Assessment of the Mineral Potential of Public Lands Located within Proposed Solar Energy Zones in Arizona

July 2012

Assessment of the Mineral Potential of Public Lands Located within Proposed Solar Energy Zones in Arizona

July 2012

CONTENTS

CONTENTS (Cont.)

FIGURES

TABLES

NOTATION

The following is a list of acronyms, abbreviations, and units of measure used in this document. Some acronyms used only in tables may be defined only in those tables.

GENERAL ACRONYMS AND ABBREVIATIONS

ADWR	Arizona Department of Water Resources
AOGCC	Arizona Oil and Gas Conservation Commission
AZGS	Arizona Geological Survey
BLM	Bureau of Land Management
CBO	Congressional Budget Office
DOE	U.S. Department of Energy
DOI	U.S. Department of the Interior
FLPMA	Federal Land Policy Management Act of 1976
FR	*Federal Register*
GIS	geographic information system
IBLA	Interior Board of Land Appeals
INEEL	Idaho National Engineering and Environmental Laboratory
LR2000	Land and Mineral Legacy Rehost 2000 System
MRDS	Mineral Resource Data System
PEIS	programmatic environmental impact statement
P.L.	Public Law
P.M.	principal meridian
ROW	right-of-way
SEZ	solar energy zone
SRMA	Special Recreation Management Area
U.S.	United States
USC	*United States Code*
USFS	U.S. Forest Service
USGS	U.S. Geological Survey

UNITS OF MEASURE

ft	foot (feet)
kg	kilogram(s)
km	kilometer(s)
km^2	square kilometer(s)
m	meter(s)
mi	mile(s)
oz	ounce(s)

ASSESSMENT OF THE MINERAL POTENTIAL OF PUBLIC LANDS LOCATED WITHIN PROPOSED SOLAR ENERGY ZONES IN ARIZONA

LANDS INVOLVED

Brenda Solar Energy Zone
Covering 3,348 acres of public land in La Paz County, Arizona
T4N, R16W, sections 1 to 4 and 9 to 11
T5N, R15W, section 31
Gila and Salt River P.M.

Gillespie Solar Energy Zone
Covering 2,618 acres of public land in Maricopa County, Arizona
T2S, R6W, sections 6 to 9, 15 to 17, and 22 to 24
T2S, R7W, sections 1 and 12
Gila and Salt River P.M.

Prepared by:

Terri L. Patton, Geologist

This page intentionally left blank.

ASSESSMENT OF THE MINERAL POTENTIAL OF PUBLIC LANDS LOCATED WITHIN PROPOSED SOLAR ENERGY ZONES IN ARIZONA

SUMMARY

The report that follows presents an assessment of the mineral resource potential of public lands located within two proposed solar energy zones (SEZs) in west-central Arizona, on behalf of the U.S. Department of Interior (DOI), Bureau of Land Management (BLM). The report was prepared in consultation with several BLM mineral specialists: Mr. Matt Shumaker, Chief Mineral Examiner (Division of Solid Minerals); Mr. Jason Powell, Geologist (Division of Solid Minerals); Mr. Jeff Garrett, Mining Engineer and Mining Law Program Lead (Arizona State Office); Ms. Amanda Dodson, Geologist (Lake Havasu Field Office); and Mr. Michael Rice, Geologist, (Phoenix District Office). Mr. Jeff Holdren, Senior Realty Specialist (Division of Lands, Realty, and Cadastral Survey), prepared the legal description for the SEZs.

The subject lands are located within two SEZs in west–central Arizona: Brenda (La Paz County) and Gillespie (Maricopa County). The mineral resource potential for each of these sites is summarized below.

S.1 BRENDA SEZ

There are no documented occurrences of locatable mineral deposits within the Brenda SEZ. Most of the metallic minerals in the region are concentrated in the Plomosa Mountains to the west and Granite Wash Mountains to the northeast. The nearest known occurrences of locatable minerals (copper, silver, and gold) are in the Bear Hills, about a 1.0 to 1.5 mi (1.6 to 2.4 km) to the south–southwest. Gypsum has been mined from a shallow deposit at the Blue Moon Mine, about 9 mi (14 km) to the northwest. Placer gold occurrences are associated with gravels deposited in streams and washes that drain the Plomosa Mountains to the west (there are numerous placer claims along drainages to the west of the mountains and four placer claims located less than a mile to the southwest of the SEZ). Modern alluvial deposits below the site extend to a depth of about 300 ft (90 m) and are underlain by older fanglomerates, which are similar in composition (mainly sand and gravel) but more consolidated. The depth of these older deposits is estimated to be about 1,200 ft (370 m) near the SEZ, but the local stratigraphy has not been well characterized. Given the proximity of placer claims to the SEZ and the presence of washes throughout the site, the potential for placer gold to occur within the SEZ is moderate (level of certainty B).[1] The occurrence of mineralized zones (such as those mined at Bear Hills)

[1] Definitions of mineral potential are from the mineral potential classification system outlined in *BLM Manual 3031* (BLM 1985). Mineral potential ratings of low, moderate, or high are assigned where the geologic environment and inferred geologic processes indicate low, moderate, or high potential for accumulation of mineral resources. Levels of certainty are defined as follows: A = available data are *insufficient* to support or refute the occurrence of mineral resources; B = available data provide *indirect* evidence to support or refute the occurrence of mineral resources; C = available data provide *direct but quantitatively minimal* evidence to support or refute the occurrence of mineral resources; and D = available data provide *abundant direct and indirect* evidence to support or refute the occurrence of mineral resources.

below the site is unconfirmed, but based on available geologic data, they are likely to be very deep (below basin sediments) if present. Therefore, the potential for metallic (lode) minerals (copper, silver, and gold) is low (level of certainty B). The potential for gypsum to occur within the SEZ is undetermined (level of certainty A).

The Brenda SEZ is an area with a high potential for the occurrence of sand and gravel (level of certainty C). The site is underlain by alluvial and basin-fill sediments; however, based on the absence of free use permits or mineral materials contracts within the site, the demand for these resources is assumed to be low.

There are no active or historical oil and gas leases within the Brenda SEZ, and there has been no history of oil and gas production in La Paz County. The only areas producing oil and gas are located in Apache County in northeastern Arizona. The SEZ is an area with low potential for oil and gas development (level of certainty A).

The SEZ is located in a region of known or potential geothermal resources; however, there are no active or historical geothermal leases and no nominated lands for geothermal sale within the site. Although there are several low-temperature geothermal wells within a few miles of the site, little development of geothermal resources has occurred in the region. The highest temperature systems are known to occur in eastern Arizona, adjacent to the boundary between the Transition Zone and Southern Basin and Range Province (in Greenlee County). Given the low temperature of geothermal resources in the region (and the absence of geothermal leases within the site), the potential for geothermal development within the SEZ is low (level of certainty B).

S.2 GILLESPIE SEZ

There are no documented occurrences of locatable mineral deposits within the Gillespie SEZ. Most of the locatable minerals in the region (copper, silver, gold, zinc, lead) occur in the Gila Bend Mountains District to the west. The nearest potential occurrences of locatable minerals include copper, gold, lead, and silver, based on the Idazona Mines prospect, about 1 mi (1.6 km) south of the site. Placer gold has been produced from river alluvium by the P&J Mine, about 6 mi (10 km) to the southeast. Given the proximity of the site to the Gila Bend Mountains and the numerous washes running through it, the potential for placer deposits (gold and copper) to occur within the SEZ is moderate (level of certainty B). (This is supported also by the pending notice for placer deposits less than a mile to the south of the central portion of the SEZ.) In addition, the location of the Idazona mines prospect indicates that hard rock may be fairly shallow in the immediate region (the author has been unable to confirm the depth to bedrock). For this reason, the potential for lode minerals (copper, gold, lead, and silver) is considered moderate (level of certainty A).

The Gillespie SEZ is an area with a high potential for the occurrence of sand and gravel (level of certainty C). The site is underlain by alluvial and basin-fill sediments; however, based on the absence of free use permits or mineral materials contracts within the site, the demand for these resources is assumed to be low.

There are no active or historical oil and gas leases within the Gillespie SEZ, and there has been no history of oil and gas production in Maricopa County. The only areas producing oil and gas are located in Apache County in northeastern Arizona. The SEZ is an area with low potential for oil and gas development (level of certainty A).

The SEZ is located in a region of known or potential geothermal resources; however, there are no active or historical geothermal leases and no nominated lands for geothermal sale within the site. No development of geothermal resources has occurred in the region. The highest temperature systems are known to occur in eastern Arizona, adjacent to the boundary between the Transition Zone and Southern Basin and Range Province (in Greenlee County). Given the absence of geothermal leases within the site, the potential for geothermal development within the SEZ is low (level of certainty B).

This page intentionally left blank.

1 INTRODUCTION

1.1 PURPOSE OF REPORT

The purpose of this report is to assess the mineral resource potential of 5,966 acres (24.1 km^2) of public lands within two SEZs in west–central Arizona, which the Secretary of the Interior may decide to withdraw from potentially conflicting uses through the issuance of a Public Land Order. If the order is approved, the public lands within the SEZs would be withdrawn, subject to valid existing rights, from settlement, sale, location, or entry under the general land laws, including the mining laws, as follows:

- New mining claims could not be filed on the withdrawn lands; however, valid mining claims filed prior to the date the lands were segregated (i.e., withdrawal application notice was published in the *Federal Register*) would take precedence over future solar energy development right-of-way (ROW) application filings.

- Lands could not be sold, exchanged, or otherwise disposed of during the term of the withdrawal.

- Withdrawn lands would remain open to mineral leasing, geothermal leasing, and mineral material laws; the BLM could elect to lease the oil, gas, coal, or geothermal steam resources, or to sell common-variety mineral materials such as sand and gravel, if the authorized officer determined there would be no unacceptable impacts on future solar energy development.

- Withdrawn lands would remain open to ROW authorizations and land leases or permits authorized under Section 302 of the Federal Land Policy and Management Act of 1976 (FLPMA).

The public lands are currently segregated under an Interim Temporary Final Rule, which was published on April 26, 2011, and is in effect until June 30, 2013 (Vol. 76, pp. 23198–23205 of the *Federal Register* [76 FR 23198–23205]).

1.2 LEGAL DESCRIPTION OF THE SUBJECT LANDS

There are two proposed SEZs in Arizona: Brenda, which is located in the Lake Havasu Resource Area in La Paz County, and Gillespie, which is located in the Lower Sonoran Resource Area in Maricopa County. One other proposed SEZ, Bullard Wash (Yavapai County), was eliminated from further consideration on the basis of public comments received on the Draft Solar Programmatic Environmental Impact Statement (PEIS) (BLM and DOE 2010). The Supplement to the Draft Solar PEIS provides the rationale for eliminating the SEZ (BLM and DOE 2011). The locations of the SEZs are shown in Figure 1. Their full legal descriptions are provided in Appendix A.

