IN THE SUPERIOR COURT OF THE STATE OF ARIZONA
IN AND FOR THE COUNTY OF APACHE

IN RE THE GENERAL ADJUDICATION OF ALL RIGHTS TO USE WATER IN THE LITTLE COLORADO RIVER SYSTEM AND SOURCE	CV 6417-203 Final Report

CONTESTED CASE NAME: *In re Hopi Reservation HSR*

HSR INVOLVED: *Hopi Reservation HSR*

DESCRIPTION: Report of the Special Master filed pursuant to Ariz. R. Civ. P. 53. Objections to the Report shall be filed with the Clerk of the Superior Court of Apache County on or before **November 21, 2022**.

NUMBER OF PAGES: 289 + Recommended Decree (119)

DATE OF FILING: May 25, 2022

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RECORD CITATIONS

Reference to the court reporter's transcript of the trial are set forth as [Month][Day][Year]:[Page} AM or PM [Witness]. Exhibits admitted during the trail are referred to as [Party]Exh.. ___. All citations are to the page number listed on the document; an electronic page number is included when there is a variance.

ABBREVIATIONS

To reduce the length and enhance readability, this document uses the abbreviation of certain terms

a) "ADWR" refers to the Arizona Department of Water Resources.

b) "ARIMA" refers to the Auto Regressive Integrated Moving Average method of projecting future population.

c) "ASLD" refers to the Arizona State Land Department.

d) "ASLD FOF" refers to a finding of fact in the Arizona State Land Department's Proposed Findings of Fact and Conclusion of Law filed June 25, 2021.

e) "CCM" refers to the cohort component method of projecting future population.

f) "COF FOF" refers to a finding of fact in the City of Flagstaff's Proposed Findings of Fact and Conclusions of Law filed June 25, 2021.

g) "C&S Gardens" is the term used by the Hopi Tribe for proposed ceremonial and subsistence gardens on the Reservation.

h) "DCMI" refers to domestic, commercial, municipal, and industrial water uses.

i) "DISM" refers to Deficit Irrigation Simulation Model.

j) "GPCD" refers to gallons per capita per day.

k) "HSR" means the hydrographic survey report filed by Arizona Department of Water Resources in December 2015 for the Hopi Reservation

l) "Hopi FOF" refers to a finding of fact in the Hopi Tribe's Proposed Finding of Fact and Conclusions of Law filed June 25, 2021.

m) "LCRC" refers to the Little Colorado River Coalition.

n) "LCRC FOF" refers to a finding of fact in the LCR Coalition's Proposed Findings of Fact and Conclusions of Law filed June 25, 2021.

o) "NN FOF" refers to a finding of fact in the Navajo Nation's Proposed Findings of Fact and Conclusions of Law filed June 25, 2021.

p) "PRSM" refers to the Precipitation Runoff Modeling System (PRMS)

q) "PWCC" refers to Peabody Western Coal Company and successors in interest.

r) "SRP FOF" refers to a finding of fact in the Salt River Project's Proposed Findings of Fact and Conclusions of Law filed June 25, 2021.

s) "U.S. FOF" refers to a finding of fact in the United States' Proposed Findings of Fact and Conclusions of Law filed June 25, 2021.

I. Scope of Case

This case adjudicates legal rights to water for use on the Hopi Reservation and 11 Allotments. The Hopi Reservation consists of two non-contiguous geographic areas covering approximately 3,000 square miles referred to individually as the 1882 Reservation and Moenkopi Island. This land is part of the territory that the Hopi Tribe considers to be its ancestral homeland known as *Hopitutskwa*. The Hopi Tribe claims water rights under federal and state law. The United States, on behalf of the Hopi Tribe and the allottees, claims water rights only under federal law.

The claims filed by the Hopi Tribe and the United States are among the thousands of claims that have been filed in the Little Colorado River System and Source General Adjudication, a comprehensive stream adjudication. The state court has jurisdiction to adjudicate the claims for water rights filed by the Hopi Tribe and the United States. Pursuant to the McCarran Amendment, 43 U.S.C. § 666, the state court has jurisdiction to adjudicate the rights of the United States to the use of water in the Little Colorado River System and Source General Adjudication. The McCarran Amendment also conveys governmental consent to suit in state court to determine reserved water rights held by the United States on behalf of the Hopi Tribe and allottees. *Colo. River Water Conservation Dist. v. United States*, 424 U.S. 800 (1976); *Ak-Chin Indian Cmty. v. Maricopa-Stanfield Irrigation & Drainage Dist.*, CV-20-00489-PHX-JJT, 2020 WL 5517307, at *2 (D. Ariz. Sept. 14, 2020). The Hopi Tribe moved to intervene in this case and appear on its own behalf. On April 30, 1985, the Court granted the Hopi Tribe's motion. The state court also has jurisdiction, under A.R.S. §45-252, to adjudicate claims made by the Hopi Tribe and allottees under state law to appropriable water in the Little Colorado River System and Source. Rights to pump percolating groundwater underlying the Hopi Reservation based on state law are outside the scope of this case.

The only claims at issue in this case are claims asserted by the Hopi Tribe, the allottees, and the United States. The Hopi Tribe, and to a lesser extent, the United States, repeatedly assert in their pleadings and request findings of fact that no other party, or no party other than the Navajo Nation, uses a particular water source to which the United States and the Hopi Tribe claim a water right. No other party's claims or water uses are at issue. Every other party who claims a right to use appropriable water or a right to water under federal law in the Little Colorado River System and Source will have those claims adjudicated, but none of those claims or water uses is the subject of this contested case.

This case is limited to claims for federal reserved water rights from sources that are appurtenant to the Hopi Reservation. The federal government does not have an unlimited right to water from any source to benefit the land it owns. The well-established rule is that the United States may acquire a federal reserved water right to water appurtenant to federal land when it withdraws the land from the public domain and reserves the land for a public purpose. *Cappaert v. United States*, 426 U.S. 128 (1976); *In re the Gen. Adjudication of All Rights to Use Water in the Gila River Sys. & Source*, 231 Ariz. 8, 289 P.3d 936 (2012); *In re Gen. Adjudication of All Rights to Use Water in Gila River Sys. & Source*, 201 Ariz. 307, 35 P.3d 68 (2001) ("*Gila V*"); *In re Gen. Adjudication of All Rights to Use Water in Gila River Sys. & Source*, 195 Ariz. 411, 419, ¶ 24, 989 P.2d 739, 747 (1999) ("*Gila III")* (it must have intended that reservation of water to come from whatever particular sources each reservation had at hand). Consistent with controlling precedent, the Court has ruled that federal reserved water rights do not extend to claims to surface streams that do not traverse any part of the Hopi Reservation. Minute Entry Order at 1 (Mar. 2, 2009), filed in CV-6417. Accordingly, the Hopi Tribe's claims to surface water from the Colorado River, the Little Colorado River, Blue Springs, and Lake Powell, and to groundwater beneath trust lands at Hart Ranch, Clear Creek Ranch, Aja Ranch, and any other land outside the boundaries of the Hopi Reservation owned by the Hopi Tribe are outside the scope of this case.

The claims for water rights adjudicated in this case are for the types of uses chosen by the Hopi Tribe and the United States in the quantities set forth below for use on the Hopi Reservation. No claim is listed for a federal reserved water right for stock and wildlife watering because the parties stipulated to a quantity, which has been approved.

Type of Use	Amount Claimed by the Hopi Tribe (acre-feet per year)	Amount Claimed by the U.S. (acre-feet per year)
Agriculture – crops and gardens	All natural flow[1]	18,897
Alfalfa fields	12,008	
C&S Gardens	9,471	
Domestic, commercial, municipal, and light industrial uses	9,322	8,746
Coal-fired electrical power generating plant	6,500	6,500
Coal liquefaction/gasification facility	20,600	
Coal mining	1,056.1 – 2,367	1,462
Hybrid coal-fired and solar electrical power generating plant	6,500	
Keams Canyon Recreational Area	26	
Pasture Canyon	315.5	315.5
Stockponds	3,576	3,572
White Ruins Canyon	12.39	

All recommendations required by A.R.S. §45-257(A)(2) are included in the Recommended Decree included in this Final Report as Section XIV.

[1] The Hopi Tribe presented alternative claims for 91,282 and 26,687 acre-feet of surface water per year.

II. Procedural History of Case

The active parties in this case are: the Hopi Tribe, the Navajo Nation, the United States, LCR Coalition[2], City of Flagstaff, Salt River Project, and Arizona State Land Department. The United States appears as a trustee on behalf of the Hopi Tribe and allottees of land included within the boundaries of the Hopi Reservation. The litigation phase of this contested case, required by A.R.S. §45-257(A), began with a status conference in July 2016 and concluded with two days of closing arguments in the fall of 2021. More than 90 witnesses testified during the 95 days of trial and in excess of 2,000 exhibits were admitted. The number of witnesses[3] called by each party is as follows:

Party	**Number of Witnesses**
Hopi Tribe	46
United States	12
Navajo Nation	6
LCR Coalition	21
City of Flagstaff	4
Arizona State Land Department	2
Salt River Project	0

The adjudication of rights for water on the Hopi Reservation began in 1985 when the United States filed Statement of Claimant 39-91441 and the Hopi Tribe filed Statement of

[2] The LCR Coalition includes the following parties: Town of Eagar, City of Holbrook, City of Show Low, Town of Springerville, Town of Snowflake, Town of Taylor, City of Winslow, City of St. Johns, Forest Lakes Domestic Water Improvement District, Silver Creek Irrigation District, Show Low/Pinetop-Woodland Irrigation Company, Lakeside Irrigation Company, Little Colorado Water Conservation District, Round Valley Water Users Association (now Pioneer Irrigation Company), Lyman Water Company, Bar T Bar Ranch, Inc., Euell Barnes, Flying M Ranch, Aztec Land & Cattle Company, Ltd., Aztec Land Company, LLC, Pinetop-Lakeside Sanitary District, West Snowflake Land Company, LLC, and Dobson Limited Partnership, LLC.

[3] The Hopi Tribe, the United States, and the Navajo Nation called witnesses in the second phase of the trial that also had been called in the first phase of the trial, so the number of separate witness appearances exceeds the number of witnesses listed above.

Claimant 39-91443 to assert claims for water rights under federal law for use on the Hopi Reservation. Thereafter, state, federal, tribal, and non-tribal parties engaged in years of settlement negotiations. In 2002, when the parties had not resolved the claims and objections by negotiation, the Court directed the United States and the Hopi Tribe to file amended Statements of Claimant. Minute Entry (July 16, 2002). Once the amended Statements of Claimant were filed in 2004, the Court directed Arizona Department of Water Resources ("ADWR") to begin its investigation of the amended claims pursuant to A.R.S. §45-256. On September 8, 2008, while ADWR was completing the preliminary hydrographic survey report (HSR) for the Hopi Reservation, the Court initiated *In re Hopi Priority*, CV 6417-201 to decide the priority dates for the federal water rights asserted by the United States and the Hopi Tribe. In 2009, the Hopi Tribe and the United States filed Second Amended Statements of Claimant. The Special Master issued a report on April 24, 2013 ("2013 Special Master Report"). The Court subsequently approved the 2013 Special Master Report as amended. Minute Entry (January 25, 2016 filed in CV 6417-201).

After the issuance of the 2013 Special Master Report, the United States and the Hopi Tribe filed Third Amended Statements of Claimant on June 2, 2015, and the Hopi Tribe filed a Supplement to its Third Amended Statement of Claimant on September 17, 2015. On October 2, 2015, ADWR moved for an order from the Court clarifying the scope of the HSR due to United States' and the Hopi Tribe's refusal to provide information requested by ADWR to allow it to complete the final HSR. The Court entered an order directing ADWR to complete the HSR based on the information provided, relieved ADWR of any further obligation to obtain information from the United States and the Hopi Tribe, and ordered the issuance of the final HSR by December 18, 2015. Minute Entry (November 10, 2015 filed in CV 6417).

Arizona Department of Water Resources timely filed the final Hopi Reservation HSR with the results of its investigation of the water rights claimed by the Hopi Tribe and the United States for the Hopi Reservation. It properly distributed the Hopi Reservation HSR in accordance with the rules of the general adjudication. Objections were due by June 15, 2016. Claimants in the general adjudication filed twenty-seven objections.

On July 12, 2016, the first status conference in this case was held to decide the appropriate procedure to adjudicate the claims and consider the objections to the Hopi Reservation HSR as required by A.R.S. §45-257. The United States proposed a division of the case into two phases with the first phase focused on the past and present uses, the subject of the Hopi Reservation HSR, and a second phase to address water rights needed for future uses. United States' Statement Re: Litigation of Hopi Main Reservation Lands and Updating Hopi and Navajo Claims, CV 6417 (July 6, 2016). At the Status Conference, attended by counsel for the United States, the Hopi Tribe, the Navajo Nation along with the other parties active in this case, all parties agreed to the proposed two-phase approach. Minute Entry at 2 (filed July 26, 2016, in CV 6417-201). The decision to bifurcate the contested case was a procedural decision that allowed the parties additional time to prepare to litigate claims for federal water rights for future uses and did not affect the underlying substantive rights to be determined. On August 29, 2016, the first Case Management Order was issued setting dates for each phase of the case, including dates for the conclusion of discovery, dispositive motions, and trial. No party objected to the Case Management Order.

On June 6, 2018, the Hopi Tribe asserted rights to water under state law for land included in 11 Allotments located on Moenkopi Island held in trust by the United States for the benefit of the original allottees and their successors in interest. Prior to that date, the Hopi Tribe had asserted rights to water based on its sovereign authority and federal law. The United States asserted rights to water for the Allotments under federal law but made no claim for a right to water for the allotted land under state law. When the Hopi Tribe failed to establish that it had a beneficial interest in the allotted land or was authorized to proceed on behalf of the allottees, an order was issued finding that no legal basis existed for the Hopi Tribe's claims for state law water rights for the allotted land. Order at 14-15 (August 16, 2018). The Hopi Tribe subsequently filed a motion under Ariz. R. Civ. P. 17 asserting that the allottees should be allowed to pursue claims under state law. It also subsequently represented that it has a beneficial interest in nine of the eleven Allotments. The motion was granted, and subsequent proceedings were held to consider notice to allottees and to schedule a separate date to try the allottees' claims under state law. Minute Entry at 13 (February 25, 2020). The claims for water for allotted lands under state law are not considered in this Report.

After the deadline for the completion of discovery for the first phase of the case that focused on past and present uses, the United States and the Hopi Tribe each filed a Fifth Amended Statement of Claimant[4] on April 17, 2018, and April 19, 2018, respectively, stating that the amended Statements of Claimant "conforms the claims to the evidence" that would be presented at the trial beginning in September 2018. The Navajo Nation, joined by the City of Flagstaff, objected and filed a Motion to Strike. Navajo Nation's Motion to Strike Untimely Disclosed Mining, DCMI, and Irrigation Claims and, in the Alternative, to Permit Limited Additional Discovery Concerning Historical Mining Leases and Production (June 22, 2018). To cure the problem created by the Fifth Amended Statements of Claimant, an order was entered that excluded evidence about the present need for water for domestic, commercial, municipal, and industrial (DCMI) uses from the trial on past and present uses, permitted the admission of evidence about those uses in the second phase of the case dealing with future uses, and extended the discovery deadline to allow additional discovery

[4] The United States and the Hopi Tribe's Fourth Amended Statements of Claimant filed December 15, 2017 described claims for water rights for off-reservation property.

on the mining claims. Order re: Navajo Nation's Motion to Strike and Motions *in Limine* Nos. 1, 2 & 5, LCR Coalition's Motion *in Limine* to Exclude Testimony and Other Evidence Relating to Future Water Uses (July 31, 2018). The parties also filed nine motions *in limine* for which orders were issued before trial began.

The trial on the first phase of the case began on September 11, 2018. Over 35 trial days 1,671 exhibits were admitted and 33 witnesses testified. The first phase concluded on December 18, 2018. A draft report containing proposed findings of fact and conclusions of law from the first phase of the case was issued on June 2, 2019, to which the parties subsequently filed objections. The draft report did not become a final report under Ariz. R. Civ. P. 53(e) subject to review. This final report is filed pursuant to Ariz. R. Civ. P 53(e) and contains all relevant findings of fact and conclusions of law for both phases of this contested case *In re Hopi Reservation HSR* along recommendations in the form of a Recommended Decree.

Before the discovery phase began for the second phase of this case, in an effort to avoid claims of unfair prejudice due to amended Statements of Claimant filed after the discovery deadline for the second phase of the case, the United States and the Hopi Tribe were each directed to file Sixth Amended Statements of Claimant and to exercise diligence to ensure that they provided a detailed description of "the basis for each claim Claimants intend to assert during the future phase of this case." Amended Case Management Order at 2 (August 23, 2018). The United States and the Hopi Tribe filed Sixth Amended Statements of Claimant on January 18, 2019. On June 16, 2020, after the discovery deadline, the Hopi Tribe filed a Seventh Amended Statement of Claimant.

In advance of the trial on the second phase of the case dealing with claims for water for future use, the parties filed 17 motions *in limine* as well as a motion regarding the conduct of cross-examination. The motions asserted various challenges to experts expected to testify and expert reports. The motions raised objections to the admission of expert reports from the first phase of the case, notes referenced in an expert report, redactions to expert reports, the expertise of the listed witnesses, multiple expert witnesses, and the admissibility of expert opinions based on timing issues. Decisions were issued for each motion. Among this set of pre-trial motions were four motions that concerned W. Michael Hanemann, an economist testifying on behalf of the Hopi Tribe. Hopi Tribe's Motion *in Limine* No. 1 Re: Testimony of Dr. Hanemann on Social-Cost Benefit Analysis (January 29, 2020); Salt River Project's Motion *in Limine* to Preclude Testimony or other Evidence Concerning Social Cost-Benefit Analysis March 9, 2020); Salt River Project's Motion *in Limine* to Preclude Admission of Manuscript by Drs. Hanemann and Whittington (March 25, 2020) and Hopi Tribe's Rule 37(c) Motion to Extend Time for Disclosure (May 4, 2020).

The Hopi Tribe retained Dr. Hanemann to testify about economic conditions on the Hopi Reservation and the appropriate method to quantify water for domestic, commercial, municipal and industrial uses. Before the trial on the first phase of the case, the City of Flagstaff had filed a motion *in limine* to preclude Dr. Hanemann from recharacterizing the legal standards established by the Arizona Supreme Court in *Gila V* in his testimony. The motion was granted. Minute Entry at 3 (August 8, 2018). The following year, the LCR Coalition moved to strike an internet survey designed by Dr. Hanemann as part of his academic research concerning the Hopi Tribe that he prepared after the deadline for the production of expert reports. The motion was granted. Minute Entry at 2 (September 27, 2019). Dr. Hanemann and two colleagues subsequently wrote an academic paper that contained an economic analysis based on the survey. On March 19, 2020, after a December 20, 2019 disclosure deadline, the Hopi Tribe listed the paper written by Dr. Hanemann *et al.* on a Disclosure Statement. The Hopi Tribe stated that it reserved the right to list the paper as a learned treatise on its exhibit list.

The four motions filed before the trial focused on two economic theories: social cost-benefit analysis and contingent valuation analysis. No social cost-benefit analysis had been undertaken. Pursuant to Ariz. R. Evid. 401 and 403, no testimony was permitted about a type of economic analysis not performed. Order at 11-12 (August 6, 2020). Contingent valuation analysis, another type of economic analysis, appeared in the academic paper co-authored by Dr. Hanemann. The paper was excluded from evidence and the motion for reconsideration to permit the admission of the survey was denied because the attempt to insert contingent valuation analysis into this case was not an easily anticipated and understood revision of an existing expert report. Instead, it was the introduction of a new, substantive economic theory after the repeatedly extended disclosure and expert report deadlines when the objecting parties could no longer retain expert economists to review the work. *Id.* at 14.

Due to the Coronavirus 2019 pandemic, the trial, originally set for June 1, 2020, was twice extended to allow the parties additional time to make arrangements and institute procedures for the protection and convenience of the witnesses. The trial was conducted via the software platform chosen by Maricopa County Superior Court to conduct court proceedings, including general civil, probate, and family trials, during the pandemic. The court system for this trial was also specially configured to provide additional telephone lines and internet connections to allow multiple points of access for the public to view the trial. The trial began on September 14, 2020, and the evidentiary phase concluded on February 22, 2021, after 66 witnesses testified and 961 exhibits were admitted. On June 25, 2021, the parties filed their proposed findings of fact and conclusions of law and closing briefs. Salt River Project moved to strike portions of The Hopi Tribe's Proposed Findings of Fact and Conclusions of Law ("Proposed Findings") because it did not comply with rules set forth in the

Minute Entry dated February 16, 2021. The motion to strike is granted with respect to Proposed Findings, page 5-12, and page 24, line 24 though page 25, line 2.

In addition to its closing brief and a 474-page Proposed Findings of Fact and Conclusions of Law, the Hopi Tribe filed a 56-page Eighth Amended Statement of Claimant to "conform the claims the Hopi Tribe asserted during the future phase of this contested case to the evidence and legal argument presented at trial." Eighth Amended Statement of Claimant at 4. The City of Flagstaff moved to strike on the grounds of unfair prejudice. Arizona Revised Statutes §45-254(E)(2) allows a claimant to file an amended Statement of Claimant without leave of the Court before the conclusion of hearings by the Special Master for a federal reservation. After the Special Master has submitted a report, leave of the Court must be obtained before an amended Statement of Claimant may be filed. A.R.S. §45-254(E)(3). In this case, the evidentiary phase had concluded before the filing, but the report had not been issued. The Hopi Tribe evidently regards its Statement of Claimant as analogous to a complaint and reads the governing statute as a general adjudication version of Ariz. R. Civ. P. 15(b). Rule 15(b) assures non-amending parties due process protections. It limits the circumstances in which an amended pleading will be allowed to assure actual notice and, if necessary, an opportunity to cure any surprise from the pleadings or a demonstration that the amendment is so prejudicial that the detrimental effect cannot be cured by a continuance or the imposition of some other condition on allowing the amendment. In this case, the motion to strike will not be granted due to the ambiguity of the language of A.R.S. §45-254(E) and the lack of full briefing to permit a proper interpretation of the statute. The Hopi Tribe's Eighth Amended Statement of Claimant will be considered with full recognition that it does not constitute evidence, was filed and made a part of the record without the due process safeguards that would have been afforded to the other parties if it were an amended pleading permitted under Rule 15(b), and with no finding that the Hopi Tribe has made a showing similar to the one required by Rule 15(b) for an amendment to be granted.

Closing arguments were held on September 30 and October 1, 2021. In advance of the arguments, the United States filed a Supplemental Citation of Authority that led to an oral motion at the closing arguments from the LCR Coalition to brief the issue that was the subject of the supplemental authority. The motion was granted, and the parties filed legal memoranda on January 10, 2022. The issue is addressed in Section X. On February 1, 2022, the parties filed a Notice of Pending Stipulation regarding the quantity of water for livestock and wildlife watering. The Stipulation was filed on March 29, 2022, and approved by order dated March 30, 2022. On March 14, 2022, the United States filed a Motion to Request Judicial Notice, joined by the Hopi Tribe, regarding a United States Census Report issued on March 10, 2022. The Motion is granted and is addressed in Section VI.

Conclusion of Law No. 1. The United States and the Hopi Tribe were given a full and fair opportunity to present evidence in support of their claims and in support of or in opposition to the Hopi Reservation HSR.

Conclusion of Law No. 2. The remaining parties were given a full and fair opportunity to present evidence in support of or in opposition to the Hopi Reservation HSR and the claims for future use asserted by the United States and the Hopi Tribe that were not analyzed as part of the Hopi Reservation HSR.

III. Attributes of Federal Water Rights

A. Federal Water Rights

A water right requires a valid legal basis. Under federal law, aboriginal title can provide a legal basis for a water right. *United States v. Winans*, 198 U.S. 371 (1905); *United States v. Adair*, 723 F. 2d 1394 (1983); *see also United States v. Abouselman*, 976 F.3d 1146 (10th Cir. 2020). The United States' constitutional power to reserve water appurtenant to federal land withdrawn from the public domain for a federal purpose can also provide the legal basis for a federal water right. *Cappaert v. United States*, 426 U.S. at 138; *Winters v. United States*, 207 U.S. 564, 577 (1908).

In its Fifth Amended Statement of Claimant, the Hopi Tribe claimed "a time immemorial priority date to Moenkopi Island on the basis of its actual continuous beneficial use of water on lands occupied by the Hopi and its ancestors." Fifth Amended Statement of Claimant at 18 (April 19, 2018). In response to a motion for partial summary judgment that challenged the asserted claim, the Hopi Tribe advanced a third basis for a water right based on prior appropriation which it referred to as an appropriative federal reserved water right. Neither *Adair* nor *Winans* supports the proposition that a water right can be established under federal law based solely on continuous, beneficial use of water.

Conclusion of Law No. 3. An appropriative federal reserved water right does not provide a legal basis for a right to water for Moenkopi Island under federal law.

In its Sixth Amended Statement of Claimant, the Hopi Tribe did not repeat the claim for an appropriative federal reserved water right but claimed "a time immemorial priority based on the Tribe's aboriginal use and occupancy of the 1882 Reservation and Moenkopi Island." Sixth Amended Statement of Claimant at 18 (January 18, 2019); *see also* The Hopi Tribe's Eighth

Amended Statement of Claimant at 18 (June 25, 2021). The Hopi Tribe stated that it asserted this priority claim notwithstanding the Court's Minute Entry (January 25, 2016) in order to preserve its rights on appeal. *Id.*

Conclusion of Law No. 4. The Hopi Tribe does not hold time immemorial water rights on tribal lands within the 1882 Executive Order reservation outside of Land Management District 6. The Hopi Tribe holds implied reserved water right to Moenkopi Island with a priority date of June 14, 1934. Minute Entry, CV 6417-201, at 2-3 (January 25, 2016).

B. Aboriginal Water Rights

Aboriginal title or right is a right of exclusive use and occupancy that is based on occupation and use and it is entitled to the protection of federal law even when it is not formally recognized as ownership by treaty or statute. *People of Vill. of Gambell v. Clark*, 746 F.2d 572, 574 (9th Cir. 1984); *see also United States v. Abouselman*, 976 F.3d at 1152 (Pueblos found to hold aboriginal water rights where court found that aboriginal title not extinguished). An aboriginal right to water is the "right to use the water as [the tribe] had always used it on the land it had reserved as a permanent homeland." *Adair*, 723 F.2d at 1414. The Supreme Court of Idaho, citing *Adair*, defined aboriginal uses as "uses of water predating the creation of the Reservation". *In re: CSRBA Case No. 49576 Subcase No. 91-7755*, 165 Idaho 517, 545, 448 P.3d 322, 350 (2019). The decision entered in *In re Hopi Priority* establishes that the Hopi Tribe holds aboriginal water rights for that part of the 1882 Reservation known as Land Management District 6 based on its aboriginal title to that land. The decision in that case contained the following legal conclusions:

> Conclusion of Law No. 2. The lands within the boundaries of Land Management District 6, as approved on April 24, 1943, and legally enlarged thereafter, are aboriginal lands of the Hopi Indians.

