Appendix H
Hydrology Study

REVIEW OF SURFACE-WATER AND GROUNDWATER CONDITIONS ARIZONA EASTERN RAILWAY GRAHAM COUNTY, ARIZONA

PREPARED FOR:
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135 Main Street, Suite 1600
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PREPARED BY:
Ninyo & Moore
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3001 South 35th Street, Suite 6
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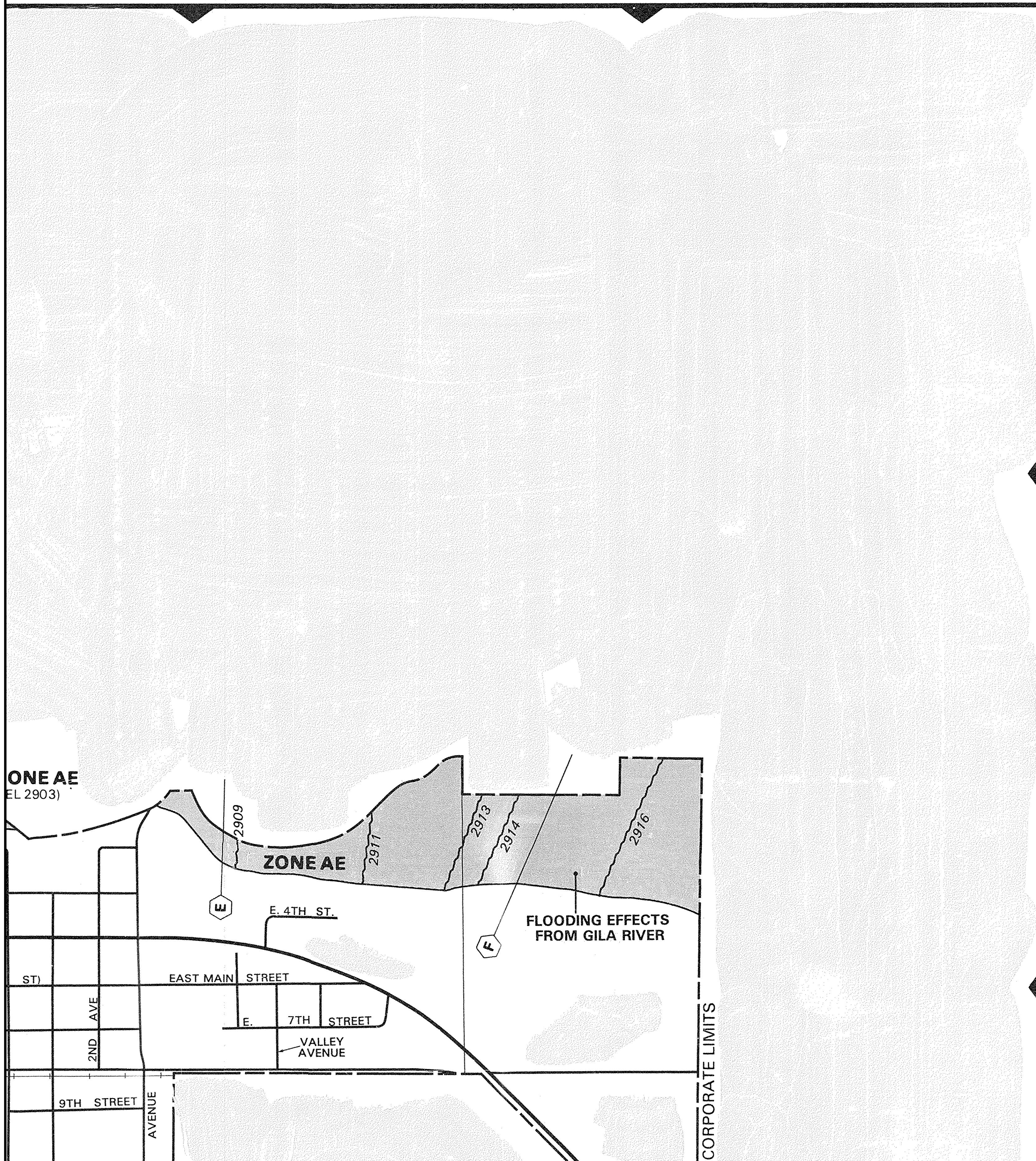
October 20, 2006
Project No. 601605002



LEGEND

SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100-YEAR FLOOD

ZONE A No base flood elevations determined.

ZONE AE Base flood elevations determined.

ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); base flood elevations determined.

ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding; velocities also determined.

ZONE A99 To be protected from 100-year flood by Federal flood protection system under construction; no base flood elevations determined.

ZONE V Coastal flood with velocity hazard (wave action); no base flood elevations determined.

ZONE VE Coastal flood with velocity hazard (wave action); base flood elevations determined.

FLOODWAY AREAS IN ZONE AE

OTHER FLOOD AREAS

ZONE X Areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood.

OTHER AREAS

ZONE X Areas determined to be outside 500-year floodplain.

ZONE D Areas in which flood hazards are undetermined.

UNDEVELOPED COASTAL BARRIERS†

Identified 1983

Identified 1990

Otherwise Protected Areas

†Coastal barrier areas are normally located within or adjacent to special flood hazard areas.

Floodplain Boundary

Floodway Boundary

Zone D Boundary

Boundary Dividing Special Flood Hazard Zones, and Boundary Dividing Areas of Different Coastal Base Flood Elevations Within Special Flood Hazard Zones.

513 Base Flood Elevation Line; Elevation in Feet*

D — D Cross Section Line

(EL 987) Base Flood Elevation in Feet Where Uniform Within Zone*

RM 7× Elevation Reference Mark

•M1.5 River Mile

*Referenced to the National Geodetic Vertical Datum of 1929

NOTES

This map is for use in administering the National Flood Insurance Program; it does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size, or all planimetric features outside Special Flood Hazard Areas. The community map repository should be consulted for more detailed data on BFEs, and for any information on floodway delineations, prior to use of this map for property purchase or construction purposes.