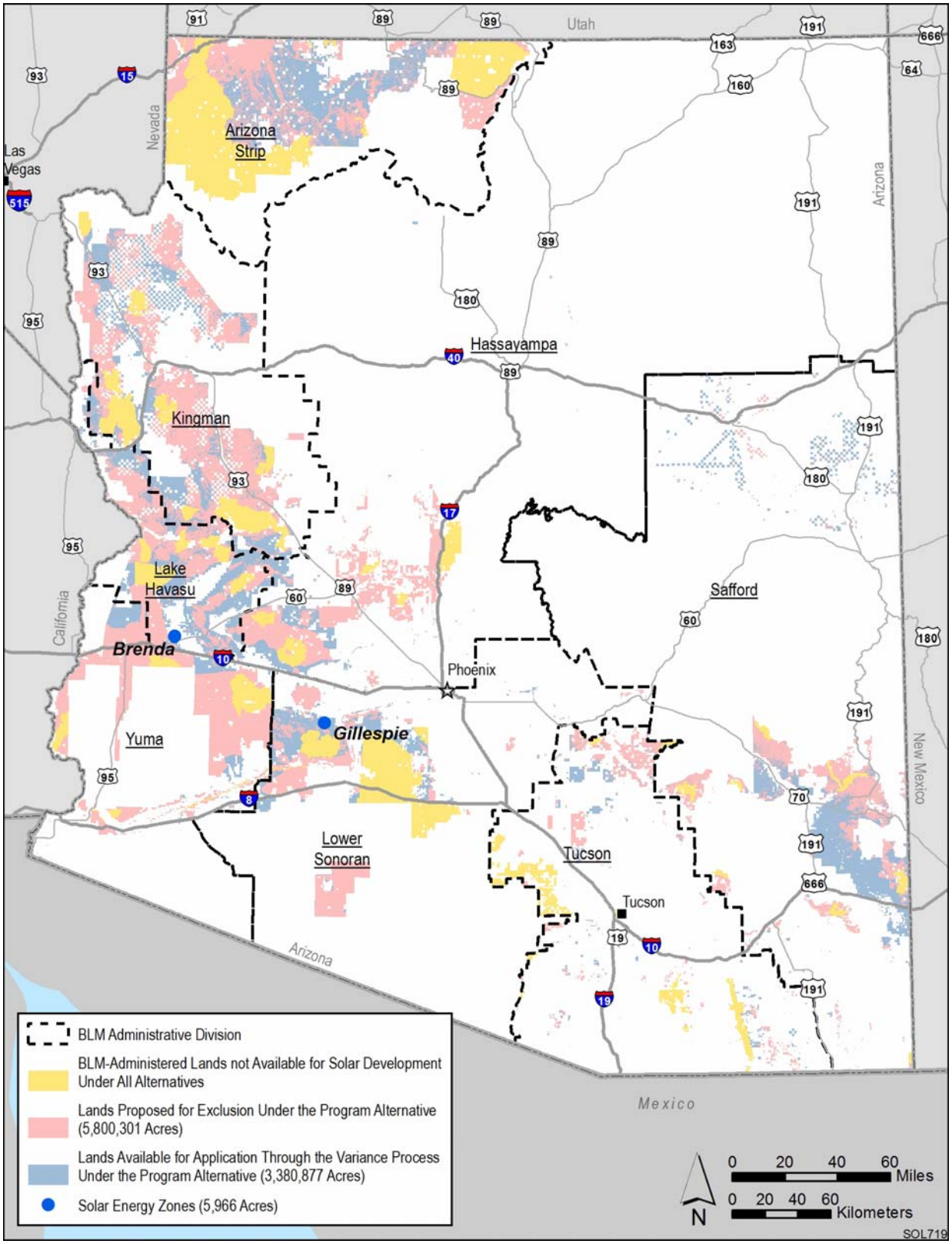

FIGURE 1 BLM-Administered Lands in Arizona Available for Application for Solar Energy Right-of-Way Authorization (the SEZs are represented by blue dots)

1.3 METHODOLOGY AND RESOURCES

The assessment presented in this report focuses on locatable (including those classified as strategic and critical), saleable, and leasable mineral resources within two SEZs in Arizona. The conclusions concerning mineral occurrence and development potential (and levels of certainty) follow the methodology outlined in *BLM Manual 3031* (BLM 1985) and are based on a review of topographic maps, geologic maps, mineral resource maps and reports, the scientific literature on the geology and mineral resources of Arizona, and consultation with BLM mineral specialists. No mapping or field sampling was conducted as part of this assessment.

Digital data for the geologic map in Figures 2 and 4 were obtained from the U.S. Geological Survey (USGS) (Ludington et al. 2007). The dataset was digitized from previously published geologic maps ranging in scale from 1:100,000 to 1:1,000,000. Detailed map unit descriptions for this map are based on the published state geologic map by Richard et al. (2000). The large-scale, folded maps (Maps 1 and 2) provided in the back of this report show the public land survey system grid (township and range) and should be consulted to locate mines and other features discussed in the text. In addition, the Solar PEIS Web site (http://solareis.anl.gov/sez/index.cfm) features mapped photographs of the SEZ.

The BLM's Legacy Rehost System (LR2000; BLM 2012) was queried on July 13, 2012, for information on active and historical (unpatented) mining claims and various leases and permits, including oil and gas leases, geothermal leases and land nominations, free use permits, and mineral materials contracts, issued on public lands within and around the proposed SEZs. Other key BLM resources consulted were the Resource Management Plans (RMPs) for the Lake Havasu and the Lower Sonoran Resource Areas (BLM 2006, 2011).

Mines and mineral prospects and occurrences and their descriptions are those reported in the USGS's Mineral Resource Data System (MRDS; USGS 2011; Lipin 2000) and supplemented with information provided by BLM mineral specialists from the field offices in which the proposed SEZs are located. The MRDS is a large database containing historical records of the USGS and the U.S. Bureau of Mines (which is now part of the USGS). These records are of variable quality and currency, so it is possible that some information will be found to be out of date (the revision and refinement of the database is an ongoing effort at the USGS). The mining activity maps in Figures 3 and 6 were prepared from the MRDS and are intended to provide a general picture of the location and nature of mining activity in the vicinity of each of the SEZs. Refinements with regard to the status of particular mines are included in the text as warranted based on conversations with BLM mineral specialists.

Geographic information system (GIS) data for mining districts in Arizona were not available; however, the mining districts originally listed in Keith et al. (1983a, b) and Welty et al. (1985) (e.g., the Northern Plomosa District in La Paz County) are easily identified on maps as areas of clustered mining activity and are acknowledged in the discussions of locatable minerals for each of the SEZs in this report, as applicable. The Arizona Geological Survey (AZGS; which consolidated with the Arizona Department of Mines and Mineral Resources in 2011) publishes maps and data on mines, prospects, quarries, and processing mills and plants by county; these are available at http://mines.az.gov/Publications/.

1.4 LOCATABLE MINERALS

Under United States (U.S.) mining laws, minerals fall into three categories: locatable, leasable, and saleable. Because these categories were created by acts of Congress, they do not fall into simple economic or mineralogical divisions. Creating an exact and thorough list of locatable minerals (e.g., those subject to appropriation by locating mining claims) is therefore difficult. Metallic minerals (e.g., gold, silver, copper, mercury, aluminum, antimony, lithium, molybdenum, tungsten, uranium, vanadium, and rare earths) are considered to be locatable. Numerous uncommon varieties of nonmetallic minerals may also be locatable, depending on their chemical content, quality, uses, and characteristics, as well as on certain associated economic and legal matters. These nonmetallic minerals could include barite, calcite, specialty clays, bentonite, diatomite, feldspar, some gemstones (e.g., opals and diamonds), gypsum, chemical-grade limestone, perlite, chemical-grade silica sand, specific types of stone, talc, zeolites, and specific and uncommon types of dolomite. The determination of the actual locatability of uncommon varieties of nonmetallic minerals and the validity of mining claims for them is complex and relies on Public Law (P.L.) 84-167 (*United States Code,* Title 30, Section 601 et seq. [30 USC 601 et seq.]) and applicable case law (e.g., *U.S. v Kenneth McClarty*, 17 Interior Board of Land Appeals [IBLA] 20, 1974 [81 Interior Department (I.D.) 472]) (Shumaker 2011).

Arizona's nonfuel raw mineral production in 2007 increased by about 7.6% over that in 2006 (which had increased by more than 55% over that in 2005). From 2004 through 2007, Arizona had the highest total nonfuel mineral production in the nation, accounting for 10.4% of the U.S. total in 2007. Copper accounted for more than 73% of the state's total nonfuel mineral production value in 2007. The remaining value was from the production of molybdenum, construction sand and gravel, portland and masonry cement, crushed stone, and lime. There were significant increases in the production values of copper, molybdenum, portland cement, and crushed stone. Smaller increases in the production values of silver, salt, and gold were also noted. The largest decreases occurred in the production value of construction sand and gravel, lime, and crude gypsum. In 2007, Arizona remained third in the production of molybdenum, construction sand and gravel, gemstones, and crude perlite, and it was sixth in the production of silver and dimension stone (USGS 2010).

1.5 STRATEGIC AND CRITICAL MINERALS

Table 1 lists the nonfuel strategic and critical nonfuel minerals that are imported by the United States for its National Defense Stockpile, as authorized by the Strategic and Critical Materials Stock Piling Act (50 USC 98 et seq.). Several of the minerals produced in Arizona are classified as strategic and critical minerals; these include beryllium, copper, manganese, tungsten, vanadium, and zinc.

TABLE 1 Strategic and Critical Nonfuel Minerals

Antimony	Copper	Platinum group
Asbestos	Diamonds (industrial)	Quartz crystals
Bauxite and alumina	Fluorspar	Rutile (titanium)
Beryllium	Graphite	Silicon
Bismuth	Iodine	Tantalum
Cadmium	Manganese	Thorium
Chromium	Mercury	Tin
Cobalt	Mica sheet	Tungsten
Columbian	Nickel	Vanadium
		Zinc

Source: CBO (1983).

This page intentionally left blank.

2 BRENDA SEZ

2.1 SUMMARY AND CONCLUSIONS

This chapter assesses the mineral resource potential of 3,348 acres (13.5 km^2) of public lands within an area known as the Brenda SEZ, located in La Paz County in west–central Arizona, 3 mi (5 km) northeast of the town of Brenda and about 18 mi (29 km) east of Quartzite, Arizona.

There are no documented occurrences of locatable mineral deposits within the Brenda SEZ. Most of the metallic minerals in the region are concentrated in the Plomosa Mountains to the west and Granite Wash Mountains to the northeast. The nearest known occurrences of locatable minerals (copper, silver, and gold) are in the Bear Hills, about 1.0 to 1.5 mi (1.6 to 2.4 km) to the south–southwest. Gypsum has been mined from a shallow deposit at the Blue Moon Mine, about 9 mi (14 km) to the northwest. Placer gold occurrences are associated with gravels deposited in streams and washes that drain the Plomosa Mountains to the west (there are numerous placer claims along drainages to the west of the mountains and four placer claims located less than a mile to the southwest of the SEZ). Modern alluvial deposits below the site extend to a depth of about 300 ft (90 m) and are underlain by older fanglomerates, which are similar in composition (mainly sand and gravel) but more consolidated. The depth of these older deposits is estimated to be about 1,200 ft (370 m) near the SEZ, but the local stratigraphy has not been well characterized. Given the proximity of placer claims to the SEZ and the presence of washes throughout the site, the potential for placer gold to occur within the SEZ is moderate (level of certainty B). The occurrence of mineralized zones (such as those mined at Bear Hills) below the site is unconfirmed, but based on available geologic data, they are likely to be very deep (below basin sediments) if present. Therefore, the potential for metallic (lode) minerals (copper, silver, and gold) is low (level of certainty B). The potential for gypsum to occur within the SEZ is undetermined (level of certainty A).

The Brenda SEZ is an area with a high potential for the occurrence of sand and gravel (level of certainty C). The site is underlain by alluvial and basin-fill sediments; however, based on the absence of free use permits or mineral materials contracts within the site, the demand for these resources is assumed to be low.

There are no active or historical oil and gas leases within the Brenda SEZ, and there has been no history of oil and gas production in La Paz County. The only areas producing oil and gas are located in Apache County in northeastern Arizona. The SEZ is an area with low potential for oil and gas development (level of certainty A).

The SEZ is located in a region of known or potential geothermal resources; however, there are no active or historical geothermal leases and no nominated lands for geothermal sale within the site. Although there are several low-temperature geothermal wells within a few miles of the site, little development of geothermal resources has occurred in the region. The highest temperature systems are known to occur in eastern Arizona, adjacent to the boundary between the Transition Zone and Southern Basin and Range Province (in Greenlee County). Given the

low temperature of geothermal resources in the region (and the absence of geothermal leases within the site), the potential for geothermal development within the SEZ is low (level of certainty B).

2.2 LANDS INVOLVED

The Brenda SEZ is located on BLM lands in the Lake Havasu Resource Area, in La Paz County. The site lies within Township 4 north, Range 16 west (T4N, R16W), sections 1 to 4 and 9 to 11; and T5N, R15W, section 31 (Gila and Salt River Principal Meridian). The SEZ boundaries were revised for the Final Solar PEIS to eliminate the area of Bouse Wash on the east side of the SEZ and the area on the west side of the SEZ to the west of the county road. Eliminating the area of the SEZ west of the county road avoids splitting solar development on the SEZ and associated internal access and security issues. In addition, the new boundary limits solar development to a distance of about 0.75 mi (1.2 km) east of the Plomosa Special Recreation Management Area (SRMA) and avoids crossing a well-vegetated drainage with wildlife values. The remaining SEZ area is 3,348 acres (13.5 km^2). No additional areas for non-development were identified within the SEZ. The SEZ is shown on the location map in the back of this report (Map 1). The full legal description of the SEZ is provided in Appendix A.