> Conclusion of Law No. 3. The aboriginal land title of the Hopi Tribe includes an aboriginal right to use the water that flows on those lands.
>
> Conclusion of Law No. 4. Aboriginal "water rights necessarily carry a priority date of time immemorial; where a tribe shows its aboriginal use of water … the water right thereby established retains a priority date of first or immemorial use." [*United States v. Adair*, 723 F. 2d 1394, 1414 (9th Cir. 1983)] Aboriginal rights "arise[ing] from occupancy and use of land by the Indians from time immemorial." [citation omitted] Aboriginal water rights predate the establishment of an Indian reservation.
>
> Conclusion of Law No. 5. The water rights that the Hopi Tribe uses on the lands within the boundaries of Land Management District 6 have a priority of time immemorial.

2013 Special Master Report at 5.

Conclusion of Law No. 5. The Hopi Tribe has no aboriginal water rights to the use of water on land outside Land Management District 6. 2013 Special Master Report, Conclusions of Law No. 3 at 19, No. 6 at 24, Nos. 7 and 8 at 26-27.

Aboriginal water uses for land to which a tribe has aboriginal title carry a priority date of time immemorial. 2013 Special Master Report, Conclusion of Law No. 4. Federal water rights incorporate one of the "fundamental principles of prior appropriation law – that priority for a particular water right dates from the time of first use." *Adair*, 723 F. 2d at 1414. As the *Adair* Court explained, the nomenclature "time immemorial" was fashioned to protect a tribe's aboriginal rights from water rights that other people may have established prior to the date of the reservation that would threaten a tribe's rights based on its first use. *Id.*

A dispute exists among the parties as to whether other types of uses are entitled to a priority date of time immemorial. The *Adair* Court directly considered the question as to which types of uses can have a priority date of time immemorial:

> The State and individual appellants argue that an implied reservation of water cannot have a priority date earlier than the establishment of the

> reservation. The Government and the Tribe argue that a pre-reservation priority date is appropriate for tribal water uses that pre-date the establishment of the reservation. We have been unable to find any decisions that squarely address this issue.

Adair, 723 F.2d at 1413. It concluded that aboriginal water uses "necessarily carry a priority date of time immemorial." *Id.*

In a later case, the court again found the existence of an aboriginal use to be the requisite basis for a time immemorial priority date. *Joint Bd. Of Control of Flathead, Mission & Jocko Irr. Districts v. United States,* 832 F. 2d 1127, 1131 (9th Cir. 1987) The court decided that because there were aboriginal rights to "fish on the lands and water in question before the reservation was created, the priority date of the reserved water rights for fishery purposes is time immemorial." A time immemorial priority date only exists for, and cannot be decoupled from, an aboriginal use.

Conclusion of Law No. 6. A time immemorial priority date does not apply to any use of water on the Hopi Reservation except aboriginal water uses within Land Management District 6.

A court will recognize that a particular use is classified as an aboriginal water right when "a tribe shows its aboriginal use of water to support" a particular lifestyle. *Adair,* 723 F.2d at 1414. A water use can be considered an aboriginal water use even though the methods and technology associated with the aboriginal practice may have changed. *Courte Oreilles Band of Lake Superior Chippewa Indians v. State of Wis.* 653 F. Supp. 1420, 1430 (W.D. Wis. 1987); *United States v. Washington,* 384 F. Supp. 312 (W.D. Wash. 1974) *aff'd* 520 F. 2d 676 (9th Cir. 1975). The determination of whether a claimed use constitutes an aboriginal use requires a factual determination of the specific actions undertaken by a tribe at the time of the reservation and the consideration of whether current use of a natural resource, such as water, is a traditional use, a modern adaption of a traditional activity, or a new use. *Lac Courte Oreilles Band of Lake Superior Chippewa Indians v. State of Wis.*, 758 F. Supp. 1262, 1270 (W.D. Wis. 1991).

The Navajo Nation agrees that methods and/or technology associated with the aboriginal practice may change but contends that aboriginal uses of water with a time immemorial priority are limited to the pre-reservation quantities of water. Navajo Nation's Consolidated Response to Closing Briefs at 7 (August 27, 2021). The cases which have addressed quantity involve fact situations where the tribes seek to restore historic uses and the courts have ruled that the quantity subject to the aboriginal use is limited to amounts currently used or sufficient to support a "moderate living." *Adair,* 723 F.3d at 1415; *see also Courte Oreilles Band of Lake Superior Chippewa Indians v. State of Wis.,* 653 F. Supp. at 1432 (approved an exercise of the rights only to the extent necessary to enjoy a modest living). In *United States v. Washington*, the court held that the aboriginal use could neither "destroy the resource or . . . preempt it totally." 384 F. Supp. at 401. In *Grand Traverse Band of Ottawa & Chippewa Indians v. Dir., Michigan Dept. of Nat. Res.*, 141 F.3d 635, 640 (6th Cir. 1998), the court considered whether aboriginal rights to traditional fishing grounds should be expanded to include a right to anchor commercial vessels at a municipality's marinas. It concluded that the aboriginal right extended to the right to anchor a commercial vessel because the absence of the right "would simply destroy all rights to commercially fish that were conveyed by them." None of the standards set by the courts would permit the quantity of an aboriginal use to be dictated by a maximum historic use or a maximum future use. The standards, however, do not limit the aboriginal use to the quantity of use at the time of the reservation.

Conclusion of Law No. 7. The quantity of water used for an aboriginal purpose on Land Management District 6 is not limited to the amount of water used for aboriginal purposes at the time the land was reserved for the Hopi Reservation.

The Navajo Nation further argues that the aboriginal water rights are limited to historic sources, stating that it would be illogical to extend aboriginal water rights to groundwater that was "neither accessed nor accessible to the tribe pre-reservation." Navajo Nation Closing Brief at 4 (June 25, 2021). The Navajo Nation cites no authority for its position. Similarly, in its response, the United States cites to no authority to support its claim that the Hopi Tribe has an aboriginal water right to groundwater. United States Consolidated Response Brief at 13 (August 27, 2021). In the context of this case, the issue is whether the aboriginal water rights to water from surface water on Land Management District 6 extend to groundwater pumped from Land Management District 6 for aboriginal uses on Land Management District 6, to which the Hopi Tribe holds aboriginal title.[5]

Aboriginal title conveys a possessory interest in land and the courts have protected the aboriginal use of natural resources on the land where that use began prior to the creation of the reservation. As discussed above, aboriginal rights to resources on the land are not limited to the methods used to access the resources at the time of the reservation. In this case, the sources of water on Land Management District 6, to which the Hopi Tribe holds aboriginal title, include surface flow such as springs and perennial and intermittent streamflow. The hydrological reality is that where there is a hydrologic connection between the aquifer and the surface water, the groundwater supplies the flow for springs and the baseflow of water sources found on the surface.

[5] In *Agua Caliente Band of Cahuilla Indians v. Coachella Valley Water Dis*t., EDCV 13-883-JGB, 2015 WL 13309103, at *9 (C.D. Cal. Mar. 24, 2015), 849 F.3d 1262 (9th Cir. 2017), the Agua Caliente Band asserted an aboriginal claim to groundwater that the court denied based on the status of its aboriginal title.

[Hopi Exh. 4579 at 41 (PDF 48)] The use of wells to access the aquifers in that situation is not accessing a new source of water when the hydrologic connection already exists between the surface water and the aquifer. The well is new technology that changes the timing and amounts of flow from the aquifer to the surface. In this case, evidence exists that "future groundwater pumping will affect the discharge at springs and base flow to streams, two of the primary natural mechanisms for groundwater discharge." [*Id.*] Extrapolating from the *Gila III* decision that extended federal reserved water rights to groundwater to protect federal rights, aboriginal water rights should extend to groundwater under land subject to an aboriginal title where a hydrological connection exists between the surface water used for an aboriginal use and the groundwater claimed for a continuation of that use. The same limitations imposed by *Gila III* on the availability of federal reserved water rights to groundwater and by the federal courts to the scope of use of aboriginal rights should also apply to the United States' and the Hopi Tribe's claim for aboriginal water rights.

Conclusion of Law No. 8. An aboriginal right to groundwater under land subject to aboriginal title may be found only where the surface waters subject to aboriginal water rights are hydrologically connected to the groundwater and inadequate to support the aboriginal uses or are so insufficient that the absence of an aboriginal right to the groundwater will result in the destruction of the aboriginal use.

C. Federal Reserved Water Rights[6]

In the 1908 *Winters* decision, the United States Supreme Court first determined that the federal government could reserve a federal right to water appurtenant to land reserved for an

[6] This section discusses the law applicable to claims for federal reserved water rights under *Winters v. United States*, 207 U.S. 564 (1908).

Indian tribe. Thereafter, the courts have developed the federal common law applicable to federal reserved water rights in cases seeking injunctions, interpreting decreed rights, and adjudicating water rights under federal law.

Conclusion of Law No. 9. The *Winters* doctrine provides that when the federal government withdraws its land from the public domain and reserves it for a federal purpose, the government, by implication, reserves only that amount of unappropriated water appurtenant to the land necessary to accomplish the purpose of the reservation.

Conclusion of Law No. 10. A federal reserved right created under the *Winters* doctrine applies to unappropriated surface water appurtenant to the reserved land and may extend to groundwater appurtenant to the reserved land when other waters are inadequate to accomplish the purpose of a reservation. *Gila III* 195 Ariz. at 420 ¶ 31, 989 P.2d at 748; *see also Silver v. Pueblo Del Sol Water Co.*, 244 Ariz. 553, 558 ¶ 13 (2018); *Agua Caliente Band of Cahuilla Indians v. Coachella Valley Water Dist.*, 849 F.3d 1262, 1271 (9th Cir. 2017) ("a reservation without an adequate source of surface water must be able to access groundwater.").

In the adjudication of a claimed federal right, the state courts apply the federal common law. *Cappaert v. United States*, 426 U.S. at 145 ("Federal water rights are not dependent upon state law or state procedures . . . ."); *Colville Confederated Tribes v. Walton*, 752 F.2d 397, 400 (9th Cir. 1985). The state courts may also apply state law when it does not conflict with federal law. *See Gila III*, 195 Ariz. at 416-417, 989 P.2d at 744-745 ("[T]he Arizona Courts must afford federal claimants the benefit, when state and federal law conflict, of federal substantive law.").

In *Gila V*, the Arizona Supreme Court addressed federal reserved water rights for Indian lands. It determined the purpose of an Indian reservation, described the appropriate methodology to quantify the amount of water reserved for the land, and set the standard for the quantified rights.

Gila V, 201 Ariz. at 310, ¶ 1, 35 P.3d at 71. The United States, the Hopi Tribe, and the Navajo Nation challenge the validity of different aspects of *Gila V* as inconsistent with their interpretations of federal law. Decisions of the Arizona Supreme Court are binding on lower courts even as to issues of federal law, unless subsequent decisions by the United States Supreme Court have rendered the position of the Arizona Supreme Court untenable. *See Prosise v. Kottke*, 249 Ariz. 75, 79, ¶ 20, 466 P.3d 386, 390 (App. 2020), *review denied* (Nov. 20, 2020); *State v. Superior Court*, 2 Ariz. App. 458, 460, 409 P.2d 742, 744 (App. 1966), *review denied* (Feb. 2, 1966 and March 1, 1966); *see also Sult v. O'Brien*, 15 Ariz. App. 384, 488 P.2d 1021 (App. 1971), *reh'g denied* (Oct. 14, 1971), *review denied* (Nov. 16, 1971). *Gila V* controls this proceeding.

Conclusion of Law No. 11. The *Gila V* decision and the standards approved by that decision govern the adjudication of federal reserved water rights asserted by the United States and the Hopi Tribe to water for use on the Hopi Reservation.

The *Gila V* Court provides an extended discussion about the purpose of an Indian reservation. The purpose defines the scope and nature of impliedly reserved water rights. *Adair*, 723 F. 2d at 1408-1409, 1419. For example, a determination that the original purpose for the creation of the reservation was to provide for agricultural and domestic use limited the quantity of water subject to federal reserved water rights to only the amount necessary to fulfill those limited purposes. *United States v. Washington*, 375 F. Supp. 2d 1050, 1064 (W.D. Wash. 2005), *vacated pursuant to settlement sub nom. U.S. ex rel Lummi Indian Nation v. Washington*, C01-0047Z, 2007 WL 4190400 (W.D. Wash. Nov. 20, 2007), *aff'd sub nom. U.S. ex rel. Lummi Nation v. Dawson*, 328 Fed. Appx. 462 (9th Cir. 2009).

Conclusion of Law No. 12. Generally, the purpose of a federal reservation of land defines the scope and nature of the impliedly reserved water rights. *Adair*, 723 F. 2d at 1419.

Quoting *Winters*, the *Gila V* Court broadly interpreted the federal government's purpose for creating Indian reservations. It rejected the approach that it must examine historical documents to define the purpose for a reservation or for each change to the boundaries of a reservation. It cited concerns that historical records would not accurately state the purpose of the reservation and would be silent on the topic of water, requiring the court to speculate about Congressional intent or the intent of the executive branch. As a result, the Court concluded that such an approach could result in "an arbitrary patchwork of water rights." *Gila V*, 201 Ariz. at 314, ¶ 18, 35 P.3d at 74.

Conclusion of Law No. 13. *Gila V* rejected the notion that if land were added to a reservation over time, separate purposes could be used to quantify federal reserved water rights for each addition to a reservation.

Conclusion of Law No. 14. *Gila V* decided that "the purpose of a federal Indian reservation is to serve as a 'permanent home and abiding place' to the Native American people living there." 201 Ariz. at 315, ¶ 25, 35 P.3d at 76. It further elaborated that "the essential purpose of Indian reservations is to provide Native American people with a 'permanent home and abiding place' (citation omitted) that is, a 'livable' environment." *Id.* at 313, ¶ 16, 35 P.3d at 74.

Having defined the purpose, the *Gila V* Court addressed the methods to quantify the rights to water consistent with that purpose. It considered the "practicably irrigable acreage" ("PIA") method that the United States Supreme Court approved in *Arizona v. California*, 373 U.S. 546 (1963) ("*Arizona I*"). 201 Ariz. at 316-17, ¶ 30, 35 P.3d at 77-78. It described the PIA method "as a two-step process. First, it must be shown that crops can be grown on the land, considering arability and the engineering practicality of irrigation. … Second, the economic feasibility of irrigation must be demonstrated." 201 Ariz. at 316-17, ¶ 30, 35 P.3d at 77-78 (citing *Arizona v. California*, 460 U.S. 605 (1983) ("*Arizona II*")). Economic feasibility requires "subjecting proposed irrigation projects to a cost-benefit analysis, ‘comparing the likely costs of the project to the likely financial returns. If the latter outweighs the former, the project can be found economically feasible, and the underlying land “practicably irrigable” . . . .’” 201 Ariz. at 78, ¶ 30, 35 P.3d at 317 (quoting Franks, “The Uses of the Practicably Irrigable Acreage Standard in the Quantification of Reserved Water Rights,” 31 *Nat. Res. J.* 549, 553 (1991)). The PIA analysis that was applied by the United States Supreme Court is applicable in this case when evaluating the future use claims for water to irrigate agricultural land on the Hopi Reservation.

Conclusion of Law No. 15. The PIA-type analysis applies to future irrigation projects proposed for the Hopi Reservation. The recognition of a federal reserved water right for irrigation purposes requires a showing that the irrigation project is both practically and economically feasible.

The *Gila V* Court decided that PIA method was not the “exclusive quantification measure for determining water rights on Indian lands.” 201 Ariz. at 318, ¶ 37, 35 P.3d at 79. Among the reasons listed by the Court for deciding that the PIA standard was not the exclusive standard is that the PIA standard would unduly limit the purpose of the reservation and it “awards what may be an overabundance of water by including every irrigable acre of land in the equation.” *Id.* at ¶ 36. The Court’s reluctance to apply a standard that may attach federal reserved water rights to undue quantities of water follows prior rulings issued by the federal courts. For example, in *United States v. Walker River Irr. Dist.*, 104 F.2d 334, 340 (9th Cir. 1939), the court warned against any arrangement that would result in an excessive quantification. If the PIA standard were the exclusive standard, the possibility exists that the federal government could acquire high priority rights to a scarce resource, all of which may not be used or usable on a reservation.

Conclusion of Law No. 16. Federal reserved water rights will be granted for proposed future agricultural irrigation projects on the Hopi Reservation only if the United States and the Hopi Tribe meet their burden of proof that the irrigation projects are both practically and economically feasible. *Arizona II*, 460 U.S. at 637-640.

Gila V determined that a fact-intensive inquiry on a reservation-by-reservation basis is required to determine the amount of water necessary to accomplish the reservation's purpose, where the PIA standard does not apply. *Gila V*, 201 Ariz. at 318, ¶ 38, 35 P.3d at 79 (citing and quoting *Gila III*, 195 Ariz. at 420, ¶ 31, 989 P.2d at 748). It articulated a non-exclusive list of six factors for the lower courts to consider when quantifying federal reserved water rights for Indian reservations. 201 Ariz. at 318-320, ¶ ¶ 41-47, 35 P.3d at 79-81.

a. Tribe's history. "A tribe's history will likely be significant. Deference should be given to practices requiring water use that are embedded in Native American traditions. Some rituals may date back hundreds of years, and tribes should be granted water rights necessary to continue such practices into the future." *Id.* at 318, ¶ 42, 35 P.3d at 79.

b. Tribal culture. "In addition to history, the court should consider tribal culture when quantifying federally reserved rights. . . . Water uses that have particular cultural significance should be respected, where possible. The length of time a practice has been engaged in, its nature (e.g., religious or otherwise), and its importance in a tribe's daily affairs may all be relevant." *Id.* at 318-319, ¶ 43, 35 P.3d at 79-80.

c. Geography, topography, and natural resources. The trial court "should also consider the tribal land's geography, topography, and natural resources, including groundwater availability." *Id.* at 319, ¶ 44, 35 P.3d at 80. It explained: "We anticipate that any development plan will carefully consider natural resources (including potential water uses), so that the water actually granted will be put to its best use on the reservation." *Id.*

d. Tribe's existing economic base. "In conjunction with natural resources, the court should look to a tribe's economic base in determining its water rights." *Id.* at 319, ¶ 45, 35 P.3d at 80. "Tribal development plans or other evidence should address, and the court should consider, 'the optimal manner of creating jobs and income for the tribes [and] the most efficient use of the water.'" *Id.* (quoting Rusinek, Note, "A Preview of Coming Attractions? *Wyoming v. United States* and the Reserved Rights Doctrine," 17 *Ecology L.Q.* 355, 397 (1990)). The Court further explained: "Economic development and its attendant water use must be tied, in some manner, to a tribe's current economic station. Physical infrastructure, human resources, including the present and potential employment base, technology, raw materials, financial resources, and capital are all relevant in viewing a reservation's economic infrastructure." *Id.* at 319, ¶ 45, 35 P.3d at 80.

e. Past water use. "Past water use on a reservation should also be considered when quantifying a tribe's rights. The historic use of water may indicate how a tribe has valued it. Logically, tribal prioritization of past water use will affect its future development." *Id.* at 319, ¶ 46, 35 P.3d at 80. With respect to this factor, the Court reiterated the need for a fact-intensive inquiry, stating that "any proposed projects should be scrutinized to ensure that they are practical and economical. Such projects should also be examined to determine that they are, in fact, appropriate to a particular homeland." *Id.*

f. Present and projected future on-reservation population. "[A] tribe's present and projected future population may be considered in determining water rights." *Id.* at 319, ¶ 47, 35 P.3d at 80. "[I]f a federally reserved water right is to be tailored to a reservation's 'minimal need,' as we believe it must, then population necessarily must be part of the equation." *Id.*

The *Gila V* Court summarized the method to quantify federal reserved water right for Indian reservations as follows:

> Again, the foregoing list of factors is not exclusive. The lower court must be given the latitude to consider other information it deems relevant to determining tribal water rights. We require only that proposed uses be reasonably feasible. As with PIA, this entails a two-part analysis. First, development projects need to be achievable from a practical standpoint—they must not be pie-in-the-sky ideas that will likely never reach fruition. Second, projects must be economically sound. When water, a scarce resource, is put to efficient uses on the reservation, tribal economies and members are the beneficiaries.

201 Ariz. at 320, ¶ 49, 35 P.3d at 81.

Conclusion of Law No. 17. Projects proposed by the United States and the Hopi Tribe for which they seek a federal reserved water right must be achievable from a practical standpoint and they must be economically sound.

After defining the methodology needed to quantify a federal reserved water right to accomplish the purpose of the reservation, the *Gila V* Court set the standard that governs the amount of water subject to federal reserved water rights for use on a reservation:

> The *Winters* doctrine retains the concept of "minimal need" by reserving "only that amount of water necessary to fulfill the purposes of the reservation, no more." *Cappaert,* 426 U.S. at 141, 83 S. Ct. 1468, 10L.Ed.2d 542 (1963). The method utilized in arriving at such an amount, however, must satisfy both present and future needs of the reservation as a livable homeland.

201 Ariz. at 316, ¶ 28, 35 P.3d at 77.

It further directed that "[t]he court's function is to determine that amount of water necessary to effectuate this purpose, tailored to the reservation's minimal need." 201 Ariz. at 320, ¶ 48, 35 P.3d at 80. Thus, the *Gila V* Court requires a comprehensive analysis to quantify that amount of water necessary to accomplish a purpose that is defined broadly and satisfies the directive that such amounts do not exceed the minimal need of the reservation.

Conclusion of Law No. 18. The requirement that federal reserved water rights must not exceed "minimal need" must be interpreted consistently with the directive that the purpose of a federal reservation is to serve as a permanent home and abiding place that is a livable environment for the Hopi people living there.

Conclusion of Law No. 19. A federal reserved water right attaches to that amount of water necessary to provide a permanent homeland for the Hopi Tribe that is a livable environment in the present and in the future that is tailored to the minimal needs of the Hopi Reservation.

The United States and the Hopi Tribe argue that additional benchmarks quantify a federal reserved water right. They urge the adoption of a concept that the maximum amount of water used in a year, or a combination of years, constitutes a baseline or minimum amount subject to a federal reserved water right that can be diverted for a particular use in a single year.[7] In support of this argument that federal reserved water rights must be quantified in an amount no less than demonstrated past use, the United States cites a trio of Supreme Court cases dealing with usufructuary treaty rights: *Minnesota v. Mille Lacs Band of Chippewa Indians,* 526 U.S. 172, 202-03 (1999); *United States v. Dion*, 476 U.S. 734, 738-40 (1986) (Congressional passage and amendment of the Eagle Protection Act divested defendant of a treaty right to hunt and kill bald eagles); and *Washington v. Wash. State Commercial Passenger Fishing Vessel Ass'n*, 443 U.S. 658 (1979). U.S. FOF 41 Those decisions stand for the proposition that only Congress can

[7] The Navajo Nation also takes the position that the maximum historic use in a single year may serve as the basis for quantifying a tribal reserved right. It specifically agrees that a maximum water use can define historic irrigation use. Navajo Nation's Objections to Draft Report of the Special Master on Past and Present Water Uses on the Hopi Reservation at 14-15(September 30, 2019).

completely abrogate treaty rights. No treaty applies to the water rights at issue in this adjudication. The *Winters* doctrine created the rights discussed in this section.

Those cases do not support the proposition that treaty rights to a natural resource cannot be reduced below the amount the tribe demonstrated it used in the past. In one case, the Court limited a treaty right to fish to a defined percentage of a fish run because "Indian treaty rights to a natural resource that once was thoroughly and exclusively exploited by the Indians secures so much as, but no more than, is necessary to provide the Indians with a livelihood—that is to say, a moderate living." *Washington v. Washington State Commercial Passenger Fishing Vessel Ass'n*, 443 U.S. at 686. In *Adair*, the court similarly rejected enforcement of hunting and fishing rights as once exercised in favor of hunting and fishing treaty rights as currently exercised. 723 F. 2d at 1414 - 1415.

"*Winters* is a forward-looking case examining existing, but also future needs." Navajo Nation Closing Brief at 4. The PIA methodology approved by the United States Supreme Court demonstrates that quantification is ultimately based on the present and future use. *See also, State ex rel. Greely v. Confederated Salish & Kootenai Tribes of Flathead Reservation*, 712 P.2d 754, 765 (1985) ("the practically irrigable acreage" standard applies to future irrigation of reservation land, not present irrigation practices and current consumptive uses."). While *Gila V* requires consideration of past uses in the quantification of a federal reserved water right because they may be probative of minimal need, past uses do not definitively quantify a *Winters* right. *Ute Distribution Corp. v. Secretary of the Interior of U.S.*, 584 F.3d 1275 (2009)*: Hackford v. Babbitt*, 14 F.3d 1457, 1461 (10th Cir. 1994).

In *Hackford*, the court explained that "reserved or 'Winters' water rights are federally created and spring from the act of reserving lands for a particular purpose, such as transforming nomadic Indians into productive agrarians or promoting Indian self-sufficiency. [citation omitted] Unlike most other water rights, it is generally accepted that 'Winters' rights held by Indians are neither created by use nor lost by nonuse." *See also State ex rel. Greely v. Confederated Salish & Kootenai Tribes of Flathead Reservation*, 712 P.2d at 762 (1985) (The purpose of the reservation, not actual use of water on the reservation, controls the quantification of federal reserved water rights.) *Winters* rights are not frozen by the past. There may be circumstances where people who lived on a reservation used or allowed others to use water from that land for a particular purpose that was later not supported or available. Past use should not dictate the federal reserved water right for current or future use. For example, in *Colville Confederated Tribes v. Walton*, 647 F.2d 42, 48 (9th Cir. 1981) the court agreed that one of the purposes for the creation of the reservation was to preserve access to fishing grounds. When the historic fishing grounds were destroyed by dams, the Colvilles created replacement fishing grounds in Omak Lake. The appellate court affirmed the district court's decision to adjudicate reserved rights necessary to maintain the Omak Lake Fishery and not for rights to the historical fishing grounds: "We note that the nature of a right to water for a replacement fishery is such that it cannot coexist with continuing rights to water for a fishery in the watershed where the fishery historically existed." *Colville Confederated Tribes v. Walton*, 647 F.2d at 48.

Under *Gila V*, past use is one of six cited factors, not a controlling or limiting factor, to be considered when quantifying a federal reserved water right. Ultimately, federal reserved water rights are quantified based on the present and future needs of the reservation to fulfill the purpose of the reservation as a livable homeland, tailored to the reservation's minimal need. Past uses are only indicative, as opposed to controlling, of the quantity of water subject to federal reserved water rights.

Conclusion of Law No. 20. Past and present uses alone do not define a federal reserved water right under the *Gila V* standard; they are factors to be considered in quantifying a federal reserved water right.

Conclusion of Law No. 21. A demonstrated past water use does not definitively quantify a minimum amount of water subject to a federal reserved water right under the *Winters* doctrine.

Conclusion of Law No. 22. A demonstrated maximum past water use does not definitively quantity a minimum amount of water subject to a federal reserved water right under the *Winters* doctrine.