Areas of Special Flood Hazard (100-year flood) include Zones A, AE, A1-A30, AH, AO, A99, V, VE and V1-V30.

N

APPROXIMATE SCALE IN FEET

1000 0 1000

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

CITY OF
SAFFORD,
ARIZONA
GRAHAM COUNTY

ONLY PANEL PRINTED

COMMUNITY-PANEL NUMBER
040124 0005 A

EFFECTIVE DATE:
JULY 3, 1997

Federal Emergency Management Agency

October 20, 2006
Project No. 601605002

Ms. Katrina Hardt, AICP
Circlepoint
135 Main Street, Suite 1600
San Francisco, California 94105

Subject: Review of Surface-Water and Groundwater Conditions
Arizona Eastern Railway
Graham County, Arizona

Dear Ms. Hardt:

In accordance with our proposal, P-91465, dated June 14, 2006, and your authorization, Ninyo & Moore has performed a review of surface-water and groundwater conditions for the above-referenced site. The attached report describes our evaluation methodology, and presents our findings, and conclusions regarding the surface and groundwater conditions at the project site.

We appreciate the opportunity to be of service to Circlepoint during this phase of the project.

Sincerely,
NINYO & MOORE

REGISTERED GEOLOGIST
CERTIFICATE NO
40164
KEENAN M.
MURRAY
Date Signed 10-20-06
ARIZONA, U.S.A.

Keenan M. Murray, R.G.
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38736
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MORRIS
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Senior Geologist

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Distribution: (3) Addressee

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1. INTRODUCTION

In accordance with our proposal, P-91465, dated June 14, 2006, and your authorization, Ninyo & Moore has performed a review of surface-water and groundwater conditions for the proposed Arizona Eastern Railway project in Graham County, Arizona. This report presents the results of our services.

1.1. Background

The project consists of the design and construction of a new railway to extend from the existing Arizona Eastern rail line northwest to the proposed Phelps Dodge's Dos Pobres and San Juan Mines, in Graham County, Arizona (Figure 1). The proposed railway corridor (corridor) is approximately 10 miles in length and extends northward from the existing rail line in Section 24, Township 7 South, Range 26 East, to the proposed mining location in the northern portion of Township 6 South, Range 26 East (Figure 2). The proposed corridor passes through Sections 5, 6, 8, 9, 10, 15, 22, 23, 26, 27, 34, and 35 of Township 6 South, Range 26 East, and Sections 1, 2, 11, 14, 23, 24, and 25 in Township 7 South, Range 26 East.

According to information included in the Agreement for Services (Project No. 2261) document, an Environmental Impact Report (EIR)/Environmental Impact Statement (EIS) is being prepared for the proposed project. Ninyo & Moore was retained by CirclePoint to complete a review of surface-water and groundwater conditions in the vicinity of the proposed corridor and to prepare a written report summarizing our findings. It is understood that our findings may be used in support of the EIR/EIS.

1.2. Scope of Services

Ninyo & Moore provided the following hydrologic and water quality services in support of CirclePoint's EIR/EIS efforts:

- Project coordination and conference call/meeting attendance, including meetings with team members and/or subconsultants. Our Hydrology and Water Quality scope of services provides up to eight hours of time for project coordination and meeting attendance.

- Review of existing maps and reports of past assessments, if available, for the alignment and properties located in near proximity to the alignment. Review of readily available historical aerial photographs of the alignment and vicinity.
- A search of readily available government surface water and groundwater conditions information.
- Contact with regulatory agency representatives, such as the Arizona Department of Environmental Quality (ADEQ) and the Arizona Department of Water Resources (ADWR), to discuss the hydrology and water quality of the area along the alignment.
- Preparation of a written report summarizing our findings regarding hydrology and water quality.

2. HYDROLOGY

Current hydrologic conditions in the vicinity of the study area are described in terms of surface-water and groundwater characteristics. The area of influence for surface water includes construction or land disturbance areas within the corridor study area that may be impacted by erosion or potential unauthorized releases of hazardous substances associated with construction and operation of the rail line. The groundwater area of influence includes aquifers that may underlie areas of rail way construction and operation, aquifers that may be sources of water for construction and operation, and downgradient portions of existing aquifers that may be impacted during construction and operation of the proposed rail line. Section 2.1 describes surface-water conditions and Section 2.2 describes groundwater conditions.

The local hydrologic system is influenced by a semiarid climate. Annual average precipitation in the vicinity of the study area ranges between 9 and 15 inches and average evaporations are high. Hydrologic surface features within the immediate study area include drainages, a dry lake, riverbeds, and intermittent rivers. The groundwater system is comprised of recharge zones, discharge points, unsaturated and saturated zones, and aquifers.

According to the *Safford, Graham County, Arizona 7.5-Minute United States Geological Survey (USGS) Topographic Map (1985), and the Weber Peak, Graham County, Arizona 7.5-Minute USGS Topographic Map (1985),* the surface elevation is approximately 3,480 feet above mean sea level (AMSL) in the vicinity of the proposed mining operations at the northwestern limits of the corridor and approximately 2,970 feet AMSL near the confluence of the San Simon and Gila Rivers at the southern limits of the corridor. The topography of the corridor study area generally slopes downward from the northeast to southwest toward the Gila River. Interpretation of topographic contours indicates that the average surface gradient over the entire distance of proposed rail corridor is approximately .010 feet per foot or approximately 50 feet per mile.

The Gila River, which flows southeast to northwest in this region, crosses the project corridor approximately one mile north of U.S. Highway 70 (U.S. Hwy-70). A channelized section of the San Simon River parallels the corridor south of the Gila River. At the time of our evaluation, the project corridor south of the Gila River consisted of agricultural land and scattered agriculture-related structures, while north of the Gila River the project corridor consisted of undeveloped desert land dissected by multiple natural drainages on southwest-sloping alluvial fans with graded and unimproved roadways. Cultural features located in, and adjacent to, the corridor include the Montezuma, Union, and Graham Canals, several aqueducts, groundwater production wells, a shooting range and the Safford Municipal Airport.

