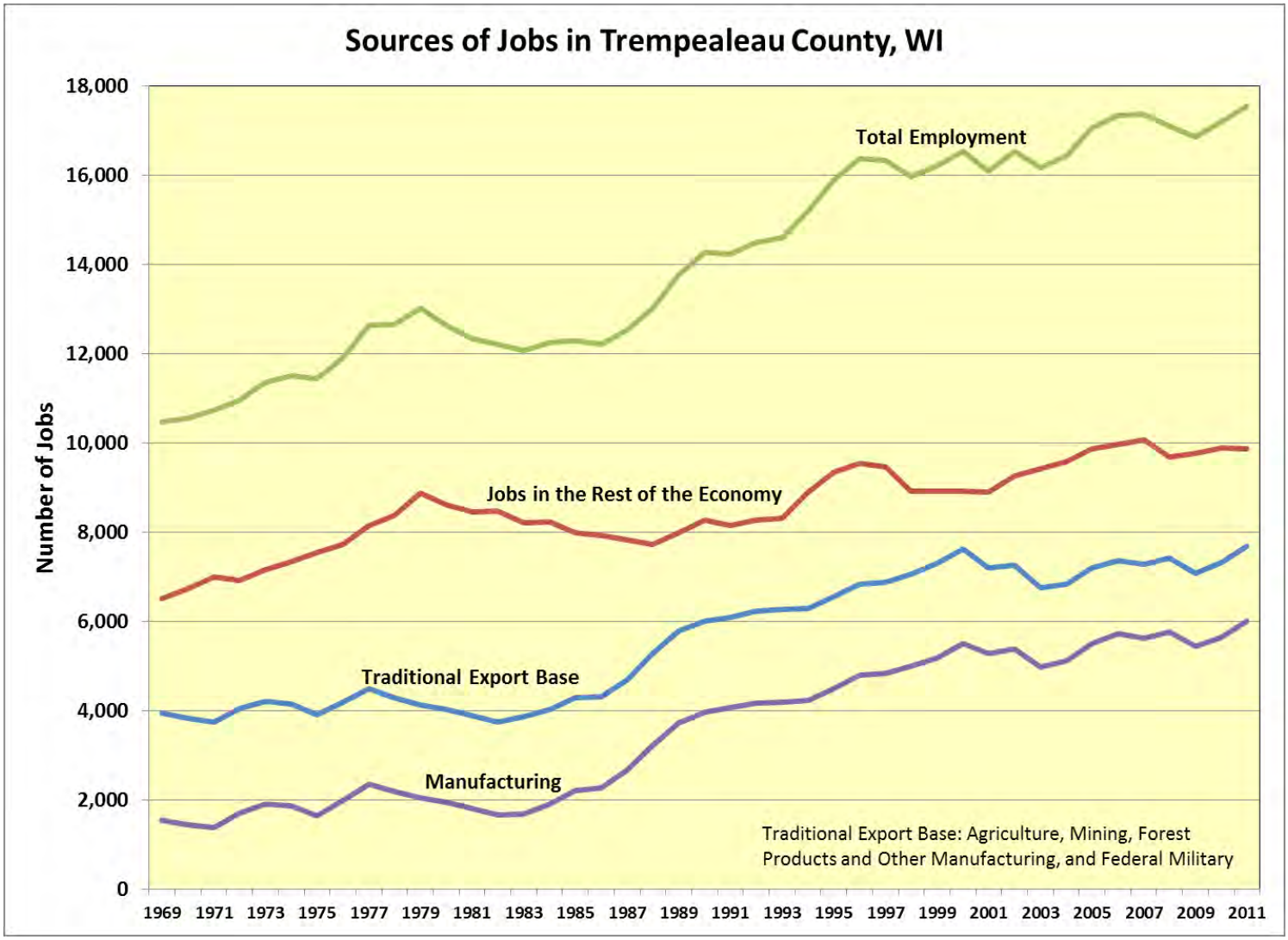


Figure N



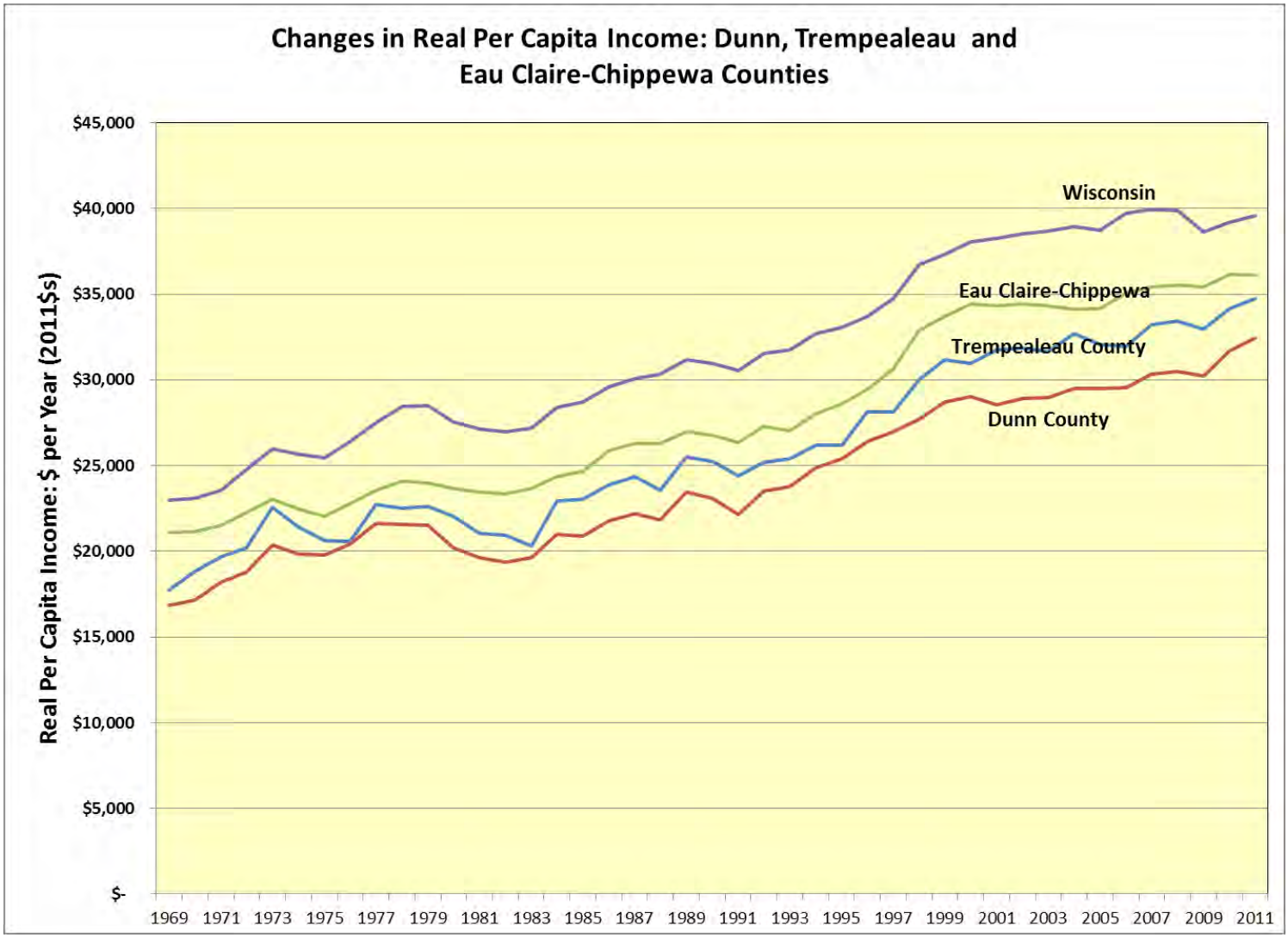
For the two counties in the Eau Claire metropolitan area, job growth in the traditional export base and the rest of the economy diverged even more between 1969 and 2011.[52] While jobs in the traditional export base *shrank* by almost 2,500 or 14 percent, jobs outside of that export base *increased* by 57,600 or 173 percent. That is, instead of employment opportunities outside of the export base following the export base downward, those "locally-oriented" jobs grew dramatically.

In Trempealeau County, the traditional export base is dominated by diverse manufacturing activities, and unlike Eau Claire, Chippewa, and Dunn Counties, the export base as well as the rest of the economy has shown considerable economic vitality in employment. See Figure N above.