2.3 LAND STATUS

According to the LR2000, accessed on July 13, 2012, there are no active or historical locatable mining claims within the Brenda SEZ (BLM 2012). However, there are four active (and numerous closed) placer claims near Bear Hills less than a mile to the southwest of the site in section 17 of T4N, R16W (Lead Files AMC 351599 and AMC 398858). The lands within the SEZ were first segregated from locatable mineral entry in June 2009, pending the outcome of the Draft Solar Energy PEIS (BLM and DOE 2010). They are currently segregated under an Interim Temporary Final Rule, which is in effect until June 30, 2013 (76 FR 23198–23205).

There are no active or closed free use permits or mineral materials contracts within the SEZ (BLM 2012). The site remains open for the disposal of saleable mineral materials.

There are no active oil and gas leases within the Brenda SEZ, and the area within the site was never leased for oil and gas in the past. (According to the Arizona Oil and Gas Conservation Commission, all of Arizona's oil and gas development occurs in Apache County [AOGCC 2012].) There are no active or historical geothermal leases and no nominated lands for geothermal sale within the SEZ. The site remains open for discretionary leasing for oil and gas, geothermal, and other leasable minerals.

2.4 GEOLOGIC SETTING

The Brenda SEZ is located in the northern part of the Ranegras Plain, a northwest-trending, broad, alluvial basin within the Basin and Range physiographic province in west–

central Arizona. The plain is bounded on the north by the Bouse Hills, on the west by the Plomosa and New Water Mountains, on the east by the Granite Wash and Little Harquahala Mountains, and on the south by the Eagletail and Little Horn Mountains. Surrounded by low, block-faulted mountains, the Ranegras Plain is one of many structural basins (grabens) typical of the Basin and Range province.

Sediments beneath the Ranegras Plain consist of unconsolidated alluvial, eolian, and lacustrine deposits of Quaternary and Tertiary age estimated to be as thick as 1,000 ft (305 m) in the center of the basin. Groundwater occurs in these deposits, with the highest yields from the gravel and sand lenses within the upper (Quaternary) layers of fill at depths ranging from 28 to 455 ft (9 to 140 m) (Metzger 1951; ADWR 2010a, b). Unconsolidated sediments overlie bedrock units of Cretaceous and Tertiary fanglomerates and volcanic rocks with a maximum depth of about 2,000 ft (610 m). The basin is underlain by a basement complex of granite and undifferentiated metamorphic rocks (Fugro National, Inc. 1979).

Exposed sediments on the Ranegras Plain are predominantly young (<10,000 years old) alluvial deposits of gravel and sand (stream channels) and of silt and clay (floodplains and playas) and also eolian sands. The surface of the Brenda SEZ is covered mainly by older (10,000 to 750,000 years old) alluvial deposits. In the surrounding mountains, exposures are predominantly composed of Tertiary volcanics and Cretaceous and Jurassic sedimentary rocks. The oldest rocks in the region are the Early to Middle Proterozoic metamorphic and granitic rocks that occur in the Plomosa Mountains to the west, Bouse Hills to the north, and the Granite Wash Mountains to the northeast. These rocks have been intruded by Mesozoic (Late Cretaceous to Tertiary) granites and granodiorites. Small outcrops of Paleozoic limestone occur throughout the area.

The Ranegras Plain covers an area of about 538,700 acres (2,360 km^2) (ADWR 2010b). It slopes to the northwest, with elevations along its axis ranging from about 1,310 ft (400 m) at its southeastern end and along its sides to about 930 ft (280 m) near the town of Bouse at its northwestern end. Alluvial fan deposits occur along the mountain fronts on both sides of the valley. The valley is drained by Bouse Wash, an ephemeral stream that captures drainage from Butler and McMullen Valleys and exits the basin near the town of Bouse. Bouse Wash is a tributary to the Colorado River (to the west). Other topographic features include sand dunes, playas, and the many unnamed washes that drain the surrounding mountains and feed the central streams in the valley center. The geology of the Ranegras Plain region near the Brenda SEZ is shown in Figure 2.

2.5 PHYSICAL FEATURES AND ACCESS

The Brenda SEZ lies between Bear Hills to the south–southwest and the Granite Wash Mountains to the northeast. Its terrain slopes gently to the northeast, with elevations ranging from about 1,240 ft (380 m) along its southwestern border to 1,100 ft (340 m) at its northeastern corner. Several drainages enter the site from the southwest; Bouse Wash drains to the northwest, just beyond the northeast corner of the site.

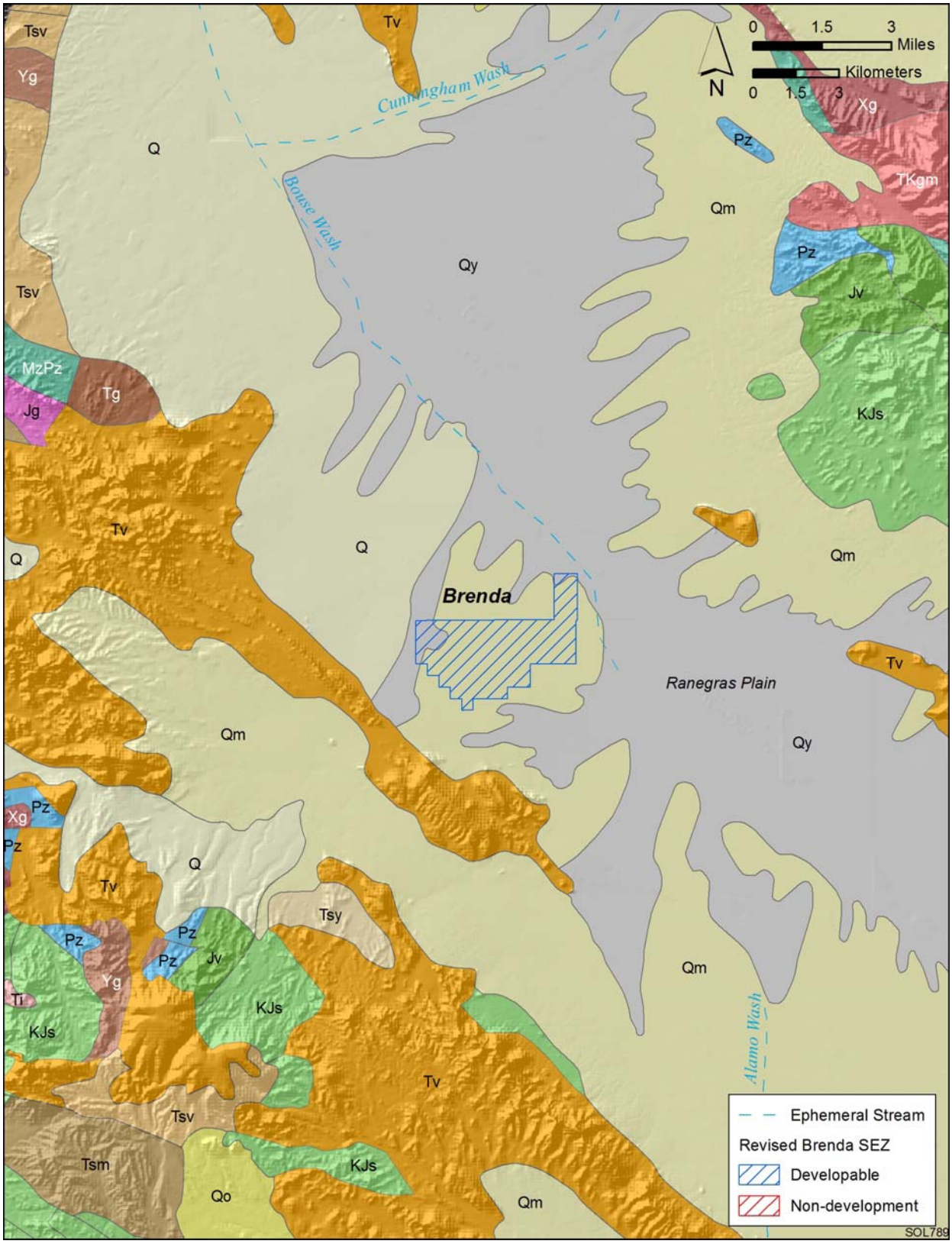

FIGURE 2 Geologic Map of the Ranegras Plain Region (Sources: Ludington et al. 2007; Richard et al. 2000)

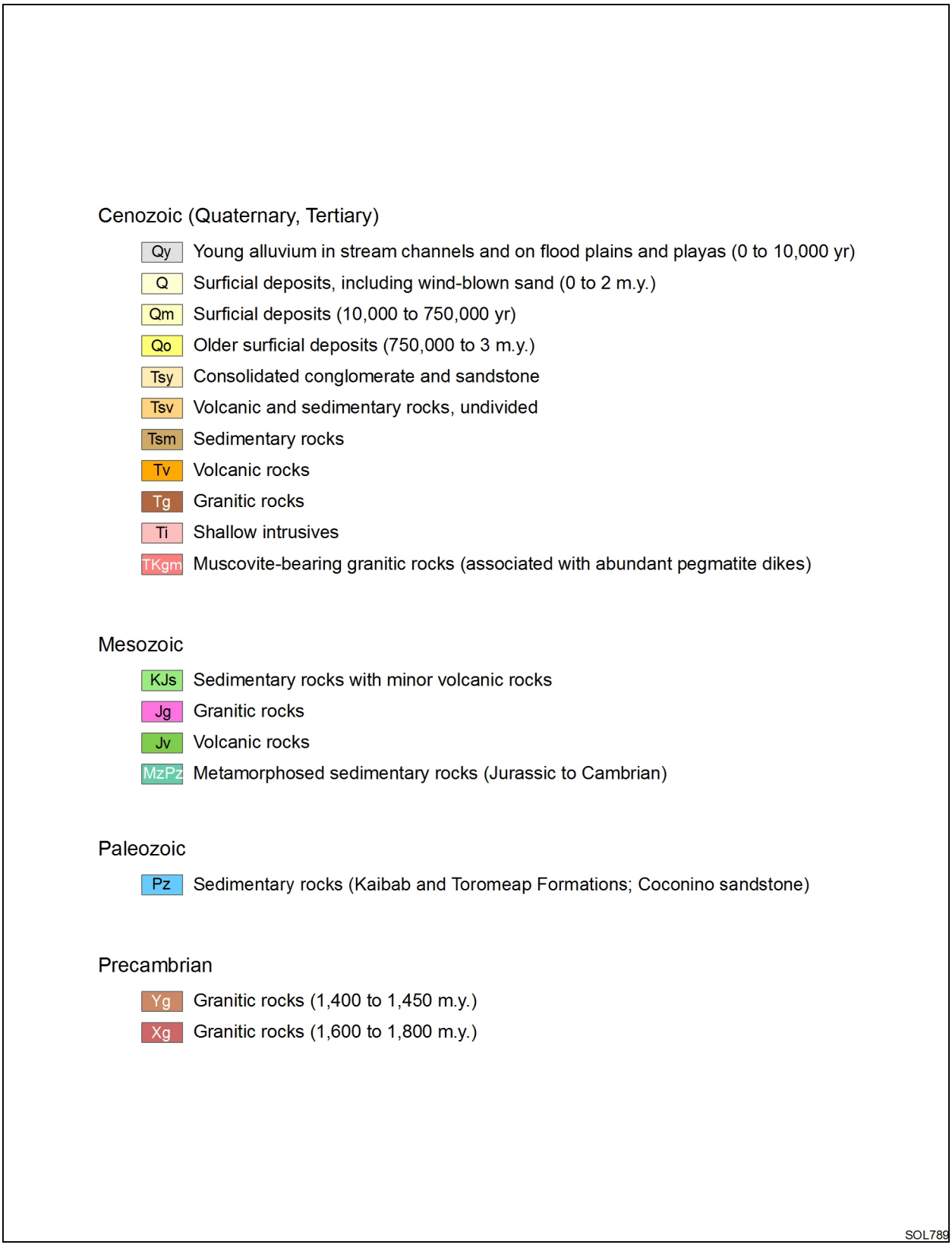

FIGURE 2 (Cont.)

The SEZ is accessible by a county road that crosses through the western portion of the site in a north–south direction. U.S. 60 lies about 0.5 mi (0.8 km) to the south and parallels the southern boundary of the site; it also provides good access to the site.