The following five aerial photographs were reviewed for this project to assess land form (geomorphic) and land use changes over the available period of record that may have impacted surface-water and groundwater flow regimes and/or quality in the vicinity of the rail corridor: a 1935 Soil Conservation Service (Fairchild) photograph, a 1964 Arizona State Highway Department photograph, a 1980 Rupp's aerial photograph, a 1998 Terraserver photograph, and a 2006 Google™ Earth photograph.

Land located along the railway corridor south of the Gila River was historically used for agricultural purposes as far back as 1935. Numerous agricultural structures were visible in the 1935 Fairchild aerial photograph along the corridor in Sections 14 and 23 of Township 7 South, Range 26 East. The Montezuma and Union Canals are visible in the 1935 Fairchild photograph. Each canal crosses the corridor south of the Gila River. The San Simon River parallels the corridor through the agricultural land located south of the Gila River. Land forms and land uses in, and adjacent to, the corridor south of the Gila River change very little in the remaining photographs reviewed for this project.

Land located along the railway corridor north of the Gila River was primarily undeveloped desert land dissected by multiple natural drainages and washes as far back as 1935. Multiple graded and unimproved roads and evidence of wildcat dumping observed adjacent to, and north of, the Gila River in the 1998 Terraserver aerial photograph were not visible in the 1964 aerial photograph. Numerous northeast to southwest trending ephemeral washes and drainages are visible along the proposed railway corridor north of the Gila River in the current and historical aerial photographs.

Review of historical aerial photographs indicates that the geomorphic expression of drainages along the proposed corridor has remained essentially the same over the period of record. However, it should be noted that fluvial responses can change dramatically in response to relatively short-term climatic changes.

Land uses in, and adjacent to, the corridor have changed very little since 1935. Agricultural structures observed in historical photographs near the proposed southern terminus of the proposed rail line may have housed hazardous substances such as agricultural chemicals, and/or petroleum products. As such, residual concentrations of agricultural chemicals and petroleum products may have impacted soil and/or shallow groundwater in the vicinity of the rail corridor. Additionally, hazardous substances and petroleum products associated with wildcat dumping areas and the recreational shooting range observed within the corridor study area north of the Gila River may have also impacted soil and/or groundwater.

2.1. Surface Water Conditions

The corridor study area lies within the upper Gila Watershed which extends from southwest New Mexico through southeast Arizona to the Coolidge Dam at the San Carlos Reservoir (Figure 3). The Arizona portion of the upper Gila Watershed drains approximately 7,430 square miles and is located partially or wholly within the Morenci, Duncan Valley, Bonita Creek, and Safford groundwater basins boundaries (ADWR, 2005a and 2006). The watershed consists of variety of physiographic terrains ranging from rugged mountain ranges to gentle valleys. Elevations range from 2,600 feet to 11,000 feet AMSL with annual precipitation varying from approximately 9 to 20 inches. Approximately 17 percent of the land within the watershed is privately owned with the remainder under the direction of state, federal, or tribal governments. Mining, ranching, and agriculture are the principle industries in the upper Gila Watershed.

The Gila River flows intermittently through the watershed, although it maintains scattered stretches of perennial flow in some portions (Figure 2). Upgradient of the Safford area, the Gila River is fed by several important tributaries including the San Francisco River, Eagle Creek, Bonita Creek, and scattered springs. Through the Safford area, the intermittently flowing San Simon River as well as numerous ephemeral washes and creeks feed the Gila River. Heavy pumping of groundwater for agricultural uses in the watershed has also affected the flow of the Gila River along some of its stretches causing it to flow intermittently.

Natural drainages that cross the rail corridor north of the Gila River are oriented northeast to southwest and include, from south to north, the Lone Star Wash, Wilson Wash, Peterson Wash, Cottonwood Wash, Watson Wash, and the Talley Wash. The Coyote Wash is located approximately 0.40 miles north of the northern terminus of the proposed rail line. Each of these drainages is tributary to the Gila River.

2.1.1. Flood Potential

Flood conditions occur infrequently across Arizona, although strong thunderstorms during the summer months can cause flash floods capable of considerable local damage. Heaviest runoff usually occurs in connection with the arrival of moist tropical air that has its origin in tropical systems, the remnants of which may spread over Arizona in July and August. Most water from summer storms is lost to evapotranspiration; however an intense storm or successive storms may result in runoff. Locally intense thunderstorms may create runoff in one wash while an adjacent wash receives little or no flow. When it occurs, intense flooding can include mud and debris flows in addition to water runoff.

Preliminary review of the USGS-Real Time Water Data for Arizona web interface indicates that there is currently no readily available stream gauge information associated with the referenced washes. According to information included in the Dos Pobres/San Juan EIS, annual average discharge of the Gila River through the Safford area has been measured at approximately 500 cubic feet per second (cfs) with historical lows and highs ranging from approximately 100 to 2,200 cfs, respectively (BLM, 2003). However, based on historical peak steamflow data obtained from the USGS, streamflows at the head of Safford Valley near Solomon have exceeded 100,000 cfs. On October 2, 1983, a flow of 132,000 cfs was recorded at this gauge. This flow rate was the highest recorded over the 91 year period of record (1914 to 2005).

The proposed rail corridor crosses 100-year flood zones, as identified on Flood Insurance Rate Maps (FIRMs) published by the Federal Emergency Management Agency (FEMA), at five locations. Specifically, the corridor crosses an approximate 1.5 mile section of designated Zone A[1] flood plain associated with the confluence of the San Simon and Gila Rivers. This portion of the corridor is located in the north half of Section 23 and the south half of Section 14 in Township 7 South, Range 26 East. The corridor also crosses the Lone Star, Wilson, Peterson, and Watson Washes; each of which is a FEMA designated Zone A 100-year flood zone. The approximate width of designated Zone A areas associated with each wash ranges from 440 feet at the Lone Star Wash to approximately 180 feet at the Watson Wash.