Many of the manufacturing jobs in Trempealeau County are associated with Ashley Furniture, Inc., a national furniture company which operates plants in Whitehall and Arcadia and is the county's largest employer. In addition there are a half-dozen other furniture firms. About 60 percent of the manufacturing payroll in Trempealeau County is associated with the furniture plants. Ashley is not located in Trempealeau primarily because of wood supply. Ashley manufactures upholstered furniture of many different types. There are also machinery, electrical equipment and instruments, metal products, plastic products, and transportation equipment manufactures in the county. There are also wood products firms such as saw mills, but they were the source of only about two percent of total manufacturing earnings in 2011. There are also food manufacturing plants, but such facilities rarely rely solely on local agricultural products for their operations.

52. All of the figures displaying data are based on the Bureau of Economic Analysis, Regional Economic Information System, U.S. Department of Commerce data base.

Figure O



During the same period, 1969 to 2011,[53] average annual real income (per capita income) grew relatively steadily in all three of our study county areas. In the Eau Claire metro area, *growth* in average income (with inflation removed) matched that of the State of Wisconsin, growing about 70 percent between 1969 and 2011. The Eau Claire metro area grew as fast as the state as a whole partially because average income growth in Wisconsin stalled 2007 with the start of the Great Recession, and by 2011 had not yet recovered its previous peak value while in the Eau Claire metro area average real income continued to grow. In Dunn and Trempealeau Counties, average real income grew significantly faster than the state of Wisconsin between 1969 and 2011, almost doubling in terms of real purchasing power. See Figure O.

The state *level* of average income remained higher than in any of our study counties although the gap narrowed somewhat. Average incomes tend to be higher in densely settled urban areas and the state Wisconsin average annual income level is largely tied to the most densely settled urban areas in the state. In 2011, the correlation coefficient between population and average annual income among the states metropolitan areas was 0.78.[54] The larger the population, the higher was the average annual income. At the extreme in Wisconsin, the average annual income in the greater Milwaukee and Madison areas was in the $45,000 to $46,000 range for the 2.1 million people living in those two metro areas. The average income across all of the state's metropolitan counties was about $41,000 per year. Almost three-quarters (73 percent) of the state's population lived in those metropolitan areas. For the state as a whole, the average annual income was $39,600 in 2011. For the non-metro counties, however, it was only about $35,000. More densely settled areas tend to have higher labor productivity, higher

53. The year 1969 was not picked arbitrarily. The U.S. Bureau of Economic Affairs maintains the Regional Economic Information System that provides annual economic data down to the individual county level for all 3,100 American counties. That data series begins in 1969. At the time of this writing, February 2013, 2011 was the latest year for which data from this series was available.

54. The log of population was used.

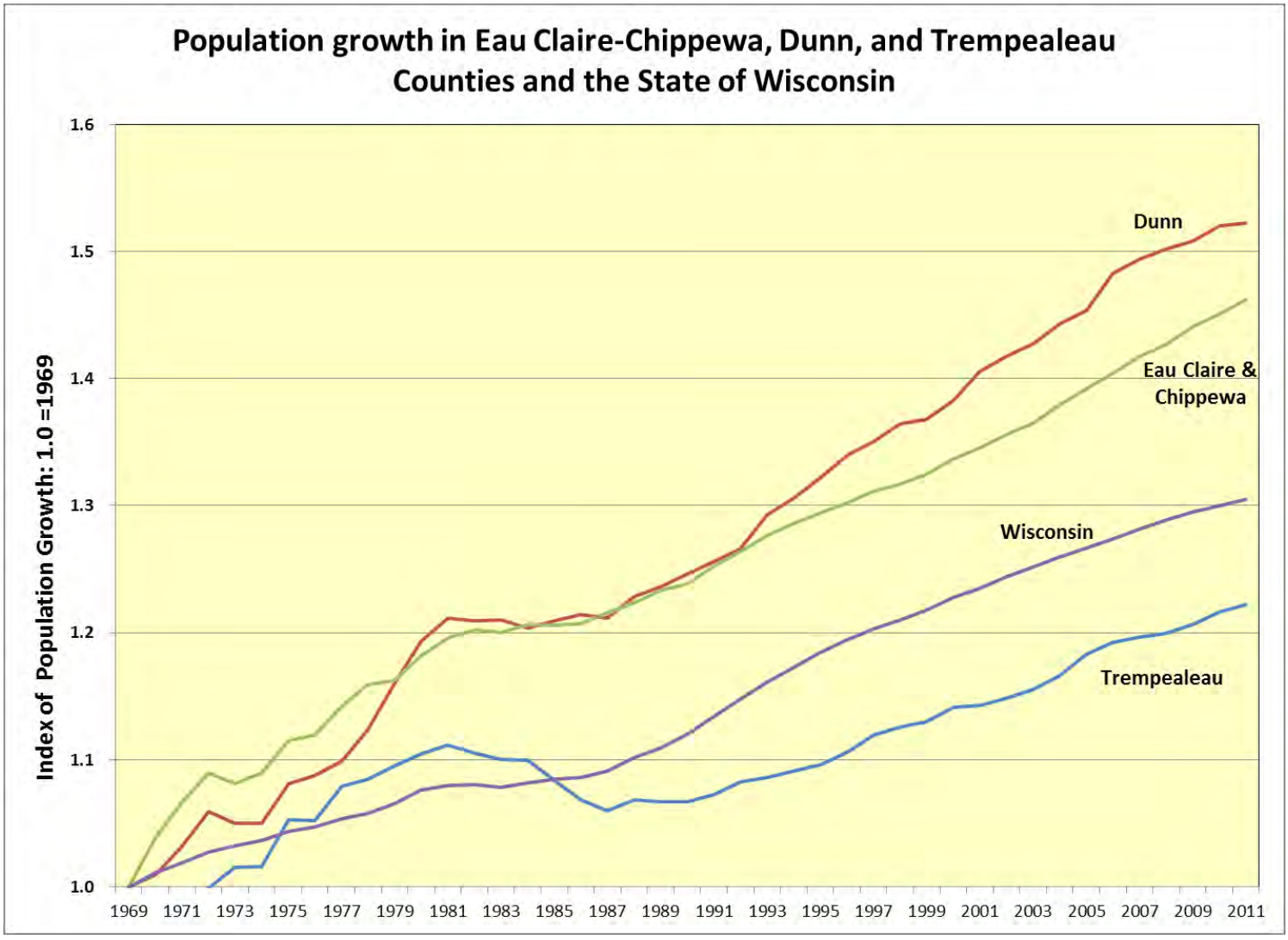
cost of living, and a broader array of urban disamenities, all of which tend to push average pay and income upward. Whether economic well-being and the average income adjusted for the cost of living are higher in the more densely settled areas is a more difficult question to answer.

The population of Dunn and Eau Claire-Chippewa Counties increased by about 50 percent between 1969 and 2011. The population of Wisconsin increase by about 30 percent and Trempealeau County's increased 22 percent. Trempealeau lost almost 700 manufacturing jobs beginning in 1977 as 60 percent of the peak real payroll in the food processing industry disappeared. Population fell by about 1,200. See Figure P below.

Clearly there were economic forces supporting job, real income, and population growth that lay outside land-based export activities. Those positive economic forces need to be identified and focused upon when considering ways of protecting and enhancing local economic vitality.

This economic vitality in Wisconsin's frac-sand country is also important in evaluating the size of the potential impact that frac-sand production could have on the state and regional economy. As was discussed earlier, the projected direct employment associated with the many existing and proposed frac-sand production facilities in Wisconsin is about 2,300 jobs. Between 1990 and 2011, Wisconsin added, on average, this number of jobs each ***month.*** In the counties with existing or proposed frac-sand production facilities in 2012, this number of jobs was created every six months. Across all of the Wisconsin counties with significant frac-sand deposits, this number of jobs was created every two months. The important point is that the State of Wisconsin as well as its frac-sand counties have regularly added this number of jobs over relatively brief periods of time, over and over again stretching back over two decades, at least. The job promise of frac-sand production is quite small compared to the economic vitality this region has regularly shown in the past.

