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

Spencer Phillips, PhD

Carolyn Alkire, PhD

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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).

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ABOUT THE AUTHORS

Spencer Phillips has been conducting and directing applied research into the relationships between natural resource stewardship, environmental quality, and human well-being for more than 25 years. He was a staff economist first at the White House Council on Environmental Quality during the first Bush Administration, and then at The Wilderness Society, where he later served as Vice President for Ecology and Economics Research. Dr. Phillips founded Key-Log Economics to help ensure that sound, independent economic research is available to those working to solve the critical environmental problems of our time. He is also a lecturer in economics, natural resource policy, and GIS analysis at the undergraduate and graduate level. Phillips holds a B.A. in economics from the University of Virginia and an M.S. and Ph.D. from Virginia Tech.

Carolyn Alkire is an environmental economist with 35 years of experience in research into the economics of land and resource management. Prior to joining Key-Log Economics, she was a resource economist with The Wilderness Society, worked for private consulting firms supporting federal agencies, and was Senior Regional Economist for San Diego's metropolitan planning organization. She earned a Ph.D. in Public Policy from George Washington University, M.S. in Economics from North Carolina State University with a Statistics minor, and B.A., *cum laude*, from the University of Richmond.

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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)

> "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)

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.

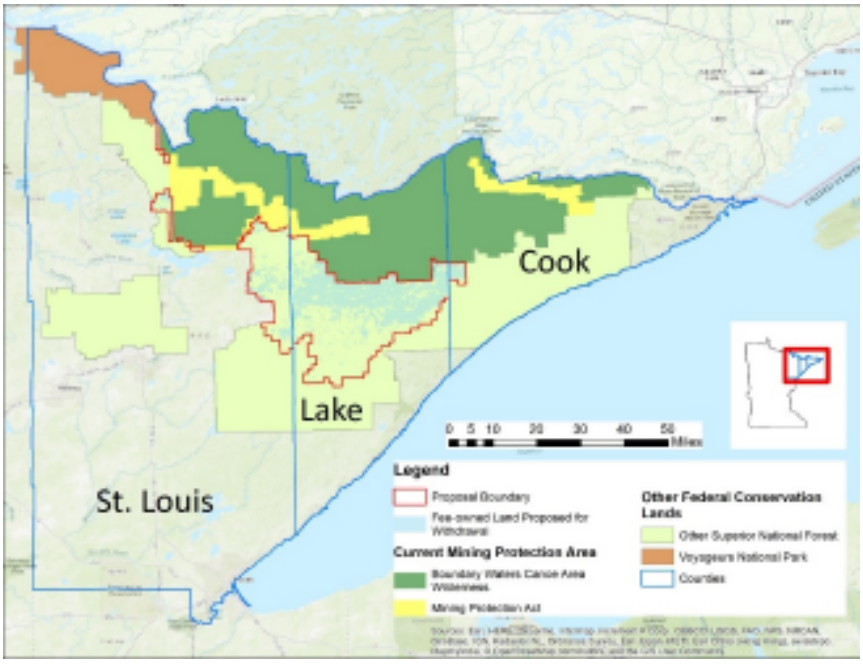
TRANSFORMATION OF THE ARROWHEAD ECONOMY, 1970-2015

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.

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.

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

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

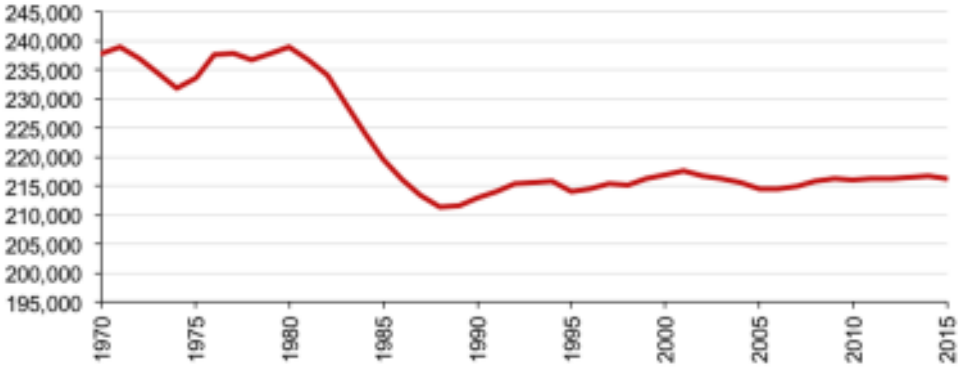
- The recession of the early 1980s coincided with a decline in mining from 10% of regional employment in 1980 to 2.5% in 2015.
- Services, including those directly connected to the region's high quality outdoor amenities (recreation and tourism) and those indicative of robust amenity-based development (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