2.6 SITE GEOLOGY

The geology of the region near the Brenda SEZ was mapped by the USGS in 1984 and 1985. The resulting geologic map titled, "Geologic Map of the Vicksburg Quadrangle, La Paz County, Arizona," was published at a scale of 1:62,500 (Sherrod et al. 1990). The thicknesses of geologic units were inferred from a cross-section transect on this map that terminates at the southwest perimeter of the SEZ.

Surface sediments at the site consist of poorly to moderately sorted, unconsolidated to weakly consolidated sand and gravel deposited in alluvial fans of Holocene (recent) and Pleistocene age. These sediments extend to a depth of about 300 ft (90 m) and are underlain by older fanglomerates (Miocene), which also consist of poorly to moderately sorted sand and gravel but are more consolidated in nature. The older fanglomerate deposits are about 100 ft (30 m) thick in most places but thicken to the southwest. These deposits sit on top of basalt flows with interspersed beds of breccia and scoria (Oligocene to early Miocene) that extend to depths below 1,000 ft (300 m). More recently, Richard et al. (2007) estimated that bedrock in the Brenda SEZ region occurs at depths below 1,200 ft (370 m).

Sedimentary rocks of Jurassic to Cretaceous age consisting of sandstone, siltstone, and conglomerate are encountered below the volcanic rock units at depths below 1,000 ft (300 m). These rocks are associated with the Ramsey mine (section 2 of T3N, R17W), a past producer of metallic and nonmetallic commodities (such as barium-barite, copper, gold, iron, lead, manganese, silver, strontium, vanadium, and zinc) in La Paz County (Sherrod et al. 1990; USGS 2011).

A northwest–southeast trending, high-angle, normal fault is located just to the southwest of the Brenda SEZ. The fault displaces older sediments but is buried by Quaternary alluvium (Sherrod et al. 1990).

There are no perennial surface water features in or near the Brenda SEZ. The SEZ is located within the Bouse Wash Basin, and Bouse Wash is located just beyond the site's northeast corner (Figure 2). Bouse Wash is an ephemeral stream that flows from the southeast to the northwest along the central axis of the Ranegras Plain. Several unnamed washes flow out of the Plomosa Mountains and through Bear Hills to the south–southwest (toward Bouse Wash), creating an alluvial fan that covers the majority of the site.

2.7 MINERAL HISTORY

There has been no documented mining within the Brenda SEZ. Most of the mining activity in the region has involved the past mining of metallic minerals in the Plomosa

Mountains to the west, the Granite Wash Mountains to the northeast, and Bear Hills to the south–southwest, and of gypsum in the valley (Blue Moon Mine, located about 9 mi [14 km] to the northwest of the SEZ). There are numerous active placer claims along streams/washes that drain the Plomosa Mountains and numerous active lode claims in the Granite Wash Mountains. According to LR2000, however, there currently are no plans of operation (or notices) on record in these regions. Several low-temperature geothermal wells are located to the northeast of the SEZ (between the SEZ and Route 72) and in the northern part of the basin.

According to the USGS MDRS, the nearest mining activity is currently taking place at the Bear Hills Jasper Field, where jasper is produced, a few miles to the south (USGS 2011); however, the status of this operation has not been confirmed by the author. The Copperstone Gold mine, which is currently under development, is the only major active mine listed for La Paz County by the AZGS (AZGS 2011).

Currently, no mineral exploration or development work is being conducted within the Brenda SEZ. The USGS reported that several companies explored for gold throughout Arizona in 2007 (USGS 2010), and these activities continue today. In April 2011, the American Bonanza Gold Corp. reported that it received an aquifer protection permit; this permit will allow it to start construction on a milling and flotation plant that it purchased in 2010 at the Copperstone Gold Mine in the northeastern Moon Mountains District in eastern La Paz County, about 25 mi (40 km) to the northwest of the Brenda SEZ (American Bonanza Gold Corp. 2011a). Gold mineralization at the Copperstone property occurs in breccia zones and locally within veins in metamorphosed volcanic rocks (Spencer et al. 1988). A recent feasibility study estimated the mine would produce 45,891 oz (1,300 kg) of gold annually for the first 3 years (American Bonanza Gold Corp. 2011b).

The South Copperstone Gold Project consists of 24 lode claims on 480 acres (1.9 km^2) in the Moon Mountains District that borders the Copperstone Gold Mine to the south. Gold-bearing bedrock is exposed in the western part of the claim block. In initial drilling, gold hosted by quartz and altered quartz latite was found. Exploration activities are ongoing at the site (Fortress Financial Group, Inc. 2011).

Another gold project is taking place at the Bouse Gold property. It consists of 18 lode claims on 360 acres (1.5 km^2) in the North Plomosa District. The property is the location of the former Homestake Gold Project, which produced gold from several historic mines (mainly the Little Butte Mine). Past drilling found gold-bearing rocks in breccias and high-angle veins. Exploration activities are ongoing at the site (Fortress Financial Group, Inc. 2011).

2.7.1 Locatable Minerals

There are no documented locatable mineral deposits or prospects within the Brenda SEZ (BLM 2012). Most of the locatable minerals in the region occur in the Plomosa Mountains to the west, the Granite Wash Mountains to the northeast, and Bear Hills to the south–southwest.

Mines and mineral prospects in the vicinity of the SEZ are shown in Figure 3. A detailed map (Map 1) of the SEZ and surrounding region is provided in the back of this report. The nearest occurrences of locatable minerals are of copper, silver, lead, gold, and manganese; these were produced from the Shamrock Mine in Bear Hills, a few miles to the south of the SEZ. There are four active (gold) placer claims near Bear Hills less than a mile to the southwest of the site (in section 17 of T4N, R16W). A small amount of gypsum was produced in the valley, about 9.0 mi (14 km) to the northwest (USGS 2011).

Mines in the vicinity of the Brenda SEZ are clustered within and around the adjacent mountain ranges, and these clusters correspond to some of the historical mining districts delineated by Keith et al. (1983a) and Welty et al. (1985). The mining areas are shown in Figure 3 and listed below; the corresponding historical mining district name is provided in parentheses. Some of the minerals produced in these districts (e.g., pumice) are not classified as locatable minerals.

- Plomosa Mountains (Northern Plomosa District): copper, gold, lead, silver, zinc, iron, manganese, barite, fluorite, silica, marble, gypsum, and gemstone (agate, jasper); 5.0 mi (8.0 km) to the northwest;

- Bouse Hills (Bouse District): manganese, tungsten, bentonite, and pumice; about 14 mi (23 km) to the north–northeast;

- Granite Wash Mountains (Ellsworth District): copper, gold, silver, lead, zinc, iron, molybdenum, tungsten, barite, kyanite, and limestone; about 6.6 mi (11 km) to the northeast; and

- Bear Hills (New Water District): copper, silver, lead, gold, manganese, and gemstone (jasper); about 1.5 mi (2.4 km) to the south.

The Northern Plomosa District has been active since the late 1800s. Early prospecting and mining focused on copper, gold, and silver. The district is highly mineralized, and mineral deposits are hosted by Tertiary sedimentary (lacustrine) and volcanic rocks and Precambrian crystalline rocks. Important minerals (copper and gold) are associated with late-stage paragenesis in a breccia matrix and occur with chrysocolla, malachite, barite, fluorite, and fine-grained silica. Manganese oxides occur in association with hematite in veins crossing volcanic rocks. Past mines in the district produced copper, gold, lead, silver, zinc, iron, and manganese. Mines in the district (e.g., Mudersbach Copper Camp, Lead Camp Mine, and Plomosa Mountains Agate Field) have produced copper, silver, gold, lead, zinc, iron, tungsten, and gemstones (Keith et al. 1983a; Duncan 1990; USGS 2011). Prospecting in the district is likely to be on the rise because of current gold prices. Duncan (1990) reports that mineralization in the Plomosa Mountains is similar to that in the Copperstone area, which is currently being explored; see Section 2.7.

The Bouse District covers the Bouse Hills to the north of the Brenda SEZ. Gold occurs in breccias (along the Plomosa detachment fault) and in steeply dipping quartz veins. In addition to gold, the district has also produced manganese, copper, tungsten, bentonite, and pumice

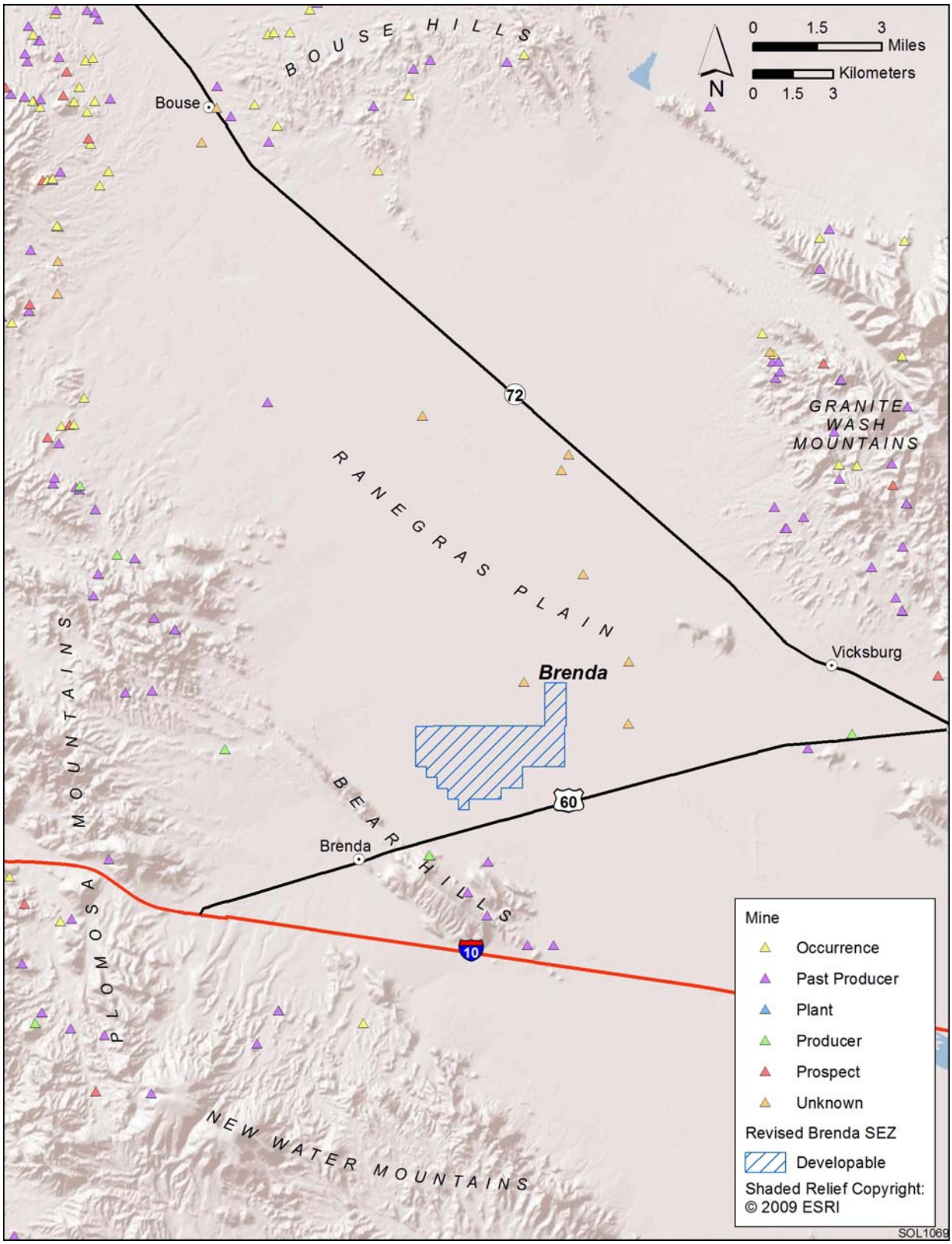

FIGURE 3 Map Showing Mines and Mineral Prospects near the Brenda SEZ (Source: USGS 2011)

(Keith et al. 1983a; USGS 2011). The district is currently inactive but is being prospected for gold and other metals (Sparrow Tech 2011).

The Granite Wash Mountains are located to the northeast of the Brenda SEZ. Mineralization in the region (also known as the Ellsworth District) occurs around intrusive centers as veins and replacement deposits and along shear zones. The region is currently inactive, but past mines produced copper, gold, silver, lead, barium, zinc, iron, molybdenum, kyanite, and tungsten (Reynolds et al. 1989; USGS 2011). There has been recent exploration for metals (copper and other by-product metals like gold, silver, molybdenum, tungsten, and zinc) at the Yuma King Mine by Big Bar Gold Corporation and AVEN Associates, LLC (Dodson 2011; PR Newswire 2006).