In general, construction-related impacts associated with these flood zones would be similar in nature to those that occur in other identified drainage areas (i.e., alteration of natural drainage patterns and possible changes in erosion and sedimentation rates and

[1] According to the explanation provided with the FEMA Flood Insurance Rate Maps, Zone A areas are areas of 100-year flood; base flood elevations and flood hazard factors are not determined.

locations). It is anticipated that construction of the proposed rail line may reduce the area through which floodwaters would typically flow. This may result in temporary ponding upstream of the crossings. As such, sedimentation may occur on the upstream side of engineered structures resulting in a potential for erosion downstream of each crossing.

It is anticipated that alterations to natural drainage patterns, sedimentation, and erosion would not increase future flood damage, increase the impact of floods on human health and safety, or result in significant adverse impact to floodplains along the proposed rail corridor. Because flash flooding is generally focused in extent and duration, potential impacts associated with construction and operation of the proposed rail line are expected to be limited. Additionally, it is anticipated that the railway design would accommodate a 100-year flood event. Use of the completed rail line is expected to have little impact on surface waters beyond the permanent drainage alterations that occur during construction. Runoff rates along the constructed railway may be higher than those of undisturbed terrain; however, given the relatively small size of potentially affected areas in the various localized drainage systems due to construction, it is anticipated that there would be little impact on overall runoff quantities.

Maintenance of the completed rail line would require periodic assessment of flood-prone areas to evaluate the condition of the track and drainage structures. Sediments accumulated upstream of rail structures would need to be removed and disposed of in an appropriate manner and eroded areas encroaching on the downstream portion of the track bed would require repair.

2.1.2. Surface Water Quality

In general, the quality of the Gila River changes considerably from its upstream source in New Mexico to the San Carlos Reservoir at the Coolidge Dam. Water at the source area is low in mineral content containing primarily calcium and bicarbonate; however, as the Gila River flows through Arizona, multiple tributaries, irrigation-return flows, and springs/seeps that have their sources in the underlying evaporite beds, increase the concentration of dissolved solids significantly. In a study conducted over a five year period during the 1950s, the concentration of dissolved solids in the Gila River at the Arizona-New Mexico border averaged 305 milligrams per liter (mg/L), while in the Bylas area northwest of Safford, the average concentration of dissolved solids was 1,397 mg/L (ADWR, 2005a and 2006).

Review of Arizona Department of Environmental Quality's (ADEQ's) List of Impaired Waters, indicates that the reach of the Gila River between it's confluence with the San Simon River and the outfall of Coyote Wash is not included on the Department's final 2004 Integrated 305(b) Assessment and 303(d) Listing Report. According to ADEQ's online web-based Arizona Unified Repository for Informational Tracking of the Environment (AZURITE) system, there have been no Arizona Pollution Discharge Elimination System (AZPDES) permits issued in the general vicinity of the railway corridor. Under the AZPDES Permit Program, facilities that discharge pollutants from any point source into waters of the United States (navigable waters) are required to obtain or seek coverage under an AZPDES permit. Pollutants can enter waters of the United States from a variety of pathways, including agricultural, domestic and industrial sources. For regulatory purposes these sources are generally categorized as either point source or nonpoint sources.

2.2. Groundwater Conditions

This section of the report summarizes regional groundwater occurrence and discusses groundwater conditions in the vicinity of the corridor study area. The regional groundwater system is discussed in Section 2.2.1. Local groundwater characteristics and quality are discussed in Section 2.2.2 through 2.2.4.

2.2.1. Regional Groundwater Occurrence

The corridor study area lies within the Safford groundwater basin in southeastern Arizona. Covering approximately 5,000 square miles, the Safford basin forms an elongated valley extending northwest to southeast through the Basin and Range and Central Highlands physiographic provinces (Figure 4). The Chiricahua, Dos Cabezas, Pinaleno, and Santa Teresa Mountains are located to the southwest, and the Peloncillo and Gila Mountains are located to the northeast. Elevations range from almost 11,000 feet AMSL at Mount Graham in the Pinaleno Mountains bordering the basin on the southwest to approximately 3,000-4,000 feet AMSL through the valleys, to approximately 2,500 feet AMSL at the San Carlos reservoir in the northwestern portion of the basin. In general, groundwater flows northwestward from the southeastern end of the basin toward the San Carlos reservoir located at the northwestern end of the basin and is drained by the San Simon and Gila Rivers. The Safford basin is divided into three sub-basins: the San Simon Valley, the Gila Valley, and the San Carlos Valley (ADWR, 2005b). The corridor study area is located in the Gila Valley sub-basin.

2.2.2. Local Groundwater Occurrence

The Gila Valley sub-basin is located in the central portion of the Safford groundwater basin and encompasses approximately 1,600 square miles (Figure 4). In general, groundwater in the Gila Valley sub-basin flows southeast to northwest from the topographically higher elevations of the Gila Mountains, located north of Safford valley, and from the Pinaleno Mountains, located south of Safford valley, toward the Gila River.

The Gila Valley sub-basin is comprised of two main stratigraphic units. A younger alluvial fill, having a fluvial origin, overlies an older alluvial fill comprised of three separate facies of different origins. The younger alluvium consists of discontinuous layers of clay, silt, sand, and gravel ranging in thickness from 30 to 85 feet (ADWR 1987 and 2005b). A discontinuous blue clay layer is found at the bottom of the younger alluvial unit and separates it from the older alluvial unit. The older alluvial unit which fills the majority of the sub-basin trough has an inferred thickness of more than 4,800 feet and in some areas may be up to 11,000 feet (ADWR, 1987). The older alluvial unit is comprised of three generally consolidated facies of various thicknesses and origins. The uppermost layer is comprised of clay and silt, the middle layer is comprised of evaporite deposits, limestone, and gypsiferious clay and shale, and the basal layer is comprised of non-indurated to moderately indurated sand and gravel (ADWR, 1987 and 2005b).

