Executive Summary

A portion of the Federal lands in western Maricopa County have been proposed for designation as Wilderness Areas, National Conservation Areas (NCAs), and Special Management Areas (SMAs) by the Sonoran Desert Heritage conservation proposal. The lands are managed by the U.S. Bureau of Land Management (BLM) and are found in highlighted sections on each map included in this report. If these areas receive permanent legislative protection, they would be withdrawn from future mining activities. However, these potential designations will not impact existing valid mining rights on these lands. An analysis was completed to understand suitability of these areas for future mining activity for precious and base metals deposits and rock products. A brief summary of findings follows.

Metal Ore Findings

Due to the extensive areas in the state that are permissive for base and precious metals deposits, there are many other viable areas in the state for mining companies to explore for these types of deposits. The removal of the small areas of prospective ground identified in the proposal will not substantively hinder exploration and mining activity directed towards these types of mineral deposits.

The following summarizes key findings related to precious metals (gold and silver) deposits:
   • The most likely area for discovery of precious metals deposits would be within the proposed NCA boundary that includes the Harquahala and Belmont Mountains.
   • Areas within the proposal area have a small chance of discovery of additional precious metals deposits.

The following summarizes key findings related to base metals (copper, lead, and zinc) deposits:
   • There is a very low likelihood that additional significant base metals deposits would be discovered in any of the areas within the proposal.

Rock Products Findings

Rock products, alluvial aggregate and crushed rock, are widely available in river beds and alluvial fans outside the proposal area. Transportation expenses quickly increase the cost of rock products if shipped outside a 50 mile radius of their use.
   • Due to the distance to markets needing these products for the construction industry, it is more likely the industry will continue to mine rock products from existing sources rather than truck them in from the proposal area.
Reason for Analysis

A portion of the wild lands in western Maricopa County have been proposed for designation as Wilderness, as well as inclusion in NCAs and associated SMAs by the Sonoran Desert Heritage proposal. These lands are currently managed by the BLM. One factor to be considered in the decision to change the management status of these lands is their suitability for future mining activity. See the Sonoran Desert Heritage Draft Proposal Map.

Mineral occurrences and the availability of mineral rights on these lands have resulted in mining for base and precious metals in the area. A small amount of mineral exploration and mining currently continues in the area, as evidenced by active mining claims, notices and plans filed with the BLM. Potential future mining activity in the area will be driven by demand for mineral commodities, the presence of valuable minerals, and the availability of land with mineral rights.

This analysis considers metallic mineral potential and mineral rights in the area, making the safe assumption that continued global population growth and economic development will provide an ongoing demand for mineral commodities potentially present in the area. This report focuses on selected base and precious metals: copper, lead, zinc, gold, and silver.

By examining the spatial coincidence of known mineral occurrences, mining claim activity, and mineral potential, the risk of including areas with valuable mineral deposits in Wilderness Areas, NCAs and SMAs can be evaluated. This analysis is based on information generated from a geographic information system (GIS) database that was constructed to help stakeholders broadly understand metallic mineral potential in the area.

In addition to metallic mineral resources, western Maricopa County hosts deposits of sand and gravel, known as alluvial aggregate, and bedrock deposits potentially suitable for making crushed stone. These materials are primarily used in a variety of construction applications. This report provides a brief summary of aggregate mining, as well as an analysis of aggregate resource potential in the areas proposed for Wilderness, National Conservation, and Special Management designations.
Potential for Metal Ore Deposits

The U.S. Geological Survey (USGS) has evaluated western Maricopa County for mineral potential for metal deposits as part of its national mineral resource assessment program. The Arizona State Land Department (ASLD) Minerals Section has also evaluated the area as part of a mineral resources assessment of Pima, Pinal, and Maricopa counties. The following mineral potential summary is based on estimates published by the USGS and ASLD.

Precious Metals (Gold and Silver)

Known Gold and Silver Occurrences

Locations of known occurrence of these metals are important considerations in estimating mineral potential. Through the use of improved modern mineral exploration methods, new ore deposits are sometimes found in areas with known occurrences and historical mining activity. Data from the USGS Mineral Resource Data System (MRDS) was filtered for occurrence of gold and silver, as well as metals that are indicators of precious metals deposits, including mercury, arsenic and antimony. These mineral occurrence locations are shown on Maps 1, 2 and 3.