Past mines in the New Water District (in Bear Hills) mainly produced small amounts of silver and copper (Keith et al. 1983a; Lane 1986). Other mines have produced gold, lead, and manganese (USGS 2011). According to the USGS MRDS, the only active mine in the area (Bear Hills Jasper Field) is located in section 21 of T4N, R16W and produces jasper (gemstone); however, the operational status of this mine could not be confirmed.

The Brenda SEZ crosses none of the mining districts identified by Keith et al. (1983a) or by Welty et al. (1985), and there has been no hard rock or locatable mining activity within the site. Most of the metallic minerals in the region are concentrated in the Plomosa Mountains (to the west) and Granite Wash Mountains (to the northeast). The nearest known occurrences of locatable minerals (copper, silver, and gold) are in the Bear Hills, about a 1.0 to 1.5 mi (1.6 to 2.4 km) to the south–southwest. Gypsum has been mined from a shallow deposit at the Blue Moon Mine, about 9 mi (14 km) to the northwest. Placer gold occurrences are associated with gravels deposited in streams and washes that drain the Plomosa Mountains to the west (there are numerous placer claims along drainages to the west of the mountains and four placer claims located less than a mile to the southwest of the SEZ). Modern alluvial deposits below the site extend to a depth of about 300 ft (90 m) and are underlain by older fanglomerates, which are similar in composition (mainly sand and gravel) but more consolidated. The depth of these older deposits is estimated to be about 1,200 ft (370 m) near the SEZ, but the local stratigraphy has not been well characterized. Given the proximity of placer claims to the SEZ and the presence of washes throughout the site, the potential for placer gold to occur within the SEZ is moderate (level of certainty B). The occurrence of copper-, silver-, and gold-bearing zones (such as those mined at Bear Hills) below the site is unconfirmed, but based on available geologic data, they are likely to be very deep (below basin sediments) if present. Therefore, the potential for metallic (lode) minerals (copper, silver, and gold) is low (level of certainty B). The potential for gypsum to occur within the SEZ is undetermined (level of certainty A).

2.7.2 Saleable Mineral Materials

Saleable mineral materials in the region include pumice, sand, and gravel. Pumice has been produced from the Hope Mine, about 5 mi (8 km) to the east of the Brenda SEZ. Most of the mineral material contracts and free use permits in the Lake Havasu Resource Area are for sand and gravel, and most of the mineral material contracts are issued to government entities as

free use permits (mainly for road maintenance) (BLM 2006). According to the LR2000, accessed on July 13, 2012, there currently are no active free use permits or mineral materials contracts within the SEZ (BLM 2012).

The Brenda SEZ is underlain by alluvial and basin-fill sediments and is, therefore, a high-potential area for sand and gravel deposits (level of certainty C). However, based on the absence of free use permits or mineral materials contracts within the site, the demand for these materials in the immediate area is assumed to be low.

2.7.3 Leasable Minerals

There are no active or historical oil and gas leases within the Brenda SEZ (BLM 2012), and there are no active oil and gas leases within the Lake Havasu Resource Area (BLM 2006). According to the AOGCC (2012), there has been no history of oil and gas production in La Paz County; the only areas producing oil and gas are located in Apache County in northeastern Arizona (Rauzi 2011). There also are no known coal resources within the immediate region of the Brenda SEZ (Ranegras Plain); the most extensive coal reserves are in Cretaceous rocks such as those in the Black Mesa and Pinedale Fields in northeastern and eastern Arizona (Peirce et al. 1970). Given the absence of exploration and production activity in the Lake Havasu Resource Area (and the absence of oil and gas leases within the site), the potential for oil and gas development within the SEZ is low (level of certainty A).

The Brenda SEZ is located in a region of known or potential geothermal resources (INEEL 2003); however, there are no active or historical geothermal leases and no nominated lands for geothermal sale within the SEZ. There are several low-temperature geothermal wells within a few miles of the site (see Map 1), but little development of geothermal resources has occurred in the region. The highest temperature systems are known to occur in eastern Arizona, adjacent to the boundary between the Transition Zone and Southern Basin and Range Province (in Greenlee County) (Fleischmann 2006). Given the low temperature of geothermal resources in the region (and the absence of geothermal leases within the site), the potential for geothermal development within the SEZ is low (level of certainty B).

This page intentionally left blank.

3 GILLESPIE SEZ

3.1 SUMMARY AND CONCLUSIONS

This chapter assesses the mineral resource potential of 2,618 acres (11 km^2) of public lands within an area known as the Gillespie SEZ, located in Maricopa County in west–central Arizona, about 7 mi (11 km) southwest of Arlington and 17 mi (27 km) southwest of Buckeye, Arizona.

There are no documented occurrences of locatable mineral deposits within the Gillespie SEZ. Most of the locatable minerals in the region (copper, silver, gold, zinc, lead) occur in the Gila Bend Mountains District to the west. The nearest potential occurrences of locatable minerals include copper, gold, lead, and silver, based on the Idazona Mines prospect, about 1 mi (1.6 km) south of the site. Placer gold has been produced from river alluvium by the P&J Mine, about 6 mi (10 km) to the southeast. Given the proximity of the site to the Gila Bend Mountains and the numerous washes running through it, the potential for placer deposits (gold and copper) to occur within the SEZ is moderate (level of certainty B). (This is supported also by the pending notice for placer deposits less than a mile to the south of the central portion of the SEZ.) In addition, the location of the Idazona mines prospect indicate that hard rock may be fairly shallow in the immediate region (the author has been unable to confirm the depth to bedrock). For this reason, the potential for lode minerals (copper, gold, lead, and silver) is considered moderate (level of certainty A).

The Gillespie SEZ is an area with a high potential for the occurrence of sand and gravel (level of certainty C). The site is underlain by alluvial and basin-fill sediments; however, based on the absence of free use permits or mineral materials contracts within the site, the demand for these resources is assumed to be low.

There are no active or historical oil and gas leases within the Gillespie SEZ, and there has been no history of oil and gas production in Maricopa County. The only areas producing oil and gas are located in Apache County in northeastern Arizona. The SEZ is an area with low potential for oil and gas development (level of certainty A).

The SEZ is located in a region of known or potential geothermal resources; however, there are no active or historical geothermal leases and no nominated lands for geothermal sale within the site. No development of geothermal resources has occurred in the region. The highest temperature systems are known to occur in eastern Arizona, adjacent to the boundary between the Transition Zone and Southern Basin and Range Province (in Greenlee County). Given the absence of geothermal leases within the site, the potential for geothermal development within the SEZ is low (level of certainty B).

3.2 LANDS INVOLVED

The Gillespie SEZ is located on BLM lands in the Lower Sonoran Resource Area, in Maricopa County. The site lies within T2S, R6W, sections 6 to 9, 15 to 17, and 22 to 24; and T2S, R7W, sections 1 and 12 (Gila and Salt River Principal Meridian). The SEZ is shown on the location map in the back of this report (Map 2). The full legal description of the SEZ is provided in Appendix A.

3.3 LAND STATUS

According to the LR2000, accessed on January 13, 2012, there are no active or historical locatable mining claims within the Gillespie SEZ (BLM 2012). However, there is an active placer claim immediately adjacent to the northern site boundary covering the northwest quadrant of section 6 in T2S, R6W and the northeast quadrant of section 1, T2S, T7W (AMC 36272705). There are also four active placer claims less than a mile south of the central portion of the site in section 21 of T2S, R6W (AMC 415609, AMC 415610, AMC 415611, and AMC 415612). A follow-up query to the LR2000 on August 30, 2012, indicated that a notice of intent was filed in May 2012 by Global Resources LLC (AZA 0359680) at this location and is pending approval.

There are 11 active (and numerous closed) lode claims in the mountains to the southwest. The closest of these (AMC 410591) is located near Black Butte in section 14 of T2S, R7W, about 1.0 mi (1.6 km) southwest of the northern end of the SEZ. Ten others are located in sections 27 and 28 of T2S, R6W (Webb Mountain), about 2.0 mi (3.2 km) to the southwest of the southern end of the SEZ.

The lands within the SEZ were first segregated from locatable mineral entry in June 2009, pending the outcome of the Draft Solar PEIS (BLM and DOE 2010). They are currently segregated under an Interim Temporary Final Rule that is in effect until June 30, 2013 (76 FR 23198–23205).

There are no active or closed free use permits or mineral materials contracts within the SEZ (BLM 2012). The site remains open for the disposal of saleable mineral materials.

There are no active oil and gas leases within the Gillespie SEZ, and the area within the site was never leased for oil and gas in the past. (According to the Arizona Oil and Gas Conservation Commission, all of Arizona's oil and gas development occurs in Apache County [AOGCC 2012].) There are no active or historical geothermal leases and no nominated lands for geothermal sale within the SEZ. The site remains open for discretionary leasing for oil and gas, geothermal, and other leasable minerals.

3.4 GEOLOGIC SETTING

The Gillespie SEZ is located within the Basin and Range physiographic province in west–central Arizona. It lies to the southeast of the Harquahala Basin (Plain), and it sits on a

dissected piedmont slope between the Gila Bend Mountains to the southwest and Centennial Wash, a dry ephemeral stream, to the northeast. Centennial Wash flows to the southeast, joining the Gila River just north of the Gillespie Dam southeast of the site. The Gillespie SEZ sits about 150 ft (45 m) above the Centennial Wash.

Exposed sediments in the vicinity of the SEZ are predominantly older Quaternary (10,000 to 750,000 years old) alluvial deposits and sedimentary rocks of conglomerate and sandstone of Tertiary age. Younger alluvial deposits (less than 10,000 years old) are associated with Centennial Wash. In the Gila Bend Mountains, exposures are predominantly composed of Tertiary volcanics (andesite and basalts) and intrusives. The oldest rocks in the region are the Early Proterozoic metamorphic and granitic rocks that occur in the Gila Bend Mountains to the southwest of the SEZ and the Maricopa and Buckeye Mountains to the east. The geology of the Centennial Wash Valley near the Gillespie SEZ is shown in Figure 4.

3.5 PHYSICAL FEATURES AND ACCESS

The Gillespie SEZ is situated about 150 ft (45 m) above the Centennial Wash, which lies to the northeast. Its terrain is fairly flat because the SEZ is narrow and generally follows the slope contour. There is a slight slope to the northeast, with elevations in the northwestern half of the SEZ ranging from about 950 ft (290 m) along the southwestern border to 920 ft (280 m) along the northeast-facing border, and with elevations in the southeastern half ranging from about 920 to 880 ft (280 to 270 m). Several broad washes enter the SEZ from the southwest and drain to the northeast toward Centennial Wash.

Agua Caliente Road, a Maricopa County road, passes through the SEZ for about 4 mi (6 km) and provides access to the site.

3.6 SITE GEOLOGY

The geology of the Gillespie SEZ area was mapped by the AZGS in 1993 and 1994. The resulting geologic map titled, “Compilation Geologic Map of the Gila Bend Mountains, Maricopa County, Arizona,” was published at a scale of 1:50,000 (Skotnicki 1994). Figure 5 shows the geology of part of the SEZ (from the northwest end to its central portion) based on this work.

Surface exposures at the site consist predominantly of consolidated basin fill deposits of Tertiary age (map unit Tsy, Figure 5). These deposits are composed of flat-lying sandstone and conglomerate that are tan in color, poorly to moderately sorted, and moderately to well consolidated. In the region north of Webb Mountain where the Gillespie SEZ is located, the Tsy unit contains clasts of both Proterozoic granite/diorite and felsic/mafic volcanic rocks (which distinguish them from Tsy units in other regions). The surface where these rocks are exposed tends to be highly dissected and forms steep, rounded ridges (Skotnicki 1994).