Conclusion of Law No. 23. The maximum amount of water used on a reservation in the past does not create a "baseline quantification" for federal reserved water rights for a reservation absent evidence that the same or greater amount of water is necessary to effectuate the purpose of the reservation tailored to the reservation's minimal need.

The Navajo Nation argues that the *Gila V* Court created confusion and imposed a parsimonious standard when it required federal reserved water rights to be tailored to the minimal need of the reservation. It further contends that the "minimal need" standard applies to the purpose of the reservation and not to the quantity of water to accomplish that purpose. Navajo Nation's Closing Brief at 8 (June 25, 2021). It argues that "[n]othing in *Winters* and nothing in the federal non-Indian non-permanent homeland cases suggests that the United States Supreme Court intended to equate 'minimal needs' with 'minimal quantity' as applied to a permanent homeland for Indians." *Id.* If the Navajo Nation were correct that the Arizona Supreme Court erred, then only the Arizona Supreme Court can change the quantification standard that will be applied in this case. *White Mountain Health Center, Inc. v. Maricopa County*, 241 Ariz. 230, 238, ¶ 28, 386 P.3d 416, 424 (App. 2017) ("[O]nly the supreme court may modify supreme court precedent.")

A "minimal need" directive could be understood as the imposition of an inflexible and unreasonable roadblock designed to lock a reservation in place and in time. The Court's standard, however, does not impose such a roadblock. The minimal need standard must be read in the context of the entire *Gila V* decision that, like *Cappaert*, describes the standard as that amount necessary to meet the reservation's purpose. *Gila V* requires the lower court to engage in careful analysis to define the minimal needs that will also accomplish the homeland purpose. Or, as described by the Salt River Project, the minimal need standard applies an upper boundary on the amount of water to which a federal reserved water right can attach for a proposed use on a reservation.

Having set the standard against which the water right should be determined, *Gila V* mandated that federal reserved water rights be precisely quantified. Necessarily, therefore, federal reserved water rights must be quantified by an objective measurement. 201 Ariz. at 313 ¶ 14; 35 P.3d at 74; *see also Gila III*, 195 Ariz. at 421 ¶ 32 n.10, 989 P.2d at 749. In *Arizona v. California*, 376 U.S. 340 (1964), the Court entered a decree for federal reserved water rights for five reservations. Each decreed right to divert flow from the Colorado River was described in "annual quantities" (time) and quantified in acre-feet (unit of volume). 376 U.S. at 344.

The Hopi Tribe contends that a federal reserved water right can be quantified as "the extent reasonably necessary" and cites to *Conrad Inv. Co. v. U.S.*, 161 F. 829 (9th Cir. 1908). The *Conrad Inv. Co.* Court set forth the subjective standard quoted by the Hopi Tribe but defined the actual right to stream flow from designated points of diversion and places of use on the reservation using a precise, objective measurement: an amount equal to "1,666 2/3 inches, or the equivalent of 33 1/3 second feet" for the reservation.[8] 161 F. at 834.

[8] The inch reference is to a miner's inch, which is a unit of flow in terms of volume per unit time, and second feet is a unit of flow equal to one cubic foot per second.

The United States points to the *Walker River* decision for the proposition that not all water uses require objective measurements because the court allowed the diversion of "reasonably necessary amount of water" for domestic use. United States Proposed Findings of Fact and Conclusion of Law at 20. *Walker River* involved a population, who would have used the water for domestic use, of 500 to 800 people. The court concluded that the current population of 500 people would not exceed 800 people in the future. The court quantified the federal reserved water right at more than 9,300[9] acre-feet of water per year for irrigation use. The *Walker River* Court's assignment of a "reasonable use" quantity to a domestic use would have amounted to a very small quantity[10] of water from the same source with the same point of diversion from which the tribe diverted 9,300 acre-feet of water for irrigation use. This case stands for the proposition that when water is diverted for one type of use, a small use, in that case an amount less than one tenth of one percent (0.1%) of the larger use, from the same source at the same place may simply be acknowledged and no quantification other than reasonable use is necessary.

In this case, the United States claims a domestic use (or more accurately a domestic, commercial, municipal, and industrial use) for a future population that it projects will require 8,746 acre-feet of groundwater to be pumped each year. This domestic claim equals 46 percent of the amount of water it claims for irrigation use diverted from surface water. The quantity of water claimed for the Hopi Reservation for domestic use does not constitute an amount that could be considered a rounding error of a much larger amount drawn from the same water source.

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[9] 26.25 cubic feet per second = 52.07 acre-feet per day. 52.07 x 180 days = 9,372.6 acre-feet annually

[10] Assuming that the population of 500 people at the time of the decision grew to the historic population of 800 people, and further assuming that each person used the same 8.8 gallons per day for domestic use that the United States' expert concluded that people who live on the Hopi Reservation and do not have access to the municipal system use, then the *Walker River* domestic use would be approximately eight acre-feet of water per year. (800 people x 8.8 gallons per day x 365 days)/325,851 gallons in an acre-foot)

The parties also cite to a decision from the Idaho Supreme Court in which the court found that a quantification of "the entire natural flow at all times" would be warranted if the United States could prove that such an amount were necessary to accomplish the limited purpose of timber and watershed protection. *Avondale Irrigation Dist. v. N. Idaho Properties, Inc.*, 99 Idaho 30, 41, 577 P.2d 9, 20 (1978). The court continued, however, to hold that:

> if on remand it is found by the district court that at any time in the seasonal and yearly variations in stream flows the entire natural flow will exceed the minimum flow necessary to achieve the purposes for which the Caribou National Forest was created, the court must find the necessary minimum flow so that the marginal excess may be available for use and appropriation. In such case, I.C. § 42-1409 would be appropriately applied to the United States, and it should be required to quantify its water rights in second feet, or acre-feet, in order to assure certainty, uniformity and clarity among the water rights of the various users in this state. As with all water litigants, the burden of proving its claim is upon the United States.

Id.

Avondale Irrigation Dist. is not controlling because the ruling is not consistent with *Gila V* although it does impose an obligation to precisely quantify the water right if the United States could not establish that it needed the entire natural streamflow. It is also not persuasive because, as authority, it relies on the short opinion in *United States v. Dist. Court In & For Eagle County, Colo.*, 401 U.S. 520 (1971). *Eagle County* simply states that "volume and scope of particular reserved rights, are federal questions." 401 U.S. at 526.

The federal courts have required precise measurements to quantify federal reserved water rights. During trial in *Arizona I*, the United States advocated for a "reasonable use" standard to quantify federal reserved water rights for five Indian Reservation. The Special Master considered that approach and rejected it:

> Reasonable use: One possibility would be to adopt an open-end decree, simply stating that each Reservation may divert at any particular time all the water reasonably necessary for its agricultural and related uses as against those who appropriated water subsequent to its establishment. However, such a limitless claim would place all junior water rights in jeopardy of the uncertain and the unknowable. Financing of irrigation projects would be severely hampered if investors were faced with the possibility that expanding needs on an Indian Reservation might result in a reduction of the project's water supply. Moreover, it would not give the United States any certainty as to the extent of its reserved rights, which would undoubtedly hamper the United States in developing them.

1960 Report at 263-264.

Finding that a federal reserved right must be objectively quantified, the Special Master determined "the United States intended to reserve enough water to irrigate all of the practicably irrigable lands on a Reservation and that the water rights thereby created would run to defined lands, as is generally true of water rights." *Id.* at 263. The Supreme Court approved this approach and decreed rights in terms of an annual delivery of a specific number of acre-feet of water or to water to irrigate a specific number of acres of land, whichever is less. 376 U.S. at 345.

Precise quantification typically requires measurements in terms of a unit of volume per unit of time. *Id.; Conrad Inv. Co. v. U.S.,* 161 F. at 834. An acceptable unit of measurement to quantify water rights for irrigation, domestic, mining, and livestock and wildlife watering uses is acre-feet per year (or acre-feet annually). The failure to adopt a convention that links the volume of water for a particular use with the time that the water will be used could result in federal reserved water rights to an excessive amount of water. For example, the United States and the Hopi Tribe calculated the past use of water for domestic purposes on the reservation as part of their claim. They added the maximum amounts of water diverted for domestic uses from four different sources in four different years over a ten-year period to claim to federal reserved water right to water to be diverted in a single year. Hopi FOF 615. The claimed amount does not accurately quantify past use because the relevant time frame (four years) for the volume claimed exceeds the time frame for the claimed use (one year).

Conclusion of Law No. 24. An acceptable objective measurement for quantities of surface flow diverted or groundwater pumped is a unit of volume associated with a unit of time.

Conclusion of Law No. 25. Quantification of a federal reserved water right to water diverted from surface flow and groundwater using objective measurements that relate a unit of volume to a unit of time is consistent with federal law and *Gila V*.

As the United States accurately notes, under the federal reserved water rights doctrine, a water right may be recognized without a unit of volume per unit of time if necessary to satisfy the purposes of the federal reservation citing to the *Cappaert* decision. United States' Objections to the Draft Report of the Special Master on Past and Present Water Uses on the Hopi Reservation at (September 30, 2019). In *Cappaert*, the federal reserved water right was quantified by a marker set into the rock wall above the surface of the pool. The Court used the distance from the marker to the surface of the pool as the unit of measurement. The effect of the decision that enjoined the groundwater pumping was to continuously preserve the volume of the pool for which the marker and distance from the marker served as a proxy for volume. The Court simply employed a common sense and easily ascertainable measurement to protect the volume of water in the pool to allow the fish to survive over time. Thus, circumstances exist where a precise measurement can be accomplished using a proxy for volume instead of a unit of volume to define the quantity of water and an assumption that the same volume will remain steady at all times.

In this case, the United States and the Hopi Tribe seek federal reserved water rights to fill and maintain stockponds, reservoirs, and other impoundments designed to hold water. The United States appropriately defined the claims in terms of acreage of the stockponds, reservoirs, and other impoundments and the volume in terms of acre-feet of water as well as addressed the time issue in terms of rights to refill to maintain a water supply. [U.S. Exh. 740]

Conclusion of Law No. 26. An acceptable unit of measurement of the storage capacity of stockponds is in acre-feet with a unit of time that specifies refilling rights.

The United States further argues that federal law does not require that a federal reserved water right be characterized by any attributes other than source, aggregate quantity, types of use, and priority date. The United States contends that federal law does not permit a water right to be defined by place of use and point of diversion because a federal water right can only be defined in the aggregate by category of use. United States Closing Brief at 6; *see also* United States Proposed Finding of Fact & Conclusions of Law at 13. It interprets *Gila V* as prohibiting a federal reserved water right from being defined by place of use because the "decree cannot create an 'arbitrary patchwork' of water rights." United States Closing Brief at 10. *Gila V* stands for the proposition that historical reasons for reserving land cannot impose distinct purposes on separate parcels of land because those reasons may not be reliable or accurate and will cause arbitrary results. Here, all types of past uses and places of use are defined by the Hopi Tribe who live on the land now and in the centuries past and use and have used the water. Future uses are proposed by the Hopi Tribe and the United States, with the consent of the Hopi Tribe, based on plans for centuries of future uses.

Conclusion of Law No. 27. *Gila V* did not decide that different types of uses of water could not be adjudicated for different areas within a reservation.

The failure to focus on place of use created quantification disputes in this case. For example, the United States claimed a right to water for livestock and quantified that right without limiting the place of use to land not otherwise used for villages, fields, schools, businesses, existing gardens, future farming plots, roads, culturally sensitive areas, areas of planned home development, areas for planned business development, coal mines, or claimed alfalfa fields. Reliance on the same land to quantify water for types of uses that cannot simultaneously co-exist will result in excessive federal reserved water rights in violation of the *Gila V* standard.

The Court's decision in *Winters* and the federal common law that has developed in the past century does not support the proposition that a federal reserved right must be defined as a single amount from a stated source for any use at any place on the reservation and cannot be defined by reference to other attributes such as particular points of diversion or places of use. In *Conrad Inv. Co. v. United States*, 161 F. at 834, the United States moved to establish federal water rights to Birch Creek to irrigate a 10,000-acre tract of land on the Blackfeet Reservation in order to enjoin a neighboring landowner from damming Birch Creek upstream of the points of diversion. The court's description of a federal reserved water right included type of use (irrigation), source of water (Birch Creek), flow rate (1,666 $\frac{2}{3}$ inches, or the equivalent of 33 $\frac{1}{3}$ second feet), location of place of use (referenced the complaint) and points of diversion (referenced the complaint).

In *U.S. ex rel. Ray v. Hibner*, 27 F.2d 909 (D. Idaho 1928), the United States sought an adjudication of federal reserved water rights for allotted land. The federal court determined a subjective standard to quantify a reserved right and the purpose of the reserved right: "a sufficient amount of water for the irrigation of their lands, and domestic purposes" and used objective, precise measurements to award a "continuous right through the entire year to the use of one miner's inch of water per acre for the irrigation of that portion of their lands which the evidence discloses is susceptible to irrigation, and with a priority of February 16, 1869." *Id.* at 911. This description includes the attributes of time, flow rate, type of use, place of use (land the evidence shows to be irrigable), and priority date. The decision concludes with the direction that counsel will "prepare appropriate decrees, with the usual provisions found in such decrees, and with definite declarations of the amount of water, right of each claimant, the date of priority, the point of diversion, and place of use." *Id.* at 912.

In *United States v. Walker River Irr. Dist.*, 104 F.2d 334 (9th Cir. 1939), the United States brought an action to restrain upstream users of the Walker River from diverting the natural flow to the extent of 150 cubic feet per second and to adjudicate the relative rights of those upstream users and the Paiute Tribe to water from the Walker River that bordered the Walker River Indian Reservation. Like *Gila V*, the court used a subjective standard to quantify the claimed right. It determined that the government had reserved water to "the extent reasonably necessary to supply the needs of the Indians." It decreed the right with objective measurements and specific attributes. *Id.* at 339–40. The court specifically rejected the United States' suggested decree that allowed the government to make an annual demand on the river subject to a maximum cap that exceeded demonstrated use: "That a decree of this sort would tend greatly to depreciate the value of the water rights of the upstream owners, and to make impossible any intelligent program of farming, is obvious. So precious is every miner's inch of water in these parched regions that no arrangement should be countenanced which would encourage waste or tend to induce it." 104 F.2d at 340. The court defined the federal reserved water and enjoined the upstream users from preventing or interfering with:

> the continuous flow of 26.25 cubic feet of water per second, to be diverted from Walker River upon or above Walker River Indian Reservation during the irrigation season of one hundred and eighty days for the irrigation of two thousand one hundred acres of land on the reservation, and the flow of water reasonably necessary for domestic and stock watering purposes and for power purposes to the extent now used by the Government, during the non-irrigating season, with a priority of November 29, 1859.

Id.

The *Walker River* Court constructed a federal reserved water right for the Walker River Indian Reservation that included: a flow rate, the source of water, general point of diversion, time period, place of use, type of use, number of acres irrigated, and a priority date.

In 1944, another federal court began its analysis with a reasonable use standard. The federal district court decreed a right to water for the Pyramid Lake Indian Reservation to water from the Truckee River to irrigate land on the reservation. The court defined the rights in the Orr Water Ditch Decree in two detailed provisions that included type of use, number of acres, place of use, point of diversion, source, flow rate, quantity measured in units of volume per unit of time, allowable transportation losses, and priority date. The first decreed right is as follows:

> For the irrigation of 3130 acres of Pyramid Lake Indian Reservation bottom lands, plaintiff, the United States of America, is entitled and allowed to divert from the Truckee River through the Indian Ditch, the intake of which is on the left bank of the river in Section 18, T. 22 N., R. 24 E., Mount Diablo Base and Meridian, not exceeding 58.7 cubic feet of water per second to an amount not exceeding 14,742 acre-feet of water in any calendar year with a priority of December 8, 1959; provided the amount of water so to be diverted shall not exceed a flow of one miner's inch or one-fortieth of one cubic foot per second per acre for the aggregate number of acres of this land being irrigated during any calendar year and the amount of water applied to the land after an estimated transportation loss of 15 percent, shall not exceed 85-100 of an inch or 85-100 of one-fortieth of one cubic foot per second per acre for the total number of acres irrigated, and provided that the amount of water so diverted during any such year shall not exceed 4.71 acre-feet per acre for the aggregate number of acres of this land being irrigated during that year, and further provided that the amount of water applied to the land shall not exceed four acre-feet per acre for the aggregate number of acres of this land being irrigated during any calendar year.

United States v. Orr Water Ditch Company, Equity Docket No. A3 at 10 (D. Nev. 1944)

Approximately ten years later, the Ninth Circuit Court of Appeals considered a quiet title action brought by the United States to claim federal reserved water rights for the Yakama Indian reservation from the Ahtanum Creek that forms the northern boundary of the reservation. *United States v. Ahtanum Irr. Dist*., 236 F.2d 321 (9th Cir. 1956). Although the court ultimately declined to adjudicate water rights or enter an injunction, it did address the evidence needed, and importantly in that case, not needed, to establish a federal water right. The Ninth Circuit found that the United States was required to show points of diversion, place of use, number of irrigable acres, type of use, source of water, and quantity:

> By maps and Indian Office records the United States showed the location, point of diversion and capacity of each ditch constructed by Indians, or by the Indian Service, and the description, irrigable area, and location of all reservation lands served by those ditches with water from Ahtanum Creek. Also shown are the rate of progress through the years since the creation of the treaty in getting this water upon these lands. Just which lands are Indian owned, whether under trust or fee patent, and which are owned by successors of Indian allottees, also was proven. The quantities of water required by these lands was both stipulated and proven. No more was required, for the United States has the right to make distribution of its water under such rules as it may adopt, as provided by 25 U.S.C.A. § 381 (note 16, supra). It is no concern of ours which particular parcels or Allotments are served by the Indian Service ditches, so long as adequate proof was made of their aggregate needs.

United States v. Ahtanum Irr. Dist., 236 F.2d 321, 340 (9th Cir. 1956). In reversing the district court, the Ninth Circuit found that the United States did not have to prove that the actions of the upstream users had impaired the ability to irrigate any particular allotment. The United States focuses on the final two sentences of the quotation cited above to contend that *Ahtanum Irr. Dist* stands for the proposition that a federal reserved water right only requires "proof of aggregate need". Such a broad reading of this language would render meaningless the court's catalog of necessary elements. Read in the context of the case, the Ninth Circuit did not eviscerate its prior list of requirements when it stated the reason for its reversal of the lower court's decision.

One of the practical reasons for properly defining a federal reserved water rights is demonstrated by the decision entered in *United States v. Orr Water Ditch Co.*, 309 F. Supp. 2d 1245 (D. Nev. 2004). The United States cites this case to support its argument that enforcement of federal reserved water rights only requires the total amount of water and a priority date. United States Closing Brief at 7 (June 25, 2021). *Orr Water Ditch Co.* was an action to change two of the attributes of a federal reserved water right. In that case, the Pyramid Lake Paiute Tribe moved under the terms of the governing decree, the Orr Water Ditch Decree, to change the type of use and place of use of the reserved water from irrigating 3,130 acres of land on the reservation to maintaining instream flow of the Truckee River. Under the terms of the decree, changes in place and type of use were permissible so long as the changes did not impair existing water rights held by other persons. *Orr Water Ditch Co.* did not find that the change in use impaired junior users; it defined the appropriate test to be applied to determine if impairment had occurred. The court concluded that impairment to a neighboring water user required a showing that "the Tribe's use of its water duty in the place and manner proposed by the transfer application would have an adverse impact as compared to the Tribe's use of its water duty in the place and manner decreed." 309 F. Supp. 2d at 1253. The *Orr Water Ditch Co.* decision demonstrates the importance of sufficiently defining a federal reserved right with attributes that include type of use, point of diversion, and place of use because in that case, those attributes served as the standard when the Tribe later moved to change the type of use.

Conclusion of Law No. 28. Federal law does not limit the definition of federal reserved water rights to type of use, source, an aggregate quantity, and priority date.

Conclusion of Law No. 29. Federal reserved water rights may be defined by type of use, source, quantity, priority date, place of use and point of diversion.

As the survey of the common law of federal reserved water rights demonstrates, the courts define federal reserved water rights by the attributes deemed necessary and appropriate under the unique facts and circumstances of each case. Similarly, the degree of specificity applied by the courts to a defining attribute differs depending upon the situation. Accordingly, in this case there will be federal reserved water rights recommended for types of uses that will be described with specificity such as rights to springs for ceremonial and religious uses. Attributes of other federal reserved rights can be described more broadly to allow needed flexibility of use, but at the same time, will not adversely affect the ability of the parties to engage in an *Orr Water Ditch* proceeding, if it becomes necessary, an enforcement action, or putting "all junior water rights in jeopardy of the uncertain and the unknowable." 1960 Report at 264.

IV. Physical Landscape of the Hopi Reservation

Finding of Fact No. 1. The Hopi Reservation covers approximately 1.66 million acres in the eastern part of Coconino County and the northern part of Navajo County in northeastern Arizona. [Hopi Exh. 1019 at 1 (PDF 22)] The Hopi Reservation is bordered on all sides by the Navajo Reservation. [Hopi Exh. 4467 at 33 (PDF 38); LCRC Exh. 1328]

Finding of Fact No. 2. The Hopi Reservation lands are located on two non-contiguous geographic areas known as the 1882 Executive Order Reservation ("1882 Reservation") and the 1934 Act Reservation ("1934 Reservation" or "Moenkopi Island"). The 1882 Reservation is comprised of Land Management District 6 and the Hopi Partitioned Lands which cover approximately 1.6 million acres. Moenkopi Island encompasses approximately 61,604 acres. [Hopi Exh. 1019 at 1 (PDF 22); U.S. Exh. 969 at 1 (PDF 2)]

Finding of Fact No. 3. The legal description for the 1934 Reservation is provided in a judicial document titled Order and Final Judgment, *Honyoama v. Shirley*, *et. al* (Dec. 4, 2006), at Attachment B. [LCRC Exh. 72 at HP015490-HP015494 (PDF 17-21); Stipulation re: Legal Descriptions of Hopi Reservation Lands (May 19, 2021) ("Geography Stipulation") at 3 (PDF 3)].[11]

Finding of Fact No. 4. The legal description for Land Management District 6 is provided in a judicial document titled Judgment, *Healing v. Jones* (Sept. 28, 1962). [LCRC Exh. 1457 at NN027628-NN027631 (PDF 1-4); Geography Stipulation at 3 (PDF 3)].

Finding of Fact No. 5. The legal description for the Hopi Partitioned Lands is

[11] Attachment B at HP015490-HP015494 in LCRC Exh. 72 is entitled "Hopi Partitioned Lands." The legal description provided refers to the Moenkopi Island lands within the 1934 Reservation and not the Hopi Partitioned Lands located within the 1882 Reservation.

provided in plat maps created by the United States Bureau of Land Management ("BLM"). [Geography Stipulation at 2-3 (PDF 2-3)]. An index of BLM's plat maps for the Hopi Partitioned Lands is contained in Exhibit C to the Geography Stipulation at Table 2.

Finding of Fact No. 6. The northern part of the reservation consists of the high mesas and plateaus of Black Mesa. The Black Mesa area is the remnant of a large sedimentary basin that has been uplifted and dissected by streams since its original formation, resulting in the formation of numerous smaller mesas such as the Hopi Mesas. The mesas are separated by wide valleys and deeply entrenched ephemeral drainages that flow from northeast to the southwest toward the Little Colorado River. Elevations in the northern portion range from 5,800–7,100 feet. [Hopi Exh. 4355 at HOPI_097439 (PDF 19); Hopi Exh. 1019 at 33 (PDF 54)]

Finding of Fact No. 7. There are large, high-quality coal reserves in the Black Mesa Basin which lies entirely within the Navajo and Hopi Reservations. [LCRC Exh. 515 at 21 (PDF 25); 091718:36 AM (Banet)] Black Mesa is a geologic formation roughly 65 miles in diameter encompassing over 3,200 square miles. [*Id.*]

Finding of Fact No. 8. Coal seams occur in Black Mesa's Wepo, Toreva, and Dakota formations. [LCRC Exh. 515 at 21 (PDF 25)] The Wepo formation contains the highest rank and highest quality coal on Black Mesa as well as the largest surface minable reserves. [*Id.*] The coal seams are thicker, more widespread, and more accessible for strip mining than the seams in the Toreva and Dakota formations. The Wepo formation is exposed at the surface across much of Black Mesa. The formation varies in thickness from 400 feet in the southwestern portions of Black Mesa to 200 feet in the northeastern portions. [*Id.*]

Finding of Fact No. 9. The southern part of the Hopi Reservation is characterized by gently rolling, wide valleys. Washes drain the high mesas and plateaus, fanning out on the valley bottoms or merging with the major washes in the valleys. Elevations in the southern portion range from 4,700–5,800 feet. [Hopi Exh. 1019 at 33 (PDF 54)]

Finding of Fact No. 10. The Hopi lands are dominated by three mesas: First, Second, and Third Mesas. The major population centers of Walpi, Sichomovi, Hanoki, Hano, Polacca, Shungopavi, Mishongnovi, Shipaulovi, Oraibi, Kykotsmovi, Bacavi, Hotevilla, and Keams Canyon are located on or near the mesas. Spider Mound is a newer community located on the eastern portion of the Reservation. [Hopi Exh. 3910 at 4-8 (PDF 6–10)]

Finding of Fact No. 11. Ecological zones on the reservation are classified based on climate, vegetation, and soil criteria. The Hopi Tribe has classified five ecological zones within the Hopi Reservation: Semi-Desert Grassland, Mixed Grassland, Sagebrush-Grassland, Pinyon-Juniper Woodland, and Wetlands. [Hopi Exh. 876 at 14-15 (PDF 21–22)]

Finding of Fact No. 12. Semi-desert grassland covers approximately 17 percent of the Hopi Reservation at the lowest elevations. [Hopi Exh. 3878 at 14-15]

Finding of Fact No. 13. Mixed grasslands located between 5500 to 6200 feet in elevation cover more than fifty percent of the Hopi Reservation (993,907 acres). [Hopi Exh. 3878 at 15]

Finding of Fact No. 14. At higher elevations, 6200-7000 feet above mean sea level, sagebrush-grassland covers 18 percent of the land. [*Id.*]

Finding of Fact No. 15. Less than one percent of the Hopi Reservation has pinyon-juniper stands that are primarily located in the northern portion of the reservation with smaller stands also located in the east-central and southeastern portions of the reservation. [Hopi Exh. 3878 at 15; Hopi Exh. 1019 at 3 (PDF 24)] Isolated riparian forest stands can also be found along portions of the washes on the Reservation. [Hopi Exh. 1019 at 3 (PDF 24)]

Finding of Fact No. 16. Approximately 1.4 million acres of the Hopi Reservation is used for grazing livestock. [Hopi FOF No. 912]

Finding of Fact No. 17. Higher temperatures are found at lower elevations on the Hopi Reservation near the bottom of the Little Colorado River valley, and lower temperatures are found in the mountainous area of the Hopi reservation. [U.S. Exh. 564 at 2-4 (PDF 13)]

Finding of Fact No. 18. Average annual rainfall within the Hopi Reservation ranges from about six inches per year at Moenkopi to about ten inches per year in the far northeast corner of the 1882 Reservation. [Hopi Exh. 4579 at 7 (PDF 14)]

Finding of Fact No. 19. Drought conditions have affected the Hopi Mesas and surrounding land during multiple periods lasting years to decades dating back to at least the 1200s. [110918:48-53 AM (Gilpin); 100118:35 PM (Adams)]

Finding of Fact No. 20. The period 1942 through 1965 was one of severe rain insufficiency. [Hopi Exh. 3889 at 32 (PDF 16)]

Finding of Fact No. 21. During the period between the 1970s through the 1990s, 18 years had above average precipitation, with 13 years being significantly above average. [012021:26 AM (Judy Prosser)] Most of the southwestern United States, including the Hopi Reservation, is currently in a drought. [092618:70 PM (Ley)] The current drought in Arizona began in the mid-1990s. Since then, only seven of the last twenty-five years have been wetter than the long-term annual average statewide. [Hopi Exh. 4561 at 3; 120920:12 PM (Leeper)] During the last 20 years there were some periods of above-average precipitation on ranches in the general area of the Hopi Reservation interspersed with the dry periods. [012021:61 AM (Judy Prosser)]

A. Surface Water – Washes

Finding of Fact No. 22. Surface water on the Hopi Reservation is present in seeps, springs, wetlands, and ephemeral, intermittent, and perennial flow through the washes. Hopi FOF 32.