Both the younger and older alluvial fill, serve as aquifers in the Gila Valley sub-basin. Although the older alluvial unit is considerably thicker and holds more groundwater than the younger alluvial fill unit, the younger alluvial unit is the primary unit utilized for production purposes. Despite the discontinuous blue clay layer along the contact between the younger and older alluvial units, water-level data and driller's logs suggests they act as a single aquifer. However, the clay-silt facies in the upper portion of the older alluvial unit sometimes acts as an aquitard restricting the vertical movement of groundwater resulting in artesian conditions (ADWR, 1987). Recharge of the Gila Valley sub-basin is primarily attributed to the Gila River; however, seepage from irrigation water and mountain-front groundwater flow also contributes to the aquifers (ADWR, 1987; BLM, 2003).

According to drilling-log data obtained through the Arizona Department of Water Resources (ADWR) on-line imaged database (55-Well Inventory) and a 1987 ADWR hydrologic report, depth to groundwater increases from south to north along the corridor study area. In general, depth to groundwater in the northern portion of the corridor study area near the proposed mining operations ranges from approximately 390 to 450 feet, in the central portion of the study area it ranges from approximately 95 to 265 feet, and in the southern portion of the study area adjacent to the Gila River it ranges from approximately 15 to 50 feet. Groundwater in the northern and central portions of the corridor study area flows toward the southwest, while groundwater in the southern portion flows toward the west along the Gila River alignment.

2.2.3. Local Groundwater Use

Groundwater in the vicinity of the proposed rail corridor is used primarily for irrigation purposes. However, according to ADWR records groundwater is also withdrawn for domestic and industrial use. Review of ADWR records indicates that groundwater withdrawal rates may approach 1,000 gallon per minute at locations near the Gila River. Groundwater production rates appear to decline beyond the area of influence associated with recharge from the Gila River. It should be noted that groundwater production wells withdrawing water from the saturated floodplain Hollcene alluvium, or otherwise deemed to be located within the lateral limits of a streams subflow zone, as determined by ADWR, or located outside the subflow zone but deemed to be pumping water from a stream or its subflow by virtue of the well's calculated cone of depression, may be subject to the Gila River Stream Adjudication.

2.2.4. Groundwater Quality

In general, the groundwater quality of the Gila Valley sub-basin is poor. Although high concentrations of dissolved solids and fluoride make the groundwater unsuitable for public consumption without treatment, it is suitable for irrigation (ADWR, 1987). According to an ADWR study, more than a third of the 108 samples collected from within the Gila Valley sub-basin from 1985 to 1990 exceeded the Maximum Contaminant Level (MCL) of 4.0 milligrams per liter (mg/L) for fluoride set forth in the U.S. Environmental Protection Agency (USEPA) Primary Drinking Water Standards. Each well exceeding the MCL for fluoride during this study was completed in the older alluvial unit. In addition, of the 108 samples analyzed, 82 exceeded the 500 mg/L USEPA Secondary Drinking Water Standard established for dissolved solids. Most of the samples that exceeded the MCL for dissolved solids were collected from wells reportedly completed in the older alluvial unit.

According to the 1985 to 1990 basin study, fluoride concentrations for water samples collected at wells completed in the younger alluvial unit ranged from 0.6 to 3.8 mg/L. Fluoride concentrations detected in wells completed in the older alluvial unit ranged from 0.4 to 16.2 mg/L. Dissolved-solids concentration values for water samples collected from wells completed in both the younger and older alluvial units during the referenced study ranged from 39 to 10,620 mg/l. A 1986 report by the USEPA stated that water with dissolved-solids concentration exceeding 1,000 mg/L may have adverse effects on crops and may be harmful to humans and animals if consumed. Measurements of dissolved-solids concentrations tended to be higher in wells located in the central portion of the basin or those wells completed in the older alluvial unit.

Six wells exhibited arsenic levels exceeding the USEPA MCL of 0.05 mg/l. Those wells were reportedly completed in the older alluvial unit and are located in Township 6 South, Range 23 and 25 East, and in Township 7 South, Range 25 and 27 East. None of the wells showing elevated arsenic levels are located within the corridor study area.

During the 1985 to 1990 study, fluoride concentrations ranging from 2.9 to 3.8 mg/L and dissolved solids concentrations ranging from 1,278 to 1,785 mg/L were detected in water samples collected at four wells located near the southern portion of the corridor study area in Township 7 South, Range 26 East. These wells were reportedly completed in the younger alluvial unit. A well located in the central portion of the corridor study area in Township 6 South, Range 26 East was sampled during the same time period. Fluoride was detected in the groundwater sample at a concentration of 13.8 mg/L. Dissolved solids were detected at a concentration of 1,320 mg/L. The well reportedly penetrated the older alluvial unit. The generally poor quality of groundwater in the subbasin can be attributed to irrigation-return flows, seepage from irrigation canals, and groundwater seepage from the evaporite facies in the older alluvial unit.

An unusual characteristic of groundwater in the Safford basin is elevated water temperatures. Low to medium temperature geothermal springs and wells are prevalent in this portion of Arizona (Witcher, 1982). According to studies conducted for the Dos Pobres/San Juan EIS, several wells in the mining operations study area exhibited elevated temperatures; however, the elevated temperatures did not necessarily correlate with high concentrations of dissolved solids. In one example, a well with a temperature of approximately 110°F had a dissolved-solids concentration of 280 mg/L, while another well with a temperature of approximately 98°F had a value of 1,600 mg/L. These low- to moderate-temperature geothermal systems in the area are believed to derive their heat from deep circulation of surface-derived water.