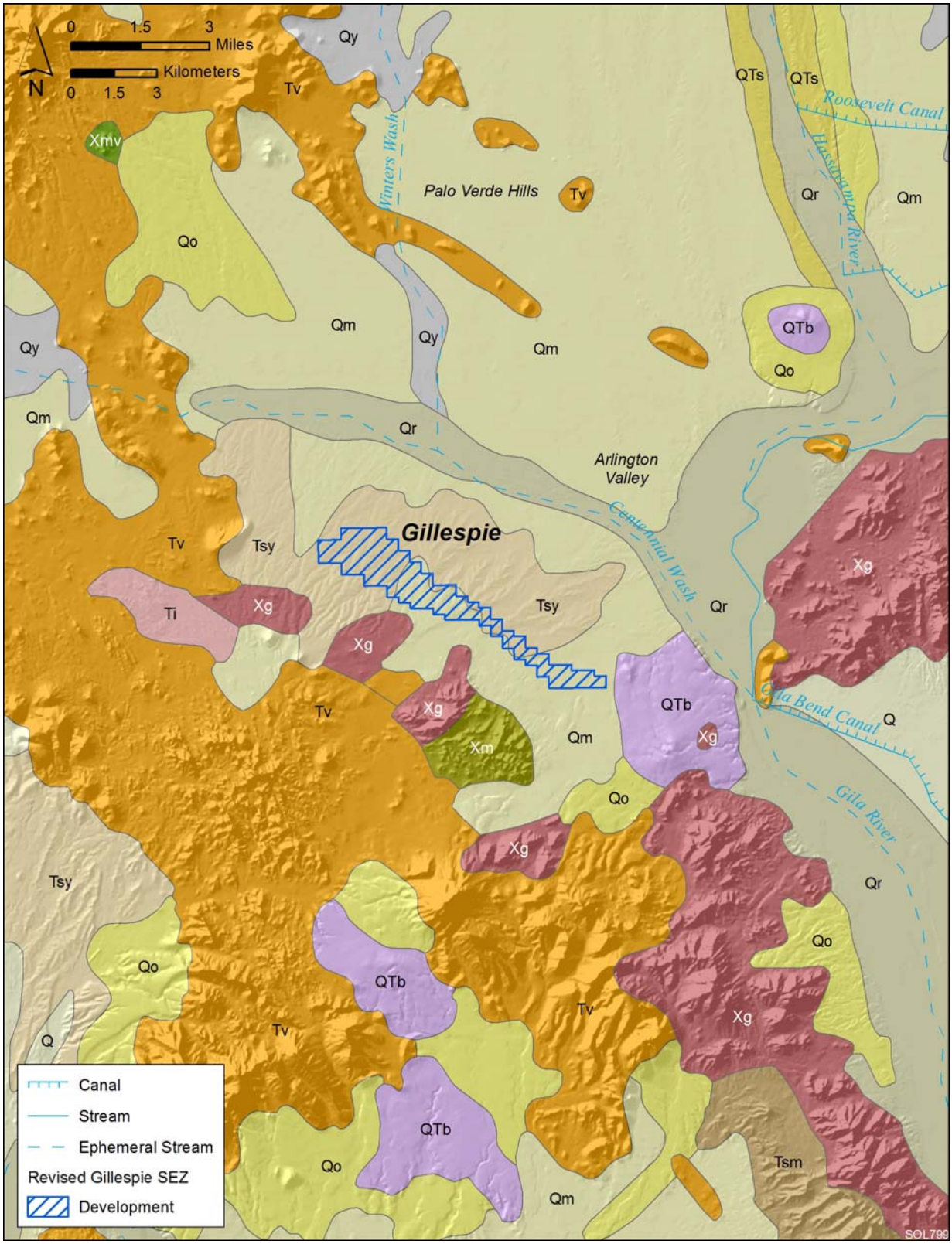

FIGURE 4 Geologic Map of the Centennial Wash Valley near the Gila Bend Mountains (Sources: Ludington et al. 2007; Richard et al. 2000)

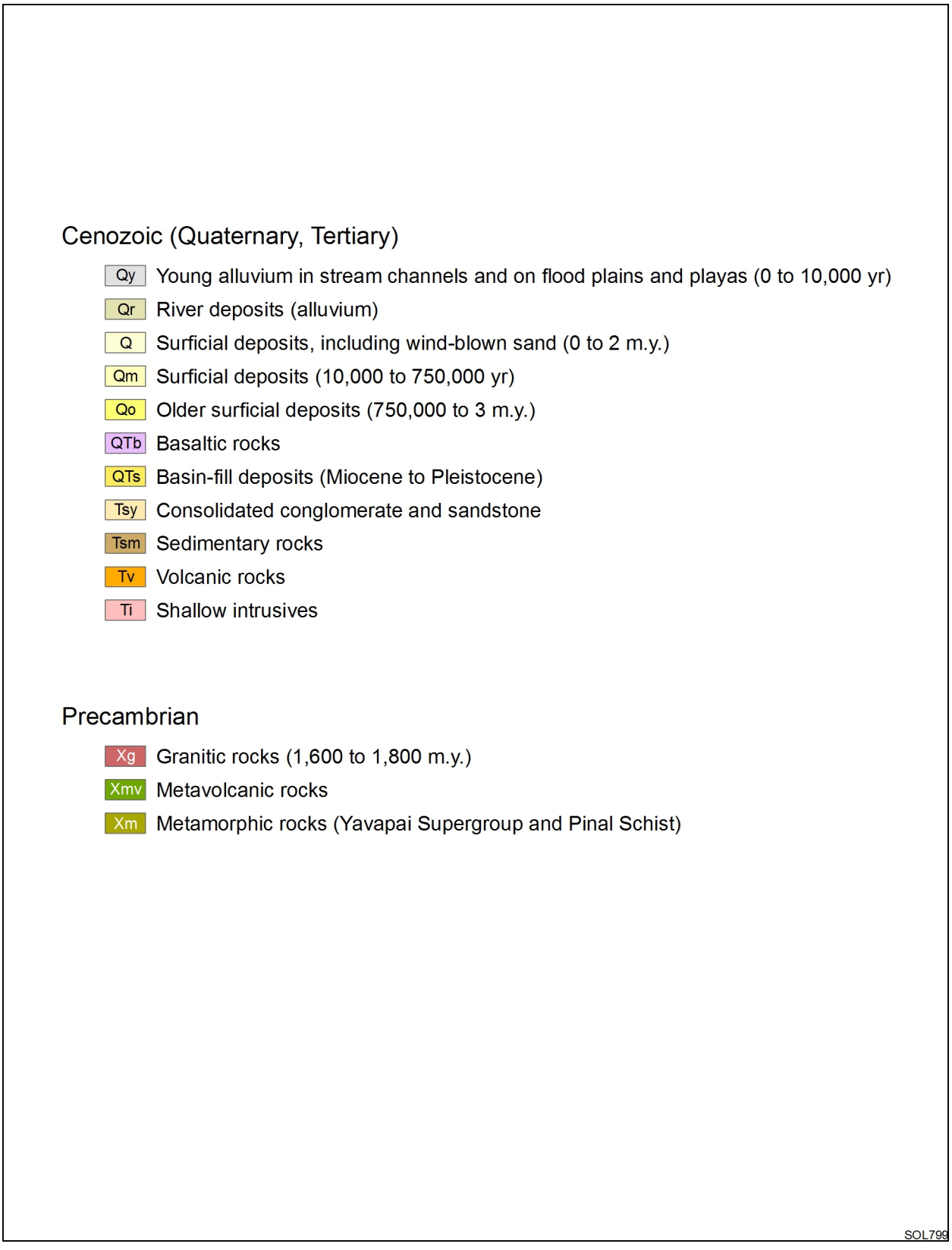

FIGURE 4 (Cont.)

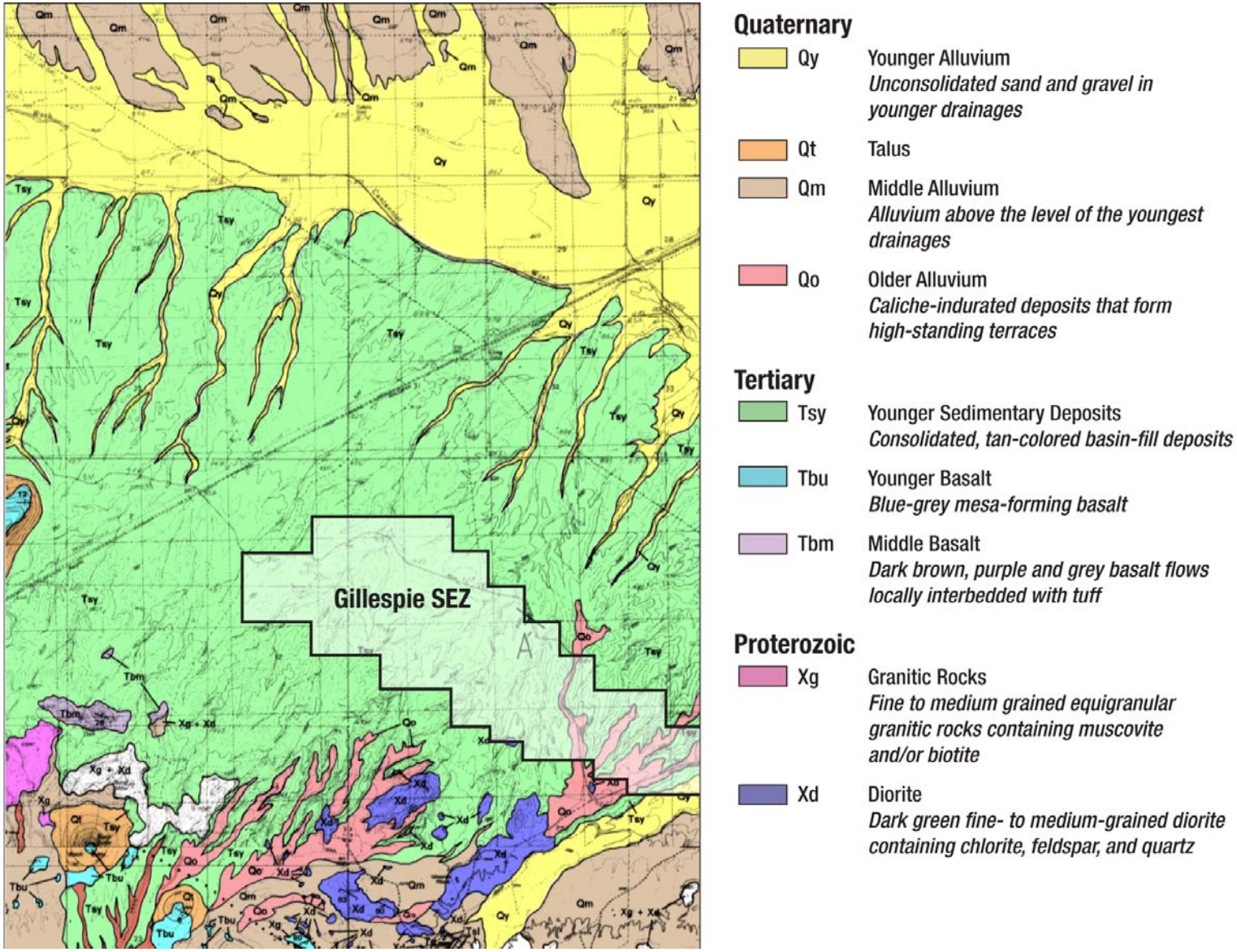

FIGURE 5 Geologic Map of the Gillespie SEZ (Source: Skotnicki 1994)

Older Quaternary alluvium (map unit Qo, Figure 5) crosses the central portion of the SEZ. It is light-colored, strongly cemented (with caliche), and poorly to moderately sorted. These deposits form caliche-capped surfaces that are 16 to 33 ft (5 to 10 m) thick and rest on the top of basin-fill deposits at elevations much higher than the younger drainages. The Qo and Tsy units are underlain by Proterozoic diorite (map unit Xd, Figure 5); exposures of this unit occur at Webb Mountain to the southwest of the site. Depth to bedrock at the site has not been determined.

The Gila Bend Mountains occur to the northwest of the SEZ. Bedrock in the central part of the mountains is predominantly felsic to intermediate volcanic rocks of Miocene age. Overlying these rocks are younger, mesa-forming basalt flows (map unit Tbu, Figure 5). Sedimentary rocks are extensive, consisting mainly of arkosic sandstone and conglomerate. These rocks lie nonconformably on crystalline basement (as occurs on the south site of Webb Mountain where conglomerate overlies crystalline rocks) and are locally interbedded with breccia, siltstone, shale, and limestone. Crystalline basement (consisting of foliated dark green diorite and nonfoliated granite) is exposed along the northern edge of the mountain range; most of the mineralization (gold and copper) occurs in this region.

The broad washes entering the SEZ from the Gila Bend Mountains and draining northeastward to Centennial Wash are favorable locations for the concentration of gold (placer) deposits. This area, however, was not catalogued by Wilson (1981), who reported that most of the placer deposits in Maricopa County occur in the north part of the county where the Centennial Wash and Hassayampa River enter the Gila River.