Finding of Fact No. 23. The five major washes on the Hopi Reservation, collectively known as the "Northern Washes" are: Moenkopi Wash (Moenkopi, Begashibito, and Hamblin forming Moenkopi Wash); Dinnebito Wash; Oraibi Wash (Oraibi and Corn Creek forming Oraibi Wash); Polacca Wash (Polacca and Wepo forming Polacca Wash, which then joins Oraibi upstream of Corn Creek Wash); and Jadito Wash (Jadito and Coyote forming Jadito Wash, which also joins Oraibi upstream of Corn Creek Wash. [U.S. Exh. 564 at 2-1 (PDF 10)] Jadito Wash is also commonly referred to as "Jeddito" Wash. [Hopi Exh. 3875 at 11]

Finding of Fact No. 24. The Northern Washes originate on the northeast corner of Black Mesa, shown on *figure 1*, where at least a portion of the headwaters for the Northern Washes originate on the Navajo Reservation. [091318:46 AM (Blandford); Hopi Exh. 3865 at 2 (figure 1)] Water flows through the Northern Washes across the Hopi Reservation where it exits on the southern border on to the Navajo Reservation. [092618:81 (Ley)]

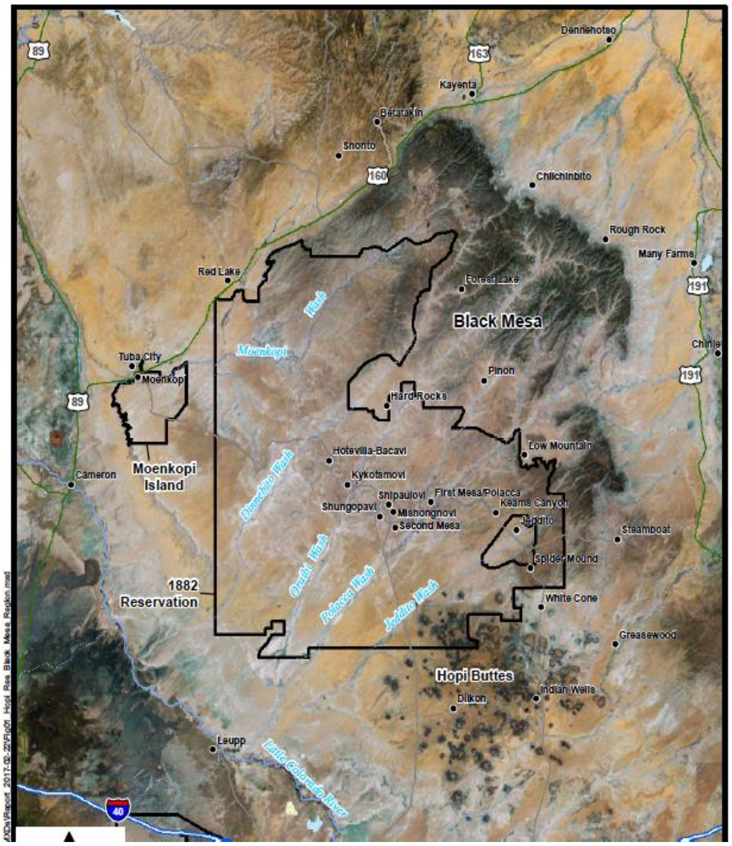

Figure 1. Map shows the boundaries of the Hopi Reservation relative to Black Mesa and the Little Colorado River.
Source: Hopi Exh. 3865 at 2.

Finding of Fact No. 25. The Northern Washes are characterized by ephemeral or intermittent flow with extensive dry periods occurring between high intensity, short duration flow events primarily in response to rainfall and to a much lesser extent, snowmelt. [Hopi Exh. 3875 at 11; U.S. Exh. 564 at 2-1 (PDF 10)] Limited reaches within the washes experience perennial flow where groundwater discharges on to the surface. [100218:67 PM (Puhuyesva); U.S. Exh. 564 at 2-1 (PDF 10)]

Finding of Fact No. 26. The average natural flow of the five Northern Washes is 29,941 acre-feet annually calculated for the time period 1949-2014. [U.S. Exh. 564 at 5-1 (PDF 58)] The largest flow during that time period occurred in 1972 with 91,320 acre-feet. The lowest amount was 7,161 in 2009. [*Id.* at 5-2, 5-3 (PDF59-60)] Flows for the ten year period 2004-2014 were:

Year	Annual Flow in Acre-Feet
2004	30,302
2005	31,918
2006	25,075
2007	17,028
2008	11,622
2009	7,161
2010	32,583
2011	17,212
2012	11,625
2013	26,245
2014	14,593

Finding of Fact No. 27. There are limited reaches within the washes where springs and seeps contribute a perennial baseflow. In these areas, baseflow varies on both an annual and a seasonal basis. [U.S. Exh. 564 at 2.1 -2.2 (PDF 10–11); *see also* 100218:67 PM (Puhuyesva); Hopi Exh. 4579 at 7 (PDF 14)]

1. Moenkopi Wash

Finding of Fact No. 28. The main flow of Moenkopi Wash passes through Moenkopi Island. [091318:44 AM (Blandford)]

Finding of Fact No. 29. Moenkopi Wash has a drainage area of 1,629 square miles and drains a large portion of the western part of Black Mesa. [Hopi Exh. 4355 at 40] Moenkopi Wash runs through the northwestern corner of the 1882 Reservation and then through Moenkopi Island. [Hopi Exh. 3883 at 5 (PDF 13)]

Finding of Fact No. 30. The USGS operates a streamflow gaging station in Moenkopi Wash near Moenkopi. Data collection at this station began in July 1976. During the period of streamflow gage operation, there has generally been continuous flow at the Moenkopi gage except for the summer months, when the stream is often dry at the gage. [Hopi Exh. 4355 at 30 (PDF 40)]

Finding of Fact No. 31. USGS assumes the median winter flow at the gaging station represents constant annual groundwater discharge, which is the baseflow of a stream. Most flow that occurs during the winter is groundwater discharge; precipitation and snowmelt runoff are infrequent during the winter months and evapotranspiration is at a minimum. The median flow for the winter months (November, December, January, and February) is therefore used as a consistent index for evaluating possible temporal trends in groundwater discharge to the washes. [Hopi Exh. 4355 at 36 (PDF 46); Hopi Exh. 4579 at 14–15]

Finding of Fact No. 32. Based on USGS' winter median flow measurements, the average baseflow for Moenkopi Wash has been estimated to be 1,200 acre-feet annually. [Hopi Exh. 4579 at 8 (PDF 15), 74; *see also* U.S. Exh. 1209 at 7 (PDF 15) (discussing measured discharge to springs and streams)] This baseflow is sourced by N Aquifer groundwater. [091318:47 AM (Blandford)]

Finding of Fact No. 33. USGS has observed a decreasing trend in the median winter flows in Moenkopi Wash during the period 1977 - 2016. [Hopi Exh. 4355 at 36 (PDF 46)]

Finding of Fact No. 34. USGS created the Precipitation Runoff Modeling System (PRMS) hydrological model to provide estimates of historic stream flows in a watershed. [U.S. Exh. 564 at ES-1 (PDF 7)] It is necessary to use a hydrological model to estimate natural flow in the Northern Washes because the historical flow records are limited and based on depleted wash outflows. [*Id.*] For the period of 1949 to 2014, PRMS estimates the average natural flow in Moenkopi Wash as 16,176 acre-feet. [U.S. Exh. 564 at 5.2-5.3 (PDF 59–60)]

Finding of Fact No. 35. Monsoon rain events occurring between July and September can result in large sediment laden flows in Moenkopi Wash. [Hopi Exh. 4355 at 30 (PDF 40)] Mr. Blandford testified the average suspended sediment concentration in Moenkopi Wash measures 186 tons per acre-foot. [Hopi Exh. 4579 at 15; Hopi FOF 43]

2. Dinnebito Wash

Finding of Fact No. 36. Dinnebito Wash has a drainage area of 473 square miles and drains part of the middle portion of Black Mesa, draining the area west of Third Mesa. [Hopi Ex. 4355 at 36 (PDF 46); Hopi Exh. 3883 at 133–135]

Finding of Fact No. 37. Dinnebito Wash is an intermittent stream with perennial sections, though most of the stream is dry much of the year. [Hopi Exh. 4355 at 36 (PDF 46)]

Finding of Fact No. 38. USGS operates a streamflow gaging station in Dinnebito Wash near Sand Springs. Data collection at this station began in June 1993. [Hopi Exh. 4355 at 30 (PDF 40), 36 (PDF 46)] The measured flows at Dinnebito Wash near Sand Springs range from about 120 to nearly 400 acre-feet per year. [Hopi Exh. 105 at 24 (PDF 29)] The estimated average baseflow for Dinnebito Wash is 260 acre-feet per year. [Hopi Exh. 4579 at 8 (PDF 15), 74] The N Aquifer discharges to the surface near Sand Springs and provides baseflow. [Hopi Exh. 105 at 24 (PDF 29); *see also* Hopi Exh. 4355 at 36 (PDF 46)] USGS reports no significant trends in the median winter flows at Dinnebito Wash. [Hopi Exh. 4355 at 36 (PDF 46)]

Finding of Fact No. 39. For the period from 1949 to 2014, PRMS estimates the average annual natural flow in Dinnebito Wash as 2,356 acre-feet. [U.S. Exh. 564 at 5.2-5.3 (PDF 59–60)]

Finding of Fact No. 40. Monsoon rains can result in sediment laden flood flows in Dinnebito Wash. [Hopi Exh. 4355 at 35 (PDF 46)] Dinnebito Wash has an estimated sediment yield of about 104 tons per acre-feet of flow, about half that of Moenkopi Wash but still very high. [Hopi Exh. 4579 at 8 (PDF 15)]

3. Oraibi Wash

Finding of Fact No. 41. The Oraibi Wash drains the area between Second Mesa and Third Mesa. [Hopi Exh. 3883 at 113 (PDF 121)]

Finding of Fact No. 42. The Oraibi Wash is dry most of the year, flowing only in response to precipitation events. When it flows, it flows from northeast and spreads out at the Oraibi delta where sediments have been washed down the Oraibi Wash to form a broad alluvial fan. [091318:45 AM (Blandford); 091318:62 PM (Blandford); U.S. Exh. 1217 at C.3 (PDF 5)]

Finding of Fact No. 43. The sediment flow of Oraibi Wash is estimated to be more than 255,000 tons a year. Consequently, each acre-foot of water flowing in Oraibi Wash contains 141 tons of sediment, or 87 cubic yards. [Hopi Exh. 3883 at 12 (PDF 20)]

Finding of Fact No. 44. For the period from 1949 to 2014, the PRMS model estimates the average annual natural flow in the Oraibi Wash as 3,026 acre-feet. [U.S. Exh. 564 at 5.2-5.3 (PDF 59–60)]

4. Polacca Wash

Finding of Fact No. 45. Polacca Wash has a drainage area of 905 square miles and drains a large section of the eastern part of Black Mesa, flowing between First and Second Mesa. [Hopi Exh. 4355 at 36 (PDF 46); 091318:44 AM (Blandford)]

Finding of Fact No. 46. Polacca Wash historically has a perennial flow sourced by groundwater from the N Aquifer that discharges to the surface near Second Mesa. [Hopi Exh. 105 at 23-24 (PDF 28–29); *see also* Hopi Exh. 4355 at 36 (PDF 46)]

Finding of Fact No. 47. USGS operates a streamflow gaging station in Polacca Wash near Second Mesa. Data collection at this station began in April 1994. [Hopi Exh. 4355 at 30 (PDF 40)] During the period of streamflow gage operation, there has been continuous flow at the gage for most months of the year apart from the summer months, when the stream is often dry at the gage. [*Id*. at 36 (PDF 46)] The measured flows at Polacca Wash near Second Mesa range from about 70 to 250 acre-feet per year. The estimated average baseflow for Polacca Wash is 145 acre-feet annually. [Hopi Exh. 4579 at 8 (PDF 15), PDF 74] USGS reports no significant trends in median winter flows at Polacca Wash. [Hopi Exh. 4355 at 36 (PDF 46)]

Finding of Fact No. 48. For the period from 1949 to 2014, the PRMS model estimates the average annual natural flow in the Polacca Wash as 4,472 acre-feet. [U.S. Exh. 564 at 5.2-5.3 (PDF 59–60)]

Finding of Fact No. 49. From July through September, the monsoon rains can result in large sediment-laden flows in Polacca Wash. [Hopi Exh. 4355 at 46]

5. Jadito Wash

Finding of Fact No. 50. Jadito Wash drains Antelope Mesa. The Jadito Wash is dry most of the time. [091318:62 PM (Blandford)]

Finding of Fact No. 51. For the period from 1949 to 2014, the PRMS model estimates the average natural flow in the Jadito Wash as 3,912 acre-feet per year. [U.S. Exh. 564 at 5.2-5.3 (PDF 59–60)]

Finding of Fact No. 52. Members of the Hopi Tribe have used water from the washes for a variety of purposes including domestic uses, livestock watering, and cultivation of crops. [1002720:21-22 PM (Onsea); 110920:45-46 PM (Tenakhongva); 020121:22, 54 (Honahnie)]

Finding of Fact No. 53. Streamflow on the Hopi Reservation would require considerable treatment if used for drinking supplies. Aside from occasional sulfate and salinity exceedances, these waters are generally suitable for livestock watering and agricultural irrigation. [Hopi Exh. 83 at 3 (PDF 5); 092920:88-107 AM (Blandford)]

B. Groundwater

Finding of Fact No. 54. Groundwater flows generally from the northeast to the southwest within the aquifers beneath the Hopi Reservation. [091318:40 PM (Blandford)]

Finding of Fact No. 55. In the areas of the Hopi Reservation where more than one aquifer is present, the aquifers overlie one another and are separated by layers of less permeable rocks. In descending order, the aquifers are the alluvial aquifers, the Bidahochi (B) Aquifer, the Toreva (T) Aquifer, the Dakota (D) Aquifer, the Navajo (N) Aquifer, and the Coconino (C) Aquifer. Hopi FOF 63 The N Aquifer provides a good source of good quality water.

Finding of Fact No. 56. The areal extent of each aquifer is shown in *figure 2*.

1. Alluvial Aquifer

Finding of Fact No. 57. The boundaries of the alluvial aquifers extend underneath the Northern Washes and consist of significant thicknesses of alluvium deposited in the washes. There are additional alluvial aquifers formed from windblow deposits. [091520:44 AM (Ward); 091318:63 AM (Blandford); Hopi Exh. 4579 at 12 (PDF 19)]

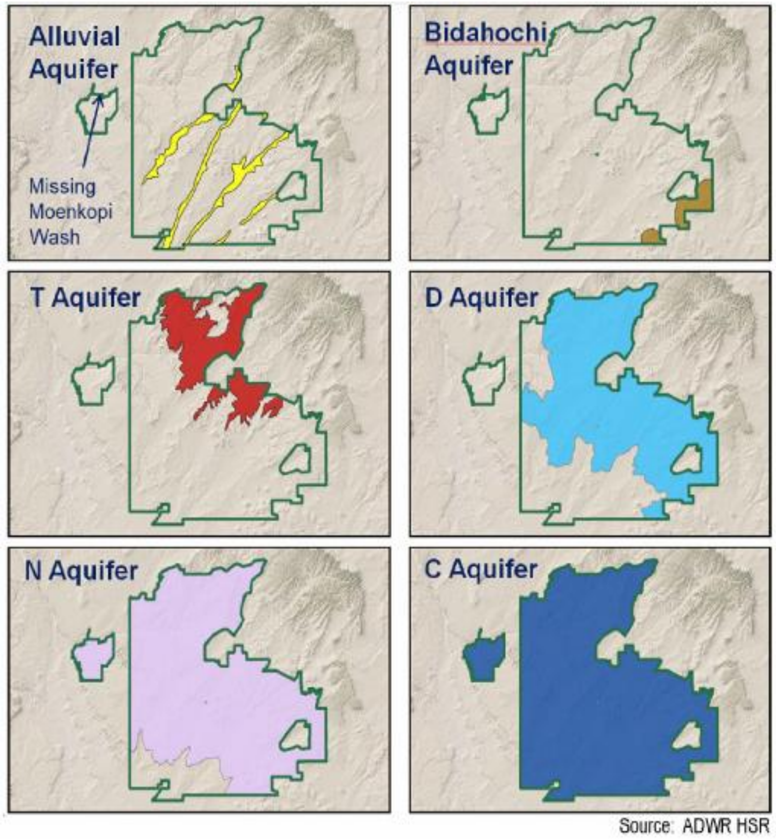

Figure 2.
Source: Hopi Exh. 4579 at figure 11 (PDF 82)]

Finding of Fact No. 58. The alluvium is recharged by precipitation, flood flows, and spring flow originating from underlying aquifers such as the D or N Aquifers. [091318:63 AM (Blandford); 093020:101 AM (Blandford); 091520:44 AM (Ward); US Exh. 1216 at B.1 (PDF 3); Hopi Exh. 4579 at 12 (PDF 19); 120720:53–54 AM (Greenslade)]

Finding of Fact No. 59. Discharge occurs as baseflow to streams, evapotranspiration by riparian vegetation, spring discharge, and underflow. [Hopi Exh. 5 at 2.2-2.3 (PDF 3–4); 091520:45 AM (Ward)]

Finding of Fact No. 60. Well information indicates small to moderate well yields from the alluvium on the Hopi Reservation, primarily used for domestic, stock watering, and gardening purposes. [U.S. Exh. 1216 at B.1 (PDF 3); 091520:45 AM (Ward) Hopi Exh. 4579 at 12 (PDF 19)]

Finding of Fact No. 61. Water quality from the alluvium generally exceeds drinking water standards for total dissolved solids (TDS) and sulfate. [Hopi Exh. 4579 at 19]

2. Bidahochi Aquifer

Finding of Fact No. 62. The B Aquifer is encountered beneath a relatively small area of the southeastern portion of the Hopi Reservation known as the Hopi Buttes. [091520:50 AM (Ward); Hopi Exh. 4579 at 12-13 (PDF 19-20); 120720:59–60 AM (Greenslade)]

Finding of Fact No. 63. Direct precipitation recharges the B Aquifer. [Hopi Exh. 5 at 2-3 (PDF 4)]

Finding of Fact No. 64. Arizona Department of Water Resources did not identify any springs that discharge from this aquifer. [Hopi Exh. 5 at 2-3 (PDF 4)]

Finding of Fact No. 65. None of the wells in the B Aquifer are known to have significant groundwater production capacity. [Hopi Exh. 4579 at 13 (PDF 20);]

3. Toreva Aquifer

Finding of Fact No. 66. The T Aquifer is encountered beneath the northeastern portion of the Hopi Reservation. [Hopi Exh. 5 at 2-3 (PDF 4)] The sandstone members of the Toreva Sandstone, after which the T Aquifer is named, form the vertical cliffs of the Hopi Mesas. [Hopi Exh. 4579 at 13 (PDF 20)]

Finding of Fact No. 67. Precipitation recharges the T Aquifer, infiltrating the sandstone. [Hopi Exh. 4579 at 13 (PDF 20); 120720:64 AM (Greenslade)] The occurrence of groundwater in the Toreva is sporadic and discontinuous. [091520:54 AM (Ward)]

Finding of Fact No. 68. The T Aquifer discharges as spring flow near the Hopi villages. [091318:52, 64 AM (Blandford); Hopi Exh. 4579 at 13 (PDF 20); 091520:53 AM (Ward)]

Finding of Fact No. 69. The T Aquifer yields small amounts of water to wells and springs (less than 15 gallons per minute). [Hopi Exh. 4579 at 13-14 (PDF 20–21); 091318:35 PM (Blandford); 120720:63–64 AM (Greenslade)] The T Aquifer supplies water for domestic, ceremonial, and agricultural purposes. [Hopi Exh. 4579 at 14 (PDF 21)]

Finding of Fact No. 70. Water quality within the T Aquifer is variable, but generally exceeds drinking water standards for TDS and sulfate. [Hopi Exh. 4579 at 13 (PDF 20)] Sulfate concentrations in Wepo Formation water in areas undisturbed by coal mining can be as high as 1,100 milligrams per liter, more than four times greater than the Environmental Protection Agency's secondary maximum contaminant level of 250 milligrams per liter. [*Id.*]

4. Dakota Aquifer

Finding of Fact No. 71. The D Aquifer, named for the Dakota Sandstone, occurs under confined conditions throughout most of the 1882 Reservation, although unconfined conditions occur toward the south where the overlying Mancos Shale is absent. [Hopi Exh. 4579 at 14 (PDF 21)] The D Aquifer is a confined aquifer for most of its location beneath the Hopi Reservation. [091318:37-38 PM (Blandford)] The D Aquifer lies entirely beneath the Hopi and Navajo Reservations. [Hopi Exh. 4588; 091520:71 AM (Ward); 120720:67–68 AM (Greenslade)]

Finding of Fact No. 72. The estimated age of the groundwater in the D Aquifer ranges from 4,000 to 30,000 years because much of the recharge to the D Aquifer occurred during the last glacial age. [Hopi Exh. 4579 at 15 (PDF 22)] The D Aquifer is recharged by precipitation that enters the aquifer primarily in the outcrop areas to the north where the aquifer rocks are not covered by confining units. [*Id*.] Recharge to the D Aquifer has been estimated to be about 5,400 acre-feet annually. [Hopi Exh. 105 at 11 (PDF 16)]

Finding of Fact No. 73. The D Aquifer discharges at springs and seeps along the perimeter of Black Mesa where the D Aquifer sandstone units crop out. [Hopi Exh. 4579 at 15 (PDF 22)] Discharge also occurs into alluvium filled-stream valleys and as downward leakage to the N Aquifer. [Hopi Exh. 105 at 11 (PDF16)]

Finding of Fact No. 74. Well yields in the D Aquifer typically range from 20 to 30 gallons per minute, with some wells yielding up to 100 gallons per minute. [091318:37–38 PM (Blandford); 091520:67 AM (Ward)] Only 11 percent of D Aquifer wells have a capacity of 75 gallons per minute. [U.S. Exh. 1216 at B.4-B.5 (PDF 6-7)] D Aquifer withdrawals were estimated at about 300 acre-feet per year, of which about 160 acre-feet per year was pumped by Peabody Western Coal Company ("PWCC") pursuant to its lease agreement with the Hopi Tribe. [*Id.*]

Finding of Fact No. 75. D Aquifer water quality is highly variable and in many locations has TDS concentrations ranging from about 1,000 to nearly 3,000 milligrams per liter. [Hopi Exh. 4579 at 15 (PDF 22)] The quality of D Aquifer water makes it unsuitable for human consumption. [Hopi Exh. 3875 at 18; 091318:37–38 PM (Blandford)]

Finding of Fact No. 76. The D Aquifer is used for livestock and for limited irrigation and domestic purposes and has been used for industrial purposes. [091418:63 PM (Blandford); 100218:68 PM (Puhuyesva); 091520:70-73 PM (Ward); Hopi Exh. 105 at 10 (PDF 15)]

Finding of Fact No. 77. The D Aquifer can supply 1,123 acre-feet per year of water for use on the Hopi Reservation. [092920:76-78 AM (Blandford)]

5. Navajo Aquifer

Finding of Fact No. 78. The N Aquifer, named for the Navajo Sandstone, and known to the Hopi as Pukya, underlies the D Aquifer, and is the first significant aquifer, in terms of quantity and quality of water, underlying the reservation [091318:57 AM (Blandford); 101018:21 AM (Pavinyama)]

Finding of Fact No. 79. The age of the water in the N Aquifer ranges from a few thousand years in the area around Shonto to 30,000 years in the central part of the aquifer beneath Black Mesa. [Hopi Exh. 4579 at 17 (PDF 24)]

Finding of Fact No. 80. The primary inflow to the N Aquifer is recharge from rainfall or snowmelt. [Hopi Exh. 4359 at 10 (PDF 17); 093020:98–99 AM (Blandford)] Estimated average annual recharge for the confined and unconfined portions of the N Aquifer is 13,000 acre-feet. [Hopi Exh. 4359 at 10 (PDF 17); 092920:18–19 PM (Blandford); 012721:11–12 AM (Loughlin)]

Finding of Fact No. 81. In Arizona, the physical extent of the N Aquifer lies entirely beneath the Hopi and Navajo Reservations. [091520:74 AM (Ward); 091520:9 PM (Ward); 120720:80 AM (Greenslade)]

Finding of Fact No. 82. The geologic units that comprise the N Aquifer occur at or near the land surface around the periphery of Black Mesa, and in these areas the aquifer is generally unconfined. The N Aquifer is unconfined under the southwestern portion of the 1882 Reservation and Moenkopi Island. [Hopi Exh. 4359 at 4 (PDF 11); Hopi Exh. 4355 at 9 (PDF 19); Hopi Exh. 4579 at 88 (Figure 17)]

Finding of Fact No. 83. The N Aquifer units beneath Black Mesa dip into a structural basin more than 1,500 feet below ground surface, and in these areas where the aquifer units are deeply buried beneath Black Mesa, the aquifer is confined. The N Aquifer is confined under the

Hopi Mesas on the 1882 Reservation. [Hopi Exh. 4359 at 4 (PDF 11); Hopi Exh. 4355 at 9 (PDF 19); Hopi Exh. 4579 at 17 (PDF 24), 88 (Figure 17)]

Finding of Fact No. 84. The confined portion of the N Aquifer receives roughly 5,000 acre-feet of recharge each year from the Shonto area on the Navajo Reservation and additional recharge from other areas and then flows to the southeast beneath Black Mesa. [012721:103 AM (Loughlin)] Most of the recharge to the N Aquifer occurs in the unconfined portion of the aquifer. [012721:105-06 AM (Loughlin)]. When wells are pumped in the confined aquifer, a groundwater model demonstrates that the wells can draw water from the entire area of the aquifer. [012721:37-38 PM (Loughlin)]