Figure P



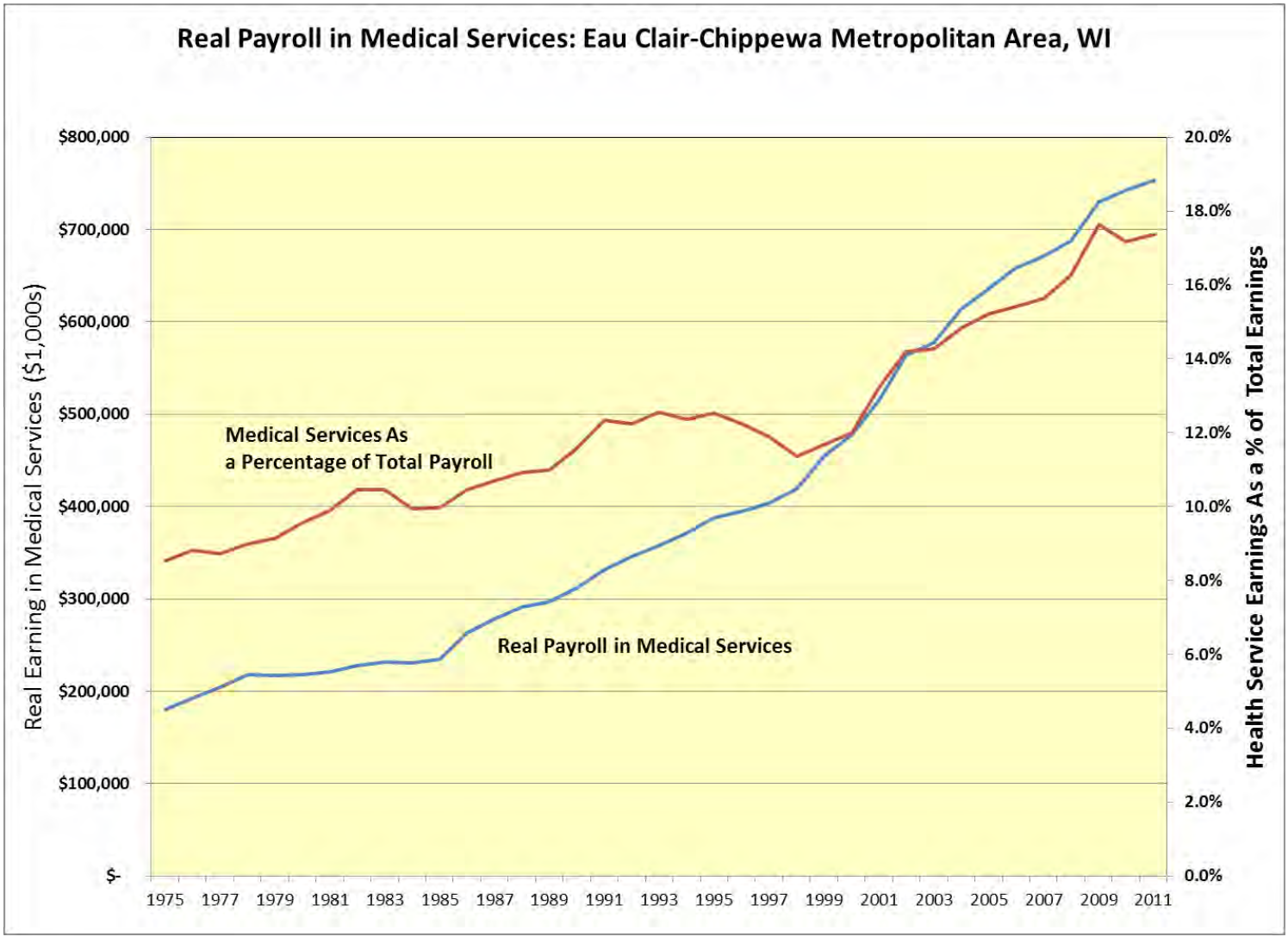
B. Including other economic activities that draw income into the local economy

One weakness of the focus on the "traditional export base" is that it focuses on the production and export of "things," raw materials, agricultural products, manufactured goods, etc. As the often discussed "shift to services" should remind us, the production of material goods has played a decreasing role in our economy. More and more of our economic activity is focused on providing services to customers.

One of the most dramatically growing service sectors has been health services. Our urban areas have become medical services centers with hospitals, clinics, and groups of specialized doctors and other medical technicians. These services may not be "exported" in the usual sense, but they do draw people and their money into those urban areas with the same impact as an industry that is exporting a product. The medical services sector of the economy in the Eau Claire metropolitan area, for instance, grew from a $180 million payroll in 1969 to $753 million, more than quadrupling in size after inflation is removed. The medical services sector grew much faster than the economy as a whole with the result that its share of total local payroll grew from 8.5 to 17.4 percent. See Figure Q. In Dunn and Trempealeau Counties, medical services also increased in importance. Not being regional trade centers, however, their relative importance as a source of payroll was not as high. The percentage share of medical services in each of these counties grew from about four percent to seven or eight percent.

Medical services are not the only service sector that plays this role. Institutions of higher education do the same thing. They do not export products, but they draw students from throughout the region, state, or nation and the funds that support those students throughout their college or graduate training. The University of Wisconsin has campuses in Eau Claire, Menomonie, La Crosse, and Stevens Point in the frac-sand belt. In addition there are UW two-year colleges in Barron County and in Marshfield in Wood County. These

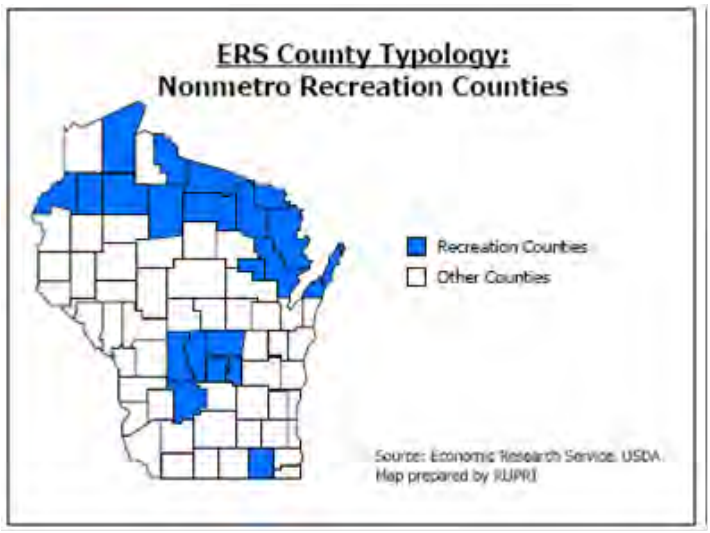
Figure Q



certainly contribute to the economic base in these counties. Student and faculty spending as well as research grants and business spinoffs can contribute significantly to local economic vitality in college towns.

The visitor economy, including outdoor recreation and tourism, is another important part of the economic base that "imports" people rather than exporting goods. Federal researchers have identified non-metropolitan counties that specialize in providing recreational experiences to visitors. One concentration of those recreational counties is across northern and central Wisconsin. See Figure R below. These counties have a high share of their jobs and payroll in recreation-related industries, a large share of housing units in seasonal use, and relatively high spending per capita on lodging. These are somewhat extreme examples of "visitor" economies with large number of hotels and second homes. More modest levels of visitors support the economic vitality of far more counties than those designated in Figure R. For instance the 2011 Wisconsin county "Visitor Spending and Impacts" analysis indicated that in the Eau Claire-Chippewa metro area 5,175 jobs were associated with serving visitors. In Dunn County, there were 819 visitor-related jobs and in Trempealeau County, 371. Other counties where there is significant frac-sand production potential also had significant contributions to local economic vitality from visitors: 3,813 in La Crosse County, 2,115 in Wood County, and 1,198 in Monroe County.[55] Clearly the visitor economy and the attractiveness of these areas to visitors is an important component of local economic vitality.

Figure R



For relatively small cities and rural areas, rules to protect the confidentiality of individual business firms prevent the federal government from reporting employment and income information when a small number of firms dominate a local economic sector. For instance, data on employment and payroll in mining, public utilities, and wholesale trade are often suppressed. That makes it difficult to paint a complete picture of that changes that have been taking place in our sample of frac-sand counties. In addition, the federal government changed the way it groups industries between 2000 and 2001, making the study of trends across that date difficult.

We provide data on the sources of job growth and decline for the 2001 through 2011 period in Table E below. The year 2001 was a recession year, and the Great Recession began at the end of 2007, and the slow recovery from it continues as a drag on many regions of the nation. In that sense, the 2001-2011 period might not be considered "typical" of economic vitality in our study areas.

55. The Economic Impact of Tourism in Wisconsin, April 2012, Tourism Economics, a report prepared for Travel Wisconsin http://industry.travelwisconsin.com/~/media/Files/Research/2012%20Economic%20Impact%20Toolkit/County%20Economic%20Impact%20Table%20-%20V2.xlsx

Table E				
Change in Employment 2001-2011				
Economic Sector	**Eau Claire-Chippewa Counties**	**Dunn County**	**Trempealeau County**	**Total Four Counties**
Agriculture	-207	-120	-221	-548
Manufacturing	-653	239	720	306
Mining	132	NA	NA	NA
Construction	-291	-127	-13	-431
Retail-Wholesale Trade	-932	-254	86	-1,100
Transport & Public Utilities	310	-566	136	-120
Health & Educational Services	3,646	1,272	285	5,203
Finance & Real Estate	2,767	365	244	3,376
Other Professional Services	3,306	588	160	4,054
Visitor Services	1,017	-71	8	954
Government	-113	211	80	178
Total	**8,982**	**1,537**	**1,485**	**12,004**
Source: BEA, REIS, U.S. Department of Commerce				

Across the four counties, on net, about 12,000 jobs were added between 2001 and 2011. Agriculture, construction, and retail-wholesale trade lost jobs in most or all of these counties. Trempealeau and Dunn Counties added jobs in manufacturing but Eau Claire-Chippewa lost a large number of manufacturing jobs.