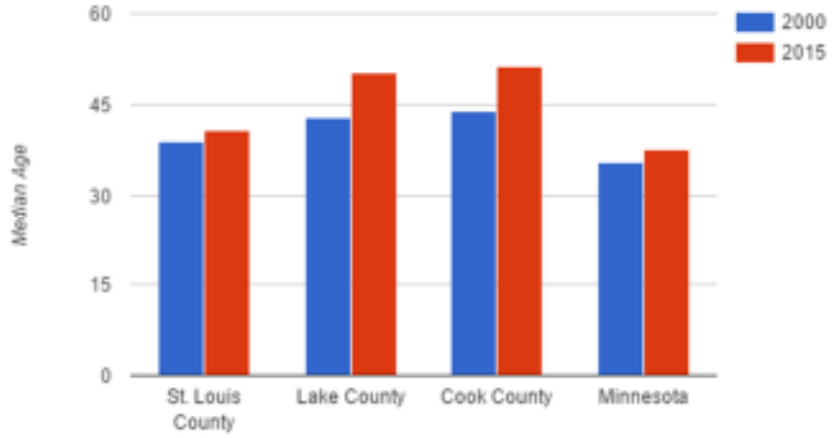
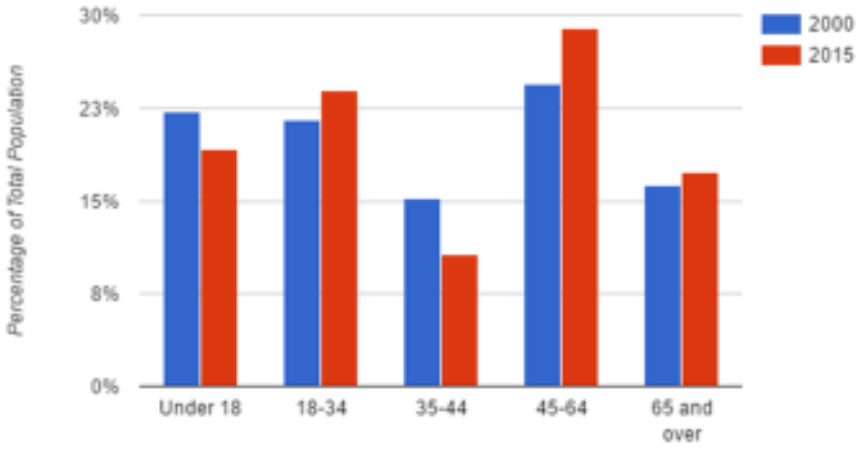


Figure 4: Age Distribution, Arrowhead Region, 2000 and 2015



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

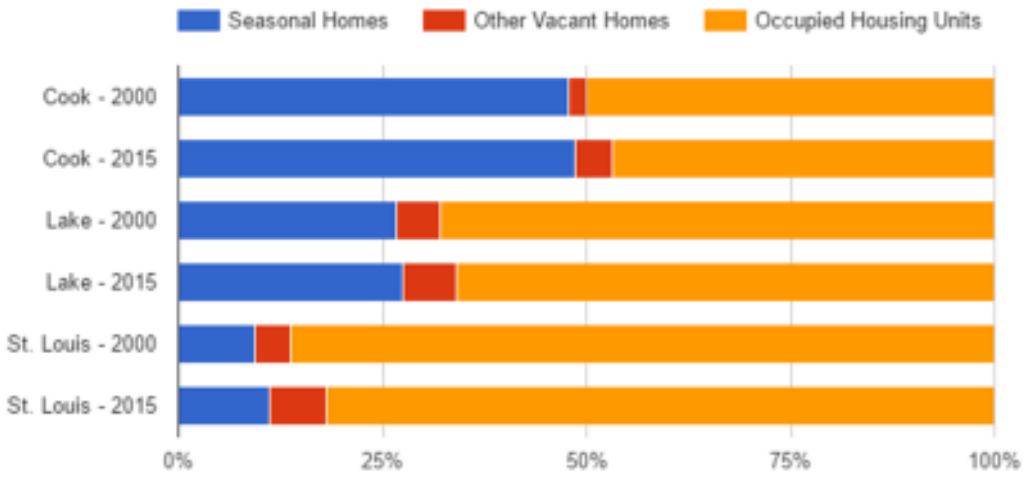
The Arrowhead region added almost 10,000 housing units (+8.6%) from 2000 through 2015. During the same period, the region's population was nearly flat (476 fewer people, or a decline of 0.22%). This seeming disconnect reveals two trends: more people are moving into their own housing units (as sign of 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/