Finding of Fact No. 85. A natural groundwater divide existed beneath Black Mesa under predevelopment conditions, i.e., before wells were drilled into the aquifer. North of the divide, the groundwater flowed to the northeast on the Navajo Reservation. South of the divide, groundwater flowed to the southwest beneath the 1882 Reservation. [Hopi Exh. 4359 at 17 (PDF 24), Figure 17] In 1983, the U.S. Geological Survey estimated annual recharge near Shonto to be 4,830 acre-feet. [Hopi Exh. 4359 at 17 (PDF 24)] More recently, the confined N Aquifer annual recharge rate has been estimated between 2,500 and 3,500 acre-feet. [Hopi Exh. 4579 at 17 (PDF 24)]

Finding of Fact No. 86. A small amount of water in the N Aquifer is derived from vertical leakage from the D Aquifer. [120720:29 PM (Greenslade); 091520:46–47 PM (Ward)] The D and N Aquifers are separated by low permeability rocks, allowing some seepage. The groundwater models assume seepage of 200 to 2,100 acre-feet per year from the overlying D Aquifer into the N Aquifer. [Hopi Exh. 4579 at 18 (PDF 25)]

Finding of Fact No. 87. Outflow from the N Aquifer occurs as surface discharge to streams and springs, evaporation and transpiration, subsurface seepage into alluvium along stream channels, and withdrawals through pumping. [Hopi Exh. 4359 at 10 (PDF 17); *see also* U.S. Exh. 1209 at 7 (PDF 15)]

Finding of Fact No. 88. There is an estimated 293 million acre-feet of water stored in the confined portion of the N Aquifer. [012721:24-25 AM (Loughlin); LCRC Exh. 135 at 17]. Not all water in storage in the N Aquifer is recoverable by wells. [021121:7–9 AM (Blandford)]

Finding of Fact No. 89. About one-fourth of the 293 million acre-feet of water stored in the N Aquifer, approximately 73 million acre-feet, could actually be withdrawn. [012721:25 AM (Loughlin); 012721:17-19 PM (Loughlin)]

Finding of Fact No. 90. There is a negligible or no hydrological connection between the N Aquifer and the underlying C Aquifer. [Hopi Exh. 4359 at 10 (PDF 17); 092920:41 AM (Blandford); 120720:85 AM (Greenslade)]

Finding of Fact No. 91. Well yield from the N Aquifer on the 1882 Reservation in the vicinity of the Hopi Mesas is about 100 gallons per minute. [091318:49–50 PM (Blandford)] The N Aquifer thickens in the northern portion of the 1882 Reservation and there the well yield is about 350 gallons per minute. In the very far northeastern corner of the 1882 Reservation, the yield is about 500 gallons per minute. [*Id.*]

Finding of Fact No. 92. Well yield from the unconfined N Aquifer under Moenkopi Island is between 25 and 30 gallons per minute. [091318:30, 49–50 PM (Blandford)] There are no locations in Moenkopi Island where significant quantities of groundwater (more than 10 to 30 gallons per minute) can be obtained from N Aquifer wells. [Hopi Exh. 4579 at 19-20 (PDF 26–27)]

Finding of Fact No. 93. In most areas, the N Aquifer water quality is very good. The N Aquifer water, however, exceeds the EPA's maximum contaminant level for arsenic at First and Second Mesas. [Hopi Exh. 4579 at 20 (PDF 27)]

a) Historical Pumping of the N Aquifer

Finding of Fact No. 94. The USGS established a monitoring program for water resources in the Black Mesa area in 1971. [Hopi Exhs. 1372–1396]

Finding of Fact No. 95. The USGS monitoring program consists of monitoring water levels and water quality in the N Aquifer, compiling information on water use by PWCC pursuant to its lease agreements with the Hopi Tribe and the Navajo Nation, maintaining several stream-gaging stations, measuring discharge at selected springs, conducting studies, and reporting findings. USGS has prepared progress reports on the monitoring program since 1978. [Hopi Exh. 4355 at 2 (PDF 12), 6-8 (PDF 16–18); Hopi Exhs. 1372–1396; Hopi Exh. 4359 at 1(PDF 8); Hopi Exh. 4361]

Finding of Fact No. 96. According to published USGS monitoring reports, groundwater withdrawals from the N Aquifer for mining and municipal uses began around 1965. Groundwater withdrawals from the N Aquifer reached a peak of 8,000 acre-feet in 2002. The average annual withdrawal between 1965 and 2016 was 5,063 acre-feet. This includes all withdrawals from the N Aquifer by PWCC, the Hopi Tribe, and the Navajo Nation. [Hopi Exh. 4355 at 5-6 (PDF 15–16)]

Finding of Fact No. 97. Groundwater pumping has caused measurable N Aquifer water-level declines. Since groundwater pumping on the PWCC Lease area has been reduced by more than three-quarters since the end of 2005, water levels have begun to recover in the observation wells. [U.S. Exh. 1209 at 9 (PDF 17)]

Finding of Fact No. 98. Water level declines have also led to reduced flow of some monitored N Aquifer springs. [Hopi Exh. 105 at 35 (PDF 40)] Primarily due to pumping at the Hopi municipal supply wells on Moenkopi, the discharge at Moenkopi School Spring has declined between 1987 and 2013. [*Id.*]

Finding of Fact No. 99. The effect of N Aquifer groundwater pumping on flows from springs emanating from the D Aquifer has been small or nonexistent. [Hopi Exh. 105 at 31 (PDF 36)] N Aquifer groundwater pumping has not affected spring flows emanating from the T Aquifer. [*Id*]

b) Modelling to Project Future Supplies of Groundwater

USGS developed a groundwater model to understand aquifer conditions and compare future effects of pumping. [Hopi Exh. 4359 at 1-3 (PDF 8–10)] The USGS model is a two-dimensional model of the N Aquifer that simulates both the confined and unconfined portions of the N Aquifer. The model was developed in 1983. [Hopi Exh. 4359] In 1988, the model was recalibrated with finer grids and revised estimates of selected aquifer characteristics. [Hopi Exh. 4361 at 1 (PDF 6)] The model was updated by to extend the simulation time and incorporate applicable historic groundwater pumping. [Hopi Exh. 4579 at 24 (PDF 31); Hopi Exh. 4355 at 6 (PDF 16)] Discharge from the N Aquifer is simulated using MODFLOW drain and river cells (representative of springs and base flows, respectively) along the southwestern and northeastern model boundaries. Recharge from precipitation is applied using the MODFLOW recharge package; the majority of recharge occurs near the Shonto area. Downward leakage from the overlying D Aquifer is simulated using the MODFLOW general head boundary, although the amount of simulated leakage is small. The model bottom is a no-flow boundary. The model has both steady-state and transient periods. [Hopi Exh. 4579 at 24 (PDF 31)]

Four parties retained hydrogeologists or hydrologists who analyzed the available groundwater supply of water to meet the claimed demand. John Ward, a hydrogeologist, testified on behalf of the United States. He updated and recalibrated the USGS model by adjusting multiple input parameters, including recharge, hydraulic conductivity, and aquifer storage coefficient. Selected boundary conditions were also adjusted. [Hopi Exh. 4579 at 26 (PDF 33); U.S. Exh. 1209 at 27–28, PDF 56–58; 091520:18 AM (Ward)] All of the experts in this proceeding agree that Mr. Ward's recalibration of the model was an improvement to the USGS model. [120720:92 AM (Greenslade); 021121:30 AM (Blandford); *see also* 020921:101 AM (Nicholls)] Mr. Ward used the recalibrated model to evaluate the impact of pumping 21,951 acre-feet per year in the future from the N Aquifer. [U.S. Exh. 1209 at 27 (PDF 35)] This amount is approximately the total of 8,750 acre-feet per year for domestic, municipal, commercial and industrial use, 1,255 acre-feet for mining, 6,500 for the coal-fired power plant, 498 acre-feet per year for stock and wildlife watering, and 4,977 acre-feet for future irrigation. (U.S. Exh. 1209 Table 3 (PDF 50) Mr. Ward testified that the criterion used to determine the physical availability of groundwater was limited to whether any of the model cells went dry during a 200-year simulation period. [U.S. Exh. 1209 at ES-2 (PDF 7)] Mr. Ward did not consider as criteria the economics of well field development and conveyance facilities or the impacts of pumping to streamflow, spring discharge, evapotranspiration, or other water resources. [Id.; 091520:86–87 AM (Ward)]

Mr. Ward concluded that there was sufficient water in the N Aquifer to pump groundwater to meet the demands identified by the United States through the year 2200. [U.S. Exh. 1209 at ES-3 (PDF 8)] While he projected water shortages in some areas of the Hopi Reservation, including on Moenkopi Island, he testified these shortfalls could be made up by additional pumping from other areas in the Hopi Reservation. [*Id* at ES-3 (PDF 8).; 091520:74, 88 AM (Ward)] The anticipated pumping would withdraw the vast majority of the groundwater from aquifer storage. The remaining pumping would draw groundwater that currently is discharged from the aquifer as stream base flow or is used by plants as evapotranspiration. [U.S. Exh. 1209 at 30 (PDF 38)]

Mr. Neil Blandford, a hydrogeologist retained by the Hopi Tribe, evaluated the physical availability of water in the N Aquifer subject to hydrologic constraints (drawdown criteria) to maintain the confined condition of the N Aquifer. [Hopi Exh. 4579 at 35-36 (PDF 42–43); 092920:44-45, 60 AM (Blandford); 092920:50 PM (Blandford); 093020:45 AM (Blandford)] The model, as revised, prevented pumping that would reduce the water table below a set level. [012721:16, 18-22 AM (Loughlin); LCRC Exh. 135, at 13]

Mr. Blandford used the model as recalibrated by Mr. Ward to simulate future pumping applying a multi-node package to estimate the water levels at specific well locations and applying drawdown constraints to maintain the confined nature of the N Aquifer at production well locations. [092920:55–56 PM (Blandford); Hopi Exh. 4579 at 44–45] Mr. Blandford testified that the changes he made that focused on simulated water levels at well locations as opposed to the larger areas used by Mr. Ward would provide a more realistic representation of N Aquifer yield and drawdown at well fields on the Hopi Reservation. [*Id.* at 56] He also imposed constraints on the amount of water that could be pumped from the N Aquifer to maintain a portion of the N Aquifer as a confined aquifer. [Hopi Exh. 4579 at 45].

Finding of Fact No. 100. Mr. Blandford, using the model as modified, analyzed two scenarios. The first scenario modelled pumping by the Hopi Tribe and the Navajo Nation of 29,089 acre-feet per year and the second totaled 45,034 acre-feet per year. [Hopi Exh. 4579 at 128] He generated a table that showed that the magnitude of claims by the Hopi Tribe, primarily for more than 19,000 acre-feet for domestic, commercial, municipal, and industrial uses and irrigation of thousands of 0.8 acre plots, could not be met by pumping the N Aquifer over an extended period if certain water levels were to be retained in the aquifer. [Hopi Exh. 4579 at 53, 129; 092920:53–54 AM (Blandford)] Similar to Mr. Ward, Mr. Blandford stated that the long-term sources of groundwater for pumping are from storage and that the pumping would reduce base flow of streams and washes, increase seepage from the D Aquifer, decrease evapotranspiration, and decrease spring flow [092920:54–55 AM (Blandford); Hopi Exh. 4579 at 11 (PDF 48), 108, 129]

Mr. Blandord ran the model for 100, 200, 500 and 1,000 years that showed the deficits (the amount of groundwater demanded that exceeded groundwater pumped from the N Aquifer). [Hopi Exh. 4579 at 53, 129; 092920:53–54 AM (Blandford)] According to Mr. Blandford's tables, the N Aquifer, as limited by his modelling constraints, could supply approximately 18,600 acre-feet per year for 200 years.

Finding of Fact No. 101. The constraints that Mr. Blandford included in the model reduced the amount of groundwater that the model would show as available to supply the Hopi Tribe's demands from the N Aquifer. [012721:16 AM (Loughlin); LCRC Exh. 135, at 13, 17]

Finding of Fact No. 102. If pumping caused the N aquifer to change from a confined to an unconfined aquifer, the change in conditions does not preclude the pumping of water from that portion of the aquifer. [093020:45 AM (Blandford)]

Finding of Fact No. 103. The reported deficits increase with time, but the accuracy of the results of a groundwater model decrease and uncertainty increases as models are run for extremely long periods of time such as 200 years or more. [092920:24-25 PM (Blandford); 091520:79 AM (Ward); 120720:19 AM (Greenslade)]

As stated in the Section I, the scope of this case is limited to the adjudication of federal reserved water rights to water appurtenant to the Hopi Reservation. The development of a management plan for the N Aquifer or the selection of policy objectives to govern the use of the N Aquifer is outside the scope of this case. Also, policy decision about whether the N Aquifer should be pumped until the confined portion of that aquifer becomes unconfined is not an issue in this case.

Mr. William Loughlin, a hydrogeologist retained by the LCR Coalition, considered the model simulations run by Mr. Blandford. He testified that 30,000 acre-feet per year could be pumped from the N Aquifer over the next 100 years and 26,000 acre-feet per year could be pumped over the next 200 years. [012721:12 AM (Loughlin)] Mr. Loughlin did not consider or model pumping from the N Aquifer over the next 1,000 years. [012721:70–71 AM (Loughlin)] Mr. Loughlin concluded that the perennial yield of the N Aquifer is 12,000 to 13,000 acre-feet annually. [012721:12 AM (Loughlin); LCRC Exh. 135 at 17]

Finding of Fact No. 104. The perennial yield of groundwater that can be withdrawn from the N Aquifer on an annual basis, without exceeding the long-term recharge or unreasonably affecting the physical or chemical integrity of the N Aquifer, is 12,000 to 13,000 acre-feet of water per year. [LCRC Exh. 110 at 7]

6. Coconino Aquifer

Finding of Fact No. 105. The C Aquifer, named for the Coconino Sandstone, is the deepest aquifer and extends beneath the entire Hopi Reservation as well as the entire Little Colorado River Basin and is generally not recharged by precipitation on Black Mesa. [091318:65 AM (Blandford); 091318:40 PM (Blandford)]

Finding of Fact No. 106. Most recharge to the C Aquifer occurs where precipitation is relatively high such as along the Mogollon Rim, in the San Francisco Peaks, and around the

Defiance Uplift near Ganado. Estimated recharge to the C Aquifer is about 319,000 acre-feet per year. [Hopi Exh. 4579 at 21 (PDF 28); NN Exh. 756 at 8 (PDF 13)]

Finding of Fact No. 107. Groundwater in the C Aquifer beneath the Hopi Reservation flows to the west and northwest from the principal recharge area along outcrops located south and east of Black Mesa. The primary discharge area for groundwater in the C Aquifer is Blue Spring and other seeps and springs near the Colorado River. [Hopi Exh. 4579 at 21 (PDF 28)]

Finding of Fact No. 108. Beneath the Hopi Reservation, the C Aquifer occurs at depths of about 2,000 to 3,000 feet below ground surface ("bgs") or more. [Hopi Exh. 4579 at 22 (PDF 29)]

Finding of Fact No. 109. The Hopi Tribe completed an exploratory well at Moenkopi to investigate the C Aquifer as a water source. The TDS of C Aquifer water was 3,610 milligrams per liter.

Finding of Fact No. 110. The completed well, MC-1, was used from 2012 to 2018, when it was discontinued due to the high cost of water treatment. [Hopi Exh. 4579 at 22 (PDF 29); NN Exh. 756 at 8 (PDF 13)]

Finding of Fact No. 111. Even though C Aquifer groundwater has high salt content, it can be used for industrial purposes. [101520:27 AM (Amali)]

Finding of Fact No. 112. C Aquifer groundwater with high concentrations of total dissolved solids is appropriate for the proposed coal operations facility because it can be treated cost-effectively. [101320:54 AM (Luenke)]

Finding of Fact No. 113. Mr. Blandford modeled the C Aquifer on the reservation. [093020:64-65 AM (Blandford)]. The drawdown in the modeled C Aquifer over 500 years did not exceed the drawdown criteria established by Mr. Blandford. [093020:65 AM (Blandford)]

C. Wetlands

Wetlands cover approximately 8,000 acres of land on the Hopi Reservation and are characterized "by the presence of water, for some or all of the year, hydric soils, and wetland vegetation." [Hopi Exh. 876 at 22] Darren Talayumptewa, Director of Wildlife and Ecosystems Management Program, testified that the wetlands sustain plants that the Hopi people use for medicinal, traditional, and consumptive purposes; provide habitat for aquatic life important to the Hopi Tribe; and support birds used in Hopi ceremonies. [100918:28, 42 PM (Talayumptewa)]

1. Pasture Canyon

Pasture Canyon is a slot canyon with seeps along the sides and wetlands areas along the bottom of the canyon. [100218:47 AM (Puhuyesva)] Lionel Puhuyesva, the former head of the Hopi Tribe's Water Resources Department, explained that the Pasture Canyon wetland is a habitat for wildlife, birds that provide feathers for religious and ceremonial purposes, and plants, such as whipple cattails, that are used in ceremonial dances. [100218:47, 52–53 AM (Puhuyesva)] Leonard Selestewa, the former president of the Moenkopi Natural Resources Conservation District and former chair of the village water and sanitation committee, explained that Pasture Canyon has religious significance to the Hopi in addition to providing a source of reeds and other plants. [101018:5–6 PM (Selestewa)]

Finding of Fact No. 114. The wetlands of Pasture Canyon have cultural and religious significance to the Hopi Tribe.

The United States, on behalf of the Hopi Tribe, claims 315.5 acre-feet annually for riparian and wetland habitat in Pasture Canyon. In the Hopi Reservation HSR, Arizona Department of Water Resources estimated water use for Pasture Canyon riparian area in the range of 165.7 to 317 acre-feet annually. [Hopi Exh. 7 at 4-40 (PDF 41); Hopi Exh. 8 at 5-8 (PDF 9); Hopi Exh. 9 at Table 5-1 (PDF 22)] Arizona Department of Water Resources did not identify a source of water. [*Id.*]

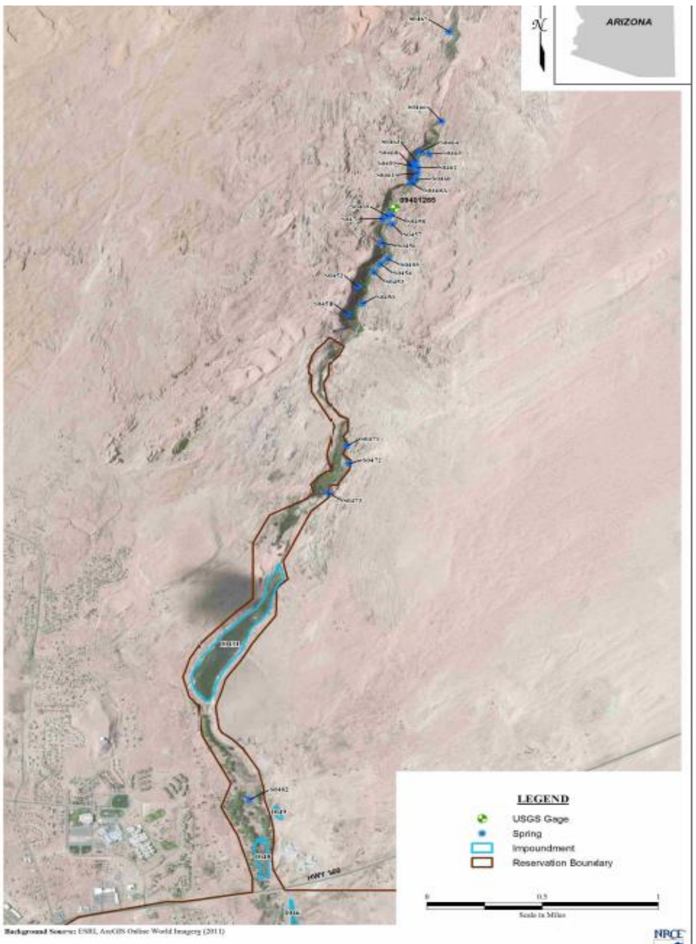

Figure 3

Finding of Fact No. 115. Pasture Canyon is located on Moenkopi Island and covers 69.4 acres. [U.S. Exh. 539 at 4-1 (PDF 20)] The southern end begins at U.S. Highway 160 and runs north for approximately 4.25 miles. [US Exh. 539 at 2-1 (PDF 7)]

Finding of Fact No. 116. The canyon floor rises from an elevation of approximately 4,820 feet above mean sea level at Highway 160 on the Hopi Reservation to 5,129 feet about mean sea level at the northern end located on the Navajo Reservation. [*Id.*]

Finding of Fact No. 117. Approximately 75 percent of Pasture Canyon is on the Hopi Reservation with the remainder on the Navajo Reservation. *See figure 3* As shown on *figure 3* there are 25 springs north of the Pasture Canyon Reservoir and a 26th spring (designated by the

United States as S0 482) is located in the canyon between Pasture Canyon Reservoir and Highway 160.

Finding of Fact No. 118. The following springs are located north of the Hopi Reservation: S0450, S0451, S0452, S0453, S0454, S0455, S0456, S0457, S0458, S0459, S0460, S0461, S0462, S0463, S0464, S0465, S0466, S0467 (Eagle Nest, Talakwava), S0468, S0468A, S0469, S0470. [U.S. Exh. 539 at 9; U.S. Exh. 739]

Conclusion of Law No. 30. In *Masayesva v. Zah*, 816 F. Supp. 1387 (1992), *aff'd in part, rev'd in part sub nom. Masayesva v. Zah*, 65 F.3d 1445 (9th Cir. 1995), *amended on denial of reh'g and reh'g en banc* (Dec. 5, 1995), the United States District Court for the District of Arizona granted the Hopi Tribe an easement to ensure the flow of the springs at the head of Pasture Canyon to the Pasture Canyon Reservoir. *Id.* at 1420, 1424. The federal court retained jurisdiction as to the matter. *Id.* at 1420.

The United States retained Dr. Thomas Ley to quantify the use of water in Pasture Canyon necessary to maintain riparian and wetland purposes. Dr. Ley conducted his analysis by categorizing Pasture Canyon into four discrete areas: grass with overlying shrub canopy; grass with overlying tree canopy; wetlands; and small, shallow open water/wet soil. [U.S. Exh. 539 at 4-1 (PDF 21)] For each category, he estimated the evapotranspiration losses normally associated with each category and consumptive requirements and used a model and data for the 66-year period from 1949 to 2014 to calculate water use. [*Id.* At 4-1 (PDF 20)] The water analysis included wet and dry cycles. [092618:16 PM (Ley)]

Water use by riparian vegetation and wetlands occurs due to physical location and generally not as a result of water diversion and conveyance to those areas. [U.S. Exh. 539 at 3-2 (PDF 15)] Thus, total consumptive water requirements of riparian areas and wetlands were assumed to be equal to the net consumptive water requirements. [*Id.*] Dr. Ley calculated that the average amount of water used on the wetlands was 286.8 acre-feet per year to provide for the needs of the four types of land within the wetlands. [092618:13 PM (Ley)] He also estimated a maximum amount of water used in the wetlands based on the assumption that the maximum amount was ten percent greater than the average amount. Dr. Ley does not provide an explanation that supports the ten percent increase.

Finding of Fact No. 119. The amount of water necessary to maintain Pasture Canyon's riparian and wetland habitat for purposes of a permanent homeland is 286.8 acre-feet per year. [092618:12–13 PM (Ley)]

Conclusion of Law No. 31. Water rights for riparian and wetland habitat are *in situ* rights at a specific location and cannot be transferred to a different location.

Initially the primary issue with respect to the wetland claims was whether the same acreage was used to support duplicate claims for water for perennial irrigation and for wetlands. Dr. Ley testified that he reviewed historical and current photographs and that none of the photographs showed an overlap between the wetlands and the irrigated areas. He further testified that the water uses for the Pasture Canyon Wetlands and for the 22.2 acres of irrigated land in the general area were mutually exclusive. [092618:11–12, 14, 16 PM (Ley)]

Finding of Fact No. 120. Duplicate claims were not made for the same acreage for perennial irrigation and Pasture Canyon Wetlands.

At trial, the disputed issue appeared to be the identification of the source of water that supported the Pasture Canyon Wetlands because the Navajo Nation's expert had not observed surface flow to or in the riparian area. [103118:46, 48 PM (Leeper)] Dr. Ley's report identified springs as the source of the water for the wetlands. [U.S. Exh. 539 at 2-4 (PDF10)] Dr. Leeper testified that he located the riparian area downstream of the dam and it consisted of cottonwood trees and vegetation, but he could not locate a source of surface flow diverted to the riparian area during his site visit. [103118:49PM (Leeper)] Dr. Leeper concluded that the source of water was subflow[12]. Dr. Ley explained that evidence of water sources varies over time, but that the upper Pasture Canyon springs provide the water source for the wetlands and riparian habitat. [U.S. Exh. 729 at 8]

Finding of Fact No. 121. Spring flow located in Pasture Canyon on the Hopi Reservation provides the primary source of water for the Pasture Canyon wetlands.

2. White Ruin Canyon Wash

The Hopi Tribe also claimed 12.39 acre-feet per year for riparian and wetland habitat in White Ruin Canyon Wash. [Hopi Exh. 153; 101518:23 AM (Stevens)]

Finding of Fact No. 122. White Ruin Canyon Wash is a tributary of upper Moenkopi Wash. [Hopi Exh. 153 at 1; 101518:21–22 AM (Stevens); 100918:41 PM (Talayumptewa)]

Finding of Fact No. 123. White Ruin Canyon Wash is located near the headwaters of Moenkopi Wash, at the following GPS coordinates: 36° 12’ 2.9844” N; 110° 44’ 10.5108” W.

Finding of Fact No. 124. White Ruin Canyon Wash area has ecological, spiritual, and cultural significance to the Hopi Tribe. [Hopi Exh. 7 at 4-38 (PDF 39); 100918:28, 42 PM (Talayumptewa)]

Finding of Fact No. 125. White Ruin Canyon Wash requires 12.39 acre-feet per year to maintain the area. [101518:23 AM (Stevens)]

[12] This case is not tried under state law so no presumption is made that the use of the term “subflow” was meant to refer to groundwater subject to the state laws governing appropriable water.