3. SUMMARY

A review of historical aerial photographs and topographic maps of the region show that the southern portion of the corridor study area south of the Gila River was utilized for agricultural land and contained agricultural structures including possible homes, canals, wells, grain bins, and aqueducts as far back as 1935. Historical land uses adjacent to, and south of, the Gila River may have resulted in impacted soil and groundwater. The Montezuma, Union and Graham Canals cross the proposed rail corridor south of the Gila River.

North of the Gila River, within the central corridor alignment, wildcat dumping and the existence of potential residences were noted in a 1998 aerial photograph. Historical land use associated with these features may have impacted soil and groundwater. Prior to 1964, land north of the Gila River was vacant desert. The northern portion of the alignment contains primarily vacant desert with multiple drainages and occasional unimproved roads crossing the corridor.

The proposed rail corridor crosses the Gila River flood plain and four washes designated as 100-year flood zones. Construction and operation of the proposed rail line is not likely to increase future flood damage, increase the impact of floods on human health and safety, or result in significant adverse impact to the floodplains along the proposed rail corridor.

The corridor study area lies within the upper Gila Watershed and is drained toward the northwest by the Gila River. In the southern portion of the corridor study area, the San Simon River flows northward out of the San Simon valley emptying into the Gila River. Surface water quality is poor with a high dissolved-solids concentration due to multiple tributaries, irrigation-return flows, and springs/seeps that have their sources in underlying evaporite beds.

The corridor study area lies within the Gila Valley sub-basin of the Safford groundwater basin that extends northwest to southeast through Basin and Range and Central Highlands physiographic provinces in southeastern Arizona. In general, groundwater flow in the Gila Valley sub-basin is from southeast to northwest following the gradient of the Gila River. The primary aquifer in the Gila Valley sub-basin is comprised of two separate layers, a younger alluvial unit and older alluvial unit.

Groundwater is used primarily for agricultural uses in the corridor study area. However, it is also used for domestic and industrial purposes. Depth to groundwater varies through out the sub-basin. Depth to groundwater may be less than 15 feet near the Gila River and may exceed 450 feet in the northern portions of the corridor. Groundwater production rates appear to be highly variable and may decline beyond the area influenced by recharge from the Gila River. Groundwater wells deemed to be withdrawing subflow associated with the Gila River may be subject to the Gila River Adjudication.

Groundwater quality is poor, but tends to vary within the sub-basin as well as within the different alluvial units. Groundwater derived from the younger alluvial unit tends to have a lower dissolved-solids concentrations and fluoride levels than groundwater derived from wells completed in the older alluvial unit. In addition, elevated arsenic levels have been associated with groundwater in six wells completed in the older alluvial unit. Groundwater quality in the sub-basin is poor with high concentrations of dissolved solids and fluoride due to irrigation-return flows, seepage from irrigation canals, and groundwater seepage from the evaporite facies in the older alluvial unit.

4. LIMITATIONS

The review of surface water and groundwater conditions presented in this report has been conducted in general accordance with current practice and the standard of care exercised by environmental consultants performing similar tasks. No warranty, expressed or implied, is made regarding the conclusions, recommendations, and opinions presented in this letter. Other potential surface and groundwater conditions may be associated with the corridor study area, that were not revealed during this review.

Our conclusions, recommendations, and opinions are based on published information, contact with regulatory agencies, and other historical data. It should be understood that the conditions of a site could change with time as a result of natural processes or the activities of man at the subject site or nearby sites. In addition, changes to the applicable laws, regulations, codes, and standards of practice may occur due to government action or the broadening of knowledge. The findings of this letter may, therefore, be invalidated over time, in part or in whole, by changes over which Ninyo & Moore has no control.