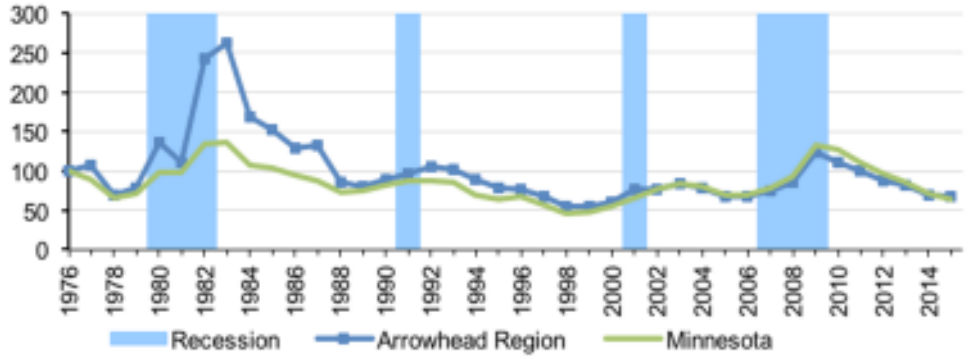
Employment and Income

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.

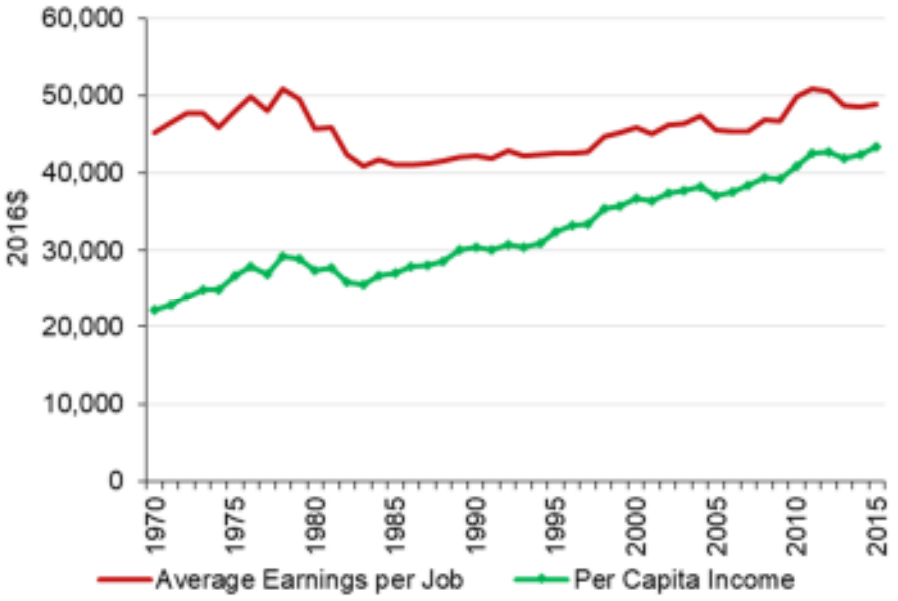
Income by Source

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

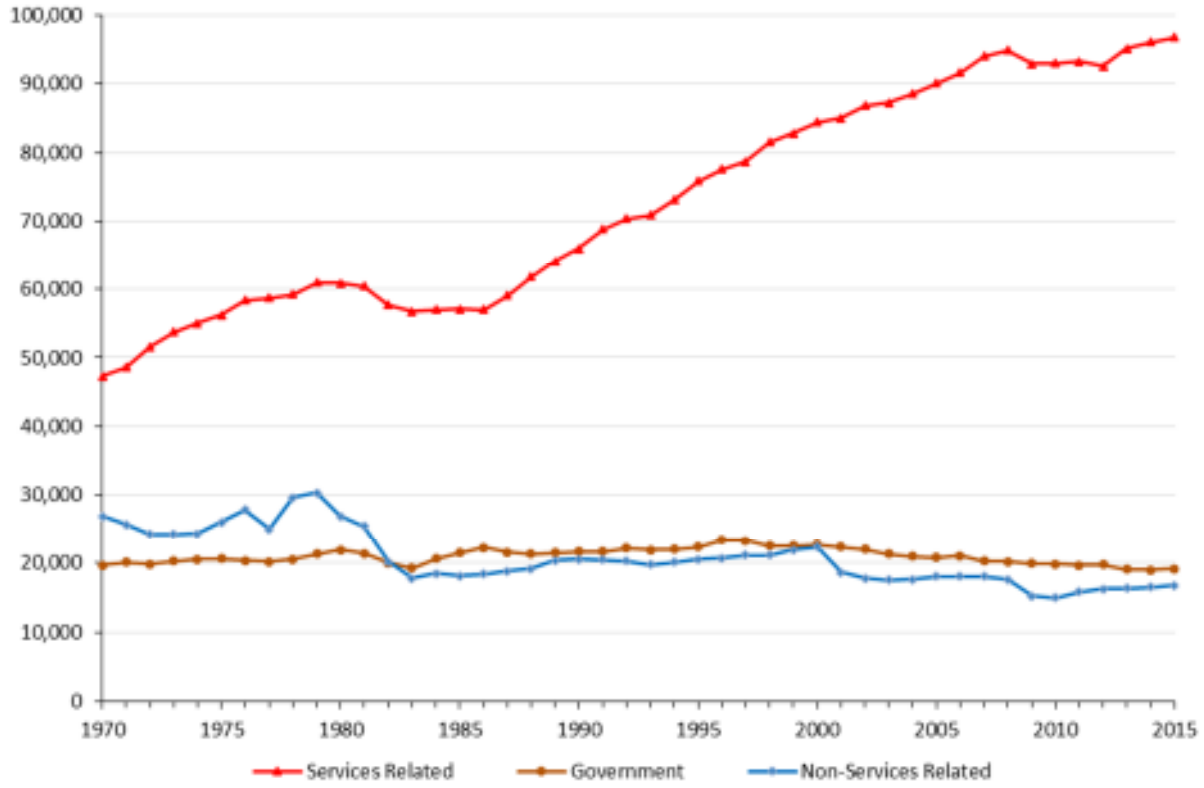


Source: Headwaters Economics: Economic Profile System- https://headwaterseconomics.org/: Socioeconomic Measures Report: Data Sources: U.S. Department of Commerce. 2016. Bureau of Economic Analysis, Regional Economic Accounts, Washington, D.C. Table CA30.