Precious Metals Potential

Deposits of gold and silver occur in western Maricopa County and some potential for additional discoveries of ore deposits in the county exists where geological conditions are permissive for the occurrence of these types of deposits. These areas, known as permissive tracts, are shown in Maps 1, 4, and 5. The USGS assessed the entire permissive tract for potential for two primary types of gold/silver ore deposits:

- Distal disseminated gold-silver deposits such as occur at Tombstone.
- Epithermal vein deposits such as occur at Oatman and at the Vulture Mine.

Tombstone type deposits: USGS estimates a low probability of occurrence of undiscovered deposits. This is interpreted as a 50 percent chance for up to two undiscovered deposits across the entire permissive tract.

Vulture Mine type deposits: USGS estimates a low probability of occurrence of undiscovered deposits. This is interpreted as a 50 percent chance for up to five undiscovered deposits across the entire permissive tract.

Precious Metals Summary

Because only very small portions of the permissive tract for these types of deposits lie in areas proposed for designation as Wilderness, NCA and SMA, there is a very small chance that a valuable mineral deposit of these types would occur in the area. It should be noted that the estimates above are for the entire permissive tract, which extends across much of the southern and western portions of the state, not just the areas contained in the Sonoran Desert Heritage

Mineral Potential in the Sonoran Desert Conservation Proposal Area in Western Maricopa County
conservation proposal. This is not to say that there is no chance to find new deposits; there is always the chance a new deposit will be discovered as new geological information becomes available. However, the probability of a new deposit being discovered in the area is quite low and many areas across the state remain for mining companies to explore.

**Base Metals (Copper, Lead, and Zinc)**

*Known Copper, Lead, and Zinc Occurrences*

Deposits of copper, lead, and zinc occur extensively in Arizona and have been historically mined in the proposal area. Examples of base metals deposits in the region include the copper deposits at Bagdad, Superior, Globe, Miami, Morenci, and those around Tucson. As is the case with precious metals deposits, an important consideration in estimating mineral potential for base metals is locations of known occurrences of these metals. New ore deposits are sometimes found in areas with known occurrences and historical mining activity. Data from the USGS MRDS was filtered for occurrences of copper, lead, and zinc and these are shown in Maps 6, 7 and 8. The Minerals Section of ASLD also conducted a mineral resource assessment for copper deposits in Maricopa County. The combined permissive tracts are shown in Map 9.

**Base Metals Potential**

The USGS assessed the area for potential for base metals in three types of ore deposits:

- Porphyry copper (such as those found in Ajo, Morenci, Bisbee, San Manuel, Sierrita, Superior, Safford, and Bagdad Mines)
- Skarn copper (such as those found in the proposed Santa Rita Mountains Rosemont Mine)
- Polymetallic vein deposits (Cottonwood Canyon area in Santa Cruz County such as Tyndall, Salero and Wrightson mining districts)

Permissive tracts for the occurrence of these types of deposits are show in Maps 8, 9 and 10. For the sake of simplicity, skarn copper and polymetallic vein permissive tracts have been aggregated and are referred to as “Other Base Metals Permissive Tracts”.

**Porphyry copper deposits:** In the combined permissive tracts, **USGS estimates a moderate probability of occurrence of undiscovered deposits**: a 50 percent chance for up to 23 undiscovered deposits. ASLD estimates a low probability of occurrence of undiscovered deposits, a 50 percent chance of one undiscovered deposit.² This estimate includes all types of copper deposits.

**Skarn copper and polymetallic replacement deposits:** USGS estimates a **high probability of occurrence of undiscovered deposits**: a 50 percent chance for up to 33 undiscovered deposits. ASLD estimates are included in the porphyry copper numbers.
Base Metals Summary

Of the permissive tracts for these deposit types, only a very small portion is present in the areas proposed for inclusion as Wilderness or in NCAs and SMAs, as seen in Map 10. The permissive tract only overlaps the Harquahala Mountains section and the Sand Tank Mountains section of the proposed NCAs and associated Wilderness areas. The USGS and ASLD resource estimates can be interpreted to mean that there is a very small chance of discovery of new base metals deposits in western Maricopa County. As is the case with the precious metals deposit types, a reasonable interpretation of these estimates is that the extensive areas in the state that are permissive for these types of deposits offer substantial opportunities for mining companies to explore for these types of deposits. The removal of the small areas of prospective land proposed for inclusion in the NCAs and SMAs will not substantively hinder exploration and mining activity directed towards these types of base metals deposits.
Rock Products (Aggregate)