5. REFERENCES

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FIGURES

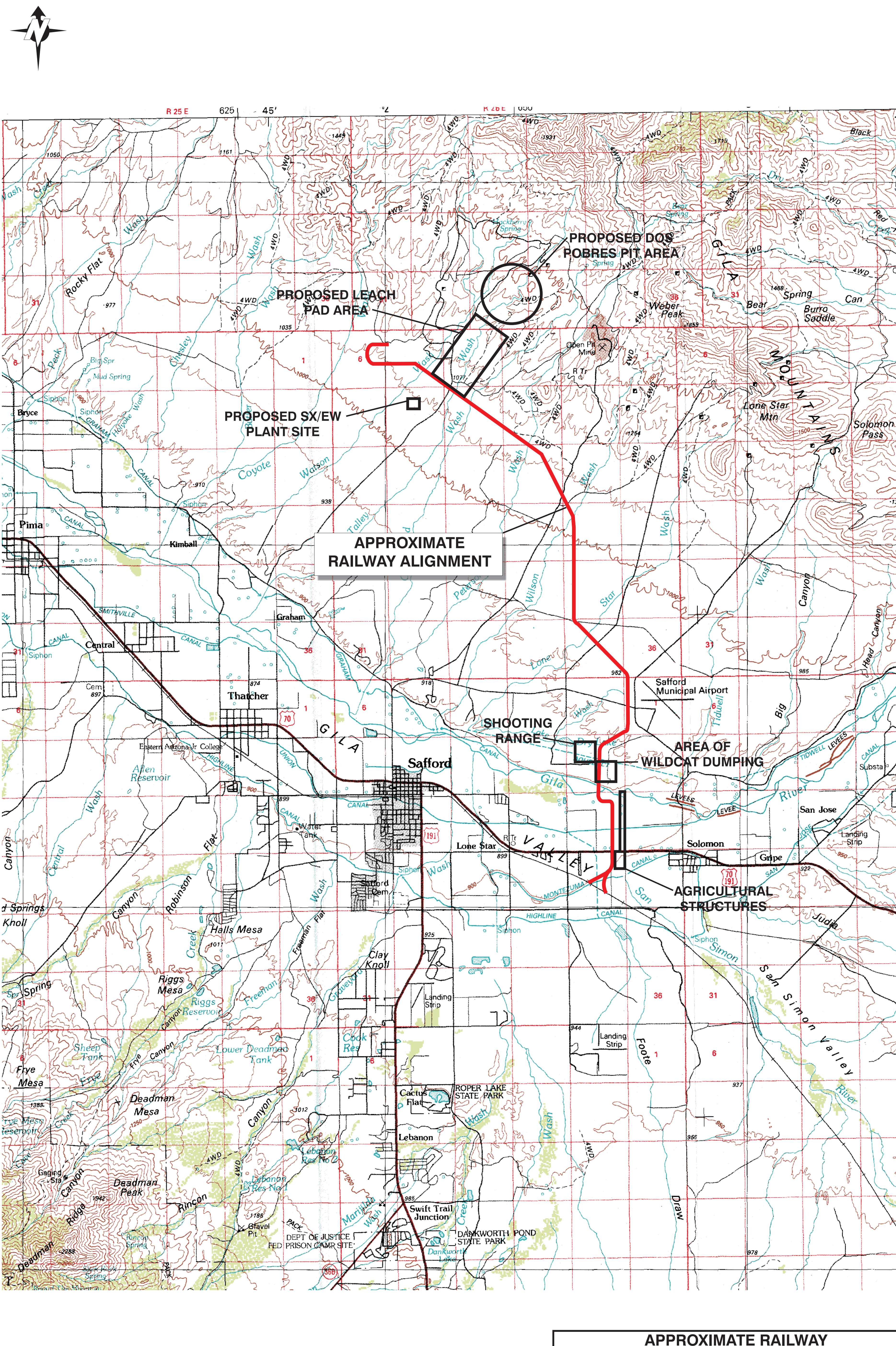
0 20 miles

Approximate Scale:
1 inch = 20 miles

SOURCE: Microsoft Streets and Trips, 2006.

Ninyo & Moore		SITE LOCATION MAP	FIGURE
PROJECT NO: 601605002	DATE: 10/06	ARIZONA EASTERN RAILWAY GRAHAM COUNTY, ARIZONA	1

file no: 1605vmap1006



0 1.57 miles

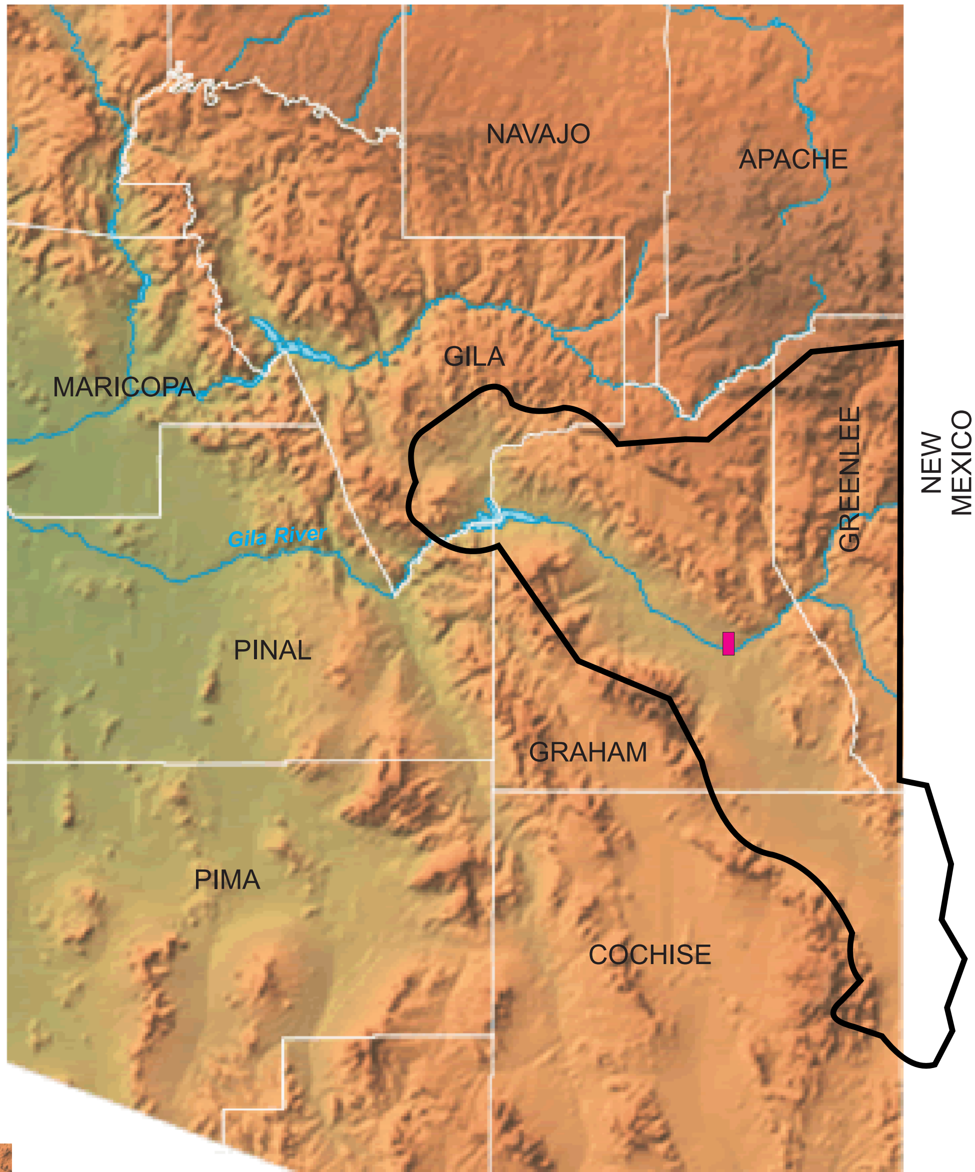
APPROXIMATE SCALE: 1 INCH = 1.57 miles

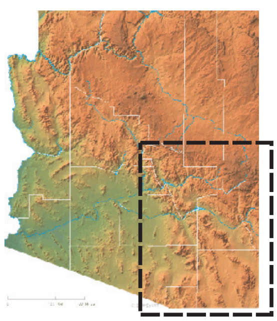
Source: USGS 1985 Safford Topographic Map

NOTE: ALL BOUNDARIES AND LOCATIONS ARE APPROXIMATE.