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



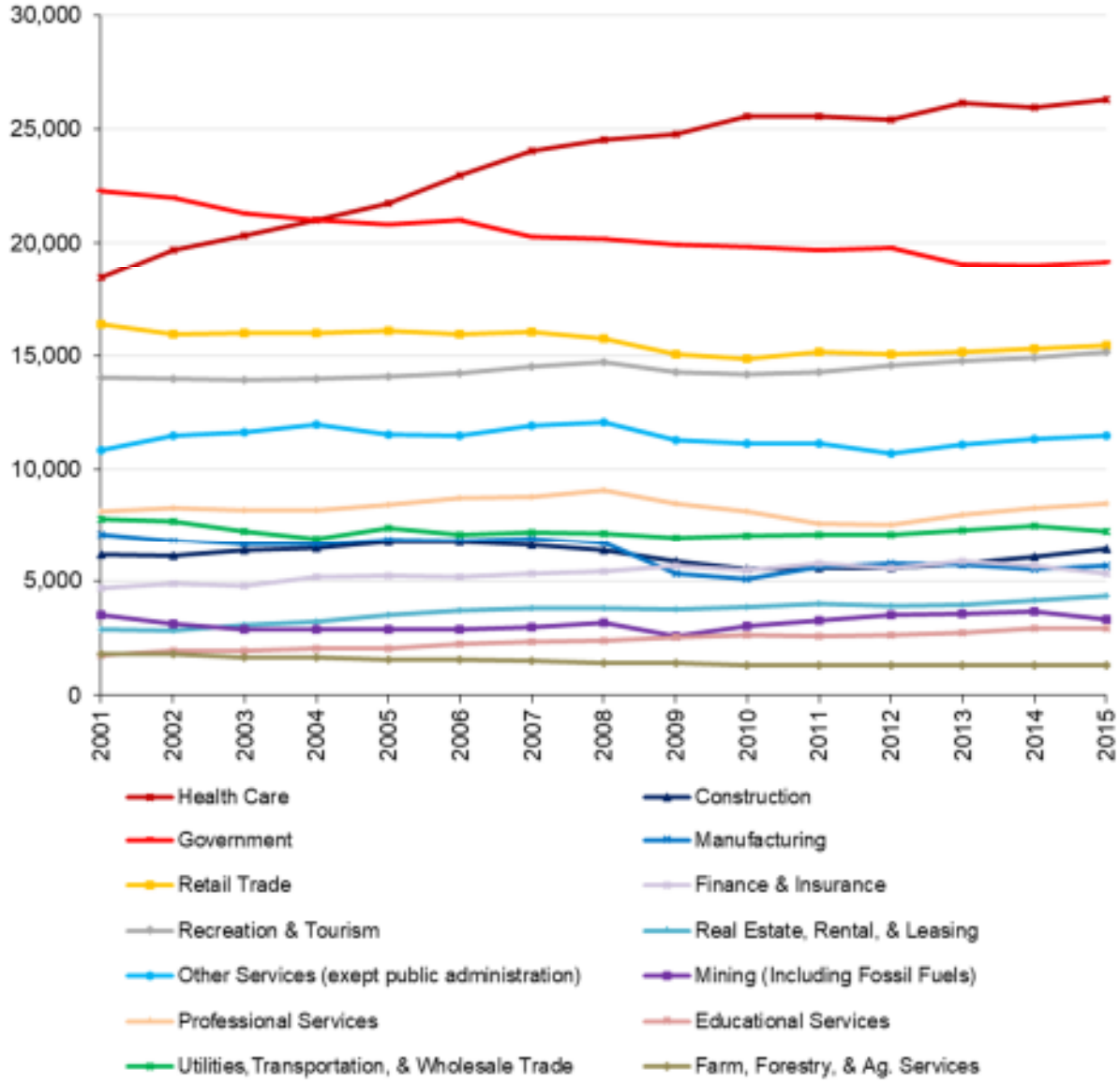
Source: Headwaters Economics: Economic Profile System- https://headwaterseconomics.org/: Socioeconomic Measures: Data Sources: U.S. Department of Commerce. 2016. Bureau of Economic Analysis, Regional Economic Accounts, Washington, D.C. Tables CA25 & CA25N. The series is split at 2000-2001 due to the 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.