All of the job gains were in the service sectors, led by health and educational services and other professional services which were responsible for 7,300 of the net gain in jobs across the four counties.[56] Finance and real estate added another 3,400 jobs. Visitor services added about a thousand jobs on net, but almost all of those job gains were in the Eau Claire-Chippewa metro area. This set of service industries was responsible for a total gain of 13,600 jobs, 1,600 more jobs than the net gain for these four counties combined, helping offset the job losses in the other sectors. This dramatizes the fact that the primary source of job growth has not been in the traditional, land-based, export sectors.

Clearly focusing on the "traditional export base" is a misleading way of thinking about a contemporary economy, even in a relatively rural area. It may provide an interesting historical view through the rear-view mirror, but it is not an accurate view of the actual sources of local economic vitality.

56. Educational services do not include public schools. Public schools are include state or local government. Thus only private education enterprises are reported in the educational services category.

C. Putting "jobs" and associated "payroll" in the perspective of the total economy

Most discussions of local economic vitality and economic well-being focus on the employment opportunities available and the pay associated with those jobs. In many ways this emphasis on "jobs" is appropriate. Adults tend to define themselves and their role in their communities at least partially in terms of their work. Employment is important not just for economic reasons but also for cultural and psychological reasons. However, when we are trying to understand ***all*** of the economic forces operating on a particular local or regional economy, we need to be careful to study all of the income flows in and out of our communities and not just *some* of them.

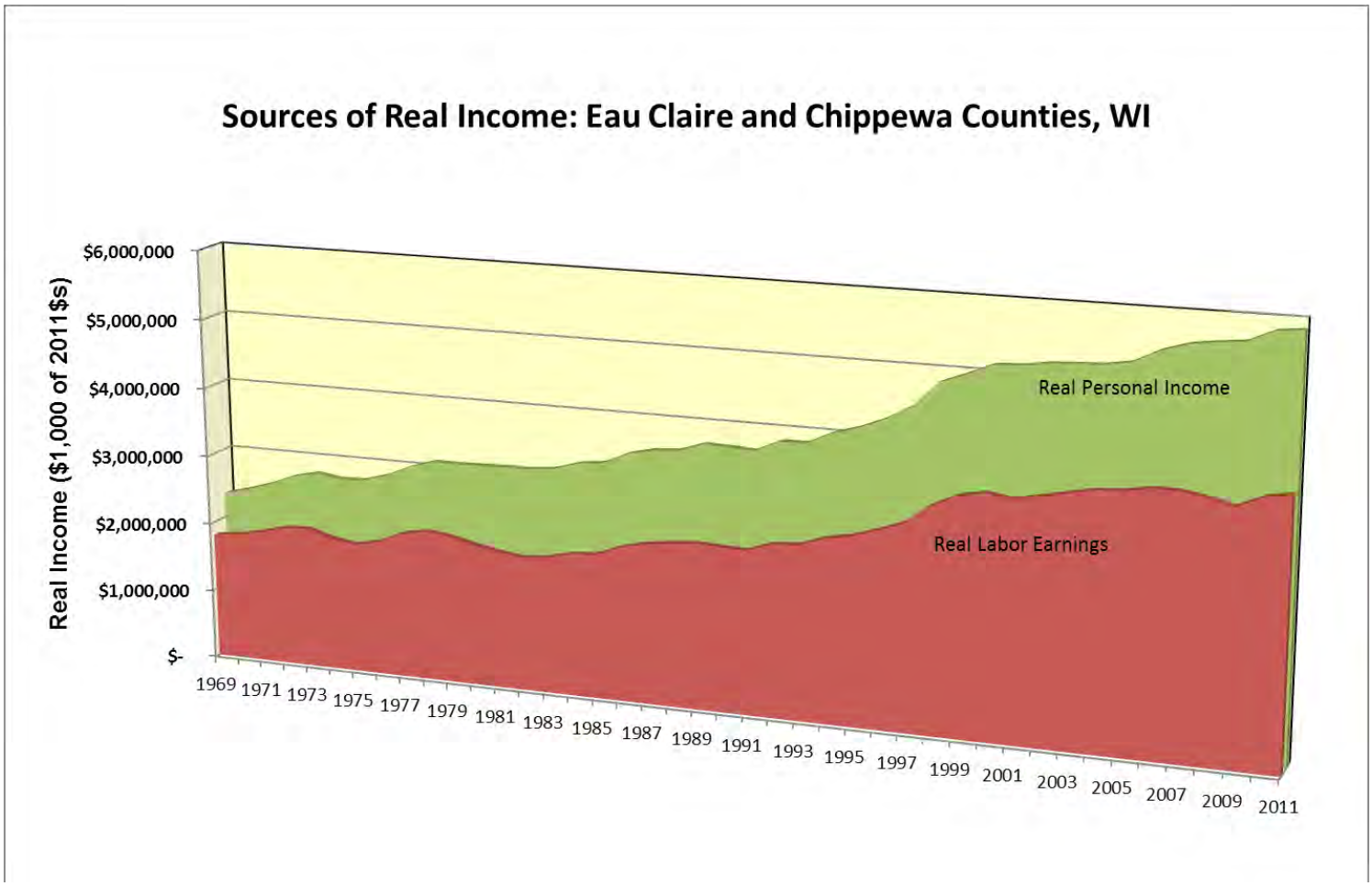
For instance, if we focus primarily on the income earned on the job, we would find that about $3.8 billion in pay flowed to residents of the Eau Claire-Chippewa metro area from those jobs. But if we look at the *total* income received by residents of that area, we would find 55 percent more income was being received, $5.9 billion dollars. See Figure S below. (All income data is in "real" term, meaning the impact of inflation has been removed.) The same pattern is also found in Dunn and Trempealeau Counties where an additional 50 to 55 percent of labor earnings was received by residents as income. If we focus *only* on the jobs in our study area and the accompanying payroll, we will ignore about a third of all the income being received by residents.

The important point here is that households do not receive income only from their current paycheck. Those who have saved and invested are also likely to be receiving income from their investments: dividends, rent, and interest. In addition, those who have retired are likely to be receiving pension payments and other retirement benefits such as medical insurance. Finally state and federal governments run income support programs that attempt to provide a safety net under those temporarily unemployed (unemployment compensation) or those living below or close to poverty (food stamps, Medicaid).

This *non-labor income* represents about a third of the income flowing to households. The largest part of these non-labor income flows is retirement-related income. This includes Social Security, Medicare, and federal veteran benefits. It also includes an estimate of the part of investment income (dividends, interest, and rent) that is flowing to retirees.[57] This retirement-related income represents about two-thirds

57 Investment income (dividends, rent, and interest) were statistically related to Social Security and Medicare payments (both on a per capita basis) to see how variations in these two federal retirement programs were associated with variations in investment income across all of Wisconsin's counties. That analysis indicated that about 55 percent of the investment income was retirement-related.

Figure S



of the non-employment income. The second significant category is government income support programs which include Medicaid payments, food stamps, and other low income programs as well as unemployment compensation. Income Support payments currently represents about a third of the non-employment income flows and is rising in importance as Medicaid costs rise steeply. See Figure T on the following page for the details of these non-employment income flows for Dunn County. Trempealeau and Eau Claire-Chippewa Counties have the same pattern.

When all of these flows of income that are not tied to current paychecks are added up, they represent a substantial income flow to households that significantly boosts household incomes over the wage and salaries associated with their jobs. That can be seen in Figure U above. For Dunn County these non-employment income flows totaled $476 million in 2011, almost twice the earnings in the traditional export base. See Figure V.