Aggregate 101

Aggregate refers to rock fragments, both sand and gravel, also known as alluvial aggregate, and crushed rock that may be used in their natural state or after processing such as crushing, washing, and sizing. Aggregate has myriad uses, but most aggregate is used to construct highways and buildings. A typical interstate highway requires up to 20,000 tons per lane mile. A typical new home and its proportional share of the associated infrastructure and buildings require more than 325 tons of aggregate.3

In Arizona, sand and gravel are mined from two primary sources, river and stream beds and alluvial fans. Crushed rock is quarried from areas where hard bedrock, mainly limestone and granite, is present at, or near, the land surface. Most of the aggregate consumed in Arizona is alluvial aggregate. Sand and gravel are primarily mined using earth-moving equipment such as bulldozers and front-end loaders. Crushed rock is generally mined in quarries by drilling and blasting rock and then removing the material with power shovels or bulldozers. After sand and gravel or crushed rock are mined they are separated by screening each into various size categories according to specifications required by the final use.

Aggregate is a bulk commodity and is transported from the mine by truck, or by rail for longer distances. Transportation charges can add significantly to the cost of aggregate. For example, transporting aggregate 20 miles by truck can double the price of the delivered aggregate product. For this reason, most aggregate is consumed within about 50 miles of where it is mined.

Aggregate is mined on federal, state, and private lands. On federal lands, aggregate is designated as a “saleable material”, which must be purchased, as opposed to metallic minerals, which are “locatable”, acquired by locating and recording a mining claim. On state trust land, aggregate properties are leased and a royalty is paid to the state.

Potential Aggregate Resources

Nearly all the construction aggregate consumed in the Phoenix metro area is mined from alluvial deposits along major river/stream systems of the Salt River, Gila River, Agua Fria River, Hassayampa River, and New River. Extensive additional alluvial aggregate resources exist in these stream systems.

Except for a short section of the Gila River west of Gila Bend, the area within the proposed NCA boundary excludes major river and stream systems, as shown in Map 11. Map unit Qr, shown with green-hachuring, indicates the extent of river and stream deposits that represent potential sources of alluvial construction aggregate. As such, potential alluvial construction aggregate resources are minimally affected by the proposal. Additionally, as noted above, extensive alluvial construction aggregate resources are present in the major river and stream systems that lie outside the boundaries of the proposed NCAs.
Potential sources of crushed rock construction aggregate are represented in Map 11 by map units YXg, Yg, Pz, MzPz, TKg, TKgm, Xg and Tg. While these units are present extensively within the proposed NCAs boundaries, they are also widely distributed near the Phoenix metro area outside the boundaries of proposed NCAs.

**Rock Products Summary**

This analysis illustrates that should the proposed NCAs be enacted, access to construction aggregates in Maricopa County would not be substantially limited because:

- potential alluvial construction aggregate resources are generally not included within the boundaries of the proposed NCAs;
- extensive alluvial construction aggregate resources are widely available elsewhere in river and streambeds in the Phoenix metro area; and
- potential crushed rock construction aggregate sources are widely distributed near the Phoenix metro area in areas outside of the proposed NCAs boundaries.
**Summary of Maps**

Sonoran Desert Heritage Draft Proposal Map.

Map 1: Gold and silver occurrences across the permissive tracts included in the proposal area.4

Map 2: Density of active claims in the northern portion of the SDH proposal for precious metals as of December 19, 2011.5

Map 3: Density of active claims in the southern portion of the SDH proposal for precious metals as of December 19, 2011.6

Map 4: Map of distal disseminated permissive tracts in Arizona with detail of SDH proposal area. Designed to show scope of permissive tracts in relation to withdrawal area for SDH.7

Map 5: Map of epithermal permissive tracts in Arizona with detail of SDH proposal area. Designed to show scope of permissive tracts in relation to withdrawal area for SDH.8

Map 6: Density of active claims in the northern portion of the SDH proposal for base metals as of December 19, 2011.9

Map 7: Density of active claims in the southern portion of the SDH proposal for base metals as of December 19, 2011.10

Map 8: Map of United States Geological Survey of Porphyry Tracts in SDH proposal area.11

Map 9: Map of Arizona State Land Department Porphyry Tracts in Arizona.12

Map 10: Other base metals permissive tracts in Arizona in relation to the SDH proposal. These are for base metals other than copper.13

Map 11: Potential sources for crushed stone, alluvial rock with associated streambed locations in relation to SDH proposal area.14
End Notes

1 According to the U.S. Geological Survey, a “permissive” tract is an area within which, using current information, geologic conditions existed that would permit the formation of deposits of a particular model type. Conversely, areas outside of permissive tracts have a negligible (<1 in 100,000) chance of containing a deposit of a given model type, assuming that the geologic conditions known today are accurate, and the deposit model adequately describes the conditions under which mineralization forms.