FILE NO. 1605ALIGN1006

APPROXIMATE RAILWAY ALIGNMENT MAP			FIGURE
ARIZONA EASTERN RAILWAY GRAHAM COUNTY, ARIZONA			2
Ninyo & Moore	PROJECT NO: 601605002	DATE: 10/06	





LEGEND

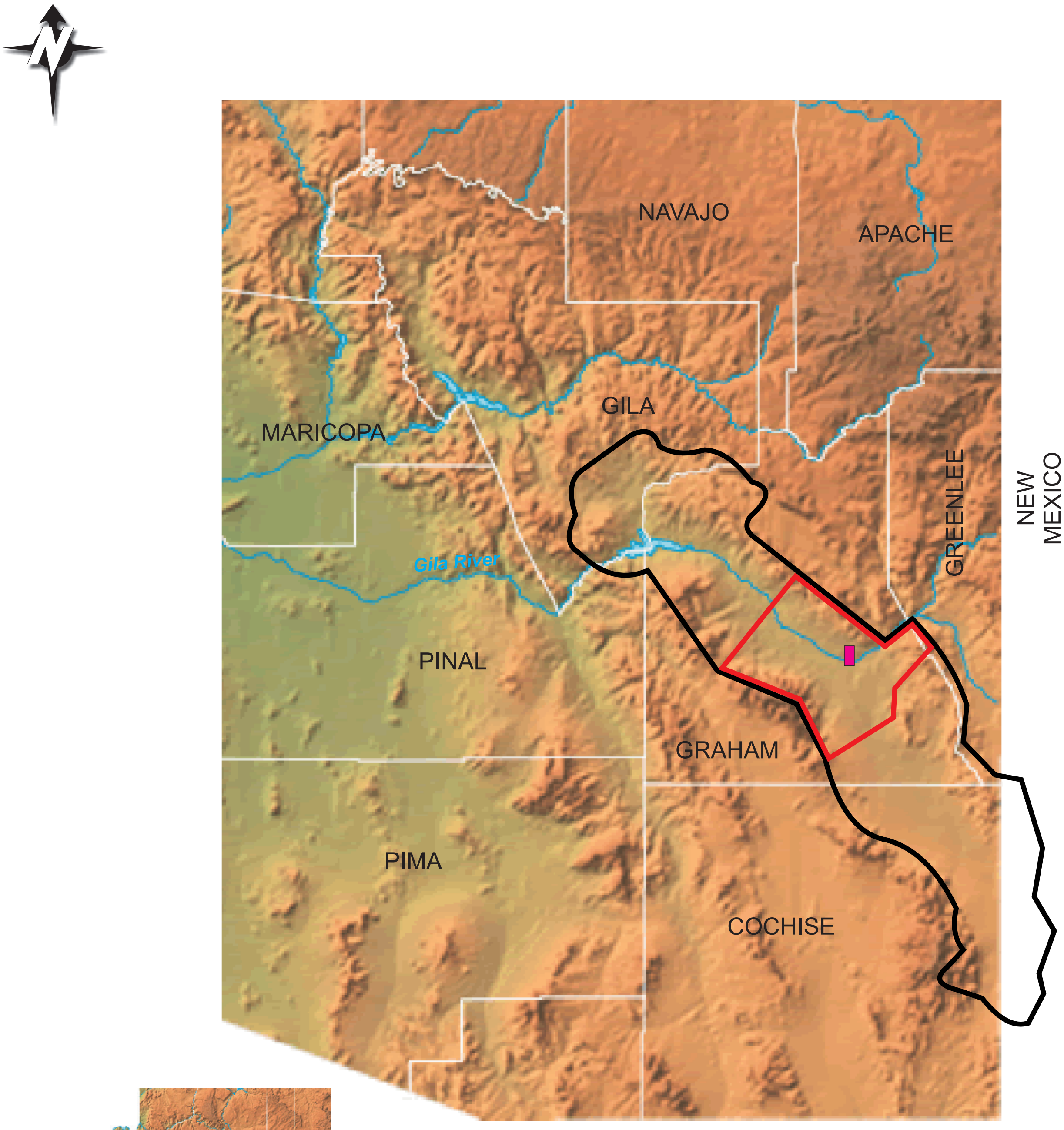
UPPER GILA WATERSHED

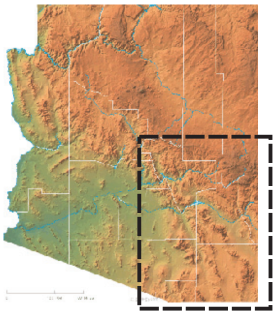
APPROXIMATE SITE LOCATION

NOT TO SCALE
BOUNDARY OUTLINES ARE APPROXIMATE

Ninyo & Moore		UPPER GILA WATERSHED MAP	FIGURE 3
PROJECT NO: 601605002	DATE: 10/06	UPPER GILA WATERSHED MAP SOUTHEAST, ARIZONA	

file no: 1605WATSHED1006





LEGEND

SAFFORD BASIN

UPPER GILA VALLEY SUB-BASIN

APPROXIMATE SITE LOCATION

NOT TO SCALE

BOUNDARY OUTLINES ARE APPROXIMATE

Ninyo & Moore	SAFFORD BASIN MAP		FIGURE 4
PROJECT NO: 601605002	DATE: 10/06	SAFFORD BASIN SOUTHEAST, ARIZONA	

file no: 1605BASIN1006