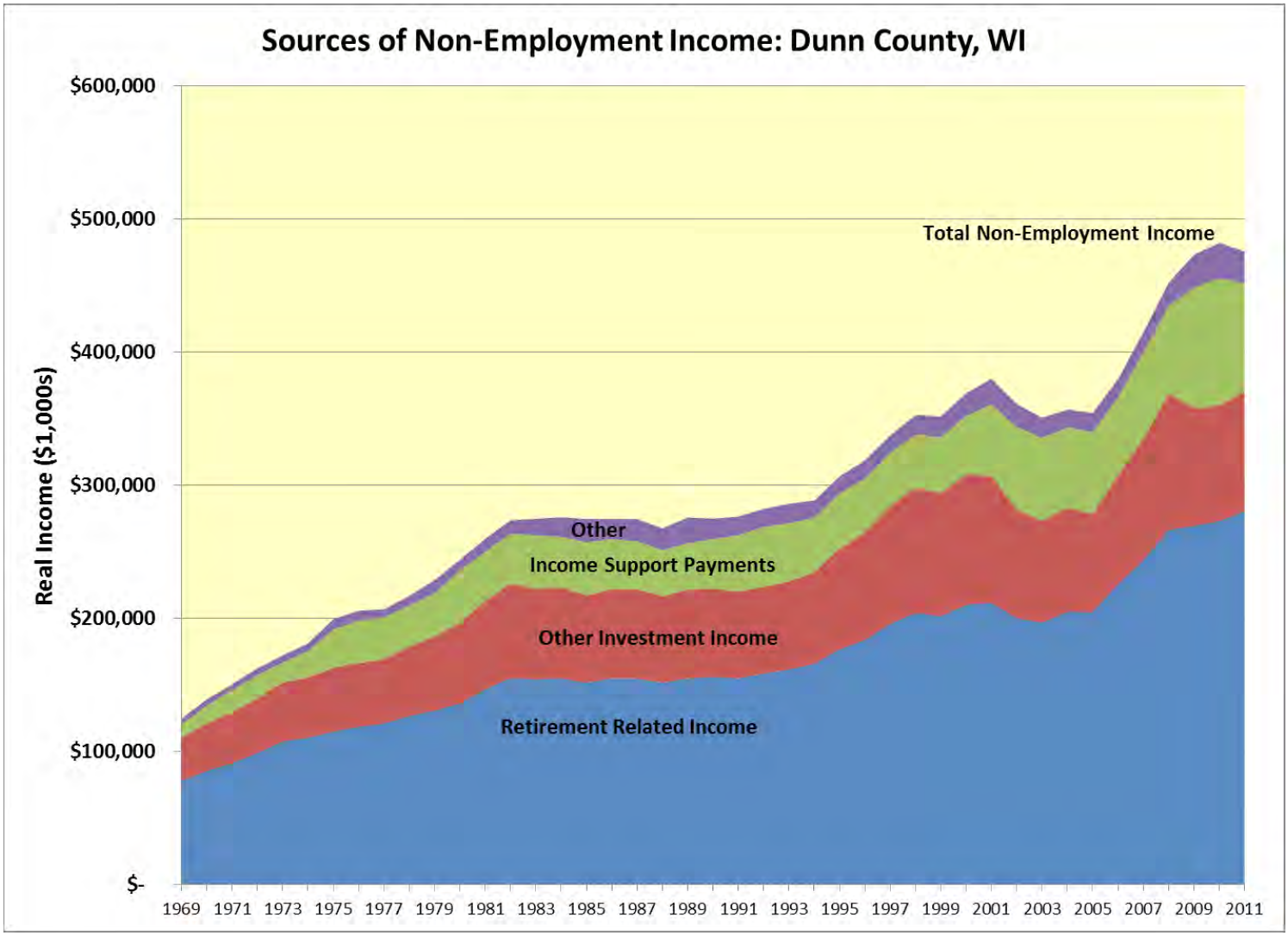
Government income support programs are designed to assist people during economic hard times. When the payrolls turn down and unemployment increases, unemployment compensation payments increase as do food stamps and Medicaid expenditures. Those income support expenditures are "counter-cyclical," rising as overall payrolls fall and falling as overall payrolls rise. See Figure W. This helps smooth out total household income, tempering the declines, sometimes even eliminating them. See Figure U.

D. The more diverse and complex west central Wisconsin economy: summary and implications

In the discussion above, we have tried to explain why many popular discussions that evaluate the economy of west central Wisconsin in terms of its "traditional export base" are incomplete and misleading. For many decades, it would have been hard to explain most of the major economic changes in the economy of this part of Wisconsin in terms of what was happening in that traditional export base. From that perspective, it is also hard to understand the contemporary sources of local economic vitality. That traditional, historically-based view of the economy has to be supplemented in several important ways:

i. We need to include in our view of the local economic base *all* economic activities that draw income into

Figure T



the community from outside, regardless of whether physical exports are involved. That includes:

a. The Visitor Economy including tourism and recreation;

b. Urban trade center activities serving the surrounding area including professional and technical services such as medical facilities;

c. Universities, colleges, and other residential schools;

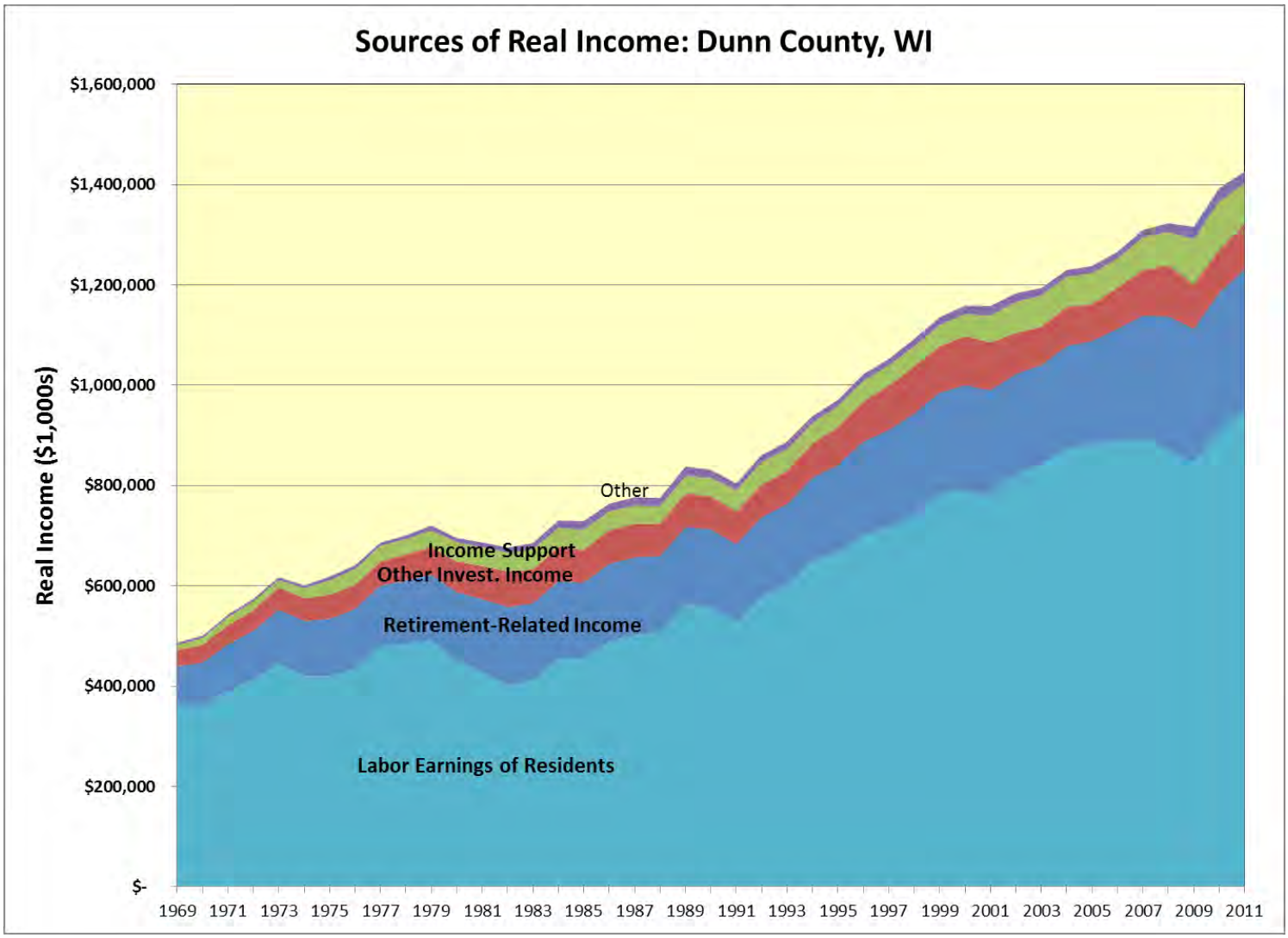
d. State and federal government institutions and facilities.

ii. Recognize that "locally-oriented" businesses are not "secondary." It is they that capture and circulate the income that flows into the community, creating the multiplier impacts. A rich and diverse commercial infrastructure is important to local economic vitality as well as quality of life.

ii. A significant part of the income flowing into a community is not tied to current employment in the labor force. This "non-employment" income includes investment income (dividends, rent, and interest) as well as retirement-related pension programs including Social Security, Medicare, other government pensions, and private pension programs. This makes the residential decisions of retired persons potentially important to local economic vitality.

