

Arizona Geological Survey Products and Services Help Power Arizona's Economy

Introduction. In Spring 2019, the Arizona Geological Survey (AZGS) worked with the University of Arizona's Eller Business Consulting Program to evaluate the impact of our research, investigations, and products on the Arizona economy.

The Eller team's three-prong research approach to estimate the AZGS' annual impact on the Arizona economy included: (1) a 31-question online survey tool that prompted 176 responses (Figure 1); (2) web analytics of AZGS web resources and products; and (3) interviews with a wide range of AZGS stakeholders from government, mineral exploration, mining, hydrogeology, environmental and geohazard consulting, academia, and archaeology. Results of the study are summarized in the *Arizona Geological Survey Economic Impact Report* (AZGS Contributed Report 19-xx). This report also includes the survey (Appendix A), survey results and statistics (Appendix B), responses to open-ended questions (Appendix C), and summaries of the 14 in-person interviews (Appendix D).

Figure 1. Geoscientists surveyed self-identified areas of occupation/expertise. Some selected more than one area with n=286, greater than the ~ 180 individual participants.

AZGS Impact on Arizona State Economy. The AZGS receives an annual appropriation of \$941,000 from the State of Arizona as a line-item in the University of Arizona budget. These funds are used for operations, salaries, and funding match for federal grant programs. In addition to this base funding, AZGS brought in an additional \$1 million in external funds - 74% of external funds stem from federal sources (Figure 2a).

The larger impact of the AZGS on the state economy is the \$30.4 million in annual cost avoidance savings (CAS) that Arizona's mining, environmental consulting, construction, and government stakeholders would incur if our products and services were not available as 'public goods' (Eller Report, p. 6).

Figure 2. a) The AZGS funding stream for fiscal year 2019. For every dollar provided by the State of Arizona, the AZGS generated an additional \$1.44 from external sources. b) Eller cost avoidance analysis shows that various categories of AZGS 'public good' geologic products and services yielded more than \$30 million in cost savings, with the bulk attributed to the availability of mining data. The use of interactive (e.g., Natural Hazards in Arizona viewer) and digital geologic maps delivers an estimated savings of ~ \$7.7 million.

When asked, 'Can you think of a specific instance when products of the AZGS (maps / reports / consultations) saved you or your organization money?', 64 individuals reported an estimated total savings of ~\$5-7 million (Eller Report, Appendix C – Q15).

Survey participants rated the AZGS digital geologic maps and reports as those materials most necessary for their organizations (Figure 3, Appendix A – Q#2). Nearly 85% indicated that reduced access to AZGS products would make the State of Arizona a less desirable location for

geologically related economic activity (Appendix A – Q#)

Socio-Economic Areas Benefiting from AZGS Products and Services

The Eller Team identified three broad socio-economic areas that benefit substantially from the AZGS products and services:

- i. Economic/natural resource development;
- ii. Public safety and community resilience;
- iii. Efficacy of public administration.