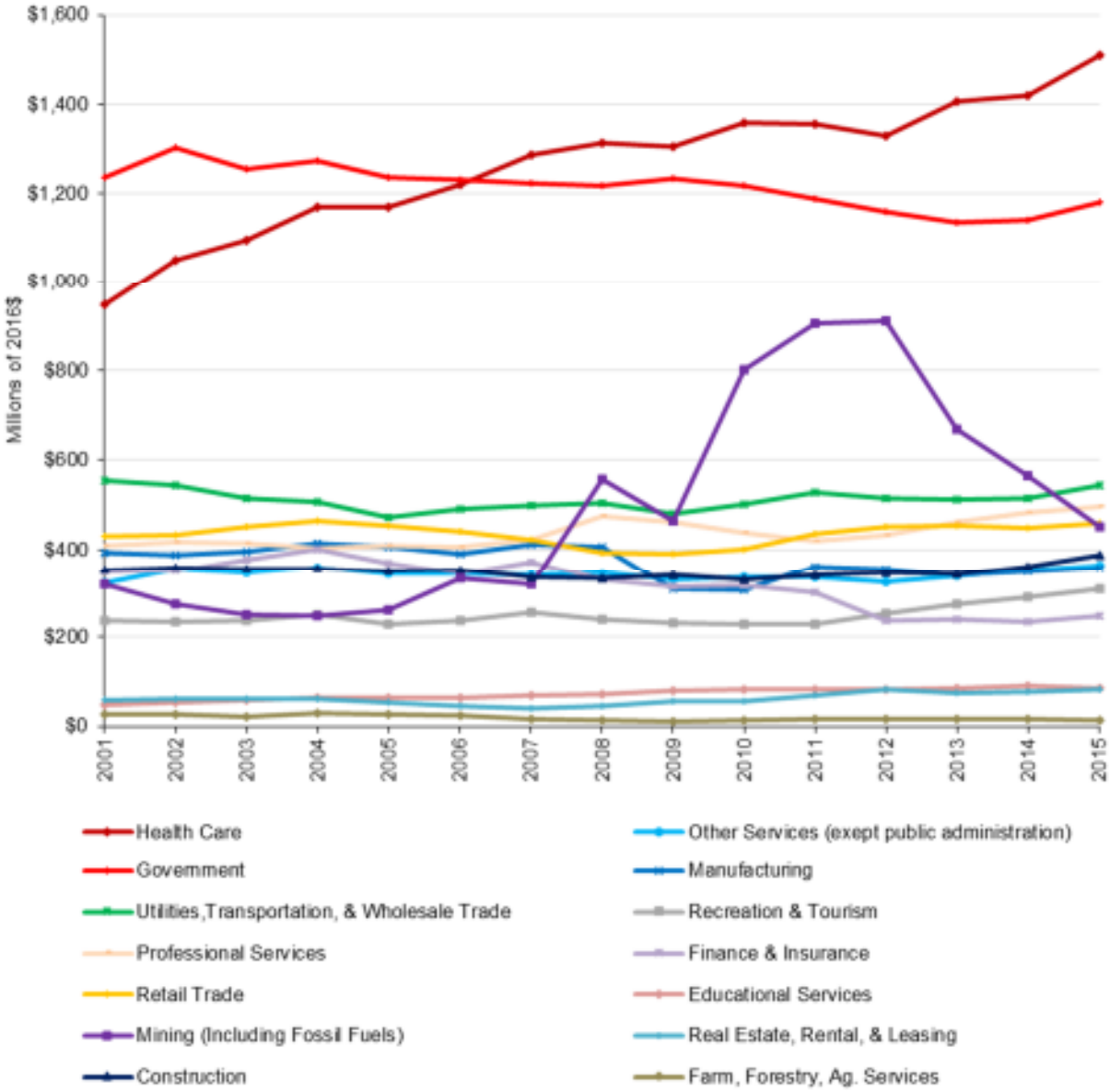
Figure 12: Employment by Industry Group, Arrowhead Region 2001 - 2015



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, Wente, 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.

> 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.

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.

[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 townships[4] 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 EFECTS 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?

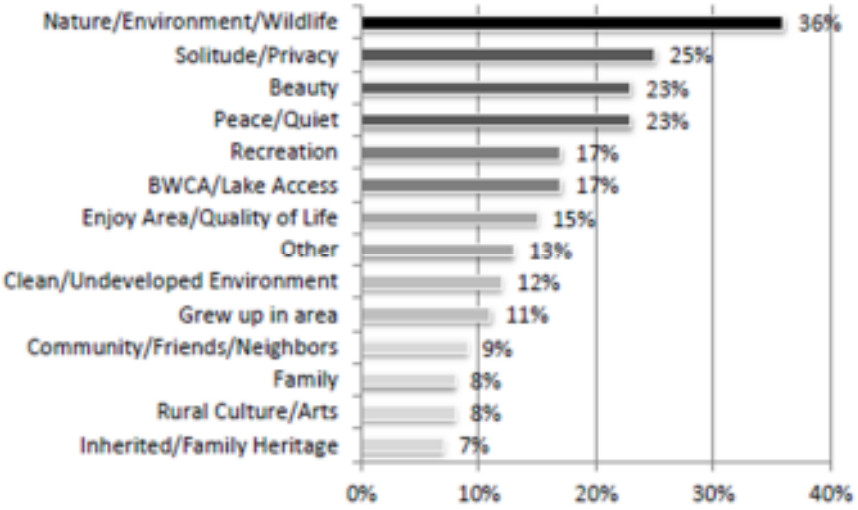
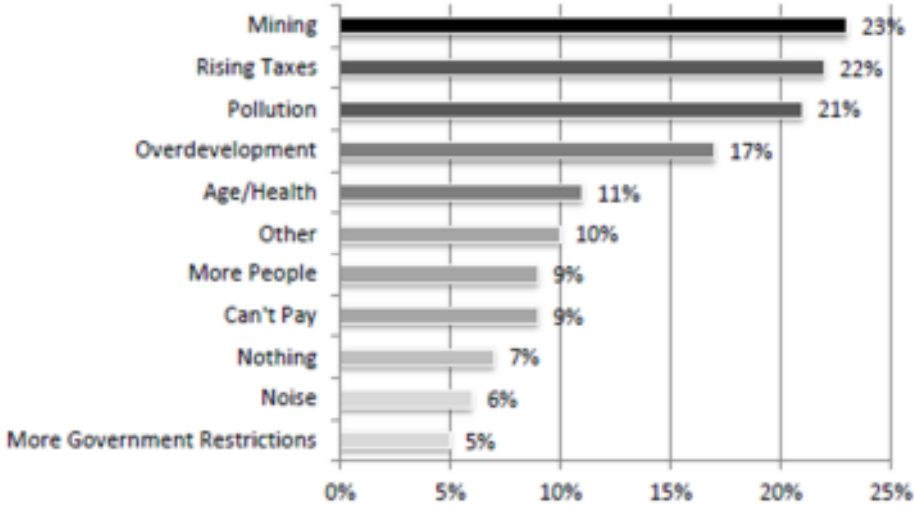


Figure 14b. Leaving: What factors would make you leave the four townships?



Source: Ronnader, R., Wente, 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 living[5] where they do and what might cause them to leave (Ronnader, Wente, 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, Wente, 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.

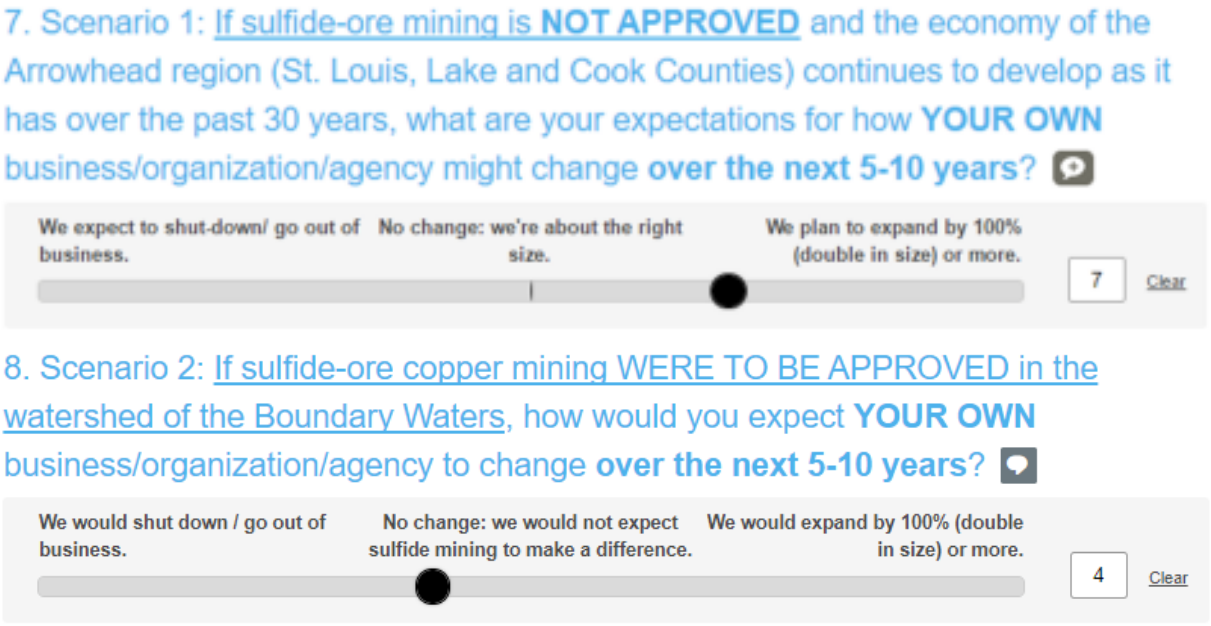
To be sure, businesses have spoken out both for and or against this new type of mining, and anecdotal evidence from letters to the editor, statements made at public meetings, and in other venues and documents (Northeastern Minnesotans for Wilderness, 2016) do suggest that for some businesses the advent 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



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, Wente, 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, Wente, 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, Wente, and Hove (2014); and tourism data cited above.

Lost Property Value

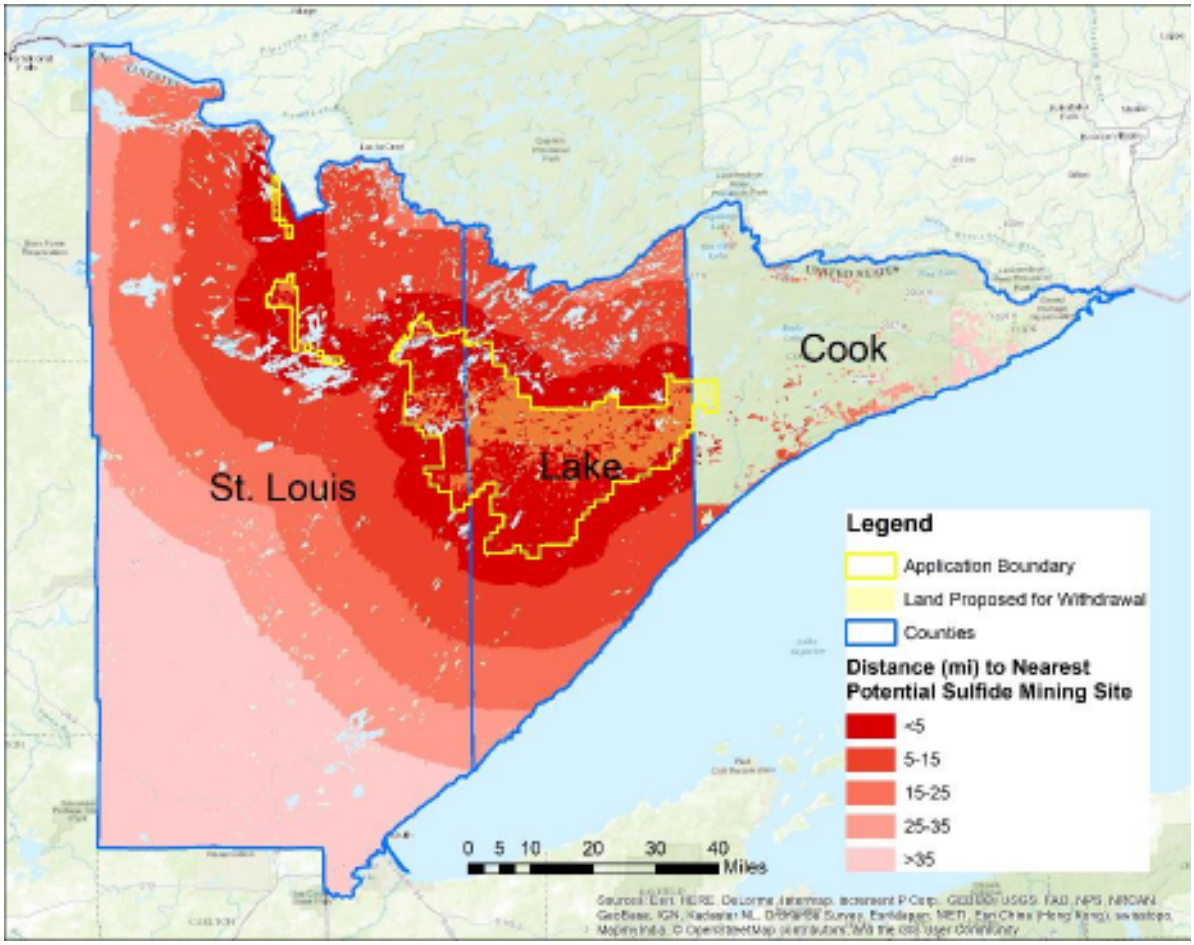
There is a ring of truth to the old saw that "location, location, and location" are the three things that matter most to the value of real estate. Namely, the location of a property relative to various amenities and disamenities can have a significant impact on buyers' willingness to pay for the property. 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.