It is important to note that many of these additional sources of local economic vitality involve decisions by people about where to live, where to shop, where to visit, or where to go to school. That is, much of this economic activity is somewhat "footloose" and is tied to the preferences of potential visitors or residents. For that reason the attractiveness of a local area, its

Figure U



social, cultural, and natural amenities, are an important part of the area's economic base and an important determinant of local economic vitality. That can be seen most clearly in tourism and recreation, choice of trade centers to visit, choice of school, or retirement locations. But there is a broader force operating as well, where in-migrants are drawn to especially attractive locations triggering a set of economic changes that stimulate the local economy.[58]

The public policy implications for local communities seeking to protect or enhance their local economic vitality are clear. Protecting local amenities that contribute to the local quality of life is important in both retaining current residents but also in attracting new residents and businesses. Maintaining and enhancing the natural, social, and cultural environments has to play an important role in any local economic development strategy. Put somewhat negatively, communities have to be careful what tradeoffs they embrace as they try to expand their economy. Steps that undermine local quality of life can be economically counterproductive. It is possible that the potential public costs associated with certain types of industrial development can damage rather than improve local economic vitality. As a result, those job losses could more than offset the job promises associated with frac-sand production, leaving the local economy, on net, worse off than before the frac-sand mining.

58. For a recent discussion of this see "Landscape influence on recent rural migration in the U.S.," David A. McGranahan, 2008, ***Landscape and Urban Planning***, 85: 228-240; and "The rural growth trifecta: outdoor amenities, creative class and entrepreneurial context, 2011, ***Journal of Economic Geography*** 13(3):529-557.

Figure V

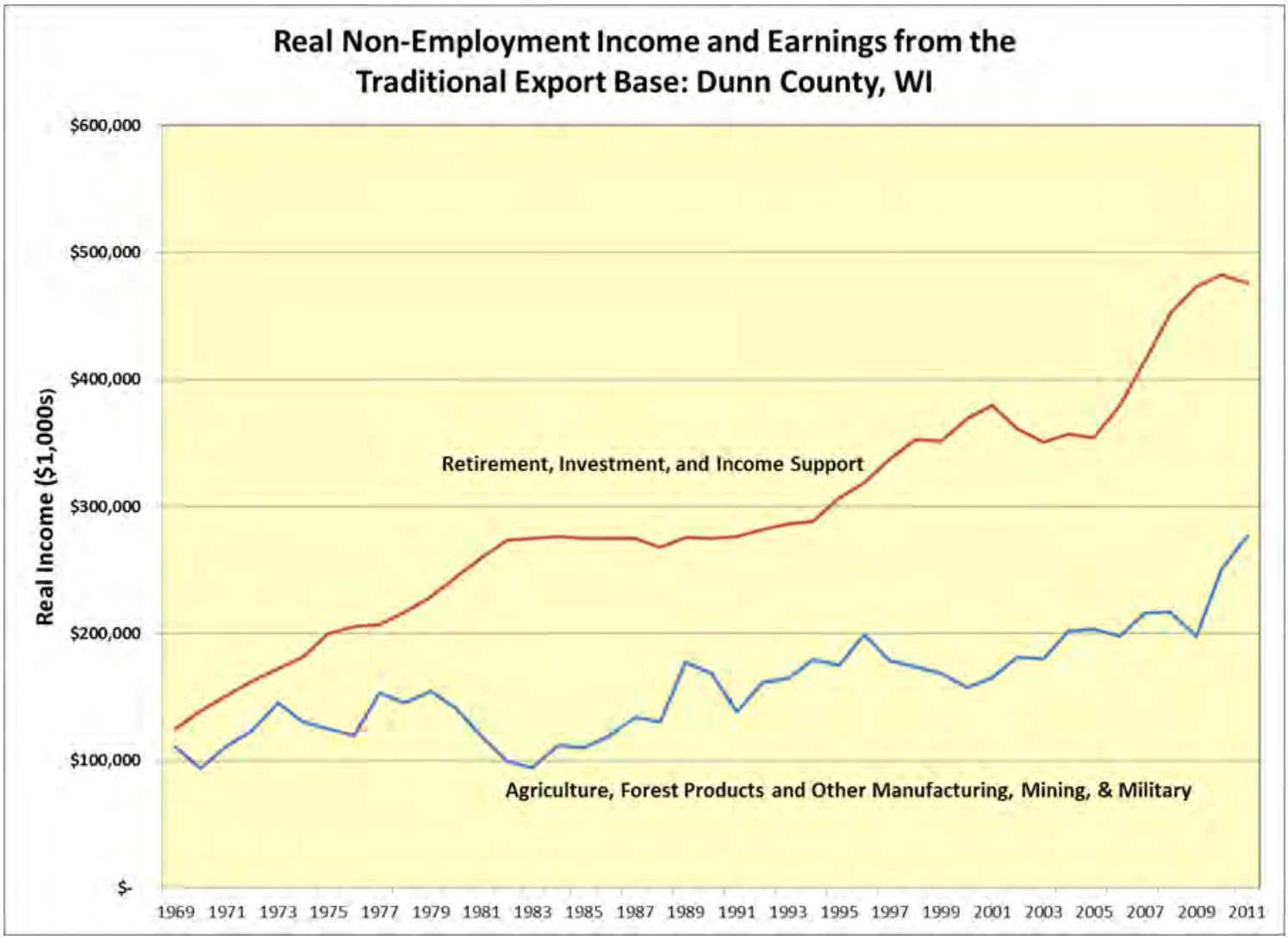

Real Non-Employment Income and Earnings from the Traditional Export Base: Dunn County, WI
Real Income ($1,000s)
$600,000
$500,000
$400,000
$300,000
$200,000
$100,000
$-
Retirement, Investment, and Income Support
Agriculture, Forest Products and Other Manufacturing, Mining, & Military
1969 1971 1973 1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011

Figure W


Income Support Payments Rise When Real Payroll Declines:
Eau Clair-Chippewa Metro Area
Real Labor Earnings
Income Support Payments
Real Earnings ($1,000s)
Real Income Support Payments ($1,000s)
$4,000,000
$3,500,000
$3,000,000
$2,500,000
$2,000,000
$1,500,000
$450,000
$400,000
$350,000
$300,000
$250,000
$200,000
$150,000
$100,000
$50,000
$-
1969 1971 1973 1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011

8. QUESTIONS FOR COMMUNITIES TO ASK AND ANSWER BEFORE AUTHORIZING ADDITIONAL FRAC-SAND PRODUCTION

One of the objectives of this report was to lay out both the potential benefits and costs associated with frac-sand production so that citizens and elected decision-makers could make better informed decisions about further expansion of the frac-sand industry in their communities. Because the potential area of Wisconsin that could be impacted by frac-sand production is very large and the communities and economies located there are very diverse, the report could not provide a detailed analysis of any particular frac-sand production proposal. This report, instead, has attempted to lay out the type of costs that other communities have experienced with mining and apply those experiences to frac-sand mining in Wisconsin. That means we have primarily provided some warnings about potential costs associated with mining based on previous experiences in Wisconsin and elsewhere. That also means that we have raised more general questions than we have provided answers to questions about particular frac-sand production proposals.

That, however, we believe is a productive way to help communities become better informed about what benefits and costs extensive expansion of frac-sand mining in Wisconsin may produce. At the very least it lays out the questions that each community ought to seek to ask and answer before authorizing cumulative increments of additional frac-sand production.