D. Springs

The Hopi Tribe claims the right to reasonable use of the natural flow of each spring on the Hopi Reservation for ceremonial, religious, and cultural uses. The United States claims all natural flow from the springs on the reservation. It produced a list of 382 springs and characterized the uses as combination of cultural, domestic, livestock watering, irrigation, and public supply uses. [U.S. Exh. 739]

Finding of Fact No. 126. Ninety percent of the springs on the Hopi Reservation have diffuse discharge that is difficult to quantify because some of the springs emerge from several areas along thousands of yards of canyon, some have low flow, making measurement difficult and time consuming, and some are in very remote and difficult to reach areas. [102920:38–40, 44–45 AM (Duffield); 092920:101 AM (Blandford)]

Finding of Fact No. 127. None of the springs listed on the United States' inventory admitted into evidence includes a quantity or a flow rate. [U.S. Exh. 739] The Arizona Department of Water Resources was able to identify discharge data for more than 200 springs, but the flow for many of the springs was less than 0.01 gallons per minute. [Hopi Exh. 48 at D-6 (PDF 8)]

Finding of Fact No. 128. There are five springs in Land Management District 6 for which ADWR provided no flow data, but the United States introduced evidence that the springs were used to irrigate lands. Those five springs are labelled by the United States as S104, S119, S1017, S137 and S1417.

Federal reserved water rights do not attach to all sources of water. For example, the federal government cannot reserve a right to rain under the *Winters* doctrine. Here, claims are made to springs that produce very small quantities of water, many so small that they cannot be precisely measured as required by *Gila V*. The Hopi Tribe and the United States contend that notwithstanding the inability to quantify the flow, they should receive federal reserved water rights to all water in the springs.

Under state law, an appropriable right will not attach to a source that produces so little water that it cannot either be quantified or put to a beneficial use. *Fourzan v. Curtis*, 43 Ariz. 140, 29 P.2d 722 (1934). In *Fourzan*, the Court found that legal rights cannot attach to a water source that could not produce more than a gallon per minute, reasoning:

> A sine qua non to a valid appropriation of water, under our law, is that it shall be applied to some beneficial use. It would seem to follow as a corollary that an amount of water which cannot be applied to such a use is not subject to the law of appropriation, and the undisputed testimony shows that it is doubtful if South Grass Seep, in its original condition, produced enough water on the surface so that it could be even gathered and carried away in cups, let alone through trenches or pipes in the ordinary manner.

43 Ariz. at 146, 29 P.2d at 724.

The reasoning of the *Fourzan* decision is consistent with federal law that limits the grant of federal reserved water rights to those water sources and in those quantities necessary for the permanent homeland and abiding place for the Hopi people living on the reservation. If the source of water produces so little water that it cannot be reasonably measured then, as the *Fourzan* Court held, it is doubtful that the water can be put to use on the reservation in such a fashion that legal rights can attach.

Conclusion of Law No. 32. A federal reserved water right cannot apply to a source of water that cannot be located.

Conclusion of Law No. 33. A federal reserved water right cannot apply to springs that produce so little water that they cannot be quantified.

In *Fourzan*, the court determined that flow equal to a gallon per minute would not suffice to serve a beneficial use. In this case, claims are made to spring flow that involves piping water for irrigation or stockwatering, which *Fourzan* determined would require a rate of flow greater than a gallon per minute to be useful. Claims are also made for ceremonial, religious, and domestic uses. Micah Loma'omvaya described collecting a gourd of water from a spring for a religious ceremony. [100418:28 (Loma'omvaya)]. Bill Preston described using a spring to wash. [120220:14 AM (Preston)] Sarah Dallas testified about hauling water from a spring for drinking and preferring it because the water had not been treated. [110420:10 AM (Dallas)] Lionel Puhuyesva related how he carried a five-gallon bucket each day to a spring to collect water for use in the home. [110420:10 AM (Puhuyesva)] Additional evidence was introduced by the United States that people without access to a municipal system hauled, on average, 8.8 gallons per day from windmills and springs. [U.S. Exh. 826 at 4] Thus, a smaller amount of flow from a spring may suffice to provide for needs that can be satisfied at the site of the spring without the need for transport. After eliminating all springs for which ADWR could measure no or very little flow, 94 springs remained that generated a measurable flow of at least 0.5 gallons per minute.

Finding of Fact No. 129. A flow of at least 0.5 gallons per minute is sufficient to meet cultural, ceremonial, religious, and domestic uses supplied by springs as described by the witnesses.

Finding of Fact No. 130. Spring flow of at least 0.5 gallons per minute is sufficient to meet cultural, ceremonial, religious, and domestic uses that are necessary to make the reservation a permanent homeland and abiding place.

Conclusion of Law No. 34. The 94 springs included in the Recommended Decree with flow rates are sufficiently quantified and otherwise described by the attributes of place of use, point of diversion, source, and type of use for which federal reserved water rights can properly be adjudicated.

Conclusion of Law No. 35. The five springs in Land Management District 6, included in the Recommended Decree, without a flow rate, are sufficiently quantified by the number of acres irrigated, and are otherwise described by the attributes of place of use, point of diversion, source, and type of use for which federal reserved water rights can properly be adjudicated.

V. Tribal History and Culture

The *Gila V* decision requires that a determination of federal reserved water rights should include consideration of tribal history and culture:

> A tribe's history will likely be significant. Deference should be given to practices requiring water use that are embedded in Native American traditions. Some rituals may date back hundreds of years, and tribes should be granted water rights necessary to continue such practices into the future. An Indian reservation could not be a true homeland otherwise.
>
> In addition to history, the court should consider tribal culture when quantifying federally reserved rights. Preservation of culture benefits both Indians and non-Indians; for this reason, Congress has recognized the "unique values of Indian culture" in our society. 25 U.S.C. § 1902 (1994) (recognizing the importance of culture when placing Indian children in foster care); *see also* 20 U.S.C. § 7801 (1994) (finding that education should "build on Indian culture"). Water uses that have particular cultural significance should be respected, where possible. The length of time a practice has been engaged in, its nature (e.g., religious or otherwise) and its importance in the tribe's daily affairs may all be relevant.

201 Ariz. at 318-319, ¶43, 35 P.3d at 79-80.

The Hopi have been living in the Little Colorado River Watershed for almost a thousand years. The occupation of the village of Orabi has been dated to as early as 1150 while another archeologist concluded that the Hopi Tribe can be traced by the archeological record to the thirteenth century. [Hopi Exh. 87 at 4 (PDF 16); Hopi Exh. 3872 at 4 (PDF 9)] Federal courts have issued decisions consistently with estimates that the Hopi have been living in the Little Colorado River Watershed for centuries. The federal district court found that "[a]s far back as the Middle Ages the ancestors of the Hopis occupied the area between Navajo Mountain and the Little Colorado River, and between the San Francisco Mountains and the Luckachukas. *Healing v.*

Jones, 210 F. Supp. 125, 158 (D. Ariz. 1962), *aff'd per curiam sub nom. Jones v. Healing,* 373 U.S. 758 (1963). The Indian Claims Commission made the following findings of fact:

> Before 1300 A.D. the ancestors of the Hopi were identified in the area between Navajo Mountain in the northwest corner of the overlap area and the Little Colorado River to the south, and between the San Francisco Mountains well south of the overlap area and the Luckachuais Mountains in the northeast portion of the subject tract.

Hopi Tribe and Navajo Tribe v. United States, 23 Ind. Cl. Comm. 290, at 292-93, *motions to amend findings denied*, 31 Ind. Cl. Comm. 16, 37 (1973) and 33 Ind. Cl. Comm. 72 (1974), *aff'd mem*., *Hopi Tribe v. United States, sub nom. Burket v. United States*, 529 F.2d 533 (Table) (Ct. Cl. 1976), *cert. dismissed*, 429 U.S. 1030 (1976)

The Hopi Tribe's oral history, as well as religious beliefs, associated with agriculture, provided below, is that the Hopi have lived on the land currently included in the 1882 Reservation as well as surrounding land as an agrarian society. Troy Honahnie testified that agriculture and farming has sustained the Hopi people for thousands of years and has allowed them to survive even through difficult periods of drought and disease. [120120:17, 27 PM (Honahnie)] European history begins with reports from Spanish explorers in the sixteenth century that the Hopi grew crops using irrigation from springs, flood irrigation from the washes, run-off from the hills, and by plantings in sand dunes. [See Hopi Exh. 3872 at 124; *see also* Hopi Exh. 87 at 116–117; Hopi Exh. 3911 at 81–82] Documented accounts of Hopi existence and agrarian practices continued into the 1800s that described abundant crops of corn, pumpkins, melons and also described groups of gardens from ten to twelve square feet planted with onions, lettuce, and cabbage and watered by a large spring. [Hopi Exh. 3883 at 150 (PDF 158)] Hopi agriculture has changed over time because they have "adopted new cultivars, agricultural implements, and farming strategies to take advantage of new opportunities and adjust to changing environmental and societal conditions." [*Id.* at 1 (PDF 9)]

Finding of Fact No. 131. For centuries the Hopi have successfully and consistently farmed land later included in the reservation by implementing a variety of farming techniques adapted to the arid region.

Finding of Fact No. 132. Hopi agricultural practices continue to the present and are a major part of the activities of the Hopi households that continue to grow and plant for ceremonial and subsistence purposes. [Hopi Exh. 4580 at 53–56; 120320:86–87 AM (Nuvangyaoma); 110920:18 AM (Tenakhongva) ("All [crops are] always used for ceremonial use, regardless of how you view it as far as consumption"); *see also id*. at 98 ("Hopi believes in every crop that we grow is for the purpose of human consumption and ceremonial use, yes.")]

Finding of Fact No. 133. The planting, growing, and harvesting of crops are important to the cultural identity and are integral to the religion of the Hopi people. [120120:27–28 PM (Honahnie); 100418:54–55 AM (Loma'omvaya)]

Finding of Fact No. 134. Corn is widely used in religious and cultural ceremonies celebrating birth, marriage, and death. [100418:38–40 PM (Loma'omvaya); *see also* 101018:40–41 AM (Selestewa) (explaining how white corn is given to a child at birth and how at death it is put in the grave); 100818:38 AM (Nuvangyaoma); 100818:61–62 PM (Youvella); 120120:20–22, 28 AM (Secakuku) (explaining how corn is used in naming ceremonies and weddings); Hopi Exh. 3883 at 40–41] Corn is treated as a relative as it is growing, and farmers sing and pray to it while caring for its needs. [101018:34 AM (Selestewa) ("[Y]ou love them, you talk to them, you sing to them"); 100518:29 AM (Elmer) (explaining that "you sing among your plants as they come up," encouraging them to grow up); 120220:31 AM (Preston)] The phrase "corn is our mother" is said to signify that corn creates culture because it sustains life. [Hopi Exh. 3883 at 28; 100418:42–43 PM (Loma'omvaya)]

The following is a description of Hopi religious beliefs submitted by and in the words of the Hopi Tribe:

> Finding of Fact No. 209. The agricultural practices of the Hopi are rooted in the sacred story of Hopi origin. According to Hopi oral history, the Hopi emerged from three previous worlds, which had become self-destructive, into this current Fourth World by maintaining vigilance, prayer, and the desire for a better life. [Hopi Exh. 876 at 10] Upon emergence in this Fourth World, the Hopi encountered the deity Maasaw who gave them his blessing to live on the land. [*Id.*] Maasaw required that the Hopi follow in his path as humble farmers and respect the land through religion and guidelines that he passed on to them. [*Id.*] A covenant was thus established between Hopi and Maasaw in which land was set aside for the Hopi to live as stewards of the land. [Id.; *see also* Hopi Exh. 3910 at 11–12; 100418:16–20, 23 PM (Loma'omvaya); 100218:93–94 PM (Puhuyesva); 100818:59–60 PM (Youvella)]
>
> Finding of Fact No. 210. To live as a farmer is part of the Hopi covenant. [110520:104 AM (Sekaquaptewa); 100418:23 PM (Loma'omvaya)] Maasaw presented the Hopi with three gifts that symbolized their life principles: corn seeds, a gourd filled with water, and a planting stick. [100418:22–23 PM (Loma'omvaya); 101018:31 PM (Selestewa); 110520:103 AM (Sekaquaptewa)] Corn was to be the soul of the Hopi people. The planting stick provided a simple and dependable farming tool. The water gourd represented Maasaw's blessings and the relationship with the natural environment. [100418:19–23, 28 PM (Loma'omvaya); Hopi Exh. 3883 at 29]
>
> Hopi Finding of Fact No. 211. Hopi religious cycles are structured around agriculture. [120120:33–34 PM (Honahnie); Hopi Exh. 3877 at 5] Between the winter solstice through March, ceremonies are performed to ensure a good planting season. The winter solstice marks the beginning of the Katsina season. A primary ceremony held in early February is the arrival of the Katsina Crow Mother and her many children who present the villagers and children with gifts of fresh bean sprouts, Katsina dolls and rattles, lightning sticks, and dancing wands. At this time, Hopi women determine which crops will be needed for the year's harvest and prepare the seeds. Seeds are blessed with water and prayer for them to grow strong. [Hopi Exh. 3877 at 5; 120220:30–31 AM (Preston); 120120:33–36 PM (Honahnie)]
>
> Hopi Finding of Fact No. 212. The season of songs, rain, and growth begins in March. The fields are planted, and the farmers guide the plants to grow by singing to them, scaring away the rabbits and rodents, clearing worms from the individual plants, and building and maintaining flood channels to the field. During this time, Katsina rituals are performed. Katsinas are believed to be the benevolent spirit beings that reside in (or essentially are) the clouds in the skies—spirits of

> ancestors. Ceremonies are performed to ask the spirits to bring rain for the crops to flourish. [Hopi Exh. 3877 at 5]
>
> Hopi Finding of Fact No. 213. Agricultural rituals include the offering of paaho (prayersticks), use of field shrines, ritual races, growing beans and corn in kivas, and smoking to bring rain clouds. [Hopi Exh. 3883 at 27; *see also* 100918:26–27 AM (Honanie) (explaining Hopi prayer and ceremonial activities); 120120:33–36 PM (Honahnie)] The end of the Katsina ceremonies comes in late July with the beginning of the monsoon season. [Hopi Exh. 3877 at 5]
>
> Hopi Finding of Fact No. 214. The harvesting season begins at the end of the summer and continues through early November. Ceremonies are conducted during this time, including the Snake or Flute dance and the priesthood ceremonies. The winter solstice marks the beginning of the Hopi new year. [Hopi Exh. 3877 at 5]
>
> Hopi Finding of Fact No. 215. In other words, religious ceremonies are associated with every aspect of farming, from the clearing and planting of fields through harvest. [Hopi Exh. 3883 at 27] The very act of farming demonstrates faithfulness to the covenant made with Maasaw. [120120:33–35 PM (Honahnie) ("[W]e're continuing to perpetuate that ceremony of life by planting and agriculture"); 120320:86–87 AM (Nuvangyaoma) ("[E]very component of planting has [a ceremonial] connection to Hopi and prayer"); 120220:30–31 AM (Preston)]

Finding of Fact No. 135. The continuation of agricultural practices on the Hopi Reservation has religious and cultural significance to the Hopi Tribe.

The dominant role of agriculture in the lives of the people living on the reservation can also be seen in the management and control of land. The distribution of farmland is traced back to the time a village was founded when farmlands were divided among the clans. Hopi kinship is based on matrilineal principles, with inheritance and primary social identity passed through women. [Hopi Exh. 3883 at 30–31; Hopi Exh. 3891 at 14; 100418:56–60 AM (Loma'omvaya); *see also Hopi* Exh. 87 at 114–115.] Within the clan, matrilineages had use of particular fields. Family fields are scattered between various plots and cultivated by the husbands, brothers, or sons of the women in matrilineages. [Hopi Exh. 3891 at 6–10, 14; Hopi Exh. 3883 at 32–33; *see also* 102920:9 PM (Lomayestewa) (clan lands belong to Hopi women); 102720:22–23 PM (Onsae) (explaining matrilineal passage of garden plots); 100818:66–68 AM (Nuvangyaoma); 100818:28–29, 31, 38 PM (Nuvangyaoma) (explaining the relationship between clan land ownership and village control/oversight)] Each family and clan has land in more than one location so that if one field fails from drought or flood, others will produce crops. [Hopi Exh. 3883 at 33–34; Hopi Exh. 87 at 109; *see also* Hopi Exh. 3891 at 21–22] Vice Chairman Tenkahongva testified that his extended family had 10 to 12 farms ranging in size from one to two acres to an 80 x 80 plot. [110920:17 AM (Tenakhongva)]

Men sometimes cultivate fields owned by their own clan for the benefit of the household they marry into, and women may similarly acquire the use of fields in the lands of their father's clan. [Hopi Exh. 3883 at 34; 120120:21, 24, 28 PM (Honahnie) (discussing his inheritance of land from his uncle); 100918:20–21AM (Honanie) (explaining the plots of land he inherited from his father); 110420:10–11 AM (Dallas) (explaining that her husband farmed his grandfather's land)] In the traditional land use system, any man could establish a field outside of clan lands by cultivating it. These individual fields could be assigned to others but if a farmer ceased planting them, the land went back into the common domain. [Hopi Exh. 3883 at 34–35; 120120:18, 55–57 PM (Honahnie) (discussing family homestead outside traditional landholding of village)]

Land use is increasingly regulated by the tribal government and permitted land assignments are now needed to establish new farms on lands not already allocated as part of the traditional clan system. Individual use rights to farmland are gradually superseding clan rights, especially in Third Mesa and Moenkopi. [Hopi Exh. 3883 at 34–35; 120120:41 PM (Honahnie); 100518:30 AM (Elmer); 110420:10–12, 26–28 AM (Dallas)]

Finding of Fact No. 136. Federal reserved rights to water for agricultural use are necessary for the permanent homeland on the Hopi reservation based on Hopi history, culture, religion, and past and current water uses.

VI. Domestic, Commercial, Municipal, and Industrial Uses

All uses of water for domestic, commercial, municipal, and light industrial uses are collectively referred to as DCMI uses. [U.S. Exh. 944 at 5 (PDF 8)] The United States claims federal reserved rights to pump 8,746 acre-feet of groundwater per year for DCMI use. United States Fifth Amended Statement of Claimant at 24. The Hopi Tribe asserts that the federal reserved rights should attach to 9,322 acre-feet of groundwater per year for the same purposes. Hopi Tribe's Sixth Amended Statement of Claimant at 24 (January 18, 2019); Hopi Tribe's Eighth Amended Statement of Claimant at 27 (June 25, 2021). No party disputes the necessity of water for DCMI uses by the people living on the reservation. The primary issue in dispute is the quantity of the federal reserved water right. The United States and the Hopi Tribe, as claimants, bear the burden to establish their entitlement to the amount of water claimed. *Arizona II*, 460 U.S. at 637.

Four general types of water use comprise DCMI use. Specific uses that fall within this category or are in this category because of practices exercised on the Hopi Reservation are as follows:

Finding of Fact No. 137. Domestic use includes water used inside the home for drinking, cooking, cleaning, toilets, bathing, and outdoor residential use. [092018:52 (Hamai); U.S. Exh. 944 at 5 (PDF 8)]

Finding of Fact No. 138. Domestic use includes water made available at public taps and public facilities to those people who live in homes without a connection to a public water service.

Finding of Fact No. 139. Domestic use includes municipal water provided by the villages to maintain gardens in the areas surrounding the homes. [092018:52, 54, (Hamai);

102218:37, 73-74 (Whittington); Hopi Exh. 4595 at 45 (Sidney)]

Finding of Fact No. 140. Domestic use includes water from the public water system used to provide for livestock in time of drought or which are stabled near the home. [Hopi Exh. 4595 at 45 (Sidney); 110520:109 AM (Sekaquaptewa); 091720:48-50 AM (Hamai)]

Finding of Fact No. 141. Commercial use includes water uses for business ventures. [U.S. Exh. 944 at 5 (PDF 8)] Current commercial uses include activities undertaken by businesses that are operated for profit which include the Hopi Cultural Center hotel and restaurant, Moenkopi Legacy Inn and Suites, Denny's, and the Tuuvi Travel Center. [092018:54, 55 (Hamai); Hopi Exh. 7 at 3]

Finding of Fact No. 142. Municipal water use includes water uses for government buildings, parks, police stations, fire hydrants, and other public service facilities. Examples of existing municipal uses on the Hopi Reservation include government buildings in Kykotsmov, schools, healthcare facilities, and the Hopi Veterans Memorial Center. [Hopi Exh. 7 at 4-2 (PDF 3); US. Exh. 944 at 5 (PDF 8)]

Finding of Fact No. 143. Light industrial uses include industries that typically produce smaller consumer goods, do not require a large, dedicated water supply, and are typically served out of the public water supply system. [U.S. Exh. 944 at 5 (PDF 8)] Historical examples of light industrial uses that required water include the pottery manufactured at the Hopi Mesa villages after 1300 and until the mid-1600s. [Hopi Ex. 3872 at 1032; NN FOF 11] The Hopis also manufactured cotton and wool textiles during this period. [*Id.*] Excluded uses are heavy industrial uses with a dedicated water supply system that are separate from the public water systems, such as mining and power generation. [Hopi Exh. 7 at 4-2 (PDF 3); 091720:13, 53 AM (Hamai); U.S. Exh. 944 at 5 (PDF 8); LCRC Exh. 583 at 2]

Finding of Fact No. 144. The quantification of water for DCMI uses necessarily includes system losses that typically occur between the point of withdrawal and delivery due to leaks or other inefficiencies as well as water used as part of the operational process—e.g., water used to flush water lines. [See 102120:27–28, 79 AM (Hanemann)] The volume of system losses typically varies from about five percent to fifteen percent of total system usage, depending on the age of the system, pipe materials, local geology, the treatment process, and other variables. [091720:58 AM (Hamai); LCRC Exh. 583 at 39 (PDF 2)]

A. Past and Present Uses

Historically, the Hopi people used little water in their homes. [Hopi Exh. 3898 at 54] They washed their clothes and bathed using water sources outside their homes. [Hopi Exh. 3898 at 54]. They made use of surface water sources: developed and undeveloped springs, running water in streams and washes, natural catchments (playas and cisterns), or artificial catchments (reservoirs). [Hopi Ex. 3872 at 25-30] "Although data on the quantities of water used by the Hopi households in the past are not available, water use was undoubtedly very low. Today, households in developing countries that walk such distances to collect water for domestic use typically collect on the order of 2-3 gallons per person per day, and in the past Hopi household water use was probably comparable." [Hopi Exh. 3898 at 54]

Conclusion of Law No. 36. Domestic water use is an aboriginal water use of the Hopi Tribe.

With the advent of modern technology, the DCMI water use on the Hopi Reservation has changed significantly. In the 1950s, the United States Health Service built small piped-water systems in most Hopi villages. [*Id.*] A well that is powered by an electric pump distributes water through a piped system. [*Id.*] Hopi tribal members testified about the changes in access to water within their homes that they experienced on the Hopi Reservation during their lifetimes. Tim Nuvangyaoma, Chairman of the Hopi Tribe, testified that until the late 1970s, his mother's house did not have water piped into the house, so they had to drive to a well from which they hauled water back to the house in a 50-gallon barrel. [100818:23-25 AM (Nuvangyaoma)] Similarly, Wallace Youvella recalled that when he was young, one of his jobs was to haul water for the family in buckets from a water source below the mesa because the family home did not have indoor plumbing. [100818:48 (Youvella)] Water is now pumped to that house. [*Id.*] Clayton Honyumptewa testified that while growing up on the Hopi Reservation he hauled water from a faucet connected to the upper village water system that was located about 500 feet from his house. [102820: 12-13 AM (Honyumptewa] Kendrick Lomayestewa testified that he hauled water for his family from local windmills and cisterns that collected rainwater. [102020:9 PM (Lomayestewa)] Michael Elmer testified that when he was a young child, he lived in a house that did not have plumbing, so he and his brother hauled water from a spring for the family. [100518:25 AM (Elmer)] Mr. Elmer remembered that the Indian Health Services arranged for indoor plumbing for his family's house in about 1958. [*Id.* at 24-25]

Finding of Fact No. 145. Most of the Hopi villages operate a community water system to at least some of the homes. [Hopi Exh. 3884 at 35 (PDF 40); Hopi Exh. 3900 at 5; 100218:28 PM (Puhuyesva)]

Finding of Fact No. 146. The Hopi villages that are considered traditional villages do not have plumbing infrastructure or have limited the installation of infrastructure. [*Id.;* 100918:53 AM (Honanie)] The villages of Oraibi and Walpi have no household connections. [100918:52 AM (Honanie); 102218:113 (Hanemann)] With funding received by the Hopi Tribe as part of the

CARES Act Emergency Response, however, Oraibi, in collaboration with the Hopi Utilities Corporation, drilled an N Aquifer well to serve the village. This is the first well that has been drilled at Oraibi. [102720:98–99 AM (Onsae)]

Finding of Fact No. 147. Where households are not connected to the village water supply, residents are required to haul water to provide for their domestic needs. [Hopi FOF No. 622]

Finding of Fact No. 148. Approximately eight percent of the homes in the Village of Lower Moencopi have private water connections. [Hopi Exh. 3899 at 5]

Finding of Fact No. 149. About 20 percent of the homes in the Village of Hotevilla do not have indoor plumbing. [110920:15 (Tenkhongva)] A low percentage of the houses in Mishongnovi and Shumgopavi have household water connections. [102218:81 (Hanemann)]

Finding of Fact No. 150. The Hopi rely on springs and wells to provide water for domestic uses.

Finding of Fact No. 151. The N Aquifer provides the primary source of municipal water for the reservation. [102218:68-69 PM (Puhuyesva)]

The United States retained Paul Hamai to estimate the present DCMI water use on the Hopi Reservation. [092018:18 (Hamai)] Mr. Hamai holds a Master of Science in civil engineering and serves as the Vice President of Water Resources for Natural Resources Consulting Engineers, Inc. where he has been employed for 26 years. [U.S. Exh. 546 at 1] Mr. Hamai quantified the amount of water presently used on the Hopi Reservation for DCMI uses by considering three categories of sources:

1) water used by people served by public water supply systems accessing the N Aquifer;

2) water used by people served from a public system not supplied by the N Aquifer; and

3) water used by people from unmonitored wells and springs.

[092018:22 AM (Hamai); U.S. Exh 944 at 5 (PDF 8)]

The USGS monitors the annual pumping of the N Aquifer by wells that serve the Hopi villages. [U.S. Exh. 825 at 5-6 (PDF 3-4)] Mr. Hamai testified that he examined the data collected by the USGS in addition to historical data for the period 1984 to 2015 that was attached to a report prepared by an expert who was retained by the Navajo Nation.