3.7 MINERAL HISTORY

There has been no documented mining within the Gillespie SEZ. Most of the mining activity in the region has been limited to the small-scale mining of sand and gravel in the basin and the mining of locatable minerals in the Gila Bend Mountains to the southwest. The nearest mining activity is currently taking place at the Fourth of July Peak Agate Field, where agate is produced, about 10 mi (16 km) to the southwest (USGS 2011). According to the AZGS (2011), there are currently no major active mines in Maricopa County.

No mineral exploration or development work is currently being conducted within the SEZ. According to the LR2000, however, there are several active lode and placer claims near the SEZ (see Section 3.3). A notice of intent was filed in May 2012 by Global Resources LLC for an area where four placer claims are located, less than a mile south of the central portion of the site (section 21 of T2S, R6W); BLM approval is pending.

Source Gold Corp. announced recently that it began its 2011 exploration program (for gold, silver, and copper) on the Vulture Peak mineral claims near Wickenburg in Maricopa County (Source Gold Corp. 2011). There have been no other reports of recent exploration or development activities in Maricopa County.

3.7.1 Locatable Minerals

There are no documented locatable mineral deposits or prospects within the Gillespie SEZ (BLM 2012). Most of the locatable minerals in the region (copper, silver, gold, zinc, lead) occur in the Gila Bend Mountains District to the west.

Mines and mineral prospects in the vicinity of the SEZ are shown in Figure 6. A detailed map (Map 2) of the SEZ and surrounding region is provided in the back of this report. The nearest potential occurrences of locatable minerals include copper, gold, lead, and silver, based on the Idazona Mines prospect about 1 mi (1.6 km) south of the site (in section 19 of T2S, R6W; see Map 2) (USGS 2011). Gold has been produced from river alluvium by the P&J Mine, about 6 mi (10 km) to the southeast (in section 11, T3S, R5W) (USGS 2011).

Mines and mineral prospects in the vicinity of the SEZ are clustered within and around the adjacent mountain ranges, and these clusters correspond to some of the historical mining districts delineated by Keith et al. (1983a) and Welty et al. (1985). The mining areas are shown in Figure 6 and listed below; the corresponding historical mining district name is provided in parentheses.

- Webb Mountain (Webb Mountain District): copper, gold, silver, and lead; about 1 mi (1.6 km) to the south;

- Gila Bend Mountains (Gila Bend District); gold and copper; about 4 mi (6.4 km) to the southwest; and

- Buckeye Hills (Buckeye Hills District): possibly beryllium and lithium; about 8 mi (13 km) to the east.

The Webb District (also referred to as part of the Gila Bend District) was active between 1935 and 1951 when mines (Hargan and Buckeye Copper Mines) produced copper, silver, gold, and lead. These deposits are associated with Tertiary quartz monzonite veins in Precambrian schist and gneiss. The district is currently inactive (Keith et al. 1983a, b; Kreidler 1986; USGS 2011). A notice of intent was filed in May 2012 by Global Resources LLC for an area where four placer claims are located, less than a mile south of the central portion of the site (section 21 of T2S, R6W).

The Gila Bend Mountains (also known as the Gila Bend District) are located to the southwest of the Gillespie SEZ. Mineralization occurs in Tertiary quartz veins and andesitic dikes and is concentrated along the northern edge of the mountain range. At the Butte Mines (section 14 of T2S, R7W) and the Idazona Mines prospect (section 19 of T2S, R6W) to the southwest and south of the SEZ, crysocolla occurs within quartz-carbonate veins in dark green diorite. The district is currently inactive (Keith et al. 1983a, b; Skotnicki 1994; USGS 2011).

The Buckeye Hills District covers the Buckeye Hills to the east of the Gillespie SEZ. Mineralization occurs in late Cretaceous or Tertiary pegmatitic deposits. There has been little

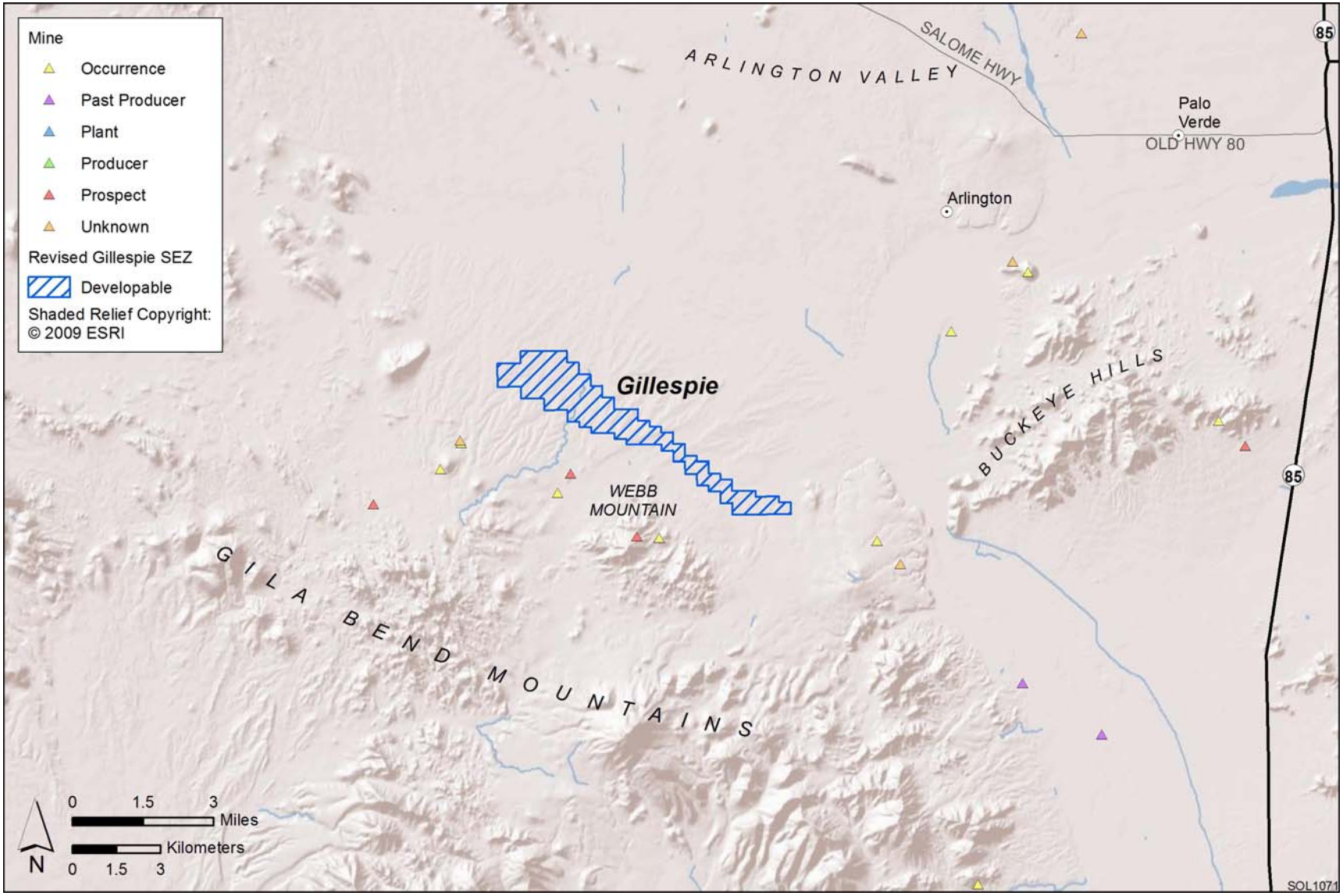

FIGURE 6 Map Showing Mines and Mineral Prospects near the Gillespie SEZ (Source: USGS 2011)

reported mining activity in the district, and the district is currently inactive (Keith et al. 1983b; USGS 2011).

The Gillespie SEZ crosses none of the mining districts identified by Keith et al. (1983a) or by Welty et al. (1985), and there has been no hard rock or locatable mining activity within the site. Most of the locatable minerals in the region (copper, silver, gold, zinc, lead) occur in the Gila Bend Mountains District to the west. The nearest potential occurrences of locatable minerals include copper, gold, lead, and silver, based on the Idazona Mines prospect, about 1 mi (1.6 km) south of the site. Placer gold has been produced from river alluvium by the P&J Mine, about 6 mi (10 km) to the southeast. Given the proximity of the site to the Gila Bend Mountains and the numerous washes running through it, the potential for placer deposits (gold and copper) to occur within the SEZ is moderate (level of certainty B). (This is supported also by the pending notice for placer deposits less than a mile to the south of the central portion of the SEZ.) In addition, the location of the Idazona mines prospect indicates that hard rock may be fairly shallow in the immediate region (the author has been unable to confirm the depth to bedrock). For this reason, the potential for lode minerals (copper, gold, lead, and silver) is considered moderate (level of certainty A).

3.7.2 Saleable Mineral Materials

Saleable mineral materials in the region are mainly limited to sand and gravel. According to the LR2000, accessed on July 13, 2012, there currently are no free use permits or mineral materials contracts within the Gillespie SEZ (BLM 2012).

The Gillespie SEZ is underlain by alluvial and basin-fill sediments and is, therefore, a high-potential area for sand and gravel deposits (level of certainty C). However, based on the absence of free use permits or mineral materials contracts within the site, the demand for these materials in the immediate area is assumed to be low.

3.7.3 Leasable Minerals

There are no active or historical oil and gas leases within the Gillespie SEZ (BLM 2012). According to the AOGCC (2012), there has been no history of oil and gas production in Maricopa County; the only areas producing oil and gas are located in Apache County in northeastern Arizona (Rauzi 2011). There also are no known coal resources in the Lower Sonoran Resource Area; the most extensive coal reserves are in Cretaceous rocks (e.g., Black Mesa and Pinedale Fields in northeastern and eastern Arizona) (Peirce et al. 1970; BLM 2011). Given the absence of exploration and production activity in the Lower Sonoran Resource Area (and the absence of active oil and gas leases within the SEZ), the potential for oil and gas development within the SEZ is low (level of certainty A).

The Gillespie SEZ is located in a region of known or potential geothermal resources (INEEL 2003); however, there are no active or historical geothermal leases and no nominated lands for geothermal sale within the SEZ. No development of geothermal resources has occurred

in the region. The highest temperature systems are known to occur in eastern Arizona, adjacent to the boundary between the Transition Zone and Southern Basin and Range Province (in Greenlee County) (Fleischmann 2006). Given the absence of geothermal leases within the SEZ, the potential for geothermal development within the SEZ is low (level of certainty B).

This page intentionally left blank.

4 REFERENCES

ADWR (Arizona Department of Water Resources), 2010a, *Lower Colorado River Hydrology—Groundwater (West Basins).* Available at http://www.adwr.state.az.us/azdwr/StatewidePlanning/WaterAtlas/LowerColoradoRiver/PlanningAreaOverview/Hydrology_West_Cont.htm. Accessed July 23, 2010.

ADWR, 2010b, *Securing Arizona's Water Future—Ranegras Plain Basin.* Available at http://www.azwater.gov/AzDWR/StateWidePlanning/RuralPrograms/OutsideAMAs_PDFs_for_web/default.htm. Accessed July 23, 2010.

American Bonanza Gold Corp., 2011a, *News Releases: American Bonanza Receives Final Major Permit for the Copperstone Gold Mine (April 20, 2011).* Available at http://www.americanbonanza.com. Accessed May 11, 2011.

American Bonanza Gold Corp., 2011b, *Copperstone—Feasibility Study*. Available at http://www.americanbonanza.com. Accessed May 12, 2011.

AOGCC (Arizona Oil and Gas Conservation Commission), 2012, *Production Reports (Years 2008 to 2011).* Available at http://www.azogcc.az.gov/production_reports. Accessed Feb. 1, 2012.

AZGS (Arizona Geological Survey), 2011, *Arizona Major Mines,* Aug. Available at http://mines.az.gov/Info/annual_production.html. Accessed July 14, 2012.

BLM (Bureau of Land Management), 1985, *BLM Manual 3031—Energy and Mineral Resource Assessment,* U.S. Department of the Interior, June 19.

BLM, 2006, *Lake Havasu Field Office Proposed Resource Management Plan and Final Environmental Impact Statement*, BLM/AZ/PL-06/008, Sept.