Here, in conclusion, we simply list the questions that flow from our analysis above:

1. What will the pay levels associated with the projected new jobs be?
    a. Direct mining and processing jobs may or may not be quite high.
    b. Transportation jobs may or may not be quite high.
    c. "Induced" jobs tied to workers spending their paychecks are likely to be low.
    d. Exactly what will be the mix of high and low paid jobs?
2. Who will get each type of job?
    a. National studies do not show faster job growth in more mining reliant communities.
    b. Can unemployed and under-employed existing residents fill the jobs or will in-commuters and in-migrants take the jobs?
3. Will frac-sand production be relatively stable?
    a. As natural gas and oil prices fluctuate, will the demand for frac-sand fluctuate?
    b. Is the recent frac-sand retrenchment and production declines a sign of the fluctuations the industry will have going forward?
    c. As more firms seek to enter the Wisconsin frac-sand market and large national firms seek to "integrate" frac-sand production with oil and gas developing companies and transportation companies, what will the impact on small local operations?
    d. As frac-sand production gets consolidated into the hands of a smaller number of large national firms, how will that impact local employment and businesses? E.g. will there be a shift to national trucking firms, railroads displacing trucking, deployment of more capital-intensive, labor-displacing technologies, the flow of profits and wages out of the community, etc.
    e. Will the damage and disruption in the downturn or "bust" be greater than the benefits of the initial growth or "boom" in sand production?
4. How big will the frac-sand production "footprint" ultimately be?
    a. The area of operating and abandoned mines?
    b. Intensity of haul truck traffic on local roads?
    c. The number and location of processing plants?
    d. Unit train loading facilities, rail spur extensions, rail heads, storage piles?
5. What will be the environmental impacts of these activities?
    a. Fine silica particulate from sand mining, handling, trucking, processing, and railroad hauling? Diesel and other emissions from all of these?

b. The likelihood of more extensive chemical treatment and/or coating of the sand and resulting pollution associated with those chemicals?

c. Likelihood of abandoned pits, storage piles, rail spurs and rail heads, etc.?

d. What level of bonding will be required to assure complete reclamation? Are frac-mine operations willing to put up such guaranteed bonds?

6. What will be the costs to other economic activities?

   a. Impact on the visitor economy from pollution, congestion, and industrialization of small towns and rural areas?

   b. Impact on holding and attracting new residents and businesses, including retirees and other amenity in-migrants.

   c. Impact on agricultural productivity of the land?

   d. Will frac-sand producers bid workers away from local businesses and/or drive the cost of labor to local businesses upward?

7. How important will the economic impact of frac-sand production be to the local economy?

   a. What will be the growth in percentage terms of the jobs, total income, and population?

   b. How does the frac-sand production impact compare, for instance, to the on-going growth in the other sectors of the economy?

   c. How short- or long-term will the impact be?

8. Will there be a sustained, long-term, positive impact on the local economy from frac-sand mining?

9. How desperate is the current and near term economic situation in potential frac-sand counties?

   a. Is it unbearable, calling for significant sacrifices of other community objectives and attractive characteristics right now.

10. Is the longer term trajectory of the community relatively attractive despite the short term disruptions associated with the national Great Recession?

a. How could frac-sand production actually contribute to the pursuit of the community's primary long-term objectives?

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Exhibit B

Containment berm at frac mine fails

May 15, 2012

http://www.presspubs.com/messenger/news/article_e64f232a-9ea5-11e1-82ae-0019bb2963f4.html

Containment berm at frac mine fails

Frac Discharge

Silica sediment from a frac mine in Grantsburg contaminated a creek after a berm at the mine failed. The sediment eventually made its way downstream into the St. Croix River. *Submitted photo*

Posted: Tuesday, May 15, 2012 10:51 am | *Updated: 2:33 pm, Tue Jun 12, 2012.*

By Joseph Pruski Contributing Writer | 1 comment

GRANTSBURG—A berm built to contain the sediment of a silica sand (frac sand) washing pond failed at Interstate Energy Partners frac sand mine in Grantsburg, resulting in sediment running off site, and eventually into the St. Croix River.

An unidentified citizen who was hiking in the area on April 22 came across the sediment they described as "creamy coffee colored" in a stream, and alerted the National Park Service and Burnett County. The complaint, which was filed April 23, made its way to the proper authorities on April 25. On April 26, Burnett County Land and Water Conservation officials identified the sediment as "silica fines" and determined that it came from the frac sand mine. Along with the Wisconsin Department of Natural Resources (WDNR), they visited the mine site.

"The containment berm did not do the job it was supposed to do, and it was not a proper berm," Dave Ferris, Burnett County Conservationist, who was on site the morning of April 26, said. "The fines moved through a wetland and then got into a creek and moved downstream into the river."

When authorities arrived the mine was shut down temporarily and the line to that particular wash pond was secured. Tiller Corporation, which operates the mine, is currently in the process of building a new permanent berm to replace the failed temporary one. There are a total of five wash ponds on site at the mine, as well as two wash ponds in Sunrise, Minn.

"What we did was stop the

operation immediately, and then pump the water from that pond into ponds that were sealed well," Mike Caron, Director of Land Use Affairs for Tiller Corporation said. "We've since reconstructed the containment area and Burnett County and the DNR have been out to inspect it."

According to Ferris, Tiller Corporation was unaware that the berm had been failing until authorities visited the mine. Given the time between when the complaint was first made and authorities first contacted the mine, it is possible that sediment had been seeping from the frac sand washing pond for at least three days. No estimate has been made of the amount of sediment that made its way into the river.

Caron said that the containment pond was newly constructed and that it had been in use for only "a couple of days."

The St. Croix River is designated as a National Scenic Riverway, and therefore subject to federal oversight by the National Park Service (NPS). Jill Medland, who serves as Environmental Coordinator of the St. Croix National Scenic Riverway, said that unnatural quantities of sediment make their way into the river, it is cause for environmental concern.

"We don't yet know site specific impacts, but in general, sediment has an impact on the river bottom which cumulatively impacts the sediment of the river and could affect fish spawning and mussels, and things like that," Medland said.

The wetland, which the sediment initially discharged into, is on Interstate Energy Partners land, and according to Ferris, "not a problem" as it is "settling out on its own." As was the case with the river, the fine silica sediment naturally settles to the river bottom and the water begins to clear. Once the line to the failed washing pond had been shut down, the river and stream water began to clear and sediment began to settle.

Officials from the NPS, WDNR, and Burnett County have continued monitoring the event and will continue to track any environmental concerns that arise. While Ferris acknowledged the mine had not been inspected regularly, he said that collective inspections by the WDNR and county would become a fixture. The most recent inspection of the mine was last fall.

Tiller Corporation has also implemented a stricter inspection schedule effective immediately.

"We're moving forward with a more vigorous monitoring schedule that includes more frequent visual inspections and water quality monitoring," Caron said. "When we're mining a natural resource in close proximity to another important natural resource (St. Croix River), we have duties and responsibilities to protect it, and it's our intention to do that."

A joint investigation by Burnett County officials and WDNR has been launched, and should be completed within a couple of weeks. This is the first time the mine has had any violations since opening last July. Ferris was unsure what, if any, penalties would be levied against the mine or mine operator.

"We haven't decided anything yet," Ferris said. "Our goal was to get proper containment put in, and when they're done with that, we'll get together with the WDNR and talk about that (penalties)."

The National Park Service is also in the process of determining what recourse they have in terms of citing the mine.

Exhibit C

Pollution worries abound in frac sand waste streams

July 13, 2013

StarTribune

Pollution worries abound in frac sand waste streams

Article by: Tony Kennedy
Star Tribune
July 13, 2013 - 6:54 PM

Waste piles at Preferred Sands in Blair, Wis., have twice absorbed enough water to turn lava-like and spill onto neighboring property.

BRIAN PETERSON • brianp@startribune.com,

Dick Eberly's property twice has had spills from Preferred Sands in Blair, Wis.

BRIAN PETERSON • brianp@startribune.com,

In Wisconsin, frac-sand mines in Trempealeau, Buffalo and Barron counties are creating unstable piles of sand waste and illicit wastewater runoff.

In Minnesota, state health officials are studying two chemicals widely used in frac-sand processing as contaminants of "emerging concern."

Four years into a mining boom that is reshaping parts of the rural countryside, mining companies and government regulators are coming to grips with the reality that the new industry involves much more than scooping sand out of the ground and hauling it away.

The states' burgeoning frac-sand industry, they have found, creates waste streams they are scrambling to understand and control.

From pyramids of discarded sand to sludge that accumulates in filtering devices, the mines create tons of waste byproducts that must be managed until they can be plowed back into the ground as part of reclamation plans designed to protect the environment and preserve the rural landscape.

"The industry just came on too fast," said Ruth King, a stormwater specialist with the Wisconsin Department of Natural Resources. "I wish we could turn back the clock a couple of years and start over."

In a rash of continuing violations that started last year, heavy rains have combined with sand-processing water to overflow holding ponds on several mining sites. The breaches have dumped sandy sediment into public waters, where it can suffocate fish eggs, kill aquatic plants and rob fish of habitat they need to reproduce.

"It really does impact the fisheries side of it," said Roberta Walls, another Wisconsin DNR water specialist.

Rich Budinger, president of the Wisconsin Industrial Sand Association, an industry trade group, said sediment pollution is indeed a threat to natural areas. The entrance of new, inexperienced sand companies and heavy rains have made conditions more challenging, he said. But, he noted, the state requires frac-sand companies to obtain stormwater permits, which should be sufficient to prevent lasting environmental damage. Any habitual violator should not expect to stay in business, he said.

"It shouldn't be an ongoing issue," Budinger said. "This doesn't represent the industry as a whole."