2 Note that this estimate is derived from a combination of estimates for five permissive tracts, which extend across most of western and southern Arizona, as shown in Map 9. Portions of these combined permissive tracts extend across much of the area proposed as Wilderness and for inclusion in NCAs and SMAs. As a result, there is a small chance that a valuable mineral deposit of this type would occur in the area.


4 Data included from BLM LS2000 database.

5 Ibid.

6 Ibid.


8 Ibid.

9 Ibid.

10 Ibid.

11 Ibid.


About Sonoran Institute

The Sonoran Institute’s mission is to inspire and enable community decisions and public policies that respect the land and people of western North America. Facing rapid change, communities in the West value their natural and cultural resources, which support resilient environmental and economic systems.

Founded in 1990, the Sonoran Institute helps communities conserve and restore those resources and manage growth and change through collaboration, civil dialogue, sound information, practical solutions, and big-picture thinking. Our passion is to help shape the future of the West with:

- Healthy landscapes that support native plants and wildlife, diverse habitat, open spaces, clean energy and water, and fresh air.
- Livable communities where people embrace conservation to protect quality of life today and in the future.
- Vibrant economies that support prosperous communities, diverse opportunities for residents, productive working landscapes and stewardship of the natural world.

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Shaping the Future of the West
Sonoran Desert Heritage Draft Proposal Map

- Proposed SMA
- Proposed NCA
- Proposed Wilderness
- National Monument
- Existing Wilderness
Map 3

Gold Occurrence
Silver Occurrence
Arsenic, Antimony, and Mercury Occurrence

Plans and Notices

Active Claims Dec. 19

# of Active Claims

- 1-20
- 21-40
- 40-60
- 60-80
- 81-100

Proposed NCA
Proposed SMA
Proposed Wilderness
National Monument
Existing Wilderness
BLM
Indian Lands
Military
State

- Miles
Map 8

- Copper, Lead, Zinc Occurrence
- USGS Porphyry Tracts
- Proposed NCA
- National Monument
- Proposed SMA
- Proposed Wilderness
- Existing Wilderness
Map 9

Study Extent
ASLD Porphyry Permissive Tracts
USGS Porphyry Tracts
Proposed NCA
Proposed SMA
Proposed Wilderness

²
Map 11

- **AZ Rivers**
- **Qt** [Miocene and Pliocene]/Alluvium
- **Qm** [Eocene to Middle Miocene]/Alluvium
- **Qy** [Late Miocene to Pliocene]/Sedimentary and Conglomerate
- **Tb** [Middle Miocene to Lower Pliocene]/Basaltic Rocks
- **Tv** [Middle Miocene to Pliocene]/Sedimentary and Volcanic rocks
- **Tg** [Lower Miocene to Pliocene]/Granitic rocks
- **Tf** [Miocene or Oligocene]/Fine-grained intrusive rocks
- **Tys** [Middle Miocene to Oligocene]/Sedimentary and Volcanic rocks
- **Tsm** [Lower Proterozoic]/Granitic rocks
- **Xm** [Lower Proterozoic]/Metasedimentary Rocks
- **Yg** [Middle or Lower Proterozoic]/Granitic Rocks
- **Yp** [Jurassic to Paleozoic]/Sedimentary and Metasedimentary rocks

- **Gila River**
- **Agua Fria River**

**Legend:**
- **Brown**: Sedimentary and Volcanic rocks
- **Gray**: Alluvium
- **Yellow**: Fine-grained fluvial floodplain deposits
- **Orange**: Fine-grained intrusive rocks
- **Green**: Volcanic rocks
- **Dark Green**: Fine-grained basaltic rocks
- **Blue**: Sedimentary and Conglomerate
- **White**: Sandstone, Conglomerate, minor andesitic volcanic rocks
- **Pink**: Granitic Rocks
- **Red**: Miocene and Triassic Volcanic Rocks
- **Gray**: Jurassic to Paleozoic Sedimentary and Metasedimentary rocks
- **Light Green**: Metasedimentary Rocks
- **Red**: Lower Proterozoic Metasedimentary Rocks
- **Red**: Lower Proterozoic Metamorphic Rocks
- **Red**: Proposed NCA
- **Red**: Proposed Special MGMA