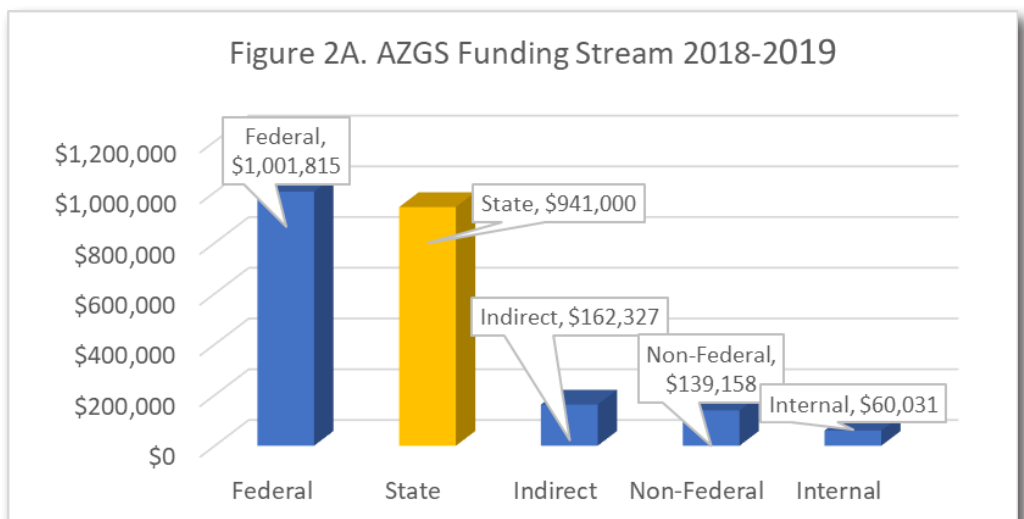
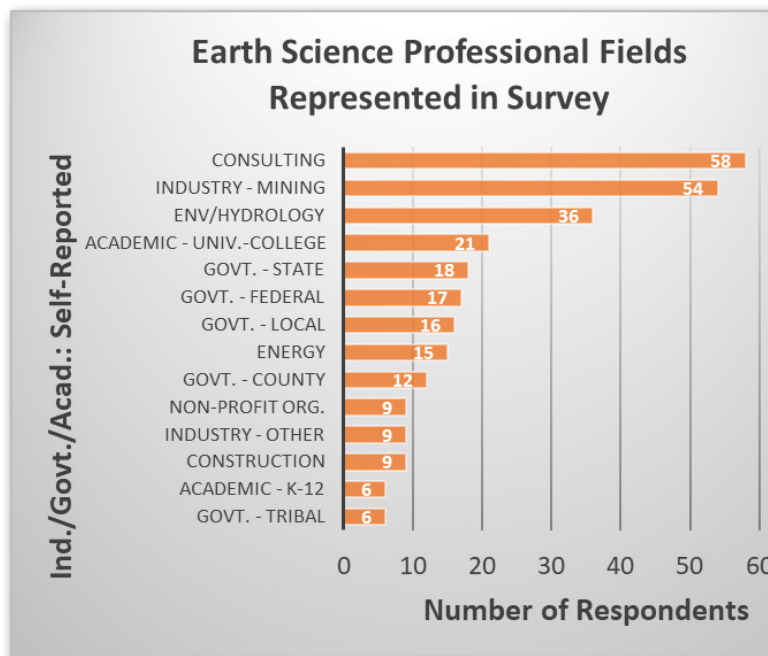
The sections below briefly detail the benefits to the

three areas from the ready availability and use of AZGS products and services. Each section begins and ends with our stakeholders describing their experiences with AZGS products.

i. Economic/Natural Resource Development

"I provide geologic services to the mineral extraction, environmental, and land development industries. I use AZGS baseline data and archival reports in every project. AZGS data and information is critical to my work and many industries", anonymous response to survey question #6.

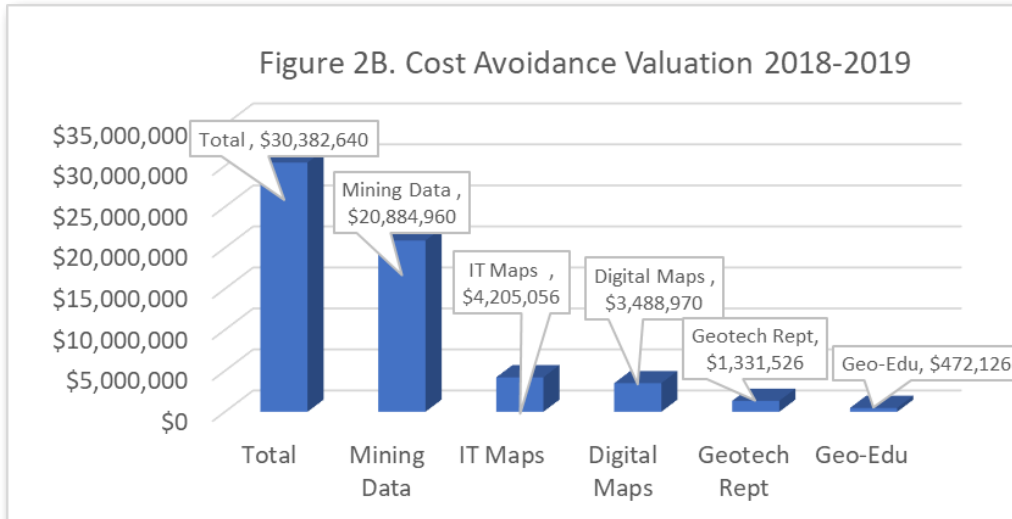
The Eller Report concluded that AZGS geologic maps, reports, and unpublished mine files ([AZGS Mining Data](#)) power exploration for Arizona's precious and base metals, as well as industrial minerals. An individual from the mining industry noted that AZGS saves his/her firm up to \$375,000 annually on projects that cost \$10-to \$12-million annually. The Eller Team's analyses of web