BLM, 2011, *Lower Sonoran and Sonoran Desert National Monument Draft Resource Management Plan and Environmental Impact Statement*, Lower Sonoran Field Office, Phoenix Ariz., Aug.

BLM, 2012, *Land and Mineral Legacy Rehost 2000 System—LR2000*, last updated Sept. 23, 2011. Available at http://blm.gov/lr2000/. Accessed Jan. 30 and July 13, 2012.

BLM and DOE (BLM and U.S. Department of Energy), 2010, *Draft Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States*, DES 10-59, DOE/EIS-0403, Dec.

BLM and DOE, 2011, *Supplement to the Draft Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States*, DES 11-49, DOE/EIS-0403D-S, Oct.

CBO (Congressional Budget Office), 1983, *Strategic and Critical Nonfuel Minerals: Problems and Policy Alternatives,* A.M. Rivlin (Director), Washington, D.C., Aug.

Dodson, A., 2011, personal communication from Dodson (Geologist, BLM Lake Havasu Field Office), to T. Patton (Argonne National Laboratory, Argonne, Ill.), June 14.

Duncan, J.T., 1990, *The Geology and Mineral Deposits of the Northern Plomosa District, La Paz County, Arizona*, Open File Report 90-10, Arizona Geological Survey, Dec.

Fleischmann, D.J., 2006, *Geothermal Resource Development Needs in Arizona*, prepared by the Geothermal Energy Association for the U.S. Department of Energy, Sept.

Fortress Financial Group, Inc., 2011, *Properties—Descriptions: Bouse and South Copperstone*. Available at http://www.fortfinancegroup.com/properties.html. Accessed May 12, 2011.

Fugro National, Inc., 1979, *MX Siting Investigation Geotechnical Summary—Prime Characterization Sites, Sonoran, Candidate Siting Province*, prepared for Space and Missile Systems Organization (SAMSO), Norton Air Force Base, Calif., Feb. 15.

INEEL (Idaho National Engineering and Environmental Laboratory), 2003, *Arizona Geothermal Resources*, Publication No. INEEL/MIS-2002-1616, Rev. 1, Nov.

Keith, S.B., et al., 1983a, *Metallic Mineral Districts and Production in Arizona*, Arizona Bureau of Geology and Mineral Technology, Bulletin 194.

Keith, S.B., et al., 1983b, *Map, Description and Bibliography of the Mineralized Areas of the Basin and Range Province in Arizona*, U.S. Geological Survey, Open-File Report 84-0086.

Kreidler, T.J., 1986, *Mineral Investigation of a Part of the Signal Mountain Wilderness Study Area (AZ-020-138), Maricopa County, Arizona*, Mineral Land Assessment 62-86 (Open File Report), U.S. Department of the Interior, Bureau of Mines.

Lane, M.E., 1986, *Mineral Investigation of a Part of the New Water Mountains Wilderness Study Area (AZ-020-125), La Paz County, Arizona*, Mineral Land Assessment 57-86 (Open File Report), U.S. Department of the Interior, Bureau of Mines.

Lipin, B.R., 2000, *Mineral Resource Databases*, Fact Sheet FS-122-00, U.S. Geological Survey, Sept.

Ludington, S., et al., 2007, *Preliminary Integrated Geologic Map Databases for the United States—Western States: California, Nevada, Arizona, Washington, Oregon, Idaho, and Utah*, Open File Report 2005-1305, Version 1.3, U.S. Geological Survey, original file updated in Dec. 2007. Available at http://pubs.usgs.gov/of/2005/1305/index.htm.

Metzger, D.G., 1951, *Geology and Ground-Water Resources of the Northern Part of the Ranegras Plain Area, Yuma County, Arizona*, Open File Report 51-28, U.S. Geological Survey.

Peirce, H.W., et al., 1970, *Coal, Oil, Natural Gas, Helium, and Uranium in Arizona*, Arizona Bureau of Mines, Bulletin 182.

PR Newswire, 2006, "Big Bar Encounters Economically Interesting By-Product Metals at Its Yuma King Copper Exploration Project," Mining and Metals News Release, Oct. 19.

Rauzi, S.L., 2011, *Oil and Gas Occurrence in Arizona*, Publication OG-35 (OGCC Chart C-1), Arizona Geological Survey, Tucson, Ariz., Feb.

Reynolds, S.J., et al., 1989, *Geologic Map, Geologic Evolution, and Mineral Deposits of the Granite Wash Mountains, West-Central Arizona (Updated Sept. 1993)*, Open File Report 89-04, Arizona Geological Survey, Aug.

Richard, S.M., et al., 2000, *Geologic Map of Arizona (Scale 1:1,000,000)*, Map M-35, Arizona Geological Survey. Available at http://www.azgs.state.az.us/services_azgeomapve.shtml. Accessed Oct. 20, 2010.

Richard, S.M., et al., 2007, *Estimated Depth to Bedrock in Arizona*, DGM-52, Arizona Geological Survey, April.

Sherrod, D.R., et al., 1990, *Geologic Map of the Vicksburg Quadrangle, La Paz County, Arizona*, Geologic Quadrangle Map GQ-1684, scale 1:62,500, U.S. Geological Survey.

Shumaker, M., 2011, personal communication from Shumaker (BLM Chief Mineral Examiner, U.S. Department of the Interior, Bureau of Land Management, Division of Solid Minerals, Phoenix, Ariz.) to T. Patton (Argonne National Laboratory, Argonne, Ill.), April 28.

Skotnicki, S.J., 1994, *Compilation Geologic Map of the Central Gila Bend Mountains, Maricopa County, Arizona (includes 1:50,000 map and text)*, Open File Report 94-18, Arizona Geological Survey, Sept.

Source Gold Corp., 2011, *Source Gold Begins 2011 Silver, Gold, and Copper Exploration Program*. Available at http://www.sourcegoldcorp.com/news.php. Accessed May 13, 2011.

Sparrow Tech, 2011, *The Eagle Nest Mining Property*. Available at http://www.sparrowtech.net/property.html. Accessed May 12, 2011.

Spencer, J.E., et al., 1988, "The Copperstone Mine: Arizona's New Gold Producer," *Arizona Bureau of Geology and Mineral Technology Field Notes* 18(2):1–3, summer.

USGS (U.S. Geological Survey), 2010, *2007 Minerals Yearbook—Arizona (Advance Copy)*, July.

USGS, 2011, *Mineral Resource Data System: Conterminous U.S.*, Mineral Resources On-Line Spatial Data. Available at http://mrdata.usgs.gov/mineral-resources/mrds-us.html. Accessed May 6, 2011.

Welty, J.W., et al., 1985, *Mine Index for Metallic Mineral Districts of Arizona,* Bulletin 196, Arizona Bureau of Geology and Mineral Technology.

Wilson, E.D., 1981, *Gold Placers and Placering in Arizona,* Arizona Bureau of Geology and Mineral Technology, Bulletin 168.

5 LIST OF PREPARERS

Table 2 lists the BLM management team members and technical reviewers for this assessment. Table 3 lists the names, education, and expertise of the report preparers.

TABLE 2 BLM Management Team and Mineral Specialists Consulted

Name	Office/Title
Linda Resseguie	Minerals and Realty Management Directorate, Realty Specialist
Shannon Stewart	Renewable Resources and Planning Directorate, Senior Planning and Environmental Analyst
Jeff Holdren	Division of Lands, Realty and Cadastral Survey, Senior Realty Specialist
Matt Shumaker	Division of Solid Minerals, Chief Mineral Examiner
Jason Powell	Division of Solid Minerals, Geologist
Jeff Garrett	Arizona State Office, Mining Engineer and Mining Law, Program Lead
Amanda Dodson	Lake Havasu Field Office, Geologist
Mike Rice	Hassayampa Field Office, Geologist

TABLE 3 Report Preparers

Name	Education/Expertise	Contribution
Linda Graf	Desktop publishing specialist; 41 years of experience in creating, revising, formatting, and printing documents.	Document assembly and production
Heidi Hartmann	M.S., Environmental Toxicology and Epidemiology; 25 years of experience in environmental assessment, exposure and risk analysis, and environmental impact assessment.	Solar PEIS Project Manager
Irene Hogstrom	M.A. Geography and Environmental Studies; B.L.A., Landscape Architecture; 23 years of experience in landscape architecture, including design, regional planning, and ecological restoration.	LR2000 queries
Patricia Hollopeter	B.A., Religion; M.A., Philosophy; 27 years of experience in technical editing and environmental assessment document production.	Editor
James E. May	M.S., Water Resources Management, B.A., Zoology; 34 years of experience in natural resources management; 8 years of consulting experience in resource management, land use planning, and NEPA compliance.	Lands and realty; and mineral review
Greg McGovern	M.S., B.S., Geology (Hydrogeology); 23 years of experience in environmental site assessment and contaminant fate and transport studies.	Site specific geology
Mary R. Moniger	B.A., English; 35 years of experience in editing and writing.	Lead editor
Michele Nelson	Graphic designer; 35 years of experience in graphical design and technical illustration	Report cover design and foldout map layout
Terri L. Patton	M.S., B.S., Geology (Igneous Petrology and Mineral Chemistry); 24 years of experience in environmental research and assessment.	Lead author; geology and mineral assessment
Kurt Picel	Ph.D., Environmental Health Sciences; 33 years of experience in environmental health analysis and 18 years in environmental assessment.	Environmental analysis and review
Lorenza Salinas	Desktop publishing specialist; 30 years of experience in creating, revising, formatting, and printing documents.	Document assembly and production

TABLE 3 (Cont.)

Name	Education/Expertise	Contribution
Barbara Simmons	B.A., Technical Writing; E.L.S. certification by the Board of Editors in the Life Sciences; Fellow, Society for Technical Communication; 45 years of experience in technical editing and publications management.	Editor
Karen P. Smith	M.S., B.A., Geology; B.S., Anthropology; more than 23 years of experience in energy and environmental regulatory and policy analysis.	Solar PEIS Program Manager
Emily A. Zvolanek	B.A., Environmental Science; 4 years of experience in GIS mapping.	GIS mapping

This page intentionally left blank.

APPENDIX A:

LEGAL DESCRIPTIONS OF ARIZONA SOLAR ENERGY ZONES

This page intentionally left blank.

APPENDIX A:

LEGAL DESCRIPTIONS OF ARIZONA SOLAR ENERGY ZONES

This appendix presents the legal descriptions for the two proposed SEZ land withdrawal areas in Arizona.

Gila and Salt River Meridian

Brenda SEZ

T. 4 N., R. 16 W.,
sec. 1, lots 3 and 4, S½NW¼, and SW¼;
secs. 2 to 4 inclusive;
sec. 9, NE¼, NE¼NW¼, and NE¼SE¼;
sec. 10, N½, N½S½, and SW¼SW¼;
sec. 11, NW¼.

T. 5 N., R. 15 W.,
sec. 31, lots 1 to 4, inclusive, E½W½, and E½SW¼.

The areas described above aggregate approximately 3,348 acres (13.5 km^2).

Gillespie SEZ

T. 2 S., R. 6 W.,
sec. 6, SW¼, W½SE¼, and SE¼SE¼, unsurveyed;
sec. 7, N½, NE¼SW¼, N½SE¼, and SE¼SE¼, unsurveyed;
sec. 8, SE¼NW¼, W½NW¼, SW¼, S½SE¼, and NW¼SE¼, unsurveyed;
sec. 9, SW¼SW¼, unsurveyed;
sec. 15, NW¼SW¼, N½SW¼SW¼, SE¼SW¼, and S½SW¼SE¼, unsurveyed;
sec. 16, S½NE¼, S½NW¼NE¼, NW¼, and N½NE¼SE¼, unsurveyed;
sec. 17, N½NE¼, N½SE¼NE¼, NE¼NW¼, and N½NW¼NW¼, unsurveyed;
sec. 22, S½NE¼NE¼, NW¼NE¼, N½SW¼NE¼, SE¼NE¼, and N½NE¼NW¼, unsurveyed;
sec. 23, SW¼NW¼, N½SW¼, SE¼SW¼, S½NE¼SE¼, NW¼SE¼, and S½SE¼, unsurveyed;
sec. 24, S½NW¼SW¼ and S½SW¼, unsurveyed.

T. 2 S., R. 7 W.,
sec. 1, SE¼SW¼, NE¼SE¼, and S½SE¼;
sec. 12, N½NE¼, SE¼NE¼, and NE¼NW¼.

The areas described above aggregate approximately 2,618 acres (10.6 km^2).

This page intentionally left blank.