20 violations

Heading into this spring, the Wisconsin DNR had cited 15 frac-sand mines for alleged violations of water regulations, including two that advanced to the Wisconsin Department of Justice for possible legal sanctions. Since then, Walls has written at least four new violation notices and King is handling another.

"It's very challenging," Walls said. "I really don't see the state being able to provide the staffing levels that the workload demands."

Most large frac-sand mines, she said, are properly sized and engineered, with zero discharge to neighboring streams and wetlands. Problems have cropped up at smaller sites where man-made holding ponds are barely large enough to contain water used for processing sand — much less heavy spring rains, melting snow and water that drains from wet stockpiles.

The Great Northern Sand processing site near New Auburn, Wis., is a case in point. Last November, the site spilled sediment-filled wastewater into Beaver Creek, which leads to an important wildlife sanctuary in Barron County, according to state records.

Jim Drost, a former U.S. Bureau of Mines engineer and an expert in industrial sand, said he was angered by the spill because he and others had warned that the site would produce sediment pollution.

Drost grew up in the area and fears that silt from a cluster of surrounding frac-sand operations will wipe out local habitat for such rare creatures as the Karner blue butterfly and Butler's garter snake.

"We'll have a dead swamp in 10 years," he said.

Great Northern worked hard to prevent another breach, King said, adding pond capacity and taking other steps. But the plant had two more spills in April, according to a document she provided.

Now the operation has given up on plans to be self-contained and will receive a permit that allows for discharge of clear water, an approach other mines are taking.

One of the biggest operations to run afoul of its zero-discharge plan is Preferred Sands of Blair, Wis. Kevin Lien, director of land management for Trempealeau County, said water from the mine repeatedly overflowed this spring into an intermittent stream that runs into Larkin Valley Creek and on to the Trempealeau River.

"It's constantly in use and being filled with sediment," Lien said of the stream.

In a statement to the Star Tribune, Pennsylvania-based Preferred Sands said it has worked closely with the DNR to resolve "complex inherited environmental issues." The company, which also operates a frac-sand mine in Woodbury, said the Blair facility is not discharging any process water off its site.

Murky wash water

The Midwest's sand mining boom was triggered by oil and gas companies that use the silica grains in a drilling process called "hydro fracturing" — and they set exacting standards for the sand they buy. To meet those specifications, sand mines in western Wisconsin have had to remove more clay and undersized sand than they projected, several regulators said. The separation process is driving greater water usage and creating larger stockpiles of spent material, Lien and others said.

"This is pretty fussy sand," said Tom Woletz, Wisconsin DNR's leading frac-sand expert until he retired last month.

As sand is filtered, the so-called "fines" are washed away from usable frac sand. Mining companies then treat the murky wash water with chemicals, called flocculants, that cause suspended particles to sink so the water can be reused. The clarified water is used to wash more sand, while the wet, sluffy fines are piled as waste material that is eventually plowed back into the ground where sand was excavated.

A well-managed frac-sand site keeps the piles stabilized, sometimes by mixing in top soils, Walls said.

But at the Preferred Sands site in Blair, the waste piles have twice absorbed enough water to turn lava-like and spill from high elevations onto neighboring property, trashing the interior of a house, flowing into a garage on another property and fouling a wetland.

"It's been a nightmare for us," said Dick Eberly, a neighbor whose property was tainted by both spills.

Preferred Sands said it will take additional steps in coming months to improve compliance with regulations. "Preferred Sands is fully committed to protecting the environment in the communities in which we operate," it said in a prepared statement.

Lien said one problem is that some mines have followed a minimum design standard and sized their holding ponds to accommodate the area's biggest rain event in the past 10 years. In Trempealeau County, Lien and others set a tougher standard, keyed to 100-year rainfall events — but even that hasn't prevented overflow problems, he said.

"It all looks good on paper when they come in for their permit," Lien said. "Now we have erosion problem after erosion problem."

‘Emerging concern’

In addition to problems with runoff and waste piles, state officials and some frac-sand companies are wary about the widespread use of a chemical called polyacrylamide to clarify sand-processing water. Polyacrylamide contains residual amounts of acrylamide, a neurotoxin linked to cancer and infertility.

So far, no one has detected acrylamide in aquifers or soil around industrial sand mining sites, and in Wisconsin’s Chippewa County, a rare acrylamide monitoring program in an area with lots of frac-sand activity has not sounded any warnings.

But small amounts of acrylamide have been shown to accumulate in mining waste water, and the chemical is widely considered to be present in stockpiles of discarded fines.

Mining reclamation plans call for those heaps to be buried back in the ground in unprecedented volumes — some of it at mines where digging goes well below the water table.

“There hasn’t been a lot of study about what happens to these chemicals when they get into the subsurface,” said Virginia Yingling, a hydrogeologist with the Minnesota Department of Health. “We are trying to find out if it’s a problem.”

Budinger said frac-sand companies in Wisconsin adhere to an approved products list for flocculants and other water additives. He said responsible operators continually are managing water quality and quantity with the environment in mind.

Using polyacrylamide to clarify wastewater allows mining companies to reuse the water, conserving valuable groundwater. And published studies demonstrate that polyacrylamide can degrade safely when stored above ground.

Even so, polyacrylamide and polydadmac, another widely used sand-processing flocculant, were recently added to the Health Department’s list of “chemicals of emerging concern” and will be screened for potential health risks.

The Minnesota Pollution Control Agency has its own study group on flocculants and might reassess existing permits that allow polyacrylamide use depending on findings.

Mike Caron, director of land use for Minnesota-based Tiller Corp., said the company’s frac-sand division has intentionally avoided polyacrylamide because of the unknowns. The company uses a starch-based flocculant sold by HaloSource Inc. of Bothell, Wash.

Several sand mining operations around the country have switched to greener technologies, said Frank Kneib, a HaloSource product manager.

Tiller operates a frac-sand mine near Grantsburg, Wis., and still is resolving a spill of dirty water that reached the St. Croix River last year. The U.S. Army Corps of Engineers treated it as a violation of the federal Clean Water Act and the Wisconsin Department of Justice is considering possible sanctions.

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Exhibit D

MN town voices opposition to frac sand operation

KARE 11

Available online at: http://bcove.me/qeaxyqm3

Exhibit E

Silica Toxicity

Dr. Hillary Carpenter, Minnesota Department of Health

SILICA TOXICITY

Hillary M. Carpenter
Minnesota Department of Health

Silica Toxicity

- Crystalline silica is widely used in industry and has long been recognized as a major occupational hazard, causing disability and deaths in workers in several industries
  - Silica exists in two forms – amorphous and crystalline
  - When discussing the toxicity of silica the real concern is with respirable crystalline silica (PM_4)

Health Impacts of Silica

- Diseases associated with Crystalline silica include:
  - Silicosis – the hallmark disease – incurable, but preventable
  - Lung cancer
  - Chronic obstructive pulmonary disease (COPD)
  - Renal disease/kidney cancer
  - Several diseases of the immune system

Health Impacts of Silica

- Disease risk is related to both the levels and duration of silica exposure.
  - The onset of disease may occur long after the exposure has ceased
- Silica has a non-linear exposure response curve – risks of disease are greater at higher exposures

Workplace Exposure Limits for Silica

- The Occupational Safety and Health Administration (OSHA) permissible exposure limit for crystalline silica is 0.100 ppm (100 µg/m^3) for an 8-hour time-weighted average exposure
  - Adjusted to 24 µg/m^3 for a 24 hour, 7 day a week exposure

Workplace Exposure Limits for Silica

- The National Institute for Occupational Safety and Health (NIOSH) recommended exposure limit is 0.05 ppm (50 µg/m^3) for a 10-hour time-weighted exposure
  - Adjusted to 12 µg/m^3 for a 24 hour, 7 day a week exposure.

Health Impacts of Silica

- Occupational silicosis is underdiagnosed
  - There is significant risk to workers chronically exposed to silica concentrations lower than the OELs
  - Silicosis has been diagnosed at autopsy in workers exposed to occupational levels of 50-100 $\mu g/m^3$

Ambient Silica Toxicity

- There appears to be a low level risk of contracting silica related disease from background levels of exposure
- However, ambient crystalline silica levels can be significantly elevated downwind of peak sources of silica such as mine or quarry operations
  - Silicosis has been reported in highly exposed, non-occupational cohorts

Silica Ambient Exposure Limit

- California's EPA has developed a chronic exposure limit for silica in ambient air of 3 $\mu g/m^3$
  - This value is 8 times less than the time-adjusted OSHA limit and 4 times less than the time-adjusted NIOSH recommendation.
  - The differences between acceptable risk levels for occupation settings and those for the general population are typically much greater than 4-8 fold.