Finding of Fact No. 152. The maximum amount of water for DCMI uses that occurred in a single year on the Hopi Reservation occurred in 2007. [Hopi FOF 618; NN FOF 20]

Finding of Fact No. 153. In 2007, 562.1 acre-feet of groundwater were pumped from the N Aquifer. [092018:23 AM (Hamai); NN FOF 20] The wells at Moenkopi accounted for 124.8 acre-feet of the 562.1 acre-feet of DCMI water pumped from the N Aquifer in 2007. [US Ex. 1209 at Table 6; NN FOF 21]

Finding of Fact No. 154. The Hopi pumped 497.3, 470.8, and 514.5 acre-feet from the N Aquifer in 2013, 2014, and 2015, respectively, to provide water for the Hopi villages, the Hopi Civic Center, the Hopi Cultural Center, and the Hopi High School. [U.S. Exh. 944 at 6 (PDF 9)]

The Hopi also use or have used water pumped from aquifers other than the N Aquifer to serve the villages of Spider Mound and Moenkopi, albeit in relatively small quantities compared to the amounts pumped from the N Aquifer. [092018:22 (Hamai)] The Navajo Tribal Utility Authority (NTUA) provides water for DCMI use in Spider Mound. [NN Exh. 765 at 7 (PDF 10)]

Finding of Fact No. 155. For the period 2012 through 2016, the NTUA provided water to Spider Mound in the following amounts (in acre-feet per year) 0.6, 2.5, 3.1, 2.6, 2.8. [NN Exh. 765 at 7 (PDF at 10)]

Mr. Hamai also testified about a well that pumped supplemental water from the C Aquifer for DCMI use in the Village of Moenkopi. For a short period, 2012-2017, the Hopi Tribe pumped water from the C Aquifer for DCMI use after treatment through reverse osmosis. This usage did not begin until 2012. [092018: 23:17-24:8, 43:15-44:10 AM (Hamai)] The amounts obtained from the C Aquifer are shown in Table 1. [U.S. Exh. 826 at 6] The reverse osmosis plant was shut down due to the expense of its operation. [100218:8 PM (Puhuyesva)]

Year	Amount (acre-feet)
2012	0.7
2013	0.7
2014	0.4
2015	1.8
2017 (Jan.-Aug.)	8.0

Table 1
Source: U.S. Exh. 826 at 6.

Springs and shallow wells provide a third source of water to those tribal members who do not have connections to a monitored public system pumping groundwater. Quantification for water use from wells and springs is not based on metered use as they are not monitored like the public systems and use fluctuates over time. [U.S. Exh. 826 at 4; 091720:63-64 AM (Hamai)] Instead, the data is based upon information obtained from a household survey. [U.S. Exh 826 at 4-5]

The Hopi Tribe retained Dale Whittington and W. Michael Hanemann to conduct a household survey in 2005 and 2006 to determine detailed household water use behavior. [102218:44 (Whittington)] Dr. Whittington, who holds a Master of Public Affairs, a Master of Science in Economics, and a PH.D. in business, engineering, and public affairs, teaches classes at the University of North Carolina, University of Manchester, and the National University of

Singapore on water policy in developing countries and water economics. [102218:39-40 (Whittington); Hopi Exh. 850 at 1] Dr. Hanemann holds a Master of Science in Development Economics and Public Finance and Decision Theory and a doctorate in economics. Currently he is a professor at Arizona State University and the University of California at Berkeley. [Hopi Exh. 840 at 1-2] Drs. Whittington and Hanemann, with the assistance of Joe Cook, authored a report entitled "Household Survey of the Hopi Reservation 2005-2006" ("Household Survey") based on a study of the Hopi Tribe and information received from surveys on 737 households in the 12 main Hopi villages. [102218:18-19 PM (Whittington)]

Finding of Fact No. 156. The population dependent on wells and springs for water uses 8.8 gallons of water per person per day. [092018: 33 (Hamai); U.S. Exh. 826 at 4]

Mr. Hamai used 2010 census data to determine that 6,607 people lived in the villages and 769 lived in the rural areas on the Hopi Reservation. According to the Household Survey, 18 percent of the people who lived in homes in villages were not connected to a public water supply. [Hopi Exh. 3898 at 78; U.S. Exh. 826 at 4] Of those people without a connection to a public water supply, 84 percent accessed water through public taps or neighbors with connections to the public system with the remaining 16 percent obtaining water from windmills and springs. [*Id.*] Based on this analysis, 2.88 percent (0.18 x 0.16) of the estimated population living in the Hopi villages relied on wells and springs for water for domestic use and, because the Household Survey was limited to the population living in the Hopi villages, 100 percent of the people living outside the villages were presumed to obtain all of their water supplies from wells and springs. [U.S. Exh. 826 at 4-5; 102218:28 (Whittington)] Mr. Hamai estimated the total amount of water obtained by people from wells and spring, all referred to as "self-supply water use" to be approximately 9.5 acre-feet per year. [U.S. Exh. 826 at 5] This estimated is not specific to any particular year.

Finding of Fact No. 157. Members of the Hopi Tribe use water from the shallow A, B and T Aquifers for domestic and ceremonial purposes. [092920:24-25 PM (Blandford); 091520:79 AM (Ward)]

Finding of Fact No. 158. The estimated amount of water drawn from wells and springs to provide for DCMI uses is 9.5 acre-feet of water annually. [092018:24-25 AM (Hamai)]

Finding of Fact No. 159. The primary source of domestic water for the Hopi villages is groundwater from wells pumping from the deeper N Aquifer. Hopi FOF 623.

Finding of Fact No. 160. The amount of water pumped from the N Aquifer for domestic use increased for the period 1984 through 2007 though the rate of increase began to slow around 2000 and after 2008 the annual amounts pumped have been level or declining. [U.S. Exh. 1209, Table 6 (PDF 54); NN Exh. 765 at 6, Table 4-1 (PDF 9)]

Finding of Fact No. 161. The amount of water pumped from the N Aquifer in 2007 exceeded the total amount of water diverted from all sources for DCMI use in 2015.

Finding of Fact No. 162. In each year since 2007, the Hopi have used less than 562.1 acre-feet of water each year with more than 95 percent of their water pumped from the N Aquifer and the remaining water provided by a combination of the NTUA, the C Aquifer in the years when the well was operational, and individual springs and wells.

Finding of Fact No. 163. In 2015, the DCMI use of the Hopi Tribe from all sources was 528.4 acre-feet. This amount includes 514.5 acre-feet of measured water from the N Aquifer, 4.4 acre-feet of measured water use at the villages of Spider Mound and Moenkopi from sources other than the N Aquifer and 9.5 acre-feet of estimated self-supply water use. U. S. FOF No. 337.

Finding of Fact No. 164. The amount of water used by the Hopi from springs and wells drilled into aquifers other than the N and C Aquifers for domestic uses during the last decade is less than two percent of the total DCMI use in each year.

Finding of Fact No. 165. Wells in the shallow aquifers could satisfy approximately 524 acre-feet per year of domestic use in the future. U.S. FOF 191; 985.

Finding of Fact No. 166. Surface water supplies on the Hopi Reservation are not reliable or available year-round to meet all of the future needs and they exceed safe drinking water standards for total dissolved solids (TDS). Capturing and storing sufficient quantities of acceptable surface water for DCMI usage on the Hopi Reservation to meet all DCMI demand is not viable. [091318:62 PM (Blandford); 091418:62-63 PM (Blandford); 091418:73-74 PM (Banet); 092920:84 AM (Blandford); Hopi Exh. 5 at 16-17; Hopi Ex. 9 at 7 (Table 2-3)]

Finding of Fact No. 167. The only practical primary source of DCMI water for the Hopi Tribe is from groundwater withdrawn from the N Aquifer and, to the extent necessary (because it is more expensive to pump and treat), the C Aquifer.

B. Future Water Demand

Finding of Fact No. 168. The past and present quantities of water used by the Hopi Tribe have been limited by inadequate infrastructure on the Hopi Reservation [Hopi Exh. 4580 at 23-28; NN FOF 22] At present, the water infrastructure is insufficient to satisfy the basic domestic needs of those who reside on the Hopi Reservation.

Due to the inadequacy of the existing infrastructure to meet current needs and the scope of future needs, the United States and the Hopi Tribe propose the installation of additional infrastructure to deliver water for DCMI uses. *Gila V* requires that new uses or significant expansions of existing water uses must be reasonably feasible. 201 Ariz. at 320 ¶49, 35 P.3d at 81.

Gila V requires that "proposed projects should be scrutinized to ensure that they are practical and economical." 201 Ariz. at 319 ¶46, 35 P.2d at 80. The Hopi Tribe contends that the claim for future DCMI use should be evaluated as "on the basis of some concept of need, rather than on the basis of ability and willingness to pay. Merit goods are often designated because they provide a service which should apply universally to everyone such as education or health care." [Hopi Exh. 4580 at 12-13]

While the government may well finance a project for the public good, it does not necessarily follow that the federal government does so with no consideration of cost. The federal government provides financial assistance to tribes for the construction and repair of drinking water and wastewater infrastructure. However, these federal programs require recipients to demonstrate project feasibility, cost efficiency, and organizational capacity before grants are awarded. [LCRC Exh. 1469 at 10-11] Congress also funds Indian water infrastructure projects directly but considers factors such as cost and feasibility before authorizing funds for Indian water projects. [LCRC Exh. 1469 at 4] As the LCR Coalition more succinctly states, "the concept of 'merit good' [is not] part of federal policies for funding DCMI water projects." LCRC Response Brief at 15, fn. 9 (August 27, 2021)

Conclusion of Law No. 37. *Gila V* does not create an exception to its requirement that future projects should be scrutinized to ensure that they are practical and economical for projects that are "merit goods".

In this case, no party disputes the feasibility of improving the DCMI water infrastructure on the Hopi Reservation to support delivery of sufficient water to meet the minimal DCMI needs of the reservation. An economic analysis for non-commercial ventures might not be focused on whether those venture will generate a profit, but it will consider whether the proposed use of water is cost effective and sustainable. The Hopi Tribe presented evidence that it has already begun making improvements to the water supply infrastructure through the Hopi Arsenic Mitigation Project ("HAMP"). Hopi FOF 404-407. Recently, the Hopi Tribe reported that it:

> also received $85.5 million dollars in funding as part of the CARES Act Emergency Response to the COVID-19 pandemic. [102720:98 AM (Onsae); Hopi Exh. 4570 (release on the CARES Act funding.); 110420:33–34 AM (Dallas) (quarantine units)] The Tribe created the CARES Act Committee to budget and expend the funds. [102720:98–99 AM (Onsae)] Funding has been designated to the following projects:
>
> - A new N-Aquifer well in the village of Oraibi, which will be the first water well in the village. [*Id.* at 99–100]
> - Power supply to the HAMP pump station and well. [*Id.*]
> - A new well on the Turquoise Trail to facilitate the extension of HAMP to Keams Canyon. [*Id.*]
> - Water sewer system equipment and upgrades. [*Id.* at 101–102]

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Finding of Fact No. 169. It will be reasonably feasible for the Hopi Tribe to improve its water supply and sanitation infrastructure based on anticipated funding sources to accommodate increased DCMI use.

The second limitation imposed by *Gila V* on a project that is feasible and practical is that the amount of the water subject to federal reserved water rights must not exceed the amount of water necessary for the reservation tailored to its minimal need. Disputes among the parties do exist about whether the claims asserted by the United States and the Hopi Tribe, which exceed existing DCMI use by more than an order of magnitude, satisfy the minimal need standard set by *Gila V*.

The United States and the Hopi Tribe elected to quantify their claims for water for future use based on: (1) an estimated future DCMI water usage rate and (2) a projected future Hopi population.[13] With these two variables, a water use demand can be calculated in acre-feet of water used per year. [Hopi Exh. 7 at 3 (PDF 4)] Specifically, the quantity of DCMI use is calculated by multiplying the projected number of people expected to live on the Hopi Reservation at a particular time (t) by the future daily water use by each of those people (gallons per capita per day ("gpcd")). To convert that number into a quantity measured in acre-feet per year, the product must be multiplied by 365 to calculate the annual usage rate and divided by 325,851 to convert the result from gallons per year to acre-feet per year. The equation to compute DCMI use is as follows:

$$DCMI\ use \ = \frac{(HopiPOP_t + NonHopiReservation\ POP_t)\ \times gpcd\ x\ 365\ days}{325{,}851\ gallons}$$

[Hopi Exh. 4580 at 50; NN Exh. 767 at 5]

Mr. Hamai testified that a future DCMI water usage rate is appropriately estimated based on an assumed usage rate per person. [091720:61 AM (Hamai)] The DCMI expert retained by the Navajo Nation, also confirmed that this method was reasonable and appropriate. [120820:47 AM (Liechty); 120820:26 PM (Liechty); NN Exh. 767 at 3, 9; *see also* NN Exh. 765 at 1 (PDF 4)] No party objected to this methodology to quantify the federal reserved water claim for DCMI use. The *Gila V* Court permits the use of population to quantify federal reserved water rights for Indian reservations and recognized that "[p]opulation forecasts are common in today's society and are recognized and relied upon by the legal system." 201 Ariz. at 319, ¶47, 35 P.3d at 80.

[13] The United States and the Hopi Tribe did not provide information about the quantification of their claimed future DCMI uses as requested by ADWR before ADWR's completion of the Hopi HSR. *See* Minute Entry in CV 6417 (filed November 10, 2015). Accordingly, ADWR was not able to provide a technical analysis of the claim.

Conclusion of Law No. 38. Calculating the quantity of a future DCMI use based on a future projected population multiplied by a daily use rate is an acceptable method to determine a federal reserved water right.

The United States and the Hopi Tribe claim that the appropriate future population figure is 52,016. The United States claims a per-person water use rate of 150 gpcd and the Hopi Tribe claims a per-person water use rate of 160 gpcd. The Navajo Nation concurs with the projected future population and also supports a per-person water use rate of 160 gpcd. The remaining objectors challenge the future population estimate and the per-person water rate of 160 gpcd. The Salt River Project, the Arizona State Land Department, and the LCR Coalition agree that a 150 gpcd use rate is appropriate to quantify a federal reserved water right. The City of Flagstaff, which currently operates on less than a 150 gpcd rate for its population, argues that the maximum per-person use rate should not exceed 100 gpcd. City of Flagstaff's Closing Brief at 12 (June 25, 2021).

Conclusion of Law No. 39. Under the *Gila V* standard, the quantity for DCMI use must not exceed the minimal need of the future population that will live on the Hopi Reservation necessary to maintain the reservation as a permanent homeland. 201 Ariz. at 316-20, ¶ 28, 38, 47, 48, 35 P.3d at 77-81.

1. Population

The United States claims that federal reserved water rights for DCMI use should be quantified based on the maximum projected future population of the reservation. It describes this population as a "stable population," meaning that the Hopi population will not experience further growth because there will be no net in-migration from people living off the reservation and the fertility rates of the women living on the reservation will have declined to a replacement level.

The United States predicts that this target population will occur more than 150 years in the future. [U.S. Exh. 950 at 22, Table 2 (PDF 26); 091620:24-25 AM (Greene)]

Conclusion of Law No. 40. *Gila V* allows consideration of future population but does not require quantification of DCMI to be based on a future maximum or "stable" population of the reservation.

The Hopi Tribe makes an alternative argument that the appropriate population is the number of people it projects will be enrolled in the Hopi Tribe in 2110 regardless of whether the people live on or off the Hopi Reservation. The remaining parties contend that the appropriate population is the projected population living on the Hopi Reservation in 2110. Each population projection necessarily includes uncertainty due to the extended time periods involved in the forecasts. [100520:61 AM (Swanson)] Uncertainty refers to the probability that the projection will not accurately calculate the true future population.

The United States, the Hopi Tribe, the City of Flagstaff, and Arizona State Land Department each called an expert witness to testify about the future projected Hopi population. The United States called Dr. Gretchen Greene, an economist who holds a doctorate in Food and Resource Economics, who opined that the stable population on the Hopi Reservation would be 52,016 at some point after 2170. [091620:25-26 AM (Greene); US Exh. 950, at 1 (PDF 5), 22 (PDF 26); LCRC Exh. 1176 at 1] Dr. Greene defined a stable population as that population when the total fertility rate is equal to a replacement level fertility of 2.1 and 70 percent of the total nationwide Hopi population lives on the reservation. [091620:25-26 AM (Greene); 091621:20-21 PM (Greene)]

The remaining parties relied on the expertise of demographers to forecast the future populations. The Hopi Tribe called Dr. David Swanson, a demographer who holds a doctorate in sociology/population studies. [100520:47 AM (Swanson); Hopi 4419 at 1 (PDF1)] He forecasted that the number of enrolled Hopi tribal members living on the reservation in 2100 would be 19,084. [100520:21, 61, 98 AM (Swanson); Hopi Exh. 4417, at 4] He further projected that there would be 23,338 Hopi tribal members living off-reservation, and 1,058 non-Hopi individuals living on-reservation, for a total population of 43,480 people. [100520:20-22 AM (Swanson)] Based on the methodology adopted by Dr. Swanson, 45 percent of the enrolled tribal members will live on the Hopi Reservation in 2100.

Dr. Jeff Tayman, an expert for the City of Flagstaff and a demographer who holds a doctorate in sociology with an emphasis in demography/statistics, forecasted a future population on the reservation in 2110 of 18,255. [Flagstaff Exh. 38, at 7; 100520:101, 114 AM (Swanson); LCRC Exh. 1193]. The Arizona State Land Department relied upon Dr. Jim Chang, the State Demographer for the State of Arizona, who holds a doctorate in sociology with an emphasis in demography, statistics, and education. [ASLD Exh. 8] The State Demographer projected a Hopi population living on the Hopi Reservation and off-reservation Hopi land of 8,155 in 2050 and no more than 8,155 in 2100. [ASLD Exh. 11, at 18-19] The different positions of the parties can be summarized as follows:

Party	**Expert**	**Projected Future Population on the Hopi Reservation**
United States	Dr. Greene	52,016
Hopi Tribe	Dr. Swanson	19,084
City of Flagstaff	Dr. Tayman	18,255
ASLD	Dr. Chang	8,155

The United States referenced Dr. Greene's opinions and model to claim that DCMI use should be based on a future population of 52,016 people. Dr. Greene has prepared Hopi population projections for twenty years. [091620:86 AM (Greene)] Before the 2019 population projection, which is at issue in this case, Dr. Greene prepared population projections in 2006, 2008, and 2009. The results of Dr. Greene's projections along with the official counts from the U.S. Census are shown in Table 2.

	2010	**2020**	**2040**	**2050**	**2110**
2006 Greene Projection	9,568	13,266			
2008 Greene Projection	9,331	13,010	22,228	27,815	51,567
2009 Greene Projection	9,893	13,613			
2019 Greene Projection	7,376	10,567	19,065	24,201	49,301
U.S. Census Report*	6,912	6,377			

Table 2. The different population figures generated by the Greene Projections identified in the first column are shown for the years listed in the top row. The populations from the U.S. Census Report for 2010 and 2020 are listed in the bottom row.

Sources: U.S. FOF 757, Table 3; U.S. Exh. 950 at 22 (PDF 26) Table 3; 091620:97, 99-100 AM (Greene); 2020 Census data, Minute Entry at 8 (filed October 18, 2021).

* The U.S. Census Report is for the population living on the Hopi Reservation and on Off-Reservation Trust Land

In 2019, Dr. Greene completed her newest projection of the Hopi population that included a projected 2020 population and a population for each decade for more than a century. As Dr. Greene stated in her rebuttal report, she made the 2019 model to accomplish one purpose, presumably among others, which was to "determine the quantity of water required to accompany the much-needed economic development that will allow the Hopi people to live and thrive on the homeland of their ancestors." [U.S. Exh 1114 at 5 (PDF 8)] Dr. Greene summarized her opinion as follows:

> The results of the population forecast suggest that the Reservation population will grow from a conservative estimate of 7,376 in 2010 to 24,201 by the year 2050, and 49,301 by year 2110. A long-term stable Reservation population is projected to be 52,016.

[U.S. Exh. 950 at 1 (PDF 5)]

Dr. Greene selected the cohort component methodology (CCM) to create her population projection. [091620:48 AM (Greene); U.S. Exh. 950 at 1 (PDF 5)] Dr. Greene chose this method to incorporate assumptions about future economic development and future migration into the model. This methodology relies on the demographic equation that population in the future is equal to the current population increased by births, decreased by deaths, increased by in-migration, and decreased by out-migration. [100520:25 (Swanson)] The equation can be written as follows:

$$\boldsymbol{Future\ Population} = \boldsymbol{Current\ Population} + \boldsymbol{Births} - \boldsymbol{Deaths} + (\boldsymbol{InMigration}) - (\boldsymbol{OutMigration})$$

The CCM requires population-specific data for each of the four variables in the equation shown above to accurately forecast a future population.

The method applies the basic demographic equation to each group or cohort of people categorized by age and gender. Dr. Greene explained the CCM as follows:

> The cohort component method is initiated with a base-year population that is divided into five-year age cohorts for each sex. These groups of people are then hypothetically aged five years, subtracting off a small percentage assumed to have died in the five-year period. Data on mortality rates are used to estimate the deaths that might occur in each age/sex cohort. The number of babies to be added to the population in each five-year period is estimated in a similar fashion by applying fertility rates to females in childbearing age cohorts. Finally, rates of in- and out-migration are also applied to each age/sex cohort to simulate the movement onto and off of the Reservation through time. The total number of people who move in, minus the total number of people who move out in a given time period, is known as net migration.

[U.S. Exh. 950 at 3 (PDF 7)]

Dr. Greene listed the key requirements for a cohort component model as: “a) good initial population estimates by age and sex cohorts, b) appropriate vital statistic information on age-specific births and deaths for the target population, and c) information about migration by age and sex cohort.” [U.S. Exh. 1114 at 3 (PDF 6)] She also stated that “the ultimate accuracy of those projections are dependent upon the underlying assumptions made by demographers about the components of change – birth, deaths, and migration.” [U.S. Exh. 1114 at 5 (PDF 8)] Given this criteria, the validity of the results yielded by the model that Dr. Greene devised depend on the quality of the data and the validity of her assumptions about the future.

The CCM is generally considered an unsuitable method for small populations due to its reliance on data about base population, fertility and mortality rates, and migration numbers, [01282021:49 (Chang); 100520:36-37, 51-52 (Swanson); COF Exh. 38 at 10-12 (PDF 11-13); ASLD Exh. 11 at 1-2] Smaller populations tend to have less data availability for the components of change that encompass fertility, mortality, and migration. [100520:89 AM (Swanson)] Small populations can have substantial fluctuations in size as well as mortality, fertility, and migration rates over short periods of time that can create higher levels of uncertainty imbedded in future projections than those encountered in larger populations. [Hopi Exh. 4417 at 4] The Hopi Reservation is a “small population.” [100520:88-90 AM (Swanson); 020321:20 AM (Tayman); ASLD FOF 43].

The 2010 United States Census data for the Hopi population was available to Dr. Greene for her model completed in 2019. It is considered the gold standard of demographic data. [01282021: 45 (Chang)] Dr. Greene affirmatively stated “the actual 2010 census data is now available and is being used as the base year data.” [U.S. Exh. 950 at 23 (PDF 27)] She did not, however, base her projection on the Hopi population reported by the 2010 census of the Hopi population. Instead, she adjusted the number upward, citing the U.S. Census Bureau's post-enumeration survey that estimated that the American Indians and Alaskan Natives ("AIAN") population living on reservations nationwide had been undercounted by 4.9 percent. [091620:50-52 AM (Greene); U.S. Exh. 950 at 15 (PDF 19); LCRC Exh. 1180 at PDF 2] Dr. Greene did not know if the people living on the Hopi reservation had been undercounted. [091620:50-52 AM (Greene)]

The U.S. Census Bureau does not use the post-enumeration survey to adjust census counts up or down because the post-enumeration survey is not a whole enumeration, like the U.S. Census count. The post-enumeration survey is a sampling survey, and therefore, has sampling errors. [ASLD Exh. 11 at 3; 012821:33 AM (Chang)]. The purpose of the post-enumeration survey is to measure the quality of the census and explore areas that can be improved for the next census. [ASLD Exh.11 at 3; 091620:51 PM(Greene)]. The 4.9 percent rate of undercount in the post-enumeration survey is an average undercount for reservations nationwide and not unique to the Hopi Reservation. [091620:52 AM (Greene)] Dr. Chang testified that the upward adjustment of the population on the Hopi Reservation was an incorrect use of the survey. [ASLD Exh. 11 at 3; 012821:46-47 PM (Chang)]

Finding of Fact No. 170. Dr. Greene's upward adjustment to the 2010 U.S. Census population for the Hopi Reservation was inconsistent with accepted demographic practices to project future populations.

In defense of her decision to increase the 2010 U.S. Census data, Dr. Greene testified that "the historic population growth helps to show that [her] base population estimates from the Census are reasonable and conservative." U.S. FOF 614. As shown in Table 3 below prepared by Dr. Greene, the preceding two decades were periods of population declines on the reservation, making it more reasonable to assume that calculated rate of growth between 2000 and 2010 would be lower, as it was based on actual 2010 U.S. Census population of 6,912, rather than the higher population number that Dr. Greene used as the starting point in her model.

Year	Population	Average Annual Rate of Growth in Preceding 10 Years
1970	6,144	1.3 percent
1980	8,253	3.0 percent
1990	7,061	-1.5 percent
2000	6,573	-.07 percent
2010	7,251	1.0 percent

Table 3: Historical data compiled by Dr. Greene to calculate annual rate of growth by decade. The 2010 population number shown is the 2010 census number as adjusted by Dr. Greene and the 1.0 percent annual growth is based on population as adjusted by Dr. Greene.

Source U.S. FOF 736, Table 1.

Although Dr. Greene had good general population data from the 2010 U.S. Census on which to begin a projection using the CCM, she used a nationwide sampling survey that was not specific to the Hopi Reservation to adjust the data upward based on assumptions of higher growth inconsistent with the population trends of the proceeding decades. As a consequence of the decision to increase the initial base population of people living on the reservation, Dr. Greene's methodology inflated the future population due to the compounded growth over the next century. [ASLD Exh. 11 at 3; 012821:15-16, 32-33 AM (Chang)]

Finding of Fact No. 171. The decision to increase the 2010 Hopi population by 4.9 percent was not grounded in facts applicable to the Hopi population living on the reservation.

In addition to the population of the people living on the Hopi Reservation in 2010, Dr. Greene also designed a method to account for the total Hopi population living within the United States. Dr. Greene generated a nationwide population based on the 2010 census data that 18,327 people self-identified as Hopi." [U.S. Exh. 950 at 20 (PDF 24)] She increased that number to

25,000 Hopi citing a paper from the U.S. Census Bureau released in 2012 that stated "for every three people who identified as AIAN [American Indian and Alaskan Native] and specified (wrote in) a principal or enrolled tribe, approximately one who identified as AIAN did not write one in." [*Id.*] Referencing this statement, she increased the self-identified population by a third to 24,436. She then added another 564 people to arrive at a national population of 25,000. The result of the calculations was to increase the self-identified nationwide Hopi population by 36 percent.[14]

The observation reported by the U.S. Census Bureau about people who did not identify with a particular group applies generally to all 2010 census data for the AIAN population. It does not apply uniquely or specifically to the Hopi Tribe. Dr. Tayman testified that the referenced paper did not provide an adequate basis upon which to increase the national Hopi population estimate to 25,000. [02032021:89 PM (Tayman)] A nationwide population of 18,327 rather than 25,000 in 2010 is also more consistent with Dr. Greene's assessment that "there have been a minimum of seven to ten thousand Hopi living permanently on the Reservation over the past decade, with another five to eight thousand people living off of the Reservation." [U.S. Exh. 950 at 8 (PDF 12)]

Dr. Greene provides no foundation to support her opinion that thousands of members of the Hopi Tribe would complete and submit a federal census form and simultaneously refuse to acknowledge any affiliation with the Hopi Tribe. The evidence better supports a conclusion that the opposite behavior pattern is more likely to occur. Dr. Greene expressed the opinion that Hopi may not complete federal census forms because Hopi have a "distrust in federal government." [091620:53 PM (Greene)] Hopi tribal reports confirm that "[t]here are traditional Hopi members who will decline to participate in any type of survey or count that may be conducted by the U.S.