analytics, survey results, and interviews demonstrate that AZGS products and services provide more than \$30 M in cost avoidance to private/public sectors each year. Products and services provided by the AZGS contributed to the assessment that Arizona was 8th of 83 jurisdictions on the Fraser Institute’s worldwide Mining Investment Attractive Index (Stedman and Green, 2019). In the U.S.,

the AzSLID data would play an integral and important role in engineering the widening of I-17 – the principal route connecting Phoenix to Prescott and Flagstaff – saving the state hundreds of thousands of dollars in engineering and consulting fees.

The Natural Hazards in Arizona interactive map, a joint product of AZGS and the Arizona Dept. of Emergency and Military Affairs, is used by government, the private sector, and the public in making land management and land use decisions. The hazard viewer displays the distribution of earthquake epicenters and faults, earth fissures, flood zones, landslides and debris flows, and active wildfires. The aggregate of cost avoidance to the geotechnical community from this and other AZGS interactive maps exceeds \$4 million annually (Figure 2b.)



The AZGS’ earth fissure mapping/monitoring program in Cochise, La Paz, Maricopa, Pima, and Pinal Counties has enabled government and the private sector to minimize encounters with fissures, potentially saving hundreds of thousands or millions of dollars in engineering fees and post-construction remediation costs (Arizona Land Subsidence Group, 2007). AZGS earth fissure products are referenced in the Disclosure Reports required by the Arizona Department of Real Estate and provided to all new home buyers to bolster consumer safety and protection. Spencer Kamps, Vice President Legislative Affairs of Home Builders Association of Central Arizona, said this about AZGS services, “Our industry (collectively) uses their products several times a week. Because new homes must disclose a number of conditions to new buyers.... Good bang for the buck for AZ provided by AZGS services. AZGS geoproducts serve private sector, including housing industry, mining, water ...”

only Nevada, Alaska and Utah were ranked higher.

AZGS products and services make small- and medium-sized businesses more competitive by providing AZGS geologic map and mine reports, which would otherwise be too expensive to pursue. Bill Greenslade, consulting hydrogeologist, said, “Only AZGS does the Holocene mapping along river systems – hard to replace, very expensive.”

The two quotes below from the 130 responses to survey question #6 (Appendix Q6 LINK), ‘How do you use geologic/environmental information provided by AZGS’, epitomize the benefits of AZGS products.

“We use the information to determine the potential for geologic hazards on a particular site or infrastructure alignment. We also use the information to assess the changes in engineering properties based on subsurface conditions. Lastly, we use the information as a basis for our geological site reconnaissance and site mapping.”

“We use a wide variety of AZGS products at ADOT because we are interested in site specific geologic and technical information at a number of places. Then we build from their internal geotechnical reports and memos for help with the planning, design and construction of highway infrastructure projects.”

ii. Improves Public Safety & Community Resilience

“AZGS supports industry and education related to natural resources and hazards at a level that is orders of magnitude greater contribution than the agency’s cost of operations.” Anonymous response to Q#29 (Eller Report: Appendix C – Q29).

In 2019 Arizona’s population grew to 7.28 million; an increase of nearly one million since the 2010 census. Rapid population growth increases societal risk (a function of geologic hazard(s), exposure, and vulnerability) from common geologic hazards – earthquakes, earth fissures, flash flooding, landslides and debris flows, severe weather, and urban wildland interface fires.

Since the 1980s, the AZGS concentrated on identifying and documenting the distribution of geologic hazards that potentially threaten Arizonans, their infrastructure, and property (e.g., Youberg and others, 2016; Cook, 2013, Pearthree and others, 2009). For example, the Arizona Statewide Landslide Inventory Database (AzSLID) identified more than 6,000 landslide features. A consultant for the Arizona Dept. of Transportation noted that

iii. Enables More Effective Public Administration

“AZGS has helped identify aggregate resources on public lands. This allows BLM to properly manage those lands. Upon leasing for use, BLM uses AZGS products to appraise royalty. This adds up to hundreds of thousands of dollars each year going into the public till.” Al Burch, consulting geologist and formally of the Bureau of Land management.

Federal, state, county and local government rely heavily on AZGS geologic products – maps and reports – for equitable assessment of the value of public lands. AZGS products are particularly valued for: 1) inferences that can be made regarding the existence, composition, and distribution of natural resources – mineral (precious and base metals, and aggregate and other industrial minerals); water resources assessments; and geologic hazards; 2) the high quality and accuracy of our geologic maps and reports; and 3) the unbiased scientific approach of AZGS staff to geologic mapping and investigations.

AZGS data supports counties and municipalities in their efforts to append their *General Plans* in compliance with the Aggregate Protection Act (APA) of 2011; APA was designed for smart land use and conservation of aggregate resources. The AZGS subsequently published a geologic database addressing aggregate resources in the Phoenix metropolitan area (Pearthree and others, 2015).

AZGS sedimentary basin analyses are shedding light on the hydrogeology of groundwater resources in a dozen basins, including those near Casa Grande, the Phoenix Metro area, Tucson, Willcox, and Yuma (e.g., Gootee and other, 2012). These data are critical for supporting the hydrogeologic models constructed by the Arizona Dept.

of Water Resources and consulting firms in their efforts to measure the quantity, flow patterns, and quality of Arizona’s finite groundwater resource. Basin analyses also provide key information regarding the potential for deep storage of liquid natural gas and carbon sequestration.

In 2017, the AZGS collaborated with the Salt River Project (SRP) to investigate the subsurface hydrogeology of the Superstition Vistas Planning Area, Maricopa and Pinal Counties, Arizona (Gootee and others, 2017). SRP project leader Karen Wolf said of the efficacy of the AZGS’ contribution, *“Would have cost \$350k to \$500k [to reproduce] and end up with lower quality result. [AZGS rendered] Much better conceptual and numerical model.”*

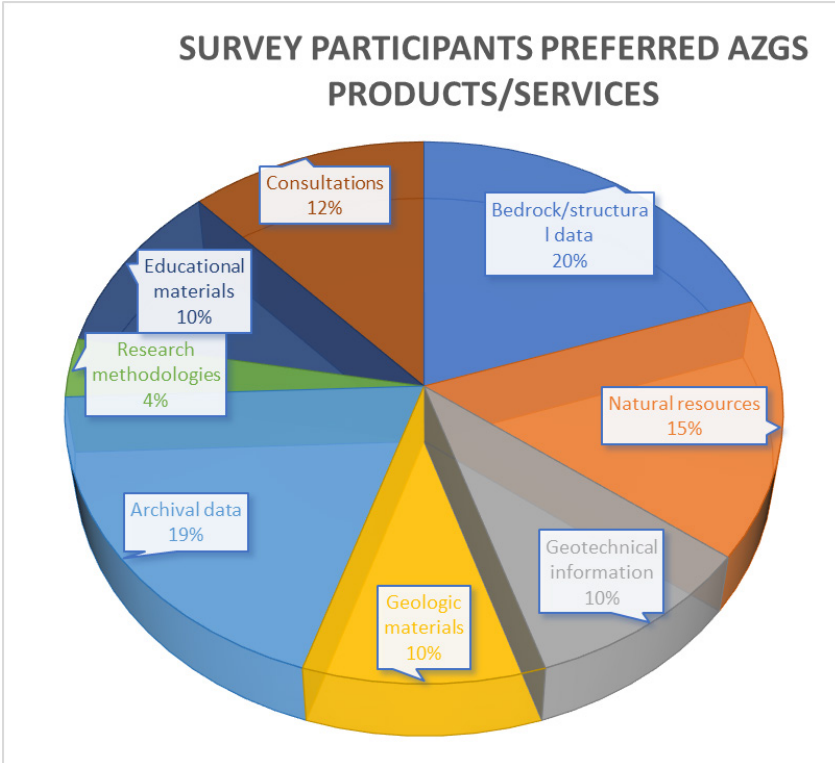


Figure 3. AZGS products and services preferred by survey participants

Last, the Eller Team report notes repeatedly the high esteem of AZGS stakeholders for the quality of maps and reports and for the impeccable reputation of the AZGS as an unbiased science agency.

AZGS and the Arizona economy: Growing together in the 21st Century

“Yes, I leverage AZGS reports and geologic maps in writing proposals and conducting research. As a voter, taxpayer, and geologist, AZGS is one of the most important assets that Arizona has.” Dr. Steve Semken, Professor, Arizona State University School of Earth and Space Exploration.

The Eller Report shows that AZGS geologic products and services contribute strongly to Arizona’s economy, with more than \$30 million in public goods cost avoidance annually. The AZGS’s geologic hazard maps and reports are instrumental in building a safer and more resilient Arizona.

The results of this report document the value of current AZGS activities and provide insights into areas we should emphasize in the future. In support of ongoing population growth and to further economic development, the AZGS will continue to produce geologic products with applications to mineral exploration and mining, and to identifying, documenting, and mitigating geologic hazards. We will continue to enhance the usefulness and accessibility of digital geologic data, and will pursue opportunities for basin analysis research (e.g., Gootee and others, 2017) to better define hydrogeologic settings – essential for quantifying groundwater resources and potential storage of fluids in deep basins.

AZGS Stakeholders Speak Out!

Al Burch, Geologic Consultant - There are few days where I don’t use some AZGS product. I use it every single day, as do my own contractors. AZGS web product helps greatly.

Bill Greenslade, Consulting Geohydrologist - Only AZGS does the Holocene mapping along river systems – hard to replace, very expensive.

Greg Hahn, CEO Arizona Silver - Since acquiring project in 2016 based on AZGS data – 2.5 million dollars to date, maybe another \$10 million, if goes to mine \$100M invested.

Doug Bartlett, geohydrologist at Geo-Logic Inc. We use a lot of AZGS reports – geology, floodplain alluvium (San Pedro, Verde). AZGS makes high quality mapping available.

Dr. Steve Semken, Professor of Geosciences, Arizona State University, – Yes, I leverage AZGS reports and geologic maps in writing proposals and conducting research. As a voter, taxpayer, and geologist, AZGS is one of the most important assets that Arizona has.

Eric Mears, Geologist at Haley and Aldrich – ‘As consultant, we use geologic maps and reports to focus our consulting reports. As an advocate for mining on public board, we use AZGS more strategically. In case of proposed public land withdrawal, we’ll request the survey put together a report on historic mine production and resources.’

Steve Trussell, Exe. Director of Arizona Mining Assn. & Arizona Rock Products Assn. (It’s) important for communities to plan and conserve natural resources. AZGS can help with assessment and have been greatly helpful. Now they will be tracking active mine locations in AZ – help planners.

Avi Buckles, Dir. of Cultural Resources, Westland Resources - My research and product is deeper and more robust because of these data (AZGS mine files). It makes me more efficient and more productive. And this can speed along the permitting process, too. There is a great deal of info applicable to health and safety – I do a little research and find info on the claim and describe the workings – this actually happened where I found underground map and assisted in mitigating hazards.

Spencer Kamps, Home Builders Assn. of Central Arizona - Our industry (collectively) uses their products several times a week. Because new homes must disclose a number of conditions to new buyers. Anything that could impact decision-making on part of new owner. Earth fissure issue brings survey into it. (The) AZGS maintains and communicates fissure info.

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