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27 February 2018

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Re: Northern Minnesota Federal Minerals Withdrawal EA

Thank you for this opportunity to comment on the proposed withdrawal of certain federal lands in the Superior National Forest from the federal minerals program. My colleagues and I have examined questions related to the lease withdrawal from an economic perspective, and with this letter we are sharing some of our key findings. Namely, we find that proceeding with the withdrawal of these lands would support significant economic benefits to the Arrowhead region comprising St. Louis, Lake, and Cook Counties, Minnesota. These benefits come in the form of avoiding damages that sulfide-ore copper mining could do to the region's existing diverse and stable economy. To put it the other way around, the mineral withdrawal would support the continued development of an economy based on sound stewardship of the Boundary Waters.

In contrast, estimates of the cost of the withdrawal, in terms of local employment and income in mining, are, at best, exaggerated. Technological and other changes in mining would blunt gains in local employment associated with sulfide-ore copper mining. And based on the track record of analyses purporting to measure future economic impacts of the mining industry, mining proponent's arguments to the effect that the region needs to keep these lands open to more mining in order to have sufficient jobs, income, or tax revenue in the future are not credible.

Economic benefits of the proposed withdrawal would be significant.

Under the National Environmental Policy Act (NEPA), the USDA Forest Service must consider the economic effects of the proposed withdraw of land from the mineral leasing program alongside ecological, aesthetic, historical, social, and health effects (40 CFR 1508.8). The salient economic effects of this action would include, as a benefit to society, the avoidance of costs associated with actual and potential sulfide-ore copper mining that, absent the proposed federal mineral withdrawal, could proceed in the watershed of the Boundary Waters. In our report dated October 2017 and attached to this letter, we presented evidence regarding those avoided costs, including conservative quantitative estimates of a small subset of them. These include

- A decline in spending as potential visitors choose alternative destinations with high quality scenic and recreational amenities undiminished by nearby mining activity. We estimate an annual loss of \$288 million in spending that would otherwise support 4,490 local jobs, \$76 million in residents' income, \$31 million in state and local taxes, and \$181 million in proprietor's income and business-to-business transactions
- 5,066 to 22,791 lost jobs, and between \$402 million and \$1.6 billion in lost annual income in the rest of the three-county Arrowhead economy if sulfide-ore copper mining suppresses or reverses growth in the amenity-based economy that has been the backbone of the region's recovery since the early 1980s

- \$509 million in lost property value. This is a one-time drop in asset value that will spawn annual reductions in local property tax revenue throughout the three-county Arrowhead region.

By implementing the mining withdrawal, as proposed, these and other costs would be avoided, thus delivering a benefit to the American people and Minnesotans equivalent to a one-time payment of more than \$6.1 billion.¹ In addition, the mining withdrawal could save between 9,556 and 27,281 jobs. (Please see the full copy of the report, attached, for details on the methods and results.)

Clearly the economic costs of sulfide-ore copper mining (or the economic benefits of withdrawing lands from the mineral leasing program) are significant and worthy of consideration as part of the NEPA review.

Costs of the withdrawal are overstated.

Just as the external costs of sulfide-ore copper mining count among the benefits of withdrawing land from the mining program, the benefits in terms of prospective regional jobs and income stemming from mining activity that might otherwise ensue should be considered among the costs of the proposed withdrawal. Mining proponents (or withdrawal opponents) have made three claims about the possible jobs and other economic effects of mining:

1. Mining and will, on net, do more for the regional economy than tourism.
2. Mining will increase employment opportunities for existing residents of the Arrowhead region.
3. Every mining job will be a good one, at least in terms of average wages.

These contentions are dubious for several reasons. First, comparing the number of jobs in mining to jobs in recreation and tourism is spurious. The study summarized above and numerous previous studies demonstrate that many sectors, not just recreation and tourism, thrive when a region takes care of its quality of life, including its scenic, aesthetic and recreational amenities.

Visitors do flock to the Boundary Waters, and those visitors do spend more than a billion dollars per year in the Arrowhead region. But as importantly, if not more so, the Boundary Waters attracts long-term residents, including retirees, entrepreneurs, and workers in many industries. These people choose to live in areas with year-round opportunities to enjoy the same amenities that visitors experience for a week, or a season each year, or once in a lifetime. The Boundary Waters is a major attraction for new residents of many industries who choose quality of life as a determining factor on place to live. (See, for example, Ronnader, Wentz, and Hove (2014), Florida (2000), and Niemi and Whitelaw (1999).)

A better comparison, therefore, would be between mining jobs that might accompany expansion of mining and all of the jobs—in manufacturing, in professional, health, and other services, as well as in recreation and tourism—that would leave the region or never arrive if sulfide-ore copper mining were to begin.

Decision makers including the Forest Service, should also recognize that mining represents a small minority (2.5% of jobs and 6.9% of income in 2015, down from 10% of employment and 20% of income in 1980) of the Arrowhead region's natural-resource-based economy. Other uses by visitors, amenity migrants, and long-term residents who might quit the region over concerns about the negative consequences of sulfide mining

¹ This is the present discounted value of the stream of future benefits (costs avoided) over the proposed withdrawal period of 20 years, and using the 0.2% discount rate recommended by the Office of Management and Budget for such analyses (2017).

(Ronnader and Wente, 2014), are equally or more important to the future of the region from an economic perspective.

In spite of these facts, a small minority of comments submitted to the Forest Service² do claim that mining should be permitted to proceed because, the commenters contend, mining contributes more to the Arrowhead region economy than the many industries that rely on the region's economy. These comments often include false or misleading statistics. For example, a resident of Ely Minnesota claims that a single mining company's annual payroll of \$205 million is "4 times the amount" for tourism (Cole 2017). The writer, however, is comparing the mining company's payroll to a very narrowly drawn estimate of earnings associated with visits to the Boundary Waters Canoe Area Wilderness itself, not to the tourism across the region that could be adversely affected by new mining activity. In fact, visitor spending in the Arrowhead tops \$1.1 billion per year (in 2015 dollars), a figure that includes almost \$300 million in wages and salaries of that industry's workers, and millions more earned by recreation/tourism business owners (Phillips and Alkire, 2017, p. 15).

Second, the claims of increased mining employment must be viewed in light of an accelerating trend of decreasing labor-intensity in the mining industry. Mining is becoming more capital-intensive due to a new wave of innovation in which autonomous and remotely controlled machinery is operated by a few individuals who may be located far from the mining site (MacLean Engineering, 2017). Rio Tinto, BHP Billiton, and Suncor, to name a few examples, use autonomous, driverless ore trucks. Robotic drills and other automated equipment are also becoming more prevalent. In the case of Rio Tinto, its fleet of robotic trucks and robotic trains is monitored from a control center 750 miles away from the mine. The company correctly sees automation as a way to increase efficiency and reduce mining staff (Simonite, 2017)

One mining company, Anglo American Plc., notes that automation will make the future mining industry "unrecognizable" to people who know it now. In the company's view, "the 'employee of the future' will only need to focus on managing the company's relations with governments and communities that live near its ("Robots will run mines within the next decade, Anglo says" 2017)". While this may be good news for corporate lobbyists and PR practitioners (and for those who design and manufacture mining robots), the replacement of humans with automation in the operation of trucks, crushers, and drills does not augur well for of rank-and-file miners who will see the number of their jobs dwindle even as mining continues.

This leads to the final claim commonly made by mining proponents: that any and all new local mining jobs that come with sulfide-ore copper mining will be high paying. Especially given the trend toward automation and the increasing capital-intensity of mining, not only are the absolute number of jobs per mine and jobs per ton of ore processed likely to decline, but also the higher paying jobs of the future are likely to skew more and more toward professional, engineering, and managerial positions and away from less skilled positions. Those jobs will also be less likely to be needed in or near the communities where mines are located. The reality is that mining jobs in the future will become increasingly scarce and less and less available to local people.

Because of the changes affecting mining employment, estimates made today are simply not reliable as indicators of what mining may have to offer 20, 10 or even 5 years from now. This is especially true when the estimates are derived from outmoded empirical models whose concepts, assumptions, and underlying data preclude consideration of the sort of changes just described. The attached report by Phillips and Alkire (2017), especially the section titled "Beyond Folk Economics" (pp. 2-4), includes a review of the shortcomings of the use of input-output models such as IMPLAN to predict future employment and income in a dynamic economy. In

² Based on our computer-assisted review of more than 81,032 comment letters (does not count postcards and petitions), 1.5% of commenters opposed the withdrawal and cited economic reasons for their opposition. An additional 0.3% opposed the withdrawal for other reasons. The remaining 98.2% of comments favored the withdrawal.. O

brief, while input-output models may have some value in describing current relationships among industries, they are practically useless for predicting outcomes more than a year or so into the future.

This is an important consideration, because several mining proponents cite IMPLAN-driven estimates from a University of Minnesota at Duluth (UMD) report on the economic impact of mining in their comment letters (Skurla et al., 2012). We reviewed that the report soon after its publication and found that, in addition to the general problems associated with using IMPLAN to predict future economic effects, the study had several technical errors that render its results suspect as part of an analysis of the costs and benefits of the proposed mineral lease withdrawal. For example, the UMD study defines a study region that is much larger than the region for which the lease withdrawal is proposed. Larger geographic regions naturally have more “local” spending, and that causes computed input-output multipliers to be larger than would be expected for the region of interest here—that is, St. Louis, Lake, and Cook Counties. (See Hjerpe and Phillips, 2013, attached, for the complete review.)

Further, and to the previous point regarding the inability of input-output models to forecast future effects, an earlier, 2009 version of the UMD study had predicted an increase of more than 2,000 direct non-ferrous mining jobs between 2007 and 2013 due to then-proposed non-ferrous mining expansions (Skurla et al. 2009, p. 48). What actually happened during that time period, however, was a large decrease in the number of those jobs. Baseline employment in non-ferrous mining fell from 531 jobs in 2007 to 175 jobs in 2013—a 67% decrease and a stunning contrast to the 298% increase predicted by the IMPLAN model and the authors back in 2009 (Skurla et al., 2009, p. 48; Skurla et al., 2012, p. 33). This precipitous decline demonstrates that new mining projects may not deliver new employment as mining proponents claim. Moreover, this result is emblematic of the lack of accuracy in UMD’s projected economic impacts.

In summary, we urge that the Forest Service carefully consider the true potential economic effects of the minerals withdrawal proposal. The evidence shows that the region has built a vibrant and diverse economy based on quality of life and quality of the environment. That economy would be put at significant risk if the withdrawal is rejected and sulfide-ore copper mining proceeds. There is, meanwhile, little reason to believe that mining will provide long-term gains sufficient to justify the sacrifice of the existing and future sustainable economy.

Sincerely,



Spencer Phillips, Ph.D.

Enclosures:

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Phillips, S., and Alkire, C. 2017. *Sulfide-Ore Copper Mining and/or A Sustainable Boundary Waters Economy: The Need to Consider Real Tradeoffs*. Charlottesville, Virginia: Key-Log Economics. 42pp.

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- Skurla, James A. et al. (2012). *The Economic Impact of Ferrous and Non-Ferrous Mining on the State of Minnesota and the Arrowhead Region, Including Douglas County, Wisconsin*. Duluth, MN: University of Minnesota, Duluth, Labovitz School of Business and Economics. November. 69pp. <http://www.d.umn.edu/lsbe/bber.php>.

**A Review of
“The economic impact of ferrous and non-ferrous mining on the State of
Minnesota and the Arrowhead Region”¹**

Evan Hjerpe, Ph.D.[†] and Spencer Phillips, Ph.D.[‡]

December 30, 2013

Brief Summary: Regional economic impact analyses can be helpful in illustrating potential changes in output, income, and employment that might result from new development. Economic impact analysis (EIA) is, however, subject to stringent methods that must be adhered to in order to provide credible estimates of impacts. Additionally, EIA is based on an underlying set of restrictive technical assumptions that may apply only in rare instances. Thus, great care must be taken in conducting and using the results of economic analysis if it is to have any value at all. The proliferation of turn-key economic impact models, such as IMPLAN, has made it extremely easy to produce estimates of economic impacts by non-economists or economists with little training in this area. Impacts can be generated with little consideration for the underlying methods and technical assumptions. This has resulted in a wide range of quality in economic impact analyses.

After examining “The economic impact of ferrous and non-ferrous mining on the State of Minnesota and the Arrowhead Region, including Douglas County, Wisconsin,” (hereafter “the UMD report”) we conclude that the University of Minnesota, Duluth’s economic impact analysis falls squarely at the “low-quality” end of the spectrum. In brief (and as detailed below), the reasons for this conclusion include the following:

- The authors of the UMD report failed to adhere to a number of the most critical EIA methods. Multiple violations of standard EIA methodology undermine all generated IMPLAN results.
- The underlying technical assumptions of input-output modeling, the core tenet of IMPLAN, lead to an unrealistic picture of the regional economy, because they inflate induced effects and multiplier effects. As such, researchers generally take a deliberately conservative approach and/or perform sensitivity analysis. The UMD report incorporates neither.
- The authors of the UMD report provide no comparison of potential mining multiplier effects to multipliers for other industries within the regional economy. Without comparison, the reader has no context with which to judge the impacts.
- The authors do not acknowledge the limited role and application that EIA results have in the overall environmental assessment of mining impacts. Apart from a brief note in Appendix B that “a detailed cost-benefit analysis is beyond the scope of this report,” the UMD study does

¹ Skurla, James A. et al., *The Economic Impact of Ferrous and Non-Ferrous Mining on the State of Minnesota and the Arrowhead Region, Including Douglas County, Wisconsin* (University of Minnesota, Duluth: Labovitz School of Business and Economics, November 2012), <http://www.d.umn.edu/lbse/bber.php>.

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nothing to place the modeled (short-term) economic impacts in the context of what are reported elsewhere to be significant, long- and short-term negative environmental, economic and fiscal impacts of non-ferrous mining in Northeast Minnesota.²

1. Introduction

New, non-ferrous mines are being proposed in northeastern Minnesota, but need to undergo an environmental planning process to help determine if the new mines are in the public interest of Minnesotans. The primary component of determining public interest is assessing the overall environmental impacts of proposed projects to determine if the public benefits outweigh the public costs. Part of this process has also typically included an assessment of potential economic impacts that might be generated by the proposed mining. A recent study, “Economic Impacts of Ferrous and Non-Ferrous Mining on the State of Minnesota and the Arrowhead Region, and Douglas County, Wisconsin,” was conducted by The Labovitz School of Business and Economics at the University of Minnesota Duluth (hereafter, “UMD report”). In this paper, we review UMD’s economic impact analysis, so as to provide an objective perspective on the associated economic impacts of proposed mining expansion, with particular attention to new non-ferrous mining. Because proposed non-ferrous (sulfide) mining is new to the region and has the greatest environmental impact, we review the report with an eye on the implications for non-ferrous mining.

The UMD report suffers from multiple technical and methodological flaws and does not address any associated costs of non-ferrous mining. These flaws include: inappropriate study area delineation, a lack of rigor in data collection, and inappropriate inclusion of past economic activities related to existing mining production. Additional problems, and technical errors, were also found throughout the report that led to consistently inflated economic impacts. The presented economic impacts are therefore not credible estimates and require an entirely new analysis to correct these fatal flaws.

2. Economic Impact Analysis (EIA) and Environmental Planning

To provide greater understanding of the role of the UMD report, it is helpful to first frame the scope of EIA in terms of its value in determining overall public costs and benefits. In the broad picture of net public interest, EIA is narrowly focused on short-term changes in regional economic indicators. As such, EIA does not shed light on any associated costs to society that might result from the proposed development (e.g., environmental impacts, damages to other industries, or long-term viability of the industry or the region). Furthermore, economic impacts, even if positive, are rarely considered as economic benefits for the regional economy.³ This is because regional economies are dynamic, but gravitate towards equilibrium in terms of economic indicators. That is, losses in one sector of the economy are generally offset by gains in other sectors; and gains in one sector are generally offset by

² Marcotty, Josephine, “Iron Range Mine Could Pollute Water for up to 500 Years,” accessed December 3, 2013, <http://www.startribune.com/local/226548091.html>; Dunbar, Elizabeth, “State’s Top Elected Officials Approve Mineral Leases, with Reservations,” *MPR News*, accessed November 25, 2013, <http://minnesota.publicradio.org/display/web/2013/10/25/elected-officials-vote-on-mineral-leases>.

³ Consumer surplus is the appropriate measure for economic benefits.

losses in others, despite the tendency for regional economies to attain overall growth or restriction in the long run.⁴

Thus, the results of economic impact studies provide only a portion of the overall economic effects associated with proposed development, for a very limited amount of time, and virtually none of the overall societal costs and benefits over time. This is important to consider when exploring regional economic development strategies.

Another consideration for the scope of economic impacts is that most are presented in isolation. While generated multipliers and impacts may appear large or small, the public and decision-makers have no context for the results if they are not compared to multipliers and impacts from other industries for a similar regional economy. What do these numbers mean? Depending on geographic, demographic, and other variables, regional economies and individual entrepreneurs have choices in the form of economic development they would like to pursue. Without a comparison to the impacts and multipliers associated with other types of industrial development in a particular region, the public and decision-makers do not have a proper context for framing results.

3. Disregard for Critical Economic Impact Analysis (EIA) Methods

We present the most critical EIA methods in detail below to provide the reader with their importance in determining all the subsequent results and economic impacts provided by models such as IMPLAN. Failure to adhere to these methods produces unreliable and inaccurate estimates of economic impacts, often leading to double, triple, and quadruple counting of unique economic impacts of income, employment, or industry purchases.

3.1 Defining initial changes in final demand

The driver of economic impact analysis is the *change in final demand* (via output, value-added, or employment) in the defined region that will be spurred by a new development. This change in final demand, or “shock” to the regional economy, is estimated by the researcher based on surveys of businesses and individuals, or in the case of the UMD report, getting input from mining companies and other groups to ascertain “employment estimates, local purchases, and operations dollar value of sales or output production (p. 3).” The change in final demand is entered into IMPLAN software and applied to the predictive I-O model for the particular region being studied. Once changes in final demand are entered into IMPLAN for the affected industry sectors, the software provides the *direct effect* to the region (subsequent analysis options allow for estimating *indirect and induced effects*).

All changes in final demand result in direct effects, but based on regional purchasing coefficients (RPCs) and location quotients as defined by the size and structure of the regional economy, IMPLAN software categorizes these direct effects by industry sector, domestic trade, and foreign trade. That is, direct effects are the initial estimate of how much of the regional final demand changes impact regional

⁴ These economic trends are perhaps easiest to understand from the individual laborer perspective. Regional economies typically have a limited labor supply. When an individual loses their job, they typically seek and find work at another company, as opposed to staying unemployed and representing a permanent loss to the economy.

industry sectors, how much leaves the defined region as domestic trade, and how much leaves the country as foreign trade.

Critically, data collection for changes in final demand is concerned only with economic activity that occurs in the defined study area. For example, if a mining company owns a mine in one part of the state, has state headquarters in another part of the state, and has international headquarters outside of the U.S., different changes in final demand will occur in all three areas based on new mineral sales. The location and impact of final demand changes based on mineral sales is different for each particular region. Given this, the proper delineation of the study area for regional economic impact analysis, and capturing final demand changes that occur within that region, are critical first steps in determining accurate direct effects and subsequent multiplier effects.

Multipliers represent the amount and number of times economic activity (e.g., output, value added, or employment) re-circulates within the defined study area. Specifically, multipliers are the ratio of total effects (direct + indirect + induced) to direct effects. All economic activity that is not captured by the local economy due to imports and purchases elsewhere is considered leakage. *The size of the defined study is a major determinant of the resulting multiplier effect, with larger study areas capturing more of the economic activity.*

Researchers have illustrated that study areas for regional EIAs should be restricted to the region most affected, not only in terms of economic impacts, but also in terms of costs incurred.⁵ The reasons for this are twofold. First, increasing the study area for localized economic development projects (such as for a few counties) beyond its primary economic influence (e.g., to the state-level) results in inflated multipliers and impacts. Secondly, and perhaps more importantly, an EIA should compare local economic impacts to local costs of such development including the need for greater public services and costs associated with environmental degradation.

As such, changes in final demand are strictly the purchases, sales, and employment that will occur within the study area. On p. 6, the UMD report correctly defines direct effects as *“Initial spending in the study area resulting from the project.”* On the same page, the UMD report also correctly defines value added and output in terms of *“contribution to the local economy”* and *“the value of local production.”* But, throughout the UMD report, two dramatically different study areas are used (the Arrowhead Region and the State of Minnesota), yet the majority of direct effects remain the same for both. This indicates that only one set of final demand changes were used for both study areas. This is a fatal flaw that undermines the credibility of the entire report.

- The authors of the UMD report utilize and present results for two different study areas: 1) the Arrowhead Region of Northeast Minnesota, which includes seven adjacent Minnesota counties and one adjacent Wisconsin county; and 2) the entire state of Minnesota, which includes 87 counties. The proposed mining expansion will all occur in the Arrowhead Region, making this the more appropriate study area. The only reason we can see for also utilizing an additional study

⁵ Hjerpe, E.E. and Y. Kim. 2007. Regional economic impacts of Grand Canyon river runners. *Journal of Environmental Management* 85(1): 137-149.

area of the entire state of Minnesota is to boost reported economic impacts. Indeed the first and primary comprehensive Table provided in the executive summary shows only the inflated impacts resulting in the entire state (p. viii). Utilizing two separate study areas is inappropriate and reflects a poor understanding of economic impact analysis. *If using multiple study areas, each study area must have its own survey (or data collection) of changes in final demand.*

- For these different study areas, most of the reported direct effects are identical. (Compare Tables 4 and 5 (p. 11); Tables 8 and 11 and Tables 9 and 12 (pages 14-15); Tables 18 and 19 (p. 20); Tables 22 and 25 (pp. 22-23); Tables 23 and 26 (pp. 23-24); Tables 33 and 35 (pp. 28-29), and Tables 34 and 36 (pp. 28 and 29). This illustrates that the researchers did not collect economic data specific to each defined study area, but rather utilized one set of final demand changes for both study areas. This is problematic for a number of reasons. First, Douglas County is in Wisconsin, and changes in final demand (and resulting direct effects) for construction, operation and output sales that occur in Wisconsin should not be counted in Minnesota. So even if 100 percent of the direct spending associated with the proposed new mining were to occur in the smaller study region, at least some of that effect would have to accrue to Minnesota's neighbor to the east.

Second, it is extremely unlikely that 100 percent of the direct spending would occur in the Arrowhead region in the first place. At least some of the increase in employment required to support the new and expanded mining would occur in the company's down-state and/or out-of-state / out-of-country offices (i.e., PolyMet state headquarters in St. Paul and international headquarters in Toronto). Wages and salaries earned by managers in the Twin Cities should not be confused with (or counted the same as) wages and salaries earned by mine workers in the Arrowhead region.

Third, it is likely that the sale of ore itself would be transacted in places far from the mine, and large portions of those sale proceeds (e.g., profits) would be part of the direct effect in those distant places, not in the Arrowhead Region. As is often the case with multinational mining companies, only the value-added portions of mineral sales would accrue as economic impacts in the Arrowhead Region.

Without seeing the precise assumptions and numbers that went into the estimation of the initial changes in final demand, it is not possible to say how much smaller the direct effect in the Arrowhead region should be. One can be certain, however, that those effects would be different, and smaller in the region than in Minnesota as a whole.

Interestingly, there are a couple exceptions in the presented Non-Ferrous Mining direct effects (Tables 22 and 25, and Tables 23 and 26) where only the value-added components are actually slightly different and are carried over to the summary tables in the combined totals at the end of the report. However, the value-added direct effects in these tables are actually higher in the smaller, Region Operations tables. We presume these are typos, as it suggests that value-added

impacts that occur in seven Minnesota counties somehow got lost on their way to the State of Minnesota. (The only way this would make sense is if the effects are so much larger in Douglas County, Wisconsin that they overwhelm the difference between Minnesota-wide effects and those occurring in the Minnesota portion of the Arrowhead region. But of course if this is true, then it further calls into question the estimates of direct value-added effects that are identical for the entire Arrowhead region and the entire State of Minnesota. (See, for example, Tables 9 and 11.))

- There is very little detail presented in the UMD report concerning their data collection and their construction of initial changes in final demand, yet this critically determines the direct effects and additional indirect and induced effects. The reader is only told that mining companies and other mining associated groups provided input to the authors to ascertain “employment estimates, local purchases, and operations dollar value of sales or output production (p. 3).” Accuracy and consistency in data collection is the first fundamental step in sound science. How were data collected? Did the author’s provide respondents with a written survey? In-person interviews? What regional economic study area was used? This information should be noted in the text and surveys and data collection instruments should be provided in an appendix.
- Many of the estimated jobs may be filled by transient workers, who will earn wages in the area and spend them elsewhere. It is not clear if this was taken into consideration for the initial estimates of changes in final demand. If not, employment effects will be overestimated for the regional economy.

3.2 Defining economic impacts

EIA, and its technical assumptions, are predicated on forecasting the impacts of *new* changes, or a “shock,” in final demand for a regional economy, most often from a proposed policy change or development plan. Economic impact analysis is defined in the IMPLAN Analysis Guide⁶ as:

“An assessment of change in overall economic activity as a result of *some change* in one or several economic activities [emphasis added].”

Despite this, the UMD report includes all *on-going* ferrous and non-ferrous mining operations in the impact study, combined with estimates of new construction and operation. The first summary table in the Executive Summary (p. viii), and likely the most important take home message from the report, claims that the total economic impacts are a “...Value Added total of almost \$5 billion, and Output of almost \$7.8 billion, and an Employment total of more than 27,300 (p. viii).”

Existing operations are supposed to be used to understand the current economic relationships between industry sectors that will be used to estimate potential economic impacts from the “shock” of new final demand changes in that industry. *These impacts have already been absorbed by the regional economy and should therefore not be counted among the impact of the new changes in the economy.* Inclusion of

⁶ IMPLAN Professional Analysis Guide. 1999. Technical Report. Minnesota IMPLAN Group, Inc.

existing operations indicates a lack of understanding economic impact analysis and grossly exaggerates impacts. In reality, such rapid mining expansion would come at the loss of existing mining industry due to increased cost of supply inputs and decreased market prices of final products from flooded local markets.⁷

4. Critiques of I-O Modeling and Implications for the UMD Report

There are numerous technical assumptions required for input-output (I-O) modeling, a core tool of economic impact analysis. I-O modeling is the balancing of all industrial sector sales and purchases, and exogenous sectors such as households,⁸ government, and foreign trade. That is, increases or decreases in one sector will yield a cascading effect on many other sectors that will ultimately balance out. The primary technical assumptions include linearity among production functions, fixed technical coefficients, homogenous sector output, and no supply constraints.⁹ The resulting implications of these assumptions yield a static regional economy, with no economies of scale, no technological advances, and an unlimited supply of resources and labor. In short, this is far from a realistic portrayal of any regional economy, but necessary for the mathematical balancing conducted within I-O models. These assumptions traditionally lead to inflated economic impacts. For example:

- Due to the unrealistic technical assumptions necessary for input-output modeling, all multipliers, and especially employment multipliers, are inflated and should be viewed with extreme caution. For example, the linear production functions lead to the presumption that businesses and households will spend and consume at the same rate. In reality, once a certain threshold in income is achieved, more saving and investing occurs (and often these savings are invested outside the region).
- Another example comes from the hypothetical economic assumption of fixed technical coefficients. Forecasting mining impacts in the year 2016 neglects improvements in technology. Labor-displacing technology is significant in the mining industry.
- The employment impacts in the UMD report are presented in terms of full and part-time jobs, not Full-Time Equivalents. Because of the seasonal and temporary nature of mining jobs, especially for all construction impacts, the reporting of employment impacts is suspect. The UMD report imparts no information of the typical percentages of seasonal and temporary workers in the mining industry. Without this context, the public and decision-makers are left wondering what the real impact will be. Likewise, the UMD report provides no comparison to potential employment impacts that might result from investments in other forms of economic

⁷ Stacking new impacts on top of on-going operations also illustrates the problems associated with unrealistic I-O modeling assumptions of linear production functions and unconstrained supply pools.

⁸ Households and other previously exogenous sectors have been “endogenized” in the structural accounting matrices used for most modern multiplier effects, such as in IMPLAN.

⁹ Miller, R.E. and P. Blair. 1985. Input-output analysis: foundations and extensions. New Jersey: Prentice-Hall, Inc.

development. How do these numbers compare to other industries that communities might want to pursue?

Given that the UMD report acknowledges how these assumptions can lead to overestimates, and given that information about the critical relationship between output and employment was provided by mining project managers without additional information taken from independent sources (p. 8), it would be reasonable to expect the UMD report to take a more conservative approach.

5. Tax impacts

The tax impacts from existing and proposed mining in Minnesota are presented in the UMD report in detail. At first glance, they appear impressive. Upon a closer examination, however, it becomes clear that the mining industry is afforded minimal taxation by the State of Minnesota.

- A calculation of overall taxes presented in the UMD report illustrate that the mining industry is afforded an *effective regional tax rate of less than one percent of calculated direct output* .

\$17.6 million in 2010 from Table 38, divided by \$1.85 billion of estimated direct output for both ferrous and non-ferrous 2010 baseline from Table 41 = 0.95%.

As direct output in the region is necessarily smaller than overall sales of final mining products, this effective regional tax rate is miniscule and represents major tax breaks provided to the mining industry. The more important question is how do these tax rates compare to other sectors in the economy? Given the normal regional rates of taxation on most industries (e.g. tourism), a comparison within the UMD report would provide substantial context for the public and decision-makers.

- No costs associated with mining are presented in the UMD report. Yet, we know from recent history that mining is a boom and bust industry, susceptible to volatile, global mineral pricing. We also know this type of development will require increased infrastructure, health, and emergency services that are needed with such rapid development. Additionally, ample public taxes will be needed in the future to pay for future rehabilitation and reclamation of degraded mining lands, as well as continual monitoring of water quality and active treatment for hundreds of years, at least.¹⁰ With such a miniscule effective tax rate for the mining industry, it seems prudent to question whether current annual taxes can keep up with the public service needs stemming from rapid development, much less provide for future clean-up costs.

But, the less than one percent effective regional tax rate per direct output is not the only exceptional characteristic of Minnesota mining taxation. A deeper look at the collected taxes

¹⁰ Karnowski, Steve, "New Environmental Review Due for PolyMet's Copper-Nickel Mine," *Associated Press*, accessed December 5, 2013, http://www.twincities.com/localnews/ci_24634015/minnesota-copper-nickel-mine-new-environmental-review.

shows that of 13 tax accounts, six are funneled back into minerals management (Table 38). While we do not know the exact distribution of each tax account,¹¹ the appearance is that a substantial portion of the taxes collected are reinvested back into the mining industry. This represents further tax breaks and kick-backs to the mining industry in Minnesota.

6. Other Problems with the UMD Report

The UMD report is deficient in many areas, leading to consistent inflation of actual economic impacts stemming from mining in the region. Other issues from the UMD report include:

- Table 1 and the discussion on Gross Regional Product (GRP) on page 4 are incorrectly presented, and very misleading. First, GRP is equivalent to a state's gross domestic product (GDP) and represents the market value of *final* goods and services. Including indirect and induced effects in GRP calculations (as noted beneath Table 1) is inaccurate and a poor use of multipliers and leads to substantial overestimates. In fact, intermediate inputs from other industries should be subtracted, not added (see BEA definition for state GDP).¹²

Secondly, the UMD report states that, "Note that the GRP for the State of Minnesota was \$281.1 billion. When compared to the State, mining GRP totals approximately 5.3% for 2010" (p. 4). At 5.3%, mining GRP for Minnesota in 2010 is presented as \$14.9 billion. However, when we looked at the source presented in Table 1 (BEA Regional data), we find that for 2010, mining as a whole represented only \$724 million of Minnesota GDP, or 0.3% of Minnesota GDP for that year (\$268.6 billion). It is unclear how the numbers in the UMD report were derived. *This is a major discrepancy and leads to vast inflation of mining's importance.*

- The comparisons to the tourism industry GRP in Table 1 are also misleading, as they vastly under-represent the industrial sectors that combine to make up the tourism industry. The tourism industry is comprised of portions of multiple industries, making it difficult to assign a GRP value. The notes for Table 1, state that tourism was estimated from two IMPLAN sectors, "amusements, gambling, and recreation," and "accommodation and food services." This, however, does not capture all tourism products. A number of researchers have illustrated that additional sectors combine to make up the tourism industry.¹³

¹¹ Some taxes may in fact be used to help clean up mine sites. But, the appearance is that a significant portion of mining taxes are spent on increasing mining development (e.g., funding university advocacy).

¹² The BEA defines gross domestic product by state as: "GDP by state is the value added in production by the labor and capital located in a state. GDP for a state is derived as the sum of the gross domestic product by state originating in all industries in a state. In concept, an industry's GDP by state, referred to as its "value added", is equivalent to its gross output (sales or receipts and other operating income, commodity taxes, and inventory change) *minus its intermediate inputs* (consumption of goods and services purchased from other U.S. industries or imported). Thus, GDP by state is the state counterpart of the nation's gross domestic product (GDP), BEA's featured measure of U.S. output." Italics ours.

¹³ For example, Marcouiller, D.W. and X. Xia (2008. Distribution of Income from Tourism-Sensitive Employment. *Tourism Economics*. 14(3): 545-565), include those sectors listed as well as portions from the Retail Trade and Passenger Transportation sectors.

- The UMD report gathered all necessary inputs from mining companies and mining-associated organizations and agencies. Given that the report was prepared for these same groups, we believe that a more objective approach would include input from other perspectives, particularly those of sectors (industries, households) likely to be harmed by non-ferrous mining in the study region.
- An earlier version of the 2012 UMD report was released by UMD in 2009. The 2009 version appears to suffer from the same methodological failures detailed above. However, one note of interest is the major decrease in economic impact for both existing and proposed non-ferrous mining expansions. The direct employment in the region for non-ferrous on-going operations decreases from 531 in baseline 2007 (in the 2009 UMD report, p. 30) to 175 in baseline 2010 (in the 2012 UMD report, p. 20), or a 67% decline. While we question the accuracy of all estimates in the reports, this is a precipitous decline if taken at face value¹⁴. It is also emblematic of the lack of accuracy in UMD's projected economic impacts. Instead of gaining more than 2,000 direct jobs in the region that were supposed to be operational by 2013 (as projected in the 2009 UMD report, p. 32), the non-ferrous industry has been losing jobs. This issue also highlights the inability of I-O models, such as IMPLAN, to account for changes in production functions and technical coefficients.

7. Conclusion

After thoroughly reviewing the UMD report, we conclude that the study is deficient in a number of areas and suffers from fundamental flaws. We also conclude that even if accurate economic impacts were presented for potential mining expansion, they should be viewed as a small component of the overall costs and benefits to society. The public interest should be most concerned with the long-term consequences of mining development, the costs incurred, and opportunities that will be lost.

Finally, communities in Northeastern Minnesota should be very cautious in pursuing a particular economic development strategy. "If some is good, then more is better," is not always applicable. To wit, economic diversification increases community resilience in times of recessions and when exposed to the "bust" cycle of an important industry sector. If mining is indeed already 30% of gross regional product in Northeastern Minnesota (p. 4), a virtual doubling of direct mining jobs will render the region utterly dependent on a known boom and bust industry, decreasing its overall economic diversification. This is not a wise economic development strategy.

¹⁴ We recognize a recession occurred during this time. However, baseline contribution of ferrous mining increased during this period.

Sulfide-Ore Copper Mining
and/or
A Sustainable Boundary Waters Economy:
The Need to Consider Real Tradeoffs

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Prepared for:

Northeastern Minnesotans for Wilderness



Research and strategy for the land community.

EXECUTIVE SUMMARY

The USDA Forest Service is considering how to analyze the environmental impacts of the proposed withdrawal, for up to 20 years, of 234,328 acres of federally-owned lands within the watershed of the Boundary Waters Canoe Area Wilderness (BWCAW) from the federal mining program (USDA Forest Service, 2017). Because environmental impacts include effects on the economy, the question of how many jobs might be created by new mining activity in the Arrowhead region (defined here as St. Louis, Lake, and Cook Counties, Minnesota) is important. Equally important, but something that has so far been lost in the debate, is how many jobs and how much income in other sectors, and how much economic value that may not show up in job and income statistics—what economists refer to as “non-market” value (Stout, Winthrop, & Moore, 2015)—could be destroyed by the introduction of novel mining activity.

Proponents of *sulfide-ore copper mining* argue that the choice between this new type of mining and amenity-based development is a false choice for the Arrowhead region (Praxis Strategy Group, 2017). Those making this claim point to the continued existence of the *taconite mining* industry during the now decades-long expansion of amenity-based development in the region as proof that northeastern Minnesota can, in essence, “have it all.” According to this argument, the region can gain a relative handful of higher-paying jobs in mining; it can continue to have an abundance of high-quality recreational, scenic, and environmental amenities; and it can have jobs, income, and quality of life that exist in the region because of those amenities.

If the proposed sulfide-ore copper mining raised only the same environmental concerns as taconite mining and/or the sulfide ores were located as far away from the Boundary Waters as taconite mining and not within the BWCAW watershed, this argument might warrant consideration. But sulfide-ore copper mining presents more serious risks, such as acid mine drainage, and it would introduce risks in and around the Boundary Waters—the area that represents and produces those high-quality natural values that are the foundation of the region’s new economy. It is therefore far more likely that the “false choice” argument is itself false. There are two primary reasons:

First, the “we-can-have-it-all” claim relies on a distorted picture of the economy in which the size and importance of mining is inflated relative to the size and importance of the amenity-based development that sulfide-ore copper mining may disrupt. This distorted picture comes from studies that focus only on the economy’s exports (whether mining or tourism experiences) to the exclusion of other important facets of the economy. Those studies rely on a model of economic development that is decades, if not generations, behind the times. The studies incorrectly assume that only sales to buyers from somewhere else—for example, a steel mill or a vacationer from out-of-state—bring revenue to or support jobs in the local and regional economy. Such studies count jobs in the mines or at a resort, but they ignore jobs and income that exist in Arrowhead region due to what is known as “amenity-based development.”

Amenity-based development is economic activity in a host of industries, including recreation/tourism, construction, personal and professional services, retail, and others that arrives or stays in a region for the sake of its scenic, recreational, environmental, and quality-of-life amenities. These amenities induce an in-migration (and support the retention) of human capacity (entrepreneurs, skilled workers) that is the real engine of economic development. Amenities also attract and retain consumers, including retirees and working-age people who could do their jobs anywhere, but who would prefer to live in a place with a high quality of life.

In a world where many jobs can be done from almost anywhere, economic research must begin with an understanding of what it is that makes people choose any given location. This is not to say that the presence of a raw material is immaterial, but it does mean that, as in the days of classical economists David Ricardo and Adam Smith, one needs to pay attention to all of the factors that bestow comparative advantage on a region.

The economy of the Arrowhead Region has moved away from dependence on mining and now has a more diverse and stable economy. This has been particularly true since the early 1980s when steel manufacturing in the United States experienced significant declines that reduced demand for iron ore, including from the Arrowhead region. Structural changes in American industry, improvement in transportation, shipping, and communications networks, and new ways of hiring, working, and living have meant changes, described below, in the Arrowhead region similar to those seen in many high-amenity areas around the country. Increases in recreation and tourism are a big part of those changes, but so is the ability of people to locate their businesses and themselves where they will. While the Arrowhead still has taconite mining, forest products, manufacturing, and other “goods-producing” industries, it now relies predominately on environmental amenities and the quality of life to attract and retain business owners, workers, visitors, and retirees. Those who choose the region create and/or support jobs in diverse industries, including construction, manufacturing, recreation services, lodging and dining, and personal, professional, and educational services.

Second, the “we-can-have-it-all” claim is based on a false assumption that all mining, no matter what type or where it occurs, is compatible with all recreation, tourism, and other amenity- and/or quality-of-life-driven development. Taconite mining (particularly in places farther away from the BWCAW, its gateway communities, and from watersheds that give the Boundary Waters its name and its scenic and environmental quality) is not the same as sulfide-ore copper mining in the Boundary Waters watershed, on those communities’ doorsteps, and among the homes and businesses that exist where they do because of that scenic and environmental quality.

It is certainly true that amenity-based development has accelerated in the Arrowhead region while mining employment has continued (albeit at a much lower level), but it does not mean that further mining for different ores and with different environmental effects would not dampen or reverse that development. Indeed, as our preliminary investigation and scenarios reported below suggest, the introduction of sulfide-ore copper mining could cost the region the unique resources that are the basis for its sustainable economic development.

In this report, we review the composition of the Arrowhead Region’s economy as it has evolved over the past several decades. We demonstrate that demographic, employment, and income trends are consistent with a now-established understanding of how rural economies actually grow. In a nutshell, people follow amenities, and jobs follow people. Or, as McGranahan, Wojan and Lambert (2010) conclude, there is a “trifecta” of attractive outdoor amenities, creative workers, and entrepreneurship strongly associated with employment and business growth in areas that would otherwise face difficult economic challenges.

Regional economic trends, explored in detail in the body of this report, are consistent with this dynamic. The Arrowhead region has seen

- steady growth in population (after an early-1980s decline),
- steady increases in employment and personal income in diverse industries,
- growth in proprietors’ employment and income, and

- increases in non-labor income (such as investment income and Social Security payments) from people who may be living in or coming to the region to retire.

Looking forward, we also consider how these trends could change with the proposed advent of sulfide-ore copper mining in the watershed of the Boundary Waters. Based on information from business owners, retirees, and others, we consider how such mining, by changing the availability of attractive amenities and changing the quality of life, could change the trajectory for future prosperity in the region. We consider impacts on the recreation and tourism industry, on the broader amenity-based economy, and on the land values that may be diminished due to proximity to potential mining activity.

As explained below, based on conservative assumptions, sulfide-ore copper mining in the watershed of the Boundary Waters could bring the following effects for the three-county Arrowhead study region:

- \$288 million in lost visitor spending each year that would otherwise support
 - 4,490 local jobs
 - \$76 million in residents' income
 - \$31 million in state and local taxes, and
 - \$181 million in proprietor's income and business-to-business transactions
- 5,066 to 22,791 lost jobs, and between \$402 million and \$1.6 billion in lost annual income in the rest of the economy if sulfide-ore copper mining suppresses or reverses growth in the amenity-based economy that has been the backbone of the region's recovery since the early 1980s
- \$509 million in lost property value. This is a one-time drop in asset value that will spawn annual reductions in local property tax revenue throughout the Arrowhead region.

By implementing the mining withdrawal, as proposed, these and other costs would be avoided, thus delivering a benefit to the American people and Minnesotans equivalent to a one-time payment of more than \$6.1 billion.¹

We do not claim that these estimates are complete. Indeed, we suspect that there may be threshold effects or feedbacks that would make actual effects much larger than what we have included in the scenario. Moreover, our estimates do not include the direct costs of long-term monitoring for, and attempts to mediate the occurrence of, acid mine drainage. Nor do they include direct impacts on local governments who may face higher road maintenance, water treatment, or other costs. The estimates developed here, therefore, should be taken as a first approximation of the sort of detailed analysis the Forest Service should complete as part of its Environmental Impact Statement examining the effects of the proposed withdrawal of federal land from the federal minerals leasing program, for a period of 20 years.

¹ This is the present discounted value of the stream of future benefits (costs avoided) over the proposed withdrawal period of 20 years, and using the 0.2% discount rate recommended by the Office of Management and Budget for such analyses (2017).

TABLE OF CONTENTS

Executive Summary.....	i
Table of Contents.....	iv
About the Authors	v
The Arrowhead Economy.....	1
Area Overview.....	1
Transformation of the Arrowhead Economy, 1970-2015	1
Beyond “Folk Economics”	2
Demographic Trends.....	5
Total Population: Decline and Regrowth.....	5
Age of the Population	5
Housing	6
Employment and Income.....	7
Unemployment Rate.....	7
Income by Source.....	9
Employment and Income by Industry.....	10
Visitor Expenditures and the Tourism Industry	14
Seasonal Residents.....	15
Potential Effects of Sulfide-Ore Copper Mining on the Arrowhead Region’s Economy.....	16
What Drives Costs of Sulfide-Ore Copper Mining?.....	17
Survey of Arrowhead and Minnesota Business Owners	19
Estimated Costs: Three Ways Sulfide-Ore Copper Mining Would Affect the Arrowhead Region’s Economy.....	21
Lost Visitor Expenditures	22
Losses to the Broader Economy	23
Lost Property Value.....	25
Summary and Recommendations to the Forest Service	28
Works Cited.....	30
Appendix A: Business Outlook Survey	A-1

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Key-Log Economics remains solely responsible for the content of this report, the underlying research methods, and the conclusions drawn. We have used the best available data and employed appropriate and feasible estimation methods but nevertheless make no claim regarding the extent to which these estimates will match the actual magnitude of economic effects experienced if the Forest Service does not implement its proposed withdrawal of lands from the federal mining program.

THE ARROWHEAD ECONOMY

Area Overview

St. Louis, Cook, and Lake Counties make up what is called the Arrowhead Region of Minnesota (see Figure 1 below). This region boasts the natural beauty of forests and deeply interconnected streams, lakes, wetlands and groundwater. Beautiful destinations within the region include Voyageurs National Park, the Superior National Forest, and across the northern border of this region, the Boundary Waters Canoe Area Wilderness.

Reputed to be America's most visited wilderness, the BWCAW attracted 155,611 visitors in 2016 (The Wilderness Society, 2017; USDA Forest Service, 2017). The Boundary Waters contains 1.1 million acres of near-pristine water and unspoiled forests and wetlands that are as important to wildlife as they are attractive to people.

Recreational resources include 1,200 miles of canoe and kayak routes, 1,175 lakes, 12 overnight hiking trails and more than 2,000 campsites (Ely Chamber of Commerce, 2016)

The Arrowhead Region's natural landscape attracts visitors who love to hunt, hike, camp, canoe, fish, and relax outdoors in a wilderness setting. As such, the landscape is vital to supporting the tourism industry of Northeastern Minnesota.

In addition, the Arrowhead Region of Minnesota exhibits what some researchers have termed "the rural growth trifecta"—a combination of outdoor amenities, creative workers, and entrepreneurship (McGranahan, Wojan, and Lambert, 2010). The area attracts retirees, seasonal residents, those working remotely (e.g., "digital nomads"), and entrepreneurs who could set up shop anywhere but who choose to do so in places with a high quality of life.

"Minnesota is known for its north woods and clean water. Those of us that live here value that and value the fact that we can vacation in our own back yard up north. Many people have cabins or lake homes in the northern part of the state. Many people dream to retire in the area. The state of Minnesota enjoys a very healthy diversified economy. I believe this is possible because of what our state has to offer to prospective businesses and talent they can bring to the state because of our quality of life."

--Retail Business Owner (Anonymous Survey)

TRANSFORMATION OF THE ARROWHEAD ECONOMY, 1970-2015

The Arrowhead Region (St. Louis, Lake, and Cook Counties) in Northeastern Minnesota is home to a large taconite mining industry once understood to be *the* major driver in the local economy. In 1970, one in ten jobs and 15 cents per dollar of income earned were in the mining industry. Decline in the U.S.-based steel industry meant less demand for iron ore and, by the mid-1980s, the mining boom in the Arrowhead had ended. Automation has increased per-worker productivity, and mining's contribution to Minnesota's Gross State Product has stabilized, hovering around 1% over the past two decades (Cao and Tate, 2016, with Minnesota data downloaded from <https://bea.gov>). The other side of the productivity coin, however, has been a continued, steady decline in employment, and today fewer than 3 in 100 jobs and less than 5 cents per dollar in personal income is directly attributable to mining.

Beyond “Folk Economics”

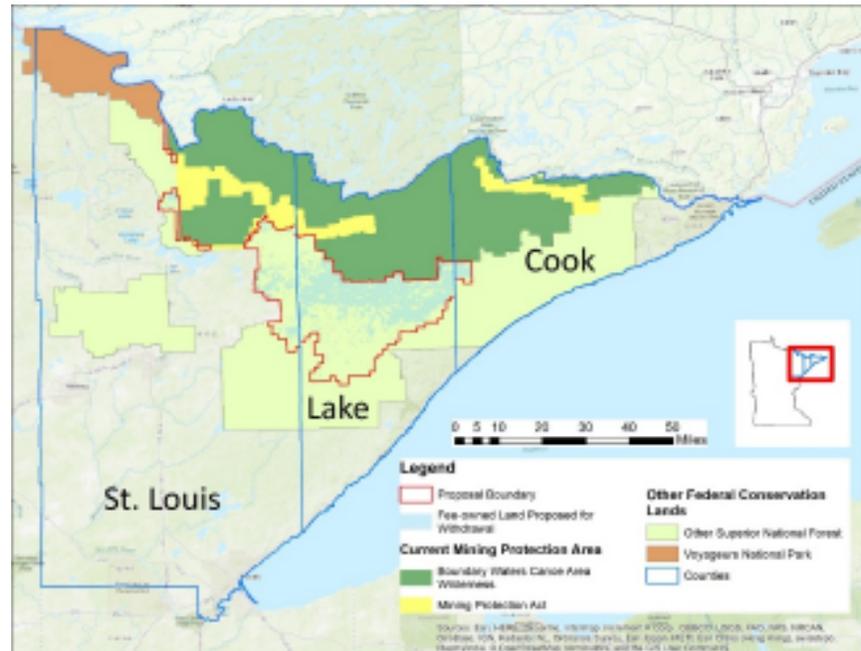
If the traditional view or “mental model” of regional economic development were still applicable, the decline in taconite mining in the Arrowhead region would doom the region to long-term decline. But such a model is, at best, out of date, and any consideration of the region’s alternative futures must be grounded in mental model, or conception, of an economy built on fundamental values in addition to the sale of material goods to other regions.

Dr. Thomas Power, in discussing the potential effects of a copper mining operation in Arizona, explains how much of our popular understanding of how economies work is rooted in “the export base view of the local economy” (2010, p 4). In this view or model, people from the local or regional area grow crops, mine for minerals, harvest timber or otherwise extract a product from the land and then export that product to another region in exchange for cash. A slightly evolved version of this model recognizes that tourism is part of the “export base” along with other goods-producing industries. The only difference is that exporting an experience (i.e., tourism) requires the buyer to come to the region, leave his or her money behind, and then take the experience home with them. In this model, that initial export transaction is the basis for all other economic activity, because the farmer, the miner, the logger, and the tourism provider all have to employ local people as laborers and buy various goods and services from other local businesses. The lumberman may hire a trucking company and buy equipment, the farmer may hire a farmhand and buy seed, and the tourism provider hires staff and buys provisions to outfit visitors’ trips into the backcountry. Empirical versions of the economic base model, generically known as “input-output models” combine the effects of spending by the employees of the exporting businesses with spending by the employees of the businesses that serve the exporting businesses to generate estimates of “multiplier effects”. These multipliers purport to show how much “output” in the form of jobs or income the region gets as a result of the initial “input” of spending on the exported goods or services. There is a limit to these rounds of impacts, because eventually some business or household is going to IMPORT a good or service from somewhere else and dollars that had been circulating among local firms “leak” out of the local economy and go on to stimulate some round of spending in another region.

There are many things wrong with this conceptual model and many more wrong with the empirical input-output models used to estimate impacts and multipliers. Not least of these, are that the empirical models have little predictive power (Krikelas, 1991) even in cases ideally suited to their

Figure 1: The Arrowhead Region

Public Lands, including the Boundary Waters Canoe Area Wilderness, and Areas Proposed for Withdrawal from the Federal Mining Program.



Sources: USDA Forest Service; U.S. Bureau of the Census; ESRI base map.

underlying structure and assumptions (Roberston, 2003). It has been 32 years since H.W. Richardson looked and concluded that 40 years' experience with economic base models [to that date] "[had] done nothing to increase confidence in them". In addition, he concluded that it would be hard to "resist the conclusion that economic base models should be buried, and without prospects for resurrection (Richardson, 1985)." Nevertheless, consultants and others persist in using these models because they conform to faulty, "folk-economic" assumptions and they provide the impressive sounding answers that those promoting various development schemes, tax breaks, or other policies may want decision makers or the public to hear.

Fundamentally, however it is not the export of goods, services, or experiences that determines the economic fortunes of a region. Rather, it is the underlying productive capacity of all of the region's resources. It is the combination of natural capital with the creativity, energy, and spirit of the people occupying those places. (Natural capital capacity for natural systems to provide food, raw materials, clean water, pleasant scenery, and recreational opportunities, among other "ecosystem services" essential to the health and well-being of people (Farley, 2012))

If the economic base model's assumption that "people will simply go to where the jobs are" was true in the past, it is true no longer. Today, people can locate where they will, and given the choice, will go where the quality of life is high, even if that means accepting a lower cash income. Niemi and Whitelaw call this getting a "second paycheck" in health, recreational access and other values, that compensates for the income they give up by not moving to a less desirable location (1999, 18). (See also Roback (1982 and 1988) for earlier statistical analysis of this phenomenon.) Moreover, businesses are comprised of people, and the people who are business owners and managers often choose to locate their business in places that offer a high quality of life, and where they can find workers who appreciate that second paycheck.

Power (2010) puts it this way:

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 (p. 3).

He concludes that an appropriate and adequate evaluation of the impact of economic changes (Power happened to be writing about potential copper mining as well) must consider the supply side of the labor market and not just the demand for labor "created" by export-oriented development. Because it is the supply of labor attracted to a region that matters most to the region's development, this newer model of regional development is typically called a "supply-side" model.

Amenity-based development has taken the place of mining as the engine of economic development in the Arrowhead region. Amenity-based development is economic activity connected to a region's scenic, recreational, environmental (clean air, clean water), and other quality-of-life assets. Amenity-based development extends far beyond the recreation and tourism industries to any good- or service-producing industry that sells homes, cars, personal or professional services, food, etc. to people who move to, or stay in, a region because of its scenic beauty, quality of life, and in the case of the Boundary Waters, unique, world-renowned recreational opportunities. Construction, medical and financial services, all manner of retail, and other diverse industries are all contributors to (and beneficiaries of) the amenity-based economy of the Arrowhead region.

This new economy still has an export component: when people from outside the region come to Ely or Grand Marais to visit, they take away the experience and the memory of the landscape, and share it with others who may be convinced to visit. Unlike mining, such use of the landscape's scenic, recreational, and other amenities can be repeated indefinitely without fundamentally altering the landscape or diminishing its capacity to supply similar values to future visitors or future generations. In other words, the Arrowhead's amenities are a resource much like minerals, with the important exception that amenities are not used up by use.

Key Trends in the Arrowhead Economy

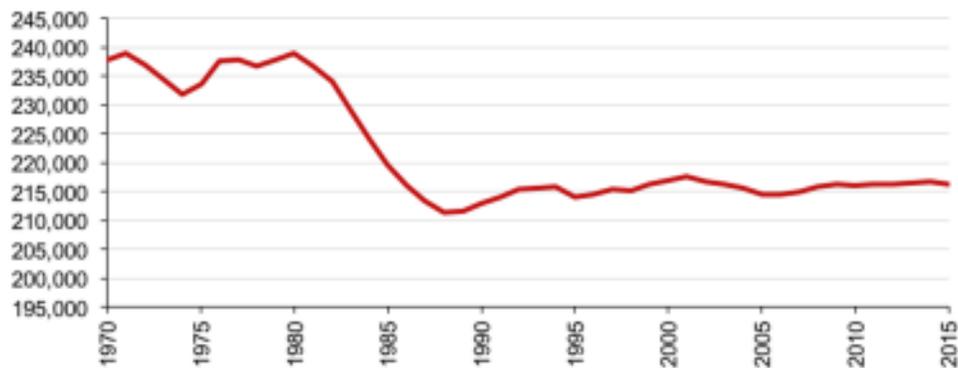
- The recession of the early 1980s coincided with a decline in mining from 10% of regional employment in 1980 to 2.5% in 2015.
- Services, including those directly connected to the region's high quality outdoor amenities (recreation and tourism) and those indicative of robust amenity-based development (construction, professional and other services) were already growing in the early 1980s and have continued to outpace all other sectors since.
- Today, more than 7 in 10 jobs are "services related."
- The fastest employment growth (since 2010) in the services category is coming from
 - information (up 13.4%)
 - professional services (up 12.3%)
 - real estate (up 12.1%)
 - educational services (up 10.0%)
 - arts, entertainment, and recreation (up 8.9%)
- The population of the three-county Arrowhead Region containing the Boundary Waters has been stable since 1990.
- Population, employment and income trends indicate the attractiveness of the Arrowhead Region to retirees and entrepreneurs.
 - Median age has increased and the largest increases in population have been among people 45 and older.
 - In 1980, sole proprietors represented slightly more jobs than mining. Today there are seven times as many proprietors as mining jobs.
 - Since 2000, growth in proprietors' employment has outpaced growth in wage-and-salary employment by a factor of 4.5 (10.3% in 2015, up from 2.3% in 2000).
 - While labor income has grown (by 8.8% since 2000), non-labor income from investments and transfer payments like social security have increased by nearly four times as much (by 33.3%).
 - Non-labor income accounts for 42% of all personal income in the region (up from 26% in 1970), with investment income and age-related transfers making up three quarters of non-labor income.
- Since the late 1980s, unemployment trends in the Arrowhead Region have tracked closely with those in the State of Minnesota as a whole.

Demographic Trends

Total Population: Decline and Regrowth

From 1970 to 2015, the total population declined from 237,809 to 216,256 people, with most of the change occurring between 1980 and 1988—a period of steep decline in mining employment. Since 1988, the population has rebounded, by 2.3% or 4,812 persons. However, from 1990 to 2014 the population of the three-county Arrowhead Region has been stable with modest growth of 2%. (See Figure 1.) (Note that these population estimates include only year-round residents, not seasonal residents.)

Figure 2: Population, Arrowhead Region, 1970 – 2015



Source: Headwaters Economics: Economic Profile System-
<https://headwaterseconomics.org/>: SocioEconomic Measures: Underlying Data Sources: U.S. Department of Commerce. 2016. Bureau of Economic Analysis, Regional Economic Accounts, Washington, D.C. Table CA30.

Age of the Population

The Arrowhead region’s population is older, and, apart from St. Louis County, is getting older faster than the population of Minnesota as a whole. From 2000 to 2015, the median age in Minnesota and in St. Louis County increased by 2 years; in Lake and Cook Counties, the increase was 7 years. Within the Arrowhead region, there are fewer in the under 18 and 35-44-year-old age brackets, with gains coming in the 18-34, 45-64, and 65 and over brackets. While not definitive, the gains in the older two brackets, coupled with the region’s rapid rise in age-related transfer payments (i.e., Social Security and Medicare payments--see below), suggest an increase in the number of people choosing the region for their retirement.

Figure 3: Change in Median Age, Arrowhead Counties and Minnesota, 2000 - 2015

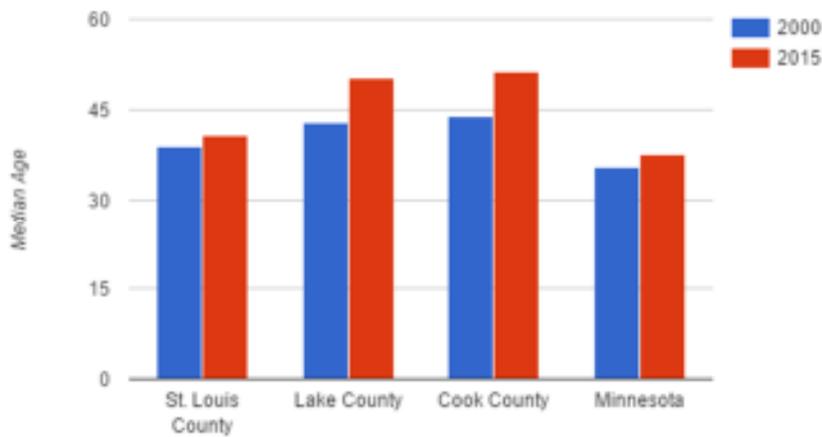
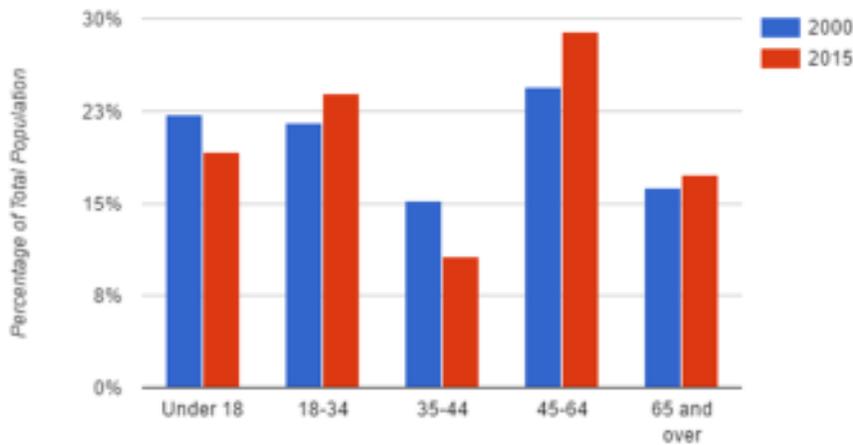


Figure 4: Age Distribution, Arrowhead Region, 2000 and 2015



Sources: US Census Bureau. (2017). American Fact Finder. Retrieved from <https://factfinder.census.gov/>; Headwaters Economics. (2017). Economic Profile System. Retrieved from <http://headwaterseconomics.org/tools/eps-hdt>

Housing

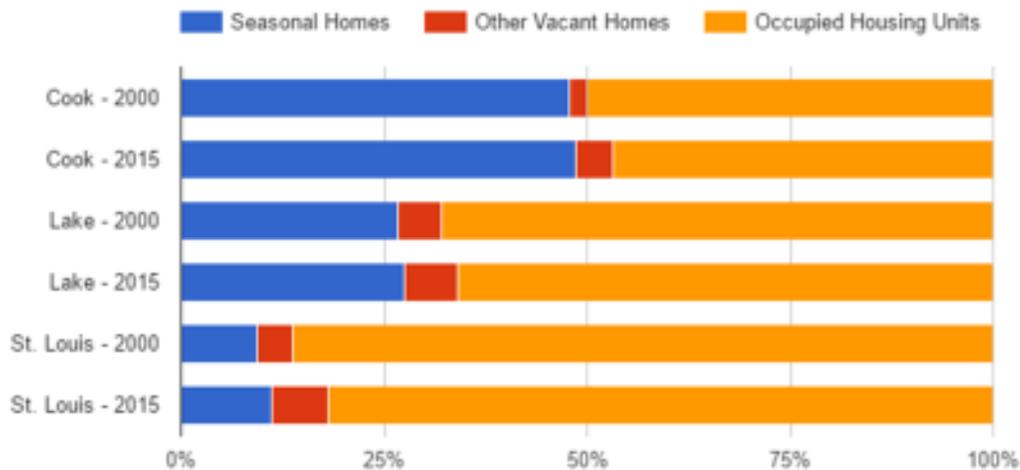
The Arrowhead region added almost 10,000 housing units (+8.6%) from 2000 through 2015. During the same period, the region’s population was nearly flat (476 fewer people, or a decline of 0.22%). This seeming disconnect reveals two trends: more people are moving into their own housing units (as sign of increasing overall prosperity); and more people are building vacation homes in the region. In contrast to the 8.6% increase in overall housing units, the number of housing units for “Seasonal, Recreational, or Occasional Use” increased by 26% in the region. In Lake and Cook Counties vacation homes now comprise nearly one third and one half, respectively, of all housing units. St. Louis County, which has many more housing units to begin with, is adding vacation homes at the fastest rate (up 29% since 2000).

These housing trends illustrate the attractiveness of the region for regular visitors. It also helps explain some of the other trends we’ll describe below, including increases in jobs and income in construction, real estate, and a host of other industries that people would use in the course of purchasing land,

building a home, and then using it repeatedly over the course of years. Groceries, utilities, home maintenance, health care while in the region, restaurant meals, and others are all part of the package when people invest in a region based on its quality of life.

The housing trends may also be a harbinger of still more future growth, if the current owners of homes for seasonal or occasional use become full-time residents. Some of these owners could be looking ahead to converting the homes for retirement use, and some may decide to move their job or business to the region. Either would represent important, long-term economic development opportunities for the Arrowhead region.

Figure 5: Housing Units by Type, Arrowhead Counties, 2000 & 2015



Sources: US Census Bureau. (2017). American Fact Finder. Retrieved from <https://factfinder.census.gov/>

Employment and Income

Unemployment Rate

In the mining bust of the early 1980s, unemployment rates spiked to nearly 20%. Since 1988, however, Arrowhead unemployment rates have remained much lower, and they have tracked closely with the statewide unemployment rate (Figure 6). This is consistent with what one would expect of an increasingly diverse economy. In another sign of increased resilience in the Arrowhead region since the late 1980s, recessions have not pushed unemployment as high and the recovery from them has been faster than before the mining bust (Figure 7).

Figure 6: Unemployment Rate, Arrowhead Region, 1976-2015

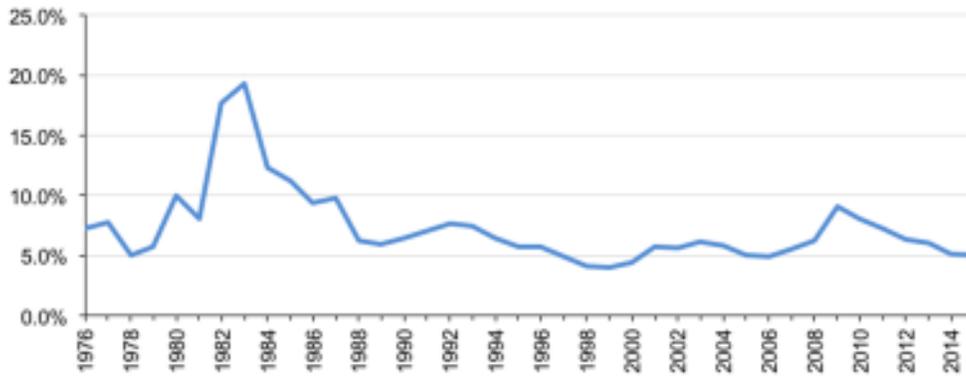
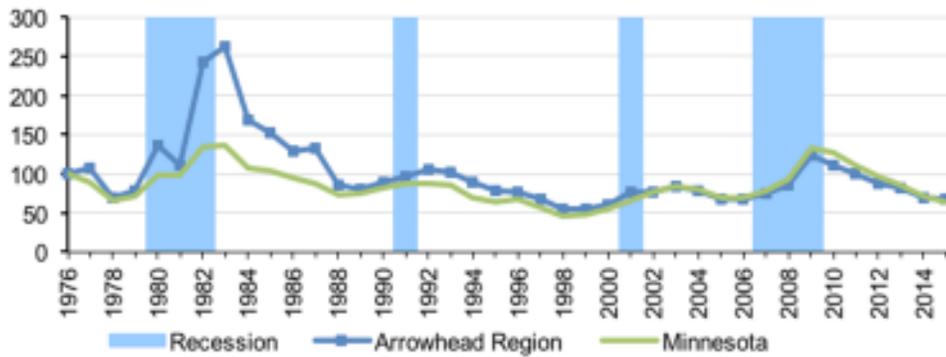


Figure 7: Unemployment Rate, Arrowhead Region and Minnesota, 1976-2015 (indexed with 1976=100)



Source: Headwaters Economics: Economic Profile System- <https://headwaterseconomics.org/>: SocioEconomic Measures: Data Sources: U.S. Department of Commerce. 2016. Bureau of Economic Analysis, Regional Economic Accounts, Washington, D.C.; U.S. Department of Labor. 2016. Bureau of Labor Statistics, Local Area Unemployment Statistics, Washington, D.C.

From 1970 to 2015, total employment in the Arrowhead region grew from 95,516 to 134,402, a 41% overall increase that erased losses sustained due to the mining-led bust of the early 1980s. From 1983 to 2015 jobs grew by 39,933, a 42% increase. While wage and salary jobs (that is, working for someone else) are most common, proprietorships are growing faster--by more than 10% since 2000, compared to the 2.3% increase in wage and salary employment over the same period (Figure 8).

By 2015, one worker in six was self-employed. This concentration of proprietors indicates the region's "entrepreneurial breadth", which is one of several key rural assets that supports economic prosperity and resilience in today's global economy (Low, 2004).

Figure 8: Employment by Type, Arrowhead Region, 1970 - 2015



Source: Headwaters Economics: Economic Profile System-
<https://headwaterseconomics.org/>: Socioeconomic Measures Report: Data Sources:
 U.S. Department of Commerce. 2016. Bureau of Economic Analysis, Regional
 Economic Accounts, Washington, D.C. Table CA30.

Income by Source

The income earned by wage-and-salary workers and by proprietors is “labor income”, and that accounts for 58.3% of total personal income of Arrowhead region residents. The other 41.7% is “non-labor” income and is comprised of income from past investments (dividends, interest, and rent), plus transfer payments, like Social Security and Medicare. Non-labor income has increased by a third (33.1%) since 2000, while labor income has increased by just 8.8%. Because non-labor income is attached to a person and not to a job or company, this is an important part of a region’s economic engine, and may be particularly sensitive to changes in quality of life, including the availability of recreational and environmental amenities. People can retire where they want, and, other things being equal, they are more likely to choose places with a safe and pleasant natural environment.

Earnings per job and income per person tell a similar story. While average earnings are increasing for wage and salary employees in the Arrowhead region (Figure 10), average income per person is rising much faster. Like the demographic trends, this reflects an aging population with relatively more investment and retirement income.

Figure 9: Labor and Non-Labor Income, Arrowhead Region, 1970 - 2015

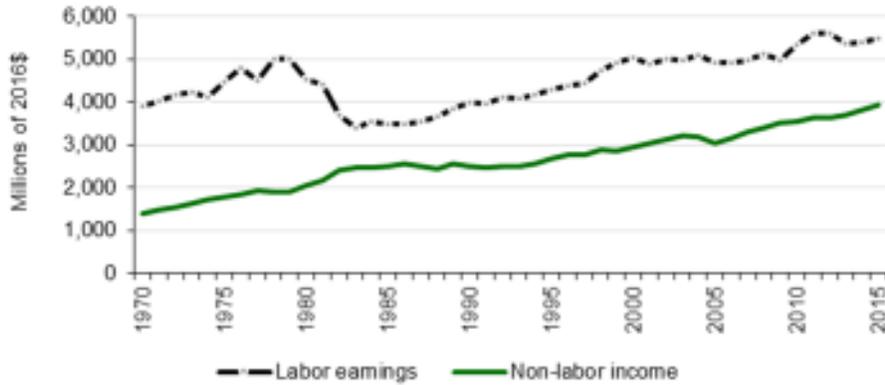


Figure 10: Earnings per Job & Per Capita Personal Income, Arrowhead Region, 1970 – 2015

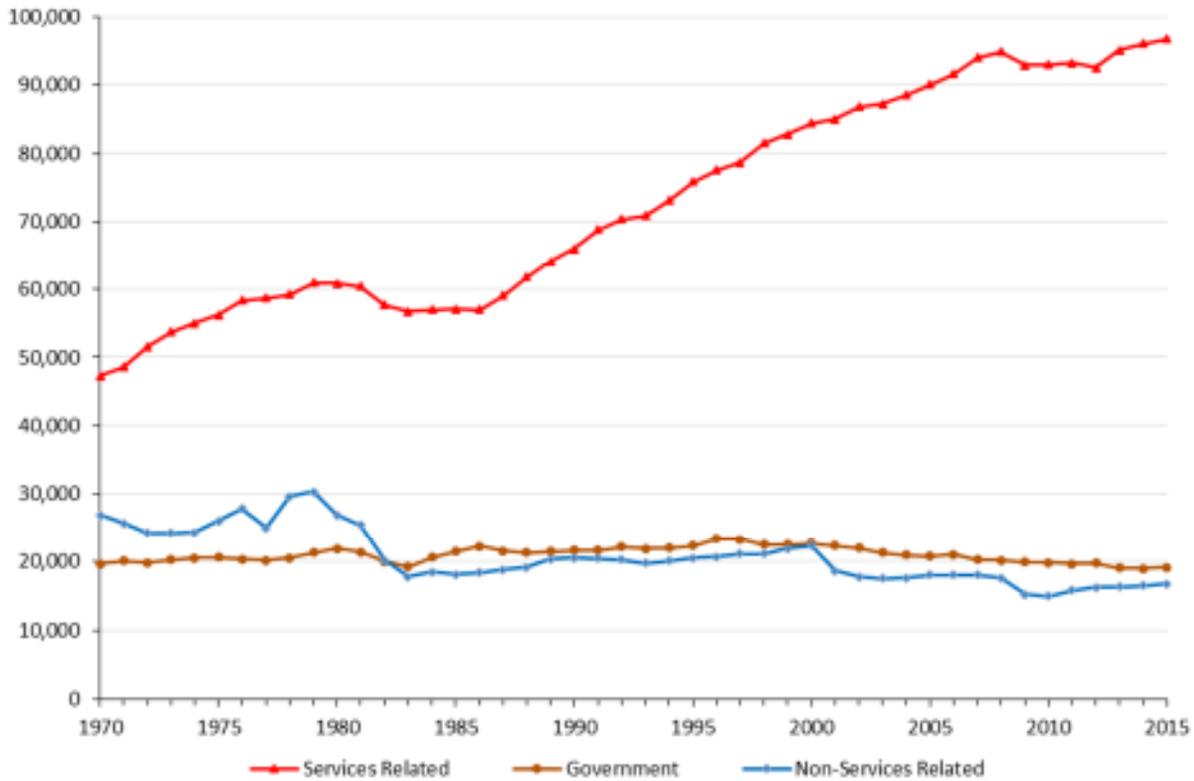


Source: Headwaters Economics: Economic Profile System-
<https://headwaterseconomics.org/>; Socioeconomic Measures Report: Data Sources: U.S. Department of Commerce. 2016. Bureau of Economic Analysis, Regional Economic Accounts, Washington, D.C. Table CA30.

Employment and Income by Industry

Since the decline of mining in the early 1980s, total employment in the public sector and in the goods-producing industries (farming, mining, construction, and manufacturing as a whole) has remained flat, while employment in services has grown steadily. Today, almost three out of four jobs are in services, while only one in eight is in the goods-producing industries. There are differences among the industries that comprise these broad categories, however. For example, the region has seen steady increases in construction employment, which reflects the increases in housing stock already discussed. The effects of amenity-based development, in other words, are not restricted to the service-producing sectors.

Figure 11: Employment by Major Industry Category, 1970 – 2015



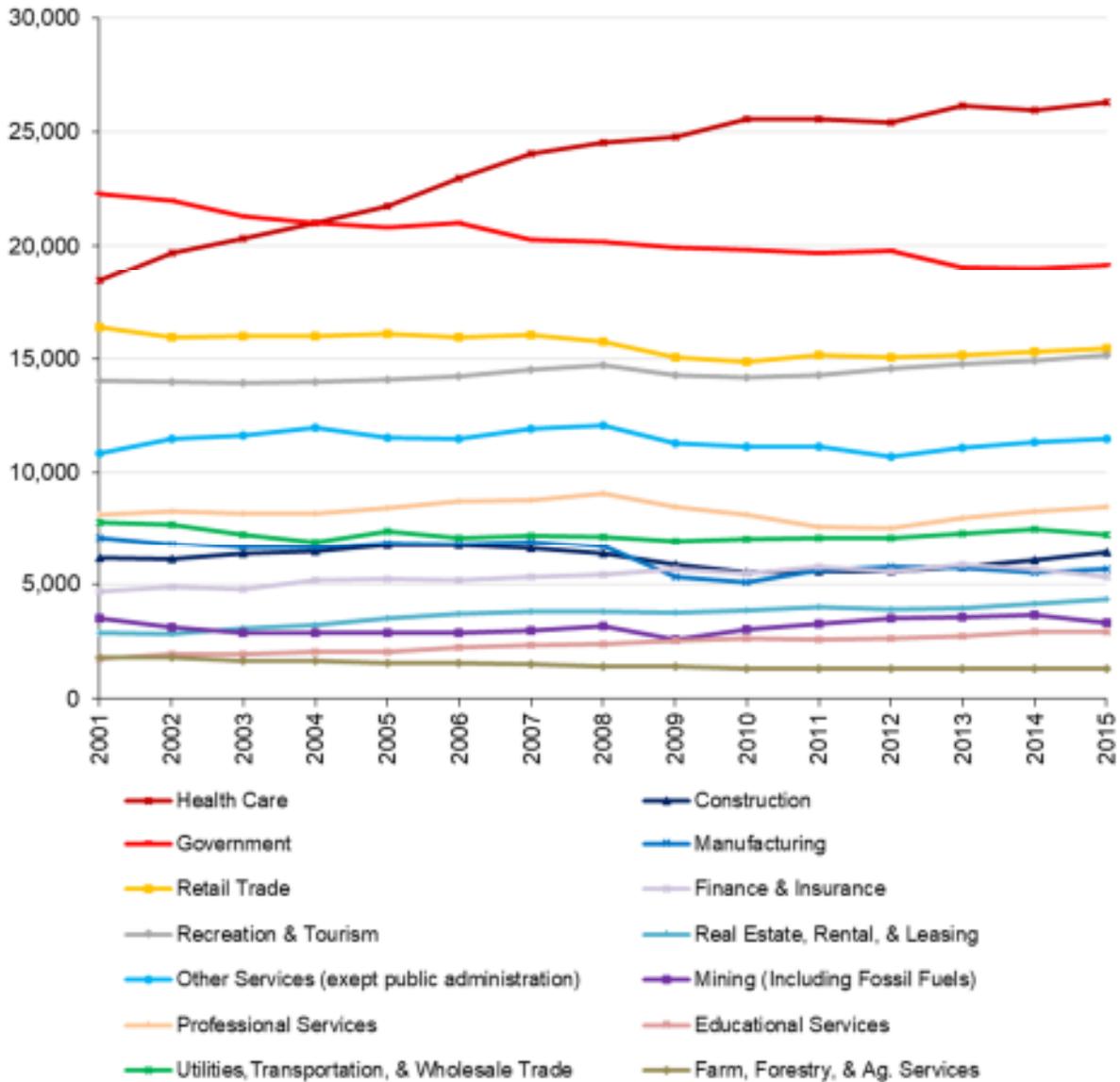
Source: Headwaters Economics: Economic Profile System- <https://headwaterseconomics.org/>; Socioeconomic Measures: Data Sources: U.S. Department of Commerce. 2016. Bureau of Economic Analysis, Regional Economic Accounts, Washington, D.C. Tables CA25 & CA25N. The series is split at 2000-2001 due to the changes in the classification of industries that does not allow direct comparisons of all data from before and after the change.

The steady increase in the number of jobs in service-related industries, coupled with the relative stability of the Arrowhead economy since 1988 indicates the extent to which the regional economy has moved beyond mining-dependence and does not need to favor the production of material goods for export to survive. (See “Beyond Folk Economics”, page 2.) Instead, the Arrowhead region has been able to recover and prosper on the basis of diverse economic activity, much of which is directly or indirectly related to the quality of the environment more broadly.²

Recreation and tourism represents 11.3% of all jobs in the region, which are perhaps most closely tied to how visitors perceive and enjoy the region’s natural assets. Visitors also support local businesses in the retail trade (11.5%), real estate rental and leasing (3.2%), educational services (which may include camps if the camp owners self-identify their business as an education rather than a lodging business) (2.2%), and other industries. Given the number of firms making outdoor apparel and equipment, and other products used by visitors, recreation and tourism also supports and is tied to local manufacturing employment and income (4.2%).

² It is important to note, however, that there is significant variation among smaller geographic areas within the Arrowhead Region, and some communities are more or less dependent on goods-exporting industries versus service-producing industries.

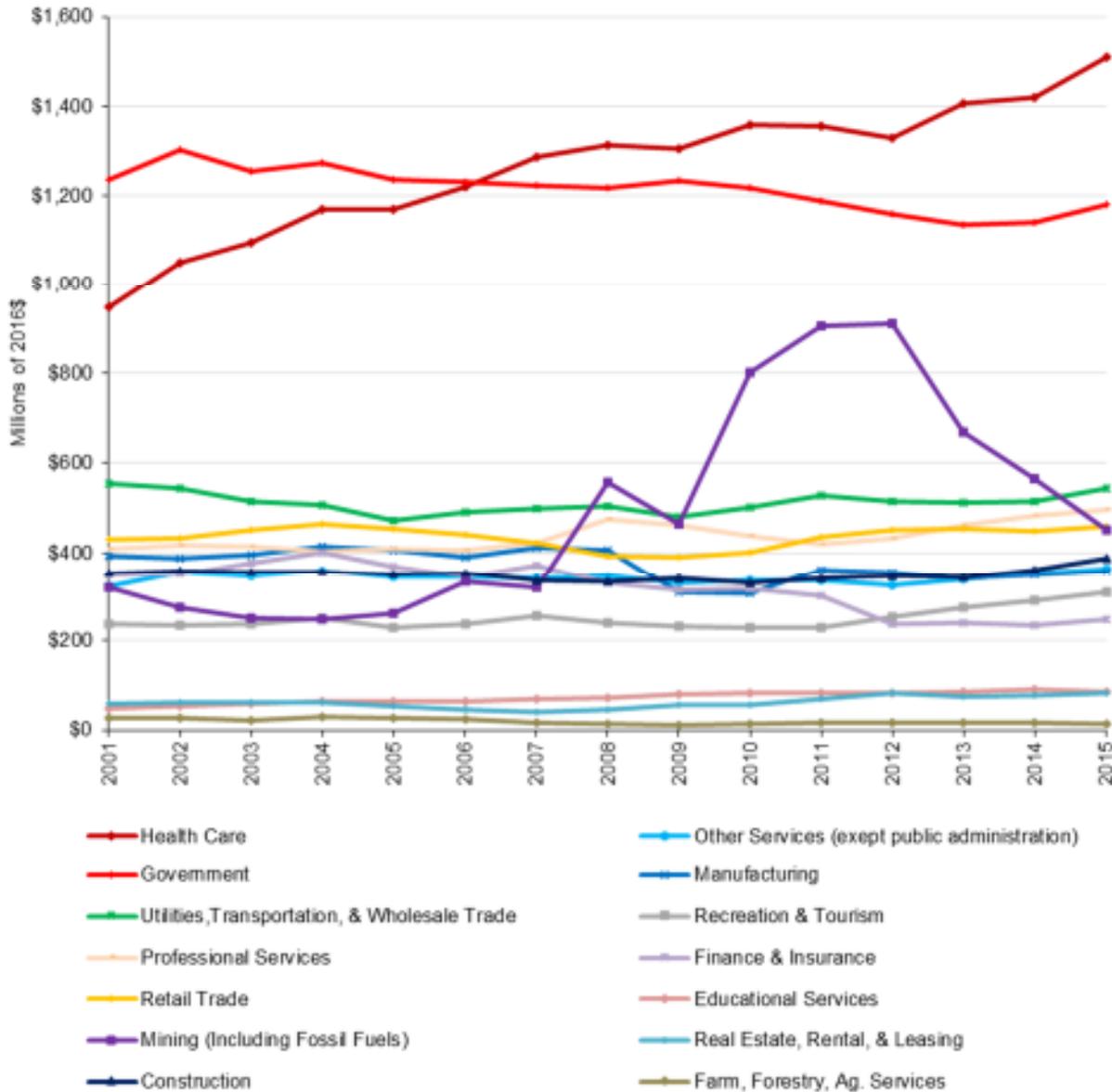
Figure 12: Employment by Industry Group, Arrowhead Region 2001 - 2015



Note: "Recreation & Tourism" includes Arts, Entertainment, and Recreation as well as Accommodation and Food Services. "Other Services" includes Other, Administrative, and Waste Services. "Professional Services" includes Professional Services, Management of companies and enterprises, and Information. "Utilities, Transportation, & Wholesale Trade" includes these categories and Warehousing. "Farm, Forestry, & Ag. Services" includes Farm, Forestry, Fishing, and Ag. Services.

Source: Headwaters Economics: Economic Profile System- <https://headwaterseconomics.org/>; SocioEconomic Measures: Data Sources: U.S. Department of Commerce. 2016. Bureau of Economic Analysis, Regional Economic Accounts, Washington, D.C. Tables CA25N.

Figure 13: Earnings of Workers, by Industry, Arrowhead Region, 2001-2015, Millions of 2016\$



Note: "Recreation & Tourism" includes Arts, Entertainment, and Recreation as well as Accommodation and Food Services. "Other Services" includes Other, Administrative, and Waste Services. "Professional Services" includes Professional Services, Management of companies and enterprises, and Information. "Utilities, Transportation, & Wholesale Trade" includes these categories and Warehousing. "Farm, Forestry, & Ag. Services" includes Farm, Forestry, Fishing, and Ag. Services.

Source: Headwaters Economics: Economic Profile System- <https://headwaterseconomics.org/>; SocioEconomic Measures: Data Sources: U.S. Department of Commerce. 2016. Bureau of Economic Analysis, Regional Economic Accounts, Washington, D.C. Tables CA05N.

Recreation-and-tourism-driven employment and income are just a portion of the region’s amenity-based development, however. Retirees and entrepreneurs who move to the region for its quality of life are perhaps even more important, because they create and support jobs in the local and broader regional economy by using health care (19.6% of jobs), professional services (6.3%), financial services

(“Finance and Insurance”) (4%), as well as services of the construction and real estate industries (8% cumulatively).

These statistics alone do not tell us many of the people behind these employment figures are located in the Arrowhead region for the sake of its environmental and other quality-of-life amenities. It is clear from other sources of information, however, that such amenities are important to decisions to move to or stay in this particular region as well as in other similar high-amenity areas (Ronnader, Wenthe, and Hove, 2014; Florida, 2000; Niemi and Whitelaw, 1999; Northeastern Minnesotans for Wilderness 2016). Therefore, to mistake recreation-and-tourism as the sum total of amenity-based development would miss much of the contribution of natural capital to the Arrowhead Economy. By the same token, to compare employment, wages, and other economic impacts from mining to those in recreation and tourism alone, as in the report by the Praxis Strategy Group (2017), is to present a distorted picture of the full extent of the “opportunity cost”³ of sulfide-ore copper mining.

Trends in earnings or income by industry, depicted in Figure 13, look much like the employment trend, with the largest share of income and some of the most rapid growth occurring in services. One relevant difference between graphs is that the pronounced boom and bust in mining *income* between 2008 and 2015 does not seem to have translated into much change in mining *employment* during that time. This suggests that while those with mining jobs do comparatively well in the boom times, the boom does not do much to increase the number of mining jobs.

Visitor Expenditures and the Tourism Industry

It should be clear by now that there are many facets to the amenity-based economy of the Arrowhead region. Tourism, however, is usually the first industry that comes to mind when one thinks about the impacts of potential land use change and loss of environmental quality. In this section, therefore, we focus on the various economic effects of the attractiveness of the Boundary Waters to visitors from other places.

Unlike “mining”, “construction”, “professional and technical services”, or other industries, there is not a single industrial classification into which all facets of the visitor services industry, or tourism as we will call it from here on, fits. Rather, the tourism industry is comprised of pieces of industries that, to varying degrees, serve visitors and residents alike. Air transportation, hotels and other lodging places, and some services might be used primarily by visitors. Restaurants, guiding and outfitting services, outdoor retailers, gas stations, and grocery stores, however, serve both residents and visitors. Estimates of jobs or income by industry, therefore, need to be augmented with other data in order to get a complete picture of the tourism industry, leavened with survey data reflecting how and where tourists actually spend their money.

Those who lose with sulfide-ore copper mining would be Arrowhead, Twin Cities, and other Minnesota residents who, perhaps having chosen their location to be near the amenities of the Boundary Waters, now have to spend more time and money to get to somewhere else.

³ “Opportunity cost” is economists’ term for what a person or the economy as a whole inherently loses in making a choice between competing options. In this case, the opportunity cost of sulfide-ore copper mining would register as jobs and income in the amenity-based economy, along with other values.

Davidson-Peterson Associates conducted such a survey of visitors for Explore Minnesota Tourism in 2007 and 2008 and developed county-by-county estimates of traveler expenditures in Minnesota and the jobs, state and local tax revenues, and other impacts those expenditures support (Davidson-Peterson Associates, 2008). Of Minnesota's 87 counties, St. Louis, Cook, and Lake Counties ranked third, thirteenth, and sixteenth from the top in terms of in-county traveler expenditures. The total for the Arrowhead region in 2008 was \$1.1 billion (adjusted for inflation to 2015 dollars). These expenditures supported almost 15,800 full-time equivalent jobs, nearly \$300 million in workers' income, and \$119 million in state and local tax revenue (all in 2015 dollars). The balance, roughly \$700 million, went to other businesses and to owners of the direct tourism businesses.

To gain a more current picture of these contributions to the Arrowhead region's economy, we turn to another Explore Minnesota report conducted by Tourism Economics (2016) which estimated year-by-year expenditures and other metrics for the entire state. According to the report, statewide visitor expenditures grew at an average annual rate of 4.97% from 2009 to 2015. Starting from the 2008 base for the Arrowhead region and applying the year-by-year growth rates for the entire state, we estimate that expenditures in the Arrowhead region would have been \$1.42 billion in 2015, which would have supported 22,174 full-time-equivalent jobs, \$376 million in resident's income, and \$152 million in state and local tax revenue.

It is important to note that these estimates reflect only those expenditures by out-of-state visitors. Minnesotans residing outside the Arrowhead who visit the region to recreate in the Boundary Waters, as well as Arrowhead region residents who recreate close to home, add to the expenditure totals and further support the region's tourism industry. As discussed under "Beyond Folk Economics" (on page 2), such expenditures by in-region or in-state residents may not be considered a true economic impact because the dollars spent are already there. We contend, however, that those expenditures should be counted as part of the economic contribution of the Boundary Waters and of the natural amenities of the Arrowhead region. The reason is that Arrowhead residents and all Minnesotans can choose where to spend their recreation and tourism dollars. If sulfide-ore copper mining were to make the Boundary Waters less suitable or attractive a place to spend one's time and money, then some portion of those expenditures by Minnesotans would occur somewhere else. The Arrowhead region would lose, and another region, perhaps one that had not sacrificed its wilderness character or environmental quality, would gain. Among the losers, of course, would be those Arrowhead, Twin Cities, and other Minnesota residents who, having chosen their location to be near the amenities of the Boundary Waters, would now have to spend more time and money to get to somewhere else.

Seasonal Residents

As the information on seasonal housing on page 6 indicates, the Arrowhead region has many part-time or seasonal residents. A recent study of four townships⁴ by the University of Minnesota, Morris' Center for Small Towns (2014) reveals that seasonal residents spend an average of \$8,008 per household per year (in 2015 dollars) in the local economy. If this average is typical of the 16,357 vacation/seasonal homes across the Arrowhead region, seasonal residents would contribute some \$131 million per year to the region's economy. This spending supports businesses and employment in all industries, including construction, automotive service, medical, retail, and entertainment.

⁴ The townships included in the study are Morse, Fall Lake, Stony River, and Eagles Nest.

POTENTIAL EFFECTS OF SULFIDE-ORE COPPER MINING ON THE ARROWHEAD REGION'S ECONOMY

The current dominant narrative from proponents of sulfide-ore copper mining seems to be focused on predictions of new jobs and economic prosperity due to new mining activity without any consideration of the magnitude of the economic costs. Indeed, proponents of sulfide-ore copper mining, by claiming the region can “have it all”, espouse a view that there would be no costs at all.

Proponents of sulfide-ore copper mining would do well to recall the famous aphorism from Nobel Laureate Milton Friedman: “There is no such thing as a free lunch.” Decision makers, in other words, should not forget that there is an “opportunity cost” to the introduction of sulfide-ore copper mining into the watershed of the Boundary Waters. This cost includes lost visitor spending and the jobs and income associated with it, lost economic development throughout the economy as sulfide-ore copper mining makes the region less attractive as a place to live and do business, and lost property value as residents flood the market with first and second homes located in places where it is no longer desirable to visit or reside.

We therefore provide the following preliminary estimate for some of these key economic costs of sulfide-ore copper mining. We want to emphasize, however, that our estimates reflect only impacts on a limited number of **market** values (property value, jobs, and income) and are, therefore, very conservative estimates of the full **economic** value at stake. Economics recognizes that the dollars that change hands in the marketplace (or don't change hands, as would be the case with sulfide-ore copper-mining-induced changes in the Arrowhead economy) are just a partial indicator or reflection of the total economic value of natural resources and the environment. For every dollar paid in market value, such as for travel or lodging to recreate in the BWCAW, to buy hard goods and provisions for the trip, or to buy a seasonal or permanent home in the region, there is additional “non-market” value in the form of the traveler's/homeowner's satisfaction from the experience. For most people and for most market transactions, there is a “consumer surplus” defined as what people *would* pay for a good, service, or experience over and above what they *do or have to pay* (that is, the market price) for it.

Our estimates do not include direct costs of monitoring and attempting to mitigate potential and actual damage to ecosystems that may occur over the course of opening, operating, and in a few short years, shutting down mining operations. The need to monitor for acid drainage and other impacts would continue for decades and centuries after operations have ceased and any benefits from sulfide-ore-mining are a distant memory. In the shorter term, erosion and sedimentation, health effects of dust and light pollution, and higher maintenance costs for roads and other infrastructure would entail expenditures by individuals and local governments as well as non-market impacts on human well-being.

Our estimates below do reflect a portion of such impacts. For example, if noise, dust, and light pollution or other insults to the ecosystem service value of land near mining sites reduces the value of a seasonal or year-round home, there would be a reduction in the market price (fewer dollars exchanged) if and when the home sells. Prior to sale, however, the current owners would experience a loss of well-being or satisfaction with their home that could be greater than the eventual loss in market value.

Finally, we have not attempted to estimate losses of what are known collectively as “passive-use value”. This is the value to people of keeping places like the Boundary Waters as clean, aesthetically

appealing, and ecologically intact as possible for the sake of potential future use by oneself (“option value”) or by one’s descendants (“bequest value”). Passive-use value also includes “existence value”, which is the value to individuals of keeping places like the BWCAW intact to even if those individuals have no expectation of ever using or enjoying the place directly.

While effects on ecosystem services and drops in passive use value may be reflected in economic measures of the effects we explore below, we do not contend that we have captured the full costs, either market or non-market, of those effects. The major caveat to these estimates, therefore, is that what we “see” or estimate here may be but the tip of a very large iceberg of economic costs that are not as readily apparent, at least not yet.

What Drives Costs of Sulfide-Ore Copper Mining?

Before getting to dollar estimates of the costs of sulfide-ore mining, we must consider what may drive the decisions to come to (or not) the region to visit, to live, or to start a business or, for those who had made such decisions in the past, whether to come back to or stay in the Arrowhead region or elsewhere in Minnesota. As noted above, the Forest Service should undertake a thorough examination of the extent to which sulfide-ore copper mining would affect such decisions. As a first step in that direction, we have considered and developed several indicators of what motivates such decisions and how strong the impacts of new mining activity in the watershed of the BWCAW might be.

Many local residents have stated that the effects of sulfide-ore copper mining operations on the community and natural environment--noise, dust, truck traffic, pollution of existing high-quality ground and surface water (which supplies drinking water to many local residents), risk of damage to fisheries and aquatic habitat--would likely result in fewer visitors to the region, discourage new businesses from locating, and deter new residents. “If there were mines in the Boundary Waters, it would change the reputation of the Boundary Waters as a whole, and damage businesses” asserts Bill Hansen, an owner of Sawbill Outfitters located between Ely and Gunflint (B. Hansen, personal communication, 2016). He continued, “once a mine has been built, it is really hard to develop new businesses near it.” Steve Piragis, owner of Piragis Northwoods Company in Ely, noted that just the perception of a sulfide-ore copper mining industrial zone on the edge of town would be enough to scare off people who might visit, or build a vacation home or otherwise settle in Ely (S. Piragis, personal communication, 2016). And the owner of Hungry Jack Outfitters (on the eastern side of the BWCAW), Dave Seaton, said he feels that there would be enough impact from the mine to damage outfitting (D. Seaton, personal communication, 2016).

In addition, residents believe the existence of sulfide-ore copper mining in the region would cause some of the current residents and businesses to leave the region (see Figures 14a and 14b, below). As the area becomes (perceived to be) less desirable, the value of remaining businesses, as well as the value of both year-round and vacation properties and related property tax receipts, all are expected to decline. Dave Seaton, for one, expressed concern about land and business values if the mine comes in, because he intends to sell Hungry Jack Outfitting at some point (D. Seaton, personal communication, 2016). Sulfide-ore copper mining would, he believes, take away from the value of the business to any prospective owner and therefore reduce the prices he might be offered.

Loving or Leaving the Boundary Waters Region

Figure 14a. Loving: Why do you choose to live or own land in the four townships area?

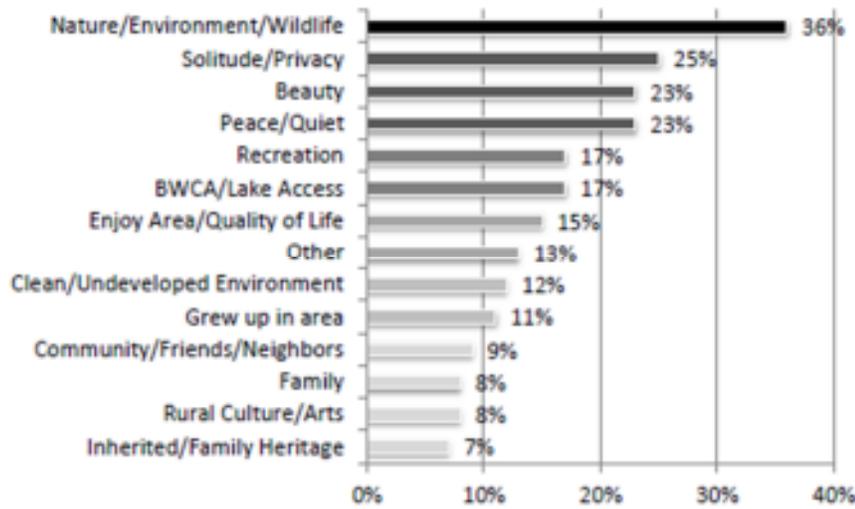
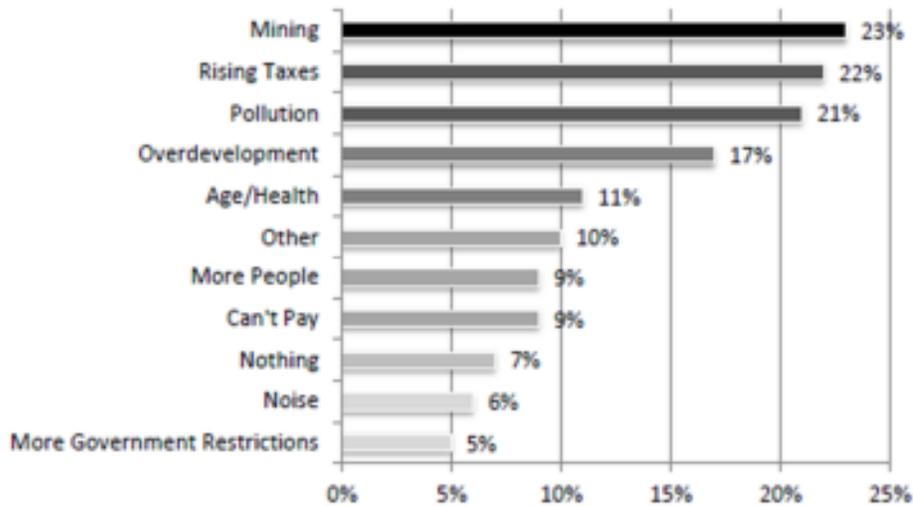


Figure 14b. Leaving: What factors would make you leave the four townships?



Source: Ronnader, R., Wentz, J., and Hove, M. (2014). *The Four Townships Area Economic, Housing Development Survey* (p. 51). Center for Small Towns and Data Services Center, University of Minnesota at Morris.

As part of *The Four Townships Area Economic, Housing and Development Survey*, researchers at the University of Minnesota, Morris asked property owners (both year-round and seasonal residents) about their reasons for owning property and/or living⁵ where they do and what might cause them to leave (Ronnader, Wentz, and Hove, 2014). The top reasons people gave for their having chosen to live

⁵ Some of the study's survey respondents owned property in the region, but do not reside there personally.

or own land in the region include “Nature”, “Beauty”, “Recreation”, “Undeveloped Environment”, and “Quality of Life” (see Figure 14a). Not surprisingly then, threats to or the loss of those amenities are among the top reasons people would leave the region. The most common reason, cited by 23% of respondents, was “Mining” (see Figure 14b). The researchers note that “a few” respondents indicated that their concern was that there are not enough mining jobs, but that mining was mentioned “mostly [by] respondents expressing [concern over] potential negative consequences from mining” (Ronnader, Wentz, and Hove, 2014, p.48). The next most common reasons, each cited by more than one in five respondents, why owners and residents would leave are “Rising Taxes”, “Pollution”, and “Overdevelopment”.

Survey of Arrowhead and Minnesota Business Owners

While the “four townships” survey described above touches on the question of whether and how sulfide-ore copper mining would affect residents’ and property owners’ decisions about whether to stay in the immediate region, there has not yet been a systematic survey conducted to discern the likely effects of sulfide-ore copper mining on the outlook of businesses in Minnesota.

To be sure, businesses have spoken out both for and or against this new type of mining, and anecdotal evidence from letters to the editor, statements made at public meetings, and in other venues and documents (Northeastern Minnesotans for Wilderness, 2016) do suggest that for some businesses the advent of sulfide-ore copper mining in the Boundary Waters watershed would be catastrophic. But such data may not be readily generalizable to the whole of the economy or even to the portions that one would consider to be most directly affected by the proposed new mining industry. We therefore recommend that the Forest Service should conduct, as part of its withdrawal study, a thorough, statistically robust poll of business owners, residents, visitors, and others who have a stake in or who may hold values related to the quality of life and the quality of the environment in the watershed of the Boundary Waters.

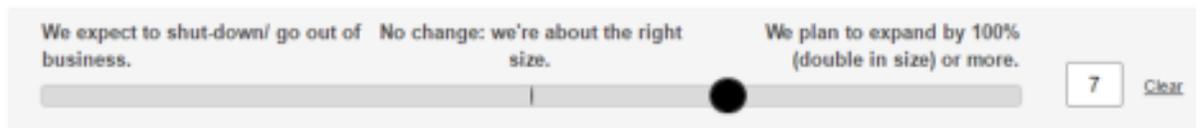
In the meantime, we have attempted to obtain and use more systematic information as part of our estimates of potential costs presented below. Specifically, we used information from three sources:

1. Personal interviews with a group of small- and medium-sized retail, recreation, and tourism business owners from Ely and Grand Marais.
2. Review of 27 sworn affidavits filed in *Franconia Minerals (US) LLC; and Twin Metals Minnesota LLC, v. United States of America: U.S. Department of the Interior; et al.* (U.S. District Court, District of Minnesota).
3. Brief, anonymous, but nonrandom survey of business owners throughout the Arrowhead region and the whole of Minnesota. The survey was sent to 140 members of the “Boundary Waters Business Coalition,” and we received 31 responses for a response rate of 22%.

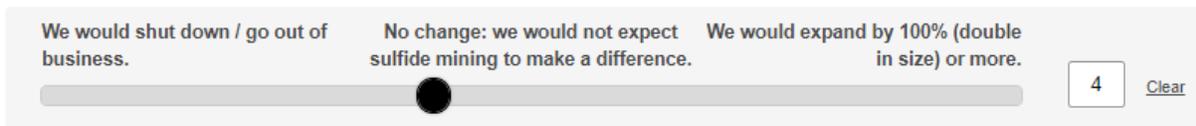
The business survey covered some basic information about each business (industry classification, size, etc.) as well as two key questions about each business owner’s (or, in some cases, a manager’s) realistic expectations for the future of their business in two scenarios: one with sulfide-ore copper mining in the watershed of the Boundary Waters, and one without. For these two questions, respondents moved a slider left or right from a “status quo” position. (See Figure 15 and Appendix A). The left and right ends of the scales represent extremes of “we expect to shut down” on the left, to “we expect to double or more” on the right. The position of the slider was automatically translated into a numerical score of zero to ten, and from this we infer a percentage change from the status quo in each scenario.

Figure 15: Survey Questions re: Business Outlook with and without Sulfide-Ore Mining in the watershed of the Boundary Waters

7. Scenario 1: If sulfide-ore mining is NOT APPROVED and the economy of the Arrowhead region (St. Louis, Lake and Cook Counties) continues to develop as it has over the past 30 years, what are your expectations for how **YOUR OWN** business/organization/agency might change over the next 5-10 years? 



8. Scenario 2: If sulfide-ore copper mining WERE TO BE APPROVED in the watershed of the Boundary Waters, how would you expect **YOUR OWN** business/organization/agency to change over the next 5-10 years? 



Note: The slider position and resulting numerical score (in the box to the right of each slider) show the average for the 31 responses received. We interpret the 7 in Scenario 1 (question 7), which is two steps above “No change” toward “...expand by 100%” to be interpretable as a 40% increase. Similarly, for Scenario 2 (question 8), the 4, which is one step (out of 5) toward “We would shut down...” to be interpretable as a 20% decrease.

Please see Appendix A for the complete survey.

From the survey responses we find that, on average, the businesses expected to grow by 40% over the next 5-10 years in a without-sulfide-ore copper mining scenario. In the with-sulfide-ore-copper-mining scenario, an average reduction in business of 20% over the same period is expected. We use this 20% reduction as the basis for estimates below of the effect of the proposed sulfide-ore copper mining industry on visitor spending, visitation, jobs, and income. Such a change does not seem unreasonable, given that traveler spending in Minnesota has increased by more than 20% in the past five years preceding 2016 (Tourism Economics, 2016)

This survey and the resulting estimates do have two countervailing caveats to keep in mind.

- First, a survey of business owners who have signed up as part of a coalition raising concerns about the mining proposal are more likely to be well-informed about the issue. Indeed, the respondents, on average, rated their awareness and knowledge of the issue as an eight on a zero to ten scale. To the extent that joining the coalition and being more informed on the issue correlates to opposition to the mining proposal, we would concede that the survey results are “biased” in the technical/statistical sense (i.e., we are not casting aspersions on the respondents), and we urge the U.S. Forest Service to conduct a random, statistically unbiased survey to get additional information about business owners’ and others’ expectations.
- Second, survey respondents do come from a range of industries (construction, manufacturing, retail, professional services, as well as recreation/tourism industries including lodging,

restaurants, guiding and outfitting). The respondents also do business from locations throughout the state. (The survey was anonymous, but we have information on industry category from a specific question, and we know something of the businesses' locations based on what some respondents volunteered in open-ended survey questions (see Appendix A). (As one might expect, businesses geographically closer to the Boundary Waters indicated that mining would have a stronger negative effect on their outlook than businesses down state.)

The fact that our cost estimates apply the statewide average to Arrowhead Region outcomes mitigates, at least partially, any sampling bias that may have colored the results. Moreover, we asked the business owners about their realistic expectations regarding the future of their businesses, not for their personal opinions. Interestingly, the lowest score on the question about expectations in the "with-sulfide-ore copper mining" scenario was a two (corresponding to a 60% reduction in the business). None of the respondents, in other words, indicated that they would go out of business completely. (Such expectations do show up in anecdotal information.) One business out of the 31 respondents, a small "retail/food & beverage" business, expects to double or more with or without the mine, even though they noted that sulfide-ore copper mining would hurt their sales and induce a change in focus toward other regions. That was an outlier, however: every other business indicated that it would either stay the same (8 businesses) or become smaller (23 businesses) in the "with-mining" scenario.

Estimated Costs: Three Ways Sulfide-Ore Copper Mining Would Affect the Arrowhead Region's Economy

There are at least three interrelated ways in which sulfide-ore copper mining would likely affect the economy of the Arrowhead region and, by extension, the entire state of Minnesota.

1. *Fewer visitors and less visitor spending:* The actual and perceived loss of environmental quality, including diminished quality of recreational experiences, would reduce the number of visitors coming to the region each year. That would translate into less spending, fewer jobs in all of the industries supported by visitor spending, and lower state and local tax revenues.
2. *Fewer in-migrants and more out-migrants:* The same effects on environmental quality would make the region less attractive to retirees, footloose entrepreneurs, mobile workers, or anyone else looking to reside or do business in a location with a high quality of life based on environmental factors and easy access to diverse, high quality outdoor activities (Florida 2000). As the "supply side" model of regional economic development suggests (see "Beyond Folk Economics", page 2), losing that quality of life will mean fewer in-migrants, more out-migrants, and as a result, less economic activity in all sectors.
3. *Loss of residential and commercial property values:* The value of being close to areas with outstanding natural amenities and opportunities for outdoor recreation is typically capitalized into nearby land values. As sulfide-ore copper mining reduces the amenities whose value is bound up with the overall value of residential and business properties, property value will fall, taking wealth away from current owners, and reducing local property tax revenue for years to come.

We consider each of these effects in turn.

Lost Visitor Expenditures

During a 12-month study period spanning 2007 to 2008, visitors (defined as persons staying one night or more in a location than 50 miles from their home) spent more than \$1 billion in the Arrowhead region (see Table 1, below) (Davidson-Peterson Associates, 2008). The study found that St. Louis, Cook, and Lake Counties ranked 3rd, 13th, and 16th, respectively, among Minnesota’s 87 counties in terms of visitor spending. The study also broke down the direct impacts of that spending into its impacts in the regional economy. For each \$1 million in visitor spending, there were

- 16 direct jobs supported,
- \$264,666 in residents’ income,
- \$106,770 in State (\$83,418) and local (\$23,352) tax revenue, and
- \$628,564 in proprietors’ income and business-to-business spending

Note that these are direct impacts only and do not include “multiplier effects” that are calculated using input-output models. In this case, multiplier effects would comprise “indirect effects”, which is spending by the businesses with whom the direct businesses (that is, those where the visitors spent their money) do business. Multipliers would also include “induced” effects that occur when people spend their earnings from work at businesses directly serving visitors or from work at the “indirect” businesses.

Davidson-Peterson Associates (2008) estimated total effects and found that multipliers in the Arrowhead region were 1.34 for jobs and 1.54 for residents’ income and taxes. Thus, for every 3 jobs directly supported by visitor spending (in a hotel, at an outfitter, at a gas station, etc.) a fourth job would be supported in another business (for example, the outfitter’s accountant, or the gas station’s parts supplier). Similarly, for every two dollars spent by visitors, a third dollar would be spent in the Arrowhead economy, as the hotel manager, the outfitter’s accountant, etc., spend their paychecks in the community.

Table 1. Estimated Direct Economic Impacts of Traveler Expenditures, 2008 & 2015, and Annual Losses with Sulfide-Ore Copper mining.

	Spending & Impacts, 2008	Impact per \$1 million Spending	Projected Spending & Impacts, 2015 (in 2016\$)	Losses with Mining (2016\$ & Jobs)
Traveler Expenditures	\$ 1,024,726,048	n/a	\$ 1,438,413,258	\$ 287,682,652
Jobs (full-time equivalent)	15,787	16	22,448	4,490
Resident Income	\$ 271,210,252	\$ 264,666	\$ 380,699,234	\$ 76,139,847
State Revenue	\$ 85,480,425	\$ 83,418	\$ 119,989,315	\$ 23,997,863
Local Revenue	\$ 23,929,452	\$ 23,352	\$ 33,589,895	\$ 6,717,979
Proprietors Income + Business-to-Businesses	\$ 644,105,920	\$ 628,564	\$ 904,134,814	\$ 180,826,963

Source: Davidson-Peterson Associates (2008), adjusted using trend data from Tourism Economics (2016).

To bring the estimates of direct visitor spending closer to the present, we turn to a recent study by Tourism Economics (2016) that tracked statewide visitor spending from 2009 through 2015. The average annual growth rate in that spending was 5.0% (range: 3.1% to 7.8%). We applied that growth rate to the Arrowhead expenditure estimate for 2008 and, applying each year's statewide growth rate,⁶ we estimate that visitor spending in the Arrowhead region reached \$1.44 billion by 2015 (in 2016 dollars) (Table 1). That 2015 spending would have supported:

- 22,448 direct jobs
- \$380.7 million in residents' income
- \$153.6 million in state (\$120.0 million) and local (\$33.6 million) taxes
- \$904.1 million in proprietors' income and business-to-business sales.

Finally, with our survey of business owners as a guide, we consider what the impact of a 20% reduction in visitor spending would mean for the Arrowhead region. Losing that \$287.7 million in spending would cost the region 4,490 jobs (about 4.9% of total private employment in the region), \$76.1 million in workers' income, \$30.7 million in state and local taxes, and \$180.8 million in proprietor's income and business-to-business sales (Table 1). That loss would occur each year that the presence and operation of sulfide-ore copper mining keeps 20% of visitors away.

Because Davidson-Peterson collected and reported data from visitors based on where they stayed (travelers were surveyed on-site during their visit), it is likely that their initial spending estimates reflect spending throughout Minnesota even though that spending is ascribed to the county where the traveler was staying when surveyed. Thus, a traveler who lodges in Ely before jumping off for a canoe trip in the Boundary Waters Canoe Area Wilderness would have been asked about all their spending to get there, what they planned to spend on provision, guiding services, what was paid for a meal at a restaurant on the way to Ely, and the cost of gas for a rental car. The entire expense of the trip would have been tagged as being due to the time in St. Louis County. By the same token, if our traveler had been surveyed during a one-night stay in a Minneapolis hotel before flying home, all those expenses would have been ascribed to Hennepin County.

This feature of the underlying data means that some travelers' expenditures are misplaced, but we assume that for any given county, the misplacement of expenditures goes both ways: some dollars are ascribed to the county that should not be, and other dollars that were spent in the county were ascribed to another county. We assume that in aggregate, these errors cancel each other out. We therefore have not attempted to estimate the portion of expenditures occurring in the Twin Cities or elsewhere in Minnesota that are, in reality, due to the attraction of the Boundary Waters.

Losses to the Broader Economy

Amenity-rich communities around the country know that a high quality of life, including a clean environment and access to high-quality outdoor recreational and scenic resources, are the natural capital that supports much of their economies. Visitation and visitor spending are certainly part of that, but the effect extends to all sectors of the economy. This is especially true for "footloose industries" or operations that do not need to be located near either input supplies (e.g., commodity raw materials),

⁶ For 2008-2009, for which calculation of a statewide annual growth rate was not possible, we used the average of the growth rates for 2009 through 2015.

or output markets. With today's global economy, and advanced communication and transportation networks, the list of industries that are footloose grows by the year.

For example, Niemi and Whitelaw (1999) state: "natural-resource amenities exert an influence on the location, structure, and rate of economic growth.... This influence occurs through the so-called people-first-then-jobs mechanism, in which households move to (or stay in) an area because they want to live there, thereby triggering the development of businesses seeking to take advantage of the households' labor supply and consumptive demand" (p. 54). They note that decisions affecting the supply of amenities "have ripple effects throughout local and regional economies" (p. 54). Similarly, Johnson and Rasker (1995) found that quality of life is important to business owners deciding where to locate a new facility or enterprise and whether to stay in a location already chosen. This is not surprising. Business owners value safety, scenery, recreational opportunities, and quality of life factors as much as residents, vacationers, and retirees.

As we have already seen (Ronnader, Wentz, and Hove, 2014), environmental quality, recreational opportunities and other quality of life factors are the most important reasons Arrowhead residents give for living in and owning property in the region.

To the extent that sulfide-ore copper mining would diminish the physical qualities of the natural environment in the Arrowhead region, or even to the extent mining would alter the perception of those qualities--that is if mining damaged the region's "brand" built on the quality of the environment--one would expect that fewer people will want to relocate to the region to retire, to take a job, or to start up a new business. The "four townships" study and our business survey gives some information about the potential magnitude of that effect, and we use that information to sketch a set of simple scenarios for what the impact on jobs and income might be. We do note up front, however, that further research to determine more precisely how mining might affect location decisions by current and potential residents would be desirable as part of the review of mining in the Boundary Waters watershed.

Ronnader, Wentz, and Hove (2014) found that 23% of property owners said that concerns over mining would cause them to leave, or at least want to leave, the region. Similarly, our survey of business owners indicates that sulfide-ore copper mining could depress their businesses' prospects by 20%, on average. One scenario, therefore, would be that there is a 20% drop in economic activity in the region.

As a general indicator of economic activity, we begin with total employment and total personal income. Both include proprietors' (the self-employed) additions to the economy. Total personal income also reflects the contribution of retirees in that it includes income from investments and transfer payments like Social Security and Medicare that retirees would spend in the region.

To avoid double counting, we then net out the contributions to jobs and income from visitor spending. We also net out those jobs and income in industries least likely to be footloose, namely farming, forestry, and mining itself.

We also consider two less drastic scenarios. In a second scenario, we consider the effect of a 10% drop in jobs and income, and in the third, we consider no actual drop, but merely a cessation of the growth the region has seen since the beginning of recovery from the mining bust of the early 1980s. Since 1983, the Arrowhead region has seen average annual job growth of 4.4% and average annual growth in total personal income of 5.0%.

The range of impacts from these scenarios range from a loss of 5,066 jobs and \$402.4 million in personal income (per year) if growth simply flatlines, to a loss of 22,791 jobs and \$1.6 billion in annual income if 20% of the economy were to, essentially, move away. See Table 2 for details.

Table 2: Overall Economic Decline in Three Scenarios for the Impact of Sulfide-Ore Copper Mining

	Jobs	Income (000s of 2016\$)
Total Jobs or Personal Income	134,402	\$ 9,400,027
Less Travel-Related	15,787	\$ 903,570
Less Commodity-Related	4,660	\$ 464,755
Potentially Amenity-related	113,955	\$ 8,031,702
Mining Impact Scenarios		
20% reduction	-22,791	-\$ 1,606,340
10% reduction	-11,396	-\$ 803,170
No Growth*	-5,066	-\$ 402,369
* Loss of 4.5% job growth, and loss of 5.0% income growth Sources: Headwaters Economics: Economic Profile System- https://headwaterseconomics.org/ : SocioEconomic Measures: Underlying Data Sources: U.S. Department of Commerce. 2016. Bureau of Economic Analysis, Regional Economic Accounts, Washington, D.C. Tables CA30, CA05N, and CA25N; Ronnader, Wentz, and Hove (2014); and tourism data cited above.		

Lost Property Value

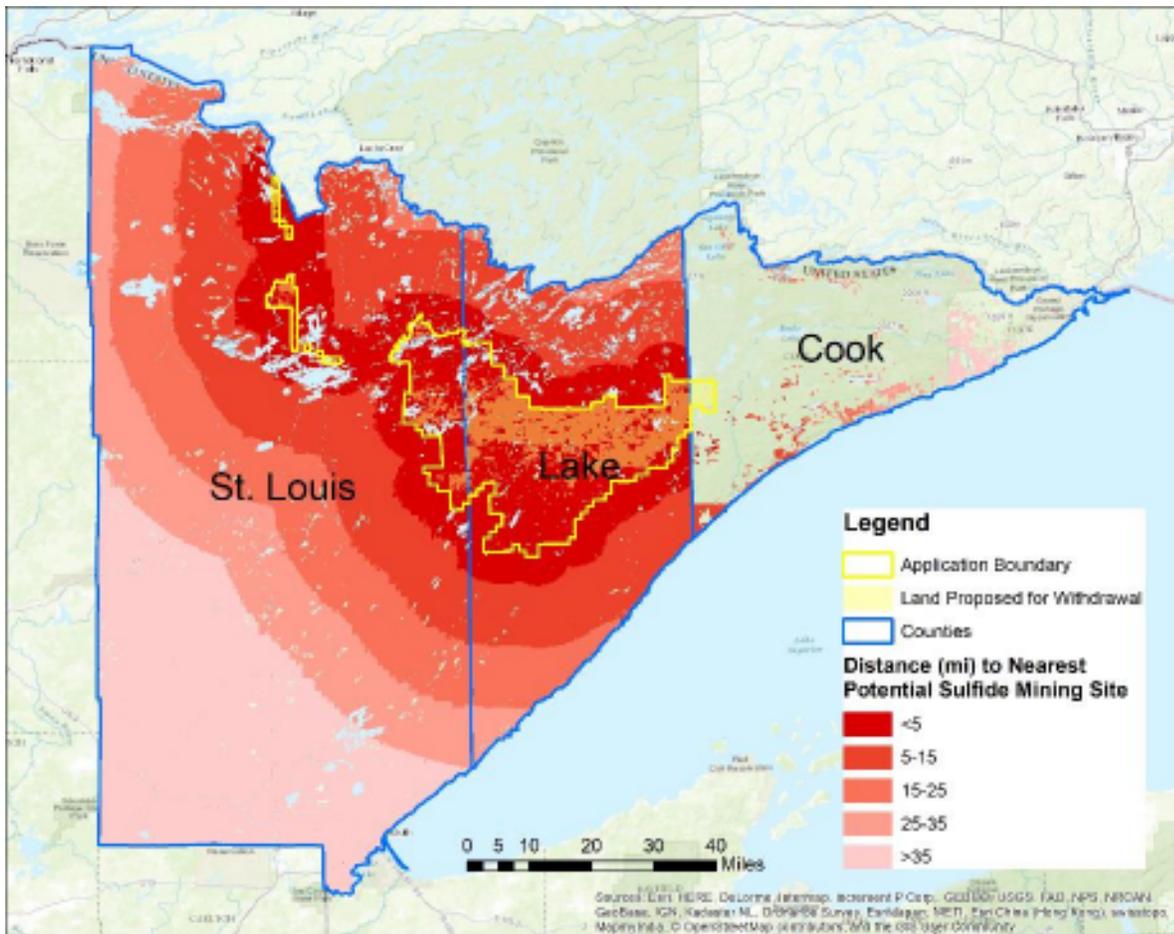
There is a ring of truth to the old saw that “location, location, and location” are the three things that matter most to the value of real estate. Namely, the location of a property relative to various amenities and disamenities can have a significant impact on buyers’ willingness to pay for the property. Natural amenities, like clear lakes (Schuetz, Boyle, and Bouchard, 2001), pastoral scenery (Fleischer and Tsur 2009), and wilderness and other protected areas (Phillips 2000; Beaton 1991) add value to properties over and above other attributes (improvements, road frontage, school quality, tax rates, etc.) that also influence land prices.

The same is true of disamenities: there are negative impacts on land value from various types of local nuisances that impose noise, light, air, and water pollution, life safety risks, and lesser human health effects risks on nearby residents and even entire communities that “gain” a new industry with such impacts (Sun, 2013; Bolton and Sick, 1999; Boxall et al., 2005; Williamson, Thurston, and Heberling, 2008). Erickcek (2006), Sun (2013), and Kim and Harris (1996) studied gravel, gold, and copper mines, respectively, and found that, in general, the closer a property is to the mine site, the lower is its property value. This negative effect typically decays with distance--that is, moving another mile closer to the mine produces a bigger drop in property value if you are already closer to the mine. In Sun’s study, which covered a time span that included both the opening and the closing of the mine, also found a large negative impact on every property in the county that occurred when the mine opened.

For this study, we apply the parameters from Kim and Harris (1996), who examined property values near a copper mine in Green Valley Arizona. To take the decay in the effect of the mine into account, they used a nonlinear transformation of distance to the mine in place of the simple distance. (The transformation is $X=1.05-(0.9947)^D$, where “D” is the distance in miles from the subject properties to the mine.) As is typical in these studies and for statistical reasons, the authors used a “log-log” version of the model in which the natural logarithm of the price of property is regressed against the natural log of the transformed distance and other variables. The coefficient on the distance function (0.2872 in their case) then represents the change, in percentage terms, of a property “moving” one percent farther away from the mine, when other things are held equal.

We do not have full information about all attributes of the properties in the Arrowhead region, but by computing distances from each property to potential sulfide-ore copper mining sites and applying the coefficient on the transformed distance, we can derive an estimate of the impact of new mining activity on properties in the Arrowhead. We conducted the analysis based on the distance from each property to the nearest Forest Service fee-owned parcel within the “Application Boundary”. In other words, we computed the distance from each private parcel to the nearest point that could, if the 20-year withdrawal is not approved, be subject to sulfide-ore copper mining. (See Figure 16).

Figure 16: Parcel Distance to Areas Potentially Open to Sulfide-Ore Copper Mining



Sources: St. Louis, Lake and Cook Counties’ respective GIS and Tax Offices, USDA Forest Service, ESRI.

We obtained parcel maps and information on the value of each parcel directly from each of the three Arrowhead counties. Due to the per-parcel fee charged for Cook County data, we obtained data only for privately owned parcels. Because publicly owned parcels do not have listed values and are not subject to sale, they should suffer no loss in market value due to mining. This gap in the data does not affect the analysis, but it is something to keep in mind when viewing the map in Figure 16. Publicly owned parcels in Lake and St. Louis Counties also have no market value, but the data sets for those counties did include all parcel boundaries.

Using the “NN Join” plugin in Quantum GIS, we calculated the distance from each parcel to the nearest polygon representing an area potentially open to sulfide-ore copper mining. The greatest potential separation is 77.9 miles to a parcel in northwest St. Louis County.

After computing these distances, and we then applied the statistical results from Kim and Harris (1996) to estimate the percentage change in property value (which is how one interprets those results when the log-log functional form is used). Parcels closest to mining sites would lose 5.74% of their value, and those farthest away would lose as little as 0.66%. By applying these percentages to each of the more than 243,000 parcels, per-parcel losses and aggregate property value losses are obtained.

Based on these procedures, we estimate that some \$508.9 million in property value would be lost if sulfide-ore copper mining were to occur on all of the areas proposed for withdrawal from the federal mining program. (See Table 3.)

Table 3. Estimated Property Value Impacts of Sulfide-Ore Copper Mining, 2016.

	Number of parcels	Total Property Value (2016\$)	Property Value Lost (2016\$)
Cook County	8,460	\$ 1,651,043,600	\$ 30,722,257
Lake County	45,303	\$ 3,378,180,900	\$ 115,161,294
St. Louis County	182,143	\$ 20,760,741,439	\$ 363,031,214
Total	235,906	\$ 25,789,965,939	\$ 508,914,765

As with other costs discussed in this report, we believe the actual impacts of sulfide-ore copper mining on land value would be much higher than those presented in Table 3. There are two primary reasons actual effects would be higher.

First, the study from which we used parameter estimates was focused on air quality impacts of copper mining that, while acute for properties closest to the mine, could decay more rapidly as distance from the mine increases. For other facets of the value of land in the Arrowhead region, such a decay may not be as pronounced, or it may not occur at all. For example, one may own (or consider buying) property in the Arrowhead region so that one can be relatively close to high quality recreational resources or to places with high levels of wilderness character.

The ability to get to high quality recreational resources and relatively pristine natural areas is reflected in buyers’ willingness to pay for properties near such resources and is capitalized into the price of properties throughout the Arrowhead region and, arguably, throughout the entire state of Minnesota. When noise, light, dust, and water pollution due to sulfide-ore copper mining diminishes the quality of the experience of areas near mining sites--or even if it diminishes only the *perception* of the quality of the experience--people will likely be willing to pay less for first or second homes purchased with an eye

toward be near the Boundary Waters. In other words, impacts on property values may remain strong over much greater distances than our conservative assumptions and these initial estimates suggest.

The other reason these property value effects are low is that they are merely “partial equilibrium” effects. They capture (at least some of) the direct nuisance effect of mining on property values, but they do not capture the second-round effects of a loss of vitality in the economy due to reductions in visitor spending and lost overall economic vitality. If population, jobs, and income decrease due to the advent of sulfide-ore copper mining, as described in the preceding sections, there will be fewer people with fewer dollars and with less optimism for a future, sustainable economy. Demand for housing will suffer along with the rest of the economy, and housing prices can be expected to fall. That may be good news for someone moving to the Arrowhead to take one of the comparative handful of new mining jobs, but for property owners already invested in the region, it will mean a loss of asset value and personal wealth.

SUMMARY AND RECOMMENDATIONS TO THE FOREST SERVICE

The Arrowhead Economy benefits from unique scenic, recreational, and environmental amenities. The clean water, peace and quiet, canoeing and hiking trails of the Boundary Waters Canoe Area Wilderness and the surrounding Superior National Forest, Voyageurs National Park, and the North Shore of Lake Superior are well-known international attractions for visitors and for new residents. In order to protect these outstanding resources “from the potential adverse environmental impacts arising from exploration and development [of mineral resources on federal lands]”, the Forest Service has proposed withdrawing 234,328 acres of federally owned land in the Rainy River watershed from the federal mining program (82 FR 4283).

The Forest Service is now scoping its Environmental Impact Analysis, which under the National Environmental Policy Act, must consider the economic effects of the proposed action alongside ecological, aesthetic, historical, social, and health effects (40 CFR 1508.8). The salient economic effects of this action would include, as a benefit to society, the avoidance of costs associated with actual and potential sulfide-ore copper mining that, absent the proposed action, could proceed in the watershed of the Boundary Waters. As the estimates described here demonstrate, even a fraction of those costs significant. The small subset of potential economic effects of sulfide-ore copper mining considered in this report include

- A decline in spending as potential visitors choose alternative destinations with high quality scenic and recreational amenities undiminished by nearby mining activity. We estimate an annual loss of \$288 million in spending that would otherwise support 4,490 local jobs, \$76 million in residents’ income, \$31 million in state and local taxes, and \$181 million in proprietor's income and business-to-business transactions
- 5,066 to 22,791 lost jobs, and between \$402 million and \$1.6 billion in lost annual income in the rest of the economy if sulfide-ore copper mining suppresses or reverses growth in the amenity-based economy that has been the backbone of the region’s recovery since the early 1980s
- \$509 million in lost property value. This is a one-time drop in asset value that will spawn annual reductions in local property tax revenue throughout the Arrowhead region.

As the caveats given along with our methods and estimates suggest, these numeric estimates should be considered conservative first approximations of the true and complete costs of sulfide-ore copper mining in the watershed of the Boundary Waters and, by the same token, of the positive economic effects of the proposed action). We would therefore recommend the Forest Service devote sufficient time and resources to fully explore all of the economic effects of the proposed action. Specifically, the agency should include the following in its Environmental Impact Assessment:

1. Conduct a systematic survey of business owners and managers to estimate the effect of potential sulfide-ore copper mining on the outlook for Minnesota, and especially Arrowhead Region, businesses in all sectors.
2. Complete a thorough, statistically valid survey of residents, visitors, vacation and second homeowners, and other stakeholders to determine the sensitivity of individual's and other stakeholders' decisions about whether to vacation, retire, locate, or stay in the Arrowhead region under alternative scenarios involving the presence and extent of sulfide-ore copper mining in the proposed withdrawal area.
3. Commission or perform a hedonic price study of residential, commercial, and other property values in areas where similar mining operations have occurred. The scope of effects in such a study should go beyond direct air, water, and visual effect, to include effects on "wilderness character". Insights and parameters from such a study should then be used to estimate land value effects near the proposed withdrawal area.
4. Examine the extent to which forecasted mining employment in both lower- and higher-wage positions will be available to, and filled by, current Arrowhead residents. That is, how will the potential benefits of sulfide-ore copper mining be distributed among existing residents and workers brought in from elsewhere.
5. Evaluate the avoided impact on all ecosystem services that would occur if the proposed withdrawal is not implemented. Ecosystem services affected would include:
 - a. timber (a renewable raw material) from forestland is lost to mine-related infrastructure, including roads, buildings, tailings piles and others;
 - b. food, including the nutritional value of fish and game species and edible wild plants no longer able to use or thrive in terrestrial and aquatic habitat affected by mining;
 - c. water for drinking;
 - d. recreational opportunities, including as valued by impacts (expenditures, jobs, income, etc., as considered in this report) as well as by benefits (the value to the recreational user over and above the out-of-pocket cost of the recreational experience). Loss of benefit if the proposed withdrawal is not implemented would afflict would-be visitors who stay away due to the new type of mining in the Boundary Waters watershed, as well as those visitors who do come but find their experienced diminished by sulfide-ore copper mining; and
 - e. other ecosystem benefits described, for example by Balmford et al. (2010).
6. Estimate impacts on passive-use value. The Boundary Waters belong to and are loved by people throughout our Nation and the world who would want to know that its resources remain unimpaired and who would want to ensure that they or their descendants have the option of future use of the Boundary Waters without the impacts of sulfide-ore copper mining.

Above all, the Forest Service's economic analyses to be included in the Environmental Impact Statement should be grounded in a 21st-century understanding of economics and the reality that there is more to the foundation of the Arrowhead Region's economy than what can be dug up and shipped away.

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APPENDIX A: BUSINESS OUTLOOK SURVEY

Using Survey Monkey, we solicited input from 140 members of the “Boundary Waters Business Coalition”. We received 31 responses (a 22% response rate) to the following 10-question survey.

1. Which of the following best describes the industry that your business (or non-profit or public agency) is a part of?

[Options included all two-digit NAICS industries, plus some three-digit industries where the distinctions between, say, “Retail, clothing and accessories” and “Retail, food & beverages” could have been helpful.]

Industries describing the respondents businesses were:

Agriculture, forestry, fishing and hunting	(n=2)
Arts and entertainment (galleries, theaters, etc.)	(n=1)
Construction	(n=1)
Information (publishing, motion pictures, internet hosting and content)	(n=1)
Manufacturing, apparel	(n=1)
Manufacturing, Other	(n=1)
Manufacturing, wood Products	(n=1)
Other services	(n=1)
Professional, scientific, and technical services (law, accounting, etc. not health)	(n=1)
Recreation, guiding and outfitting	(n=7)
Retail, clothing and accessories	(n=1)
Retail, food & beverages	(n=2)
Retail, sporting goods (which may include clothing)	(n=7)
Other or Combination	(n=4)

2. Which of the following best describes your role in the business/organization/agency?

Owner/Co-owner	(n=26)
Senior Manager	(n=2)
Employee	(n=3)

3. How many FULL-TIME employees did the company have in 2016? (Include yourself if applicable.) Please count only those who worked full-time and year-round.

1-4	(n=19)
5-9	(n=3)
10-19	(n=6)
1,000 or more	(n=1)
No answer	(n=2)

4. How many PART-TIME employees did you have in 2016? (Include yourself if applicable.) Please count employees who worked less than full time AND those who worked any number of hours per week, but for less than the full year.

1-4	(n=10)
5-9	(n=7)
10-19	(n=6)
20-49	(n=2)
50-99	(n=1)

1,000 or more	(n=1)
No answer	(n=4)

5. Gross Sales: What was the level of your gross sales (or if an organization or agency, what was your budget) in 2016? Remember, your answers are confidential and will be used only as part of aggregate measures (averages, etc.).

Less than \$100,000	(n=6)
\$100,000 - \$500,000	(n=12)
\$500,000 - \$1 million	(n=5)
\$1 - \$5 million	(n=6)
More than \$100 million	(n=1)
No answer	(n=1)

6. How would you rate your awareness of/knowledge about the issue of sulfide-ore copper mining in the watershed of the Boundary Waters, and your level of engagement (talking about, writing letters, reading up on, etc.) related to the issue?

Average of 8 (range 5-10, n=31) on a 0-10 slider, where

0 corresponded to "I have not heard much or anything about it."

5 corresponded to "I am pretty well informed about the issue, but I am not actively following or taking any action related to it.", and

10 corresponded to "I know a lot about the issue, and I am regularly engaged in conversations and actions related to it."

7. Scenario 1: If sulfide-ore mining is NOT APPROVED and the economy of the Arrowhead region (St. Louis, Lake and Cook Counties) continues to develop as it has over the past 30 years, what are your expectations for how YOUR OWN business/organization/agency might change over the next 5-10 years?

Average of 7 (range 5-10, n=31) on a 0-10 slider, where

0 corresponded to "We expect to shut-down/ go out of business."

5 corresponded to "No change: we're about the right size.", and

10 corresponded to "We plan to expand by 100% (double in size) or more."

8. Scenario 2: If sulfide-ore copper mining WERE TO BE APPROVED in the watershed of the Boundary Waters, how would you expect YOUR OWN business/organization/agency to change over the next 5-10 years?

Average 4 (range 2-10, n=31) on a 0-10 slider, where

0 corresponded to "We expect to shut-down/ go out of business."

5 corresponded to "No change: we're about the right size.", and

10 corresponded to "We plan to expand by 100% (double in size) or more."

9. For the second scenario please describe HOW you would expect sulfide-ore mining in the watershed of the Boundary Waters to affect your outlook and your plans for your business or organization.
10. Please use this space for anything else you would like to say about the current and future business climate, economic development, or the prospects for your own business as it relates to sulfide-ore copper mining proposed for the watershed of the Boundary Waters.