[14] $\frac{25000-18327}{18{,}327} = .3641$

Census Bureau or the Tribe/Village." [Hopi Exh. 4467 at 37 (PDF 42)] Dr. Greene also testified that the cultural ties of the Hopi are "stronger than anywhere else that I've seen. The people - the many, many people that I've spoken with, for example, they'll all tell me it's a village, it's a land. They'll talk to me about honoring their ancestors, that sort of thing, and the land, in a way that I haven't seen on other reservations." [091620:54 PM (Greene)] She explained that each Hopi is associated with a village regardless of whether the person lives on or off the reservation as evidence of strong cultural ties that the Hopi maintain even when living off of the reservation. U.S. FOF 686. Based on this record, the more credible conclusion is that a Hopi who files a census form with the federal government will self-identify as a Hopi.

The United States points to Dr. Greene's determination of the existence of a significant number of Hopi eligible for tribal membership who have not enrolled as evidence to support the 25,000 nationwide population. U.S. FOF 756. A "significant number" is not a useful quantification in a demographic study and certainly does not address the issue of whether that "significant number of people" filed census forms and failed to acknowledge their membership in the Hopi Tribe. Dr. Greene's decision to use 25,000 as a nationwide population inflated the future population by the creation of a larger pool from which to project future population under the CCM model.

Finding of Fact No. 172. The conclusion that more than a third of the Hopi people would submit a federal census form and decline to identify an affiliation with the Hopi Tribe is not credible.

Finding of Fact No. 173. No credible basis exists for a nationwide Hopi population in 2010 of 25,000 people.

Using her nationwide Hopi population and the adjusted 2010 base population, Dr. Greene created a third population for her CCM model. She determined the population of the Hopi people who did not live on the Hopi Reservation. Dr. Greene quantified the off-reservation population as the difference between her nationwide population and the adjusted 2010 population of the Hopi Reservation. She used the off-reservation Hopi population component in the CCM as the source of expected migration on to the reservation over the ensuing decades. [U.S. Exh. 950 at 20 (PDF 24); U.S. Exh. 1114 at 4 (PDF 7)] For the period 2010-2015, the model calculated the off-reservation population by subtracting an on-reservation population of 7,251 in 2010 from a nationwide Hopi population that Dr. Greene approximated as 25,000 people. As a result, the model operated on the assumption that the Hopi population available to migrate onto the reservation between 2010 and 2015 consisted of 17,749 people. Dr. Greene's model performs the same calculation for each five-year period by subtracting a calculated on-reservation population from a nationwide populations. [091620:106 AM (Greene); U.S. Exh. 948 at tab "model base year 2010," cell F-120] Thus, the validity of the number of the off-reservation population depends upon the validity of the number associated with the nationwide Hopi population.

The next data set that Dr. Greene identified as key to her CCM model is the vital statistic information on age-specific births and deaths for the Hopi population. Dr. Greene did not rely upon fertility and mortality rates specific to the people living on the Hopi Reservation to project future Hopi population. [091620:55, 57 AM(Greene)] In place of fertility rates for Hopi women, Dr. Greene's population projection used an average fertility rate for American Indian and Alaska Native women in Apache, Navajo, and Coconino Counties. [091620:54 AM (Greene)] Dr. Chang agreed that Dr. Greene appropriately used this substituted data to set the initial total fertility rate of 2.58 in 2010 because there are "simply not enough births or deaths in any given year to compute age-specific birth rates and survival rates [on the Hopi Reservation] that are stable and suitable for use." [ASLD Exh. 11 at 3] In addition to initial fertility rates, the model also required data to support future fertility rates to calculate the future population. Dr. Greene anticipated that the final fertility rate would be 2.1, the replacement rate, once the population reached its maximize size. Thus, the model had to incorporate assumptions about the timing and rate of decline of fertility rates.

Dr. Greene made the decision that the tri-county data for AIAN women that she used to set the initial fertility rate could not be used to project the future rate of decline in fertility rates. The data set Dr. Greene chose for the initial fertility rate showed that a fertility rate of 2.34 had been reached by 2013 as shown in *figure 4.* [ASLD Exh. 11 at 5; US Exh. 1114 at Table 4] She also rejected the projection from the U.S. Census Bureau that fertility rates for AIAN women would decline to 2.34 by 2025. [U.S. Exh. 950 at 16 (PDF 20)] Instead, Dr. Greene decided that the future fertility rates of Hopi women would more likely track the more slowly declining fertility rates found among Hispanic women.[15] [*Id.*] Dr. Greene constructed her model so that fertility rates for Hopi women declined to 2.34 by 2050 and 2.1 in 2100. [*Id.*]

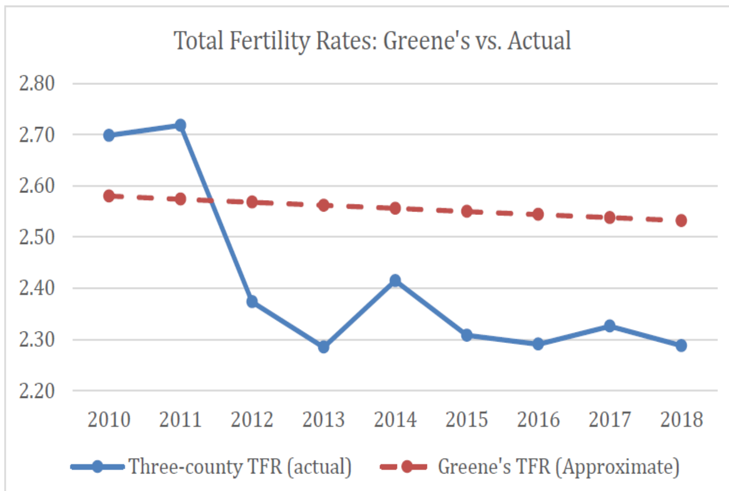

Figure 4.
Source: ASLD Exh. 11 at 5

[15] The U.S. Census Bureau released a new projection in 2012 showing faster declines in both Hispanic and American Indian and Alaska Native fertility rates in the United States. [020321:20 AM (Tayman); Flagstaff Exh. 38 at 14 (PDF 15)].

Dr. Chang did not agree with Dr. Greene's determination about the rate of decline in fertility rates over the succeeding decades. Dr. Chang concluded that Dr. Greene:

> demonstrably and significantly overstated the current fertility rate and overestimated future fertility rates. The current overstatement of total fertility rate is roughly 0.24. This means that for a generation of 1,000 women, the author would over-project approximately 240 births. With many more thousands of women over several generations, the phantom births will add up, which is partially responsible for the inflated population projections.

[ASLD 11 at 6].

Dr. Greene responded to Dr. Chang's assessment by separately plotting the fertility rates for each of Navajo, Apache, and Cochise counties to demonstrate that her selected fertility rates were below the fertility rates for Navajo County between 2010 and 2017. While it is true that the fertility rates used by Dr. Greene were below those of Navajo County for 2010 to 2017, they did not reflect the same rate of decline. Navajo County fertility rates fell by over ten percent in that period whereas Dr. Greene's rates declined by a much slower two percent. The fertility rates for Coconino and Apache Counties fell below fertility rates used by Dr. Greene in every year but 2011 due to the decline in fertility rates as observed by Dr. Chang. [U.S. Exh. 1114 at 17 (PDF 20)] By overestimating the future fertility rates, the CCM model overstates future population. Dr. Greene's disaggregation of the tri-county AIAN data to focus on Navajo County and exclude Coconino County in which portions of the Hopi Reservation are located, also raises methodologically questionable decisions about the use of a CCM model to forecast a future population in the absence of vital statistics for the targeted population. It also supports Dr. Tayman's assessment that Dr. Greene did not adequately mitigate the lack of relevant data for the Hopi population in her model, which caused the method to be unsuitable to prepare the population projection. [020321:20 AM (Tayman); Flagstaff Exh. 38, at 12 (PDF 13)]

Finding of Fact No. 174. Dr. Greene's use of data to construct fertility projections does not demonstrate a consistent use of relevant county and U.S. census data and information within the fertility projection or within the model structure as a whole.

Finding of Fact No. 175. A reasonable basis does not exist for the rate of decline applied to fertility rates used in the CCM model or for the conclusion that fertility rates would not decline to 2.34 until 2050.

The third requirement of the three identified by Dr. Greene for a model based on the CCM is information about migration by age and sex cohort. Dr. Greene thoroughly accessed historic data from the U.S. Census that reflected migration on and off the reservation. [012821:18 AM (Chang)] Dr. Chang summarized the migration pattern shown between 1990 and 2010:

> It is abundantly clear that all age groups below 55 experienced net out-migration, with the youngest age groups experiencing very large out-migration. The age groups of 55 and above mostly experienced net in-migration, but on a smaller scale. It is also significant that net in-migration happened to the older age groups and net out-migration happened to the younger age groups. The in-migration at old ages do not have multiplicative effects on population growth because these individuals are already past their reproductive ages and will not be adding births to the population. Furthermore, their mortality rates are much higher than the general population. Some will be subtracted from the population of the Reservation soon after they arrive. In contrast, the out-migration of younger individuals has long-lasting negative effects on population growth on the Reservation. With the out-migration of younger women, so goes the potential for future births on the Reservation, which further reduces the opportunity for population growth.

[ASLD Exh. 11 at 9]

Dr. Greene did not use the historic in-migration and out-migration data for the Hopi population to project the future migration pattern and future population. She explained that her model is not intended to predict the future population growth based on past trends. [091620:29-30 AM (Greene)] The purpose of the model, according to Dr. Greene's testimony, is to generate a contingency projection of future population growth built on anticipated economic development. [091620:29-30 AM (Greene)] Based on the assumption of future economic development, Dr. Greene rejected the empirical evidence concerning migration patterns on and off the Hopi Reservation and assumed that the reservation would experience net in-migration in all age groups. [COF Exh. 38 at 5] She constructed a model to annually move a group of people, who had not previously lived on the reservation, on to the reservation. Lacking any age or gender data about the projected population of in-migrants, Dr. Greene used the historical in-migration/out-migration data to allocate the group of projected future in-migrants into future age and sex cohorts. [012821:105 PM (Chang); U.S. Exh. 950 at 21] For example, based on the large number of young people who had historically migrated off the reservation, she determined that the future in-migrants would be dominated by young people, not because they had historically moved to the reservation but because they were the most likely to move. [ASLD Exh. 11 at 13] As a result, Dr. Greene's model cannot generate a projection based on historical migration patterns on and off the reservation.

Dr. Greene programmed the model to move a number of people equal to one percent of the nationwide Hopi population (the sum of people living on and off the reservation) each year from the off-reservation group to the on-reservation group. For the years, 2010 and 2015, the model moved a total of 1,275 people from the off-reservation group to the on-reservation group. [U.S. Exh. 948 tab "Model Base Year" cell F105; 02032021:24 (Tayman)] Dr. Greene testified that the percentage of the national Hopi population that would migrate on to the reservation would gradually decline to zero:

> The in-migration used in the model assumes that a percentage of the national population of Hopi moves onto the Reservation each year through the projection period. The percentage of the population who moves is assumed to be larger in the initial years of the projection period

> (beginning with just over one percent of the national population in the medium scenario model) and slowly decline through time. . . . Between 2010 and 2110, the percent of the national population that is projected to migrate onto the Reservation moves from just over one percent to zero.

[U.S. Exh. 950 at 21 (PDF 25)]

Dr. Greene's description of the operation of her model created confusion. Obviously, the people living on the reservation, who are part of the national population, cannot migrate onto the reservation. The model operates by multiplying "just over one percent" by the national population and that product sets the number of people moved by the model from the off-reservation population to the on-reservation population. As a consequence, the percentage of the off-reservation population moving on to the reservation each year exceeds one percent of that off-reservation population. Also, as a result of Dr. Greene's configuration of the model, both the percentage of the off-reservation population and the number of people migrating on to the reservation gradually increases for decades. [091621:77-78 AM (Greene); U.S. Exh. 948, tab "model base year 2010] row 109] The operation of the model can be illustrated by the results of the initial five years:

MODEL: 25,000 national population x 5.1 percent = 1,275 in-migration for 2010 - 2015

RESULT: 1,275 in-migration / (25,000 – 7,251 adjusted on-reservation 2010 population) = .0718 off-reservation population

Dr. Greene testified that the actual percentages were not important because she used the percentages and the model design simply to generate a number of in-migrants that she deemed to be reasonable. [091620:12-13 PM (Greene)] Dr. Greene's testimony suggested that she evaluated whether the number of people moving on to the Hopi Reservation was reasonable based on her assessment of the long-range planning process for economic development on the reservation.

Dr. Greene determined "that the goals of employment, housing, and other appropriate economic development are achievable." [U.S. Exh. 1114 at 4 (PDF 7)] Dr. Greene formed her judgment about the likelihood of economic development on the Hopi Reservation by reviewing the Hopi Tribe's 2001 Strategic Land Use and Development Plan, the Hopi Tribe's 2016 Comprehensive Economic Development Strategy, and prior versions of the Hopi Tribe's Comprehensive Economic Development Strategy. [U.S. Exh. 950 at 20 (PDF 24)] These documents contain the Hopi Tribe's plans for development of the reservation. She met with Hopi tribal government personnel to discuss conditions on the reservation that would affect forecasted economic development. [091620:63-65 AM (Greene); U.S. Exh. 950 at 4 (PDF 8)] Dr. Greene also reviewed economic development on other Indian reservations in recent decades and determined that there is a national trend of improved economic conditions on Indian reservations. U.S. FOF 662. Dr. Greene concluded that economic development is likely to occur on the Hopi Reservation in the future based on the plans, including a master plan and annual economic development strategies prepared by the Hopi Tribe. *Id.* At trial, she testified that increased economic development on the Hopi Reservation would result in increased employment and housing opportunities on the reservation, which in turn, would cause Hopi tribal members living off the Hopi Reservation to migrate on to the Hopi Reservation. [091620:61-63 AM (Greene)]

Although it is desirable for a demographer to study a community's plans, it should be done with a critical eye. [ASLD Exh 11 at 10] Dr. Greene did not analyze future housing on the Hopi Reservation. [020321:21-22 AM (Tayman); 020321:83-84 PM (Tayman)] Dr. Greene acknowledged the past difficulties that the Hopi Tribe has encountered in the implementation of the housing development plans. For example, the 2001 Hopi Strategic Land Use Development Plan anticipated the development of 3,200 housing units by 2020, but by 2010 only 183 houses or six percent of the goal had been achieved. [020321:21-22 AM (Tayman); COF Exh. 38 at 17 (PDF 18)] In their 2019 analysis of housing on the reservation, two economists retained by the Hopi Tribe described a severe housing shortage and overcrowded conditions. [Hopi Exh. 4580 at 33-34, 36] Dr. Greene evidently disregarded the difficulties represented by past building rates as demonstrated by her projection that for the coming decades, more than 1,000 people would move on to the reservation every five years. She did not discuss the steps that could and would need to be taken in order to alleviate the existing housing shortage and provide housing starts at the level needed to accommodate the number of people she anticipated would live on the reservation. [Hopi Exh. 4581 at 14]

Finding of Fact No. 176. Dr. Greene did not provide any analysis of future housing on the Hopi Reservation that demonstrates that the reservation could accommodate the projected future population at the rate projected.

"It is a well-established fact that employment change is an important determinant of migration." [COF Exh. 38 at 17] Dr. Greene, an economist by training, performed no analysis of the number of jobs that would become available on the Hopi Reservation in the future based on the economic development plans she reviewed. [091620:65 AM (Greene)] To make informed decisions about the development of a model, a demographer must have information about the number of new jobs created, wages, and a whole host of characteristics that would be affected by implementing a new economic plan. Unemployment levels are important because newly created jobs may be filled by people currently living on the reservation. [COF Exh. at 17] In 2006, the average unemployment rate on the Hopi Reservation was 22.6 percent [U.S. Exh. 944 at 8 (PDF 11)] According to the 2019 CEDS, the unemployment rates for the Hopi Tribe remained at 2010-

2017 levels, "with no increase in economic development, therefore no jobs." [Hopi Exh. 4467 at 51]

Finding of Fact No. 177. Dr. Greene did not provide an analysis of future economic development on the Hopi Reservation to determine that the number of jobs needed to accommodate or attract the projected future population could be generated on the reservation and that the increased job opportunities would cause the predicted number of off-reservation Hopi to move to the reservation at the projected rate.

As Dr. Tayman correctly observed, Dr. Greene provided no empirical connection between her chosen percentage of in-migration and the impact of economic development strategy. [02032021:22 (Tayman)] She provided no specific information or analysis about how economic development plans would alter conditions on the reservation to provide more opportunities and impetus to eligible members of the Hopi Tribe to move to the reservation. [020321:22 AM (Tayman); Flagstaff Exh. 38 at 17] The absence of a correlation between actual economic development and the projected in-migration is demonstrated by Dr. Greene's assumption of annual in-migration and population growth from 2010 to 2020. During that time period, the Hopi Tribe was contending with revenue decreases and facing significant economic challenges. More specifically, Dr. Greene's assumptions about economic growth did not account for or evaluate the impact of the recent changes in the Hopi's coal industry.

In February 2017, the owners of the Navajo Generating Station made a decision to extend the Navajo Generating Station lease only until the end of 2019. [Hopi Exh. 4277 at 23] The Hopi Tribe clearly identified the economic situation in its 2016 and 2018 Comprehensive Economic Development Strategy Plans ("CEDS"). [Hopi Exh. 184 at 28-29 (PDF 33-34); Hopi Exh. 4468 at 33-34 (PDF 38-39)] The Hopi Tribe described the economic situation as follows:

Finding of Fact No. 257. Until recently, the revenue generated by Black Mesa coal leases with Peabody Energy produced 88 percent of the Hopi Tribe's General Fund, which the Tribe relied upon to fund many essential government services and jobs. [Hopi Exh. 4467 at 8–9; 120320:28, 30–31 AM (Nuvangyaoma); *see also* Hopi Exhs. 4455 and 4457] The closure of the Navajo Generating Station (NGS), formerly the sole buyer of Hopi coal, forced the closure of the mine. [Hopi Exh. 4467 at 9; 120320:27 AM (Nuvangyaoma)]

Finding of Fact No. 258. The CEDS states the loss of revenue from coal leases would result in the loss of 1,360 to 1,904 indirect jobs on the reservation in addition to the loss of direct jobs at NGS. [Hopi Exh. 4467 at 48; *see also* 102920:29–33 PM (Lomayestewa) (testifying there has been "a really huge reduction in the tribal workforce," encompassing not only those directly employed by NGS and the Kayenta Mine, but also "those that work out in the fields, on the windmills, on the fence lines, things like that")]

Finding of Fact No. 259. The lack of jobs on the Reservation continues to be an economic challenge. The recent closure of NGS created "an existential economic crisis" for the Hopi Tribe, which is now focused on diversifying its economy, generating new revenues, and creating jobs for its people. [120320:28–30, 43 AM (Nuvangyaoma); Hopi Exh. 4581 at 17–18] The CEDS sets a goal to "increase public facilities and generate jobs along with the local Hopi economy." [Hopi Exh. 4467 at 56]

Hopi FOF 257-259.

By the time that Dr. Greene completed her corrected model in April 2019, the Hopi Tribe had issued its 2016 and 2018 CEDS that also included population numbers. [Hopi Exh. 184 at 23 (PDF 28)] The 2016 CEDS reported an on-reservation population of 7,803, and reported that the on-reservation population decreased by 12 people from 2015. [*Id.*] The 2018 CEDS reported a similar situation, at odds with the model projections, with an on-reservation population as of May 2017 of 7,800. During this period, the reservation population was not increasing by the "reasonable number of in-migrants" projected by Dr. Greene's model and it was not increasing by the projected annual growth of 3.8 percent. *See Table 4*. At best, no population growth on the reservation occurred between 2015 and 2018.

The divergence between the model's projected population and the actual population of the reservation can be quantified by a comparison of the 2020 U.S. Census data and the projected 2020 population. The 2020 Census reported an on-reservation population of 6,377, more consistent with the trend reported in the Hopi CEDS and indicative of the economic situation described by the Hopi Tribe above, than the 10,567 population projected by the model that Dr. Greene devised. Thus, Dr. Greene's model completed in 2019 overestimated the 2020 population by 4,190 people. A comparison of Dr. Greene's population projection for the first decade of her long-term projection with the actual population as reported by the 2020 U.S. Census, demonstrates serious flaws in the underlying assumptions and model design.

Year	**Population**	**Average Annual Rate of Growth in Preceding 10 Years**
1956	5,134	
1970	6,144	1.3 percent
1980	8,253	3.0 percent
1990	7,376	-1.5 percent
2000	6,573	-.07 percent
2010	7,251	1.0 percent
2020	*10,567*	*3.8 percent*
2030	*14574*	*3.3 percent*
2040	*19,065*	*2.7 percent*
2050	*24,201*	*2.4 percent*
2060	*30,107*	*2.2 percent*

Table 4. The table shows the average annual growth rates for the period 1956 through 2010 calculated by Dr. Greene. The average annual growth rates from 2010-2060 shown in italics are based on the decennial population projections generated by the model. The reported 2010 population is data from the U.S. Census that Dr. Greene revised. **Source**. U.S. Exh. 950, Table 1 and Table 3.

On March 14, 2022, the United States filed a Request for Judicial Notice regarding the post-enumeration survey performed for the United States 2020 Census. The U.S. Census Bureau's *National Census Coverage Estimates for People in the United States by Demographic Characteristics, United States' Census Bureau's 2020 Post-Enumeration Survey Estimation Report* (March 2022) ("2022 Survey") stated that American Indian and Alaska Natives living on a reservation were undercounted by 5.64 percent and those groups living off-reservation were overcounted by 3.06 percent. Judicial notice will be taken of the 2022 Survey pursuant to Ariz. R. Evid. 201(c)(2) of the 2022 Survey.

The submission of the 2022 Survey is a continuation of the practice criticized by Dr. Chang of using data from a sample survey to adjust the results of a population census from a total enumeration. It is also another instance of selectively applying data for the nationwide American Indian and Alaska Native population to the Hopi population without a showing of its applicability to the unique facts and circumstances on the Hopi Reservation. Even assuming that the 2022 Survey correctly identified a 5.64 percent undercount of the Hopi population, meaning that the 2020 population was 6,737 rather than 6,377 people, the 2022 Survey does not support the conclusion that Dr. Greene's model can accurately project the Hopi population in either the short-term or the long-term. A comparison of the 2020 Census population adjusted upward by 5.64 percent and the 2020 projection made by the model, shows that the model erred by 3,830 people. To state the result differently, the model completed in 2019 overstated the 2020 population by 57 percent.

Finding of Fact No. 178. The CCM model as constructed by Dr. Greene and completed in 2019 failed to accurately project the population of the Hopi Reservation for 2020.

Finding of Fact No. 179. Dr. Greene's model substantially overstates the future population on the Hopi Reservation over the short-term.

Finding of Fact No. 180. No credible basis exists for Dr. Greene's conclusion that economic development will cause net in-immigration to occur in every decade beginning with 2010 for more than a century in the amount projected by Dr. Greene's model.

The United States argues that even though Dr. Greene's projection of the Hopi Reservation population is based on a particular timeline for future economic development on the reservation, the maximum population will still be achieved if economic development happens at a slower pace than assumed in the model. U.S. FOF 726. The Navajo Nation makes essentially the same argument that the maximum population will be achieved, albeit at a later date. Navajo Nation's Consolidated Response to Closing Briefs at 20 (August 27, 2021). According to these arguments, if the majority of the reservation's economic development and corresponding in-migration were to occur between 2050 and 2080, instead of between 2010 and 2040, then the same net in-migration would occur later and continue beyond the date the model projected until the 52,016 population had been achieved. [091620:32-33 AM (Greene); 091620:30-31, 55-56 PM (Greene)]

It is well accepted, that the longer the projection period, the greater the likelihood that the projections will not accurately predict the actual future population. [COF Exh. 38 at 8] Moreover, the shift forward in time does not eliminate the need for economic analysis that demonstrates that in the new decades chosen by Dr. Greene, the anticipated economic development will begin. As Dr. Chang testified, only solid evidence of current economic development activities can support an assumption of large in-migration. [01282120:22 (Chang)]

Finding of Fact No. 181. Dr. Greene's economic analysis failed to demonstrate the availability of additional housing or jobs during the period 2050 to 2080 that would support the projected future population.

The final issue raised is the United States' approach is the assumption that eventually 70 percent of the nationwide Hopi population will live on the Hopi Reservation. According to Dr. Greene, once 70 percent of the nationwide Hopi population lived on the reservation, net in-migration would cease. Dr. Greene testified that she does not have any data to support her opinion that 70 percent of tribal members will ultimately live on the Hopi Reservation and 30 percent will live off the reservation. [091620:43-44 PM (Greene)] That assumption is based on her "professional judgment." [091620:67 AM (Greene); 091620:43 PM (Greene)] Greene explained that the genesis of the 70 percent figure is her belief that half of the people currently living off the reservation will eventually move to the reservation:

> Using the tribal membership data, approximately 58 percent of tribal members lived on the reservation in 2007 (see Appendix D). Alternatively, if we consider 7,109 to be the 2010 AIAN population on the Reservation and 25,000 to be the pool of Hopi nationwide, this suggests that just 28 percent of the Hopi population were living on the Reservation at that time. Using the average of these two estimates (43 percent) and assuming that half of the off-reservation share (28.5 percent is half of the 57 percent not on the Reservation), is motivated to in-migrate, this produces an estimate of 71.5 percent of the total population who may end up living on the Reservation. Rounding, and erring on the conservative side, we assume that no more than 70 percent of the national population ever resides on the Reservation.

U.S. Exh 950 at 21 (PDF 25)]

Dr. Tayman determined that, as the model is currently designed, the 70 percent goal was met by 2070 and the on-reservation population exceeded that percentage through 2110. [COF Exh. 38 at 19 (PDF 20)] The model projected a population of 35,844 in 2070. [U.S. Exh. 950 at 22 (PDF 26)] Thus, if the combination of replacement level fertility rates and 70 percent test validly define the stable population, then the application of corrected fertility rates applied to female population could result in the maximum, or stable, Hopi population occurring sooner than and at a lower level than projected by Dr. Greene.

Dr. Greene subsequently defended her position about the significance of the 70 percent of the national Hopi population living on the reservation, stating that it "is not about precision, but a general discussion," and also included the statement in her report that "the long-term, stable population remains with less than 70 percent of our estimated total potential Hopi tribal population." [U.S. Exh. 1114 at 11 (PDF 14)]

The calculation of a future population cannot be based upon speculation. *United States v. Washington*, 375 F. Supp. 2d 1050, 1067 (W.D. Wash. 2005), *vacated pursuant to settlement sub nom. U.S. ex rel Lummi Indian Nation v. Washington*, C01-0047Z, 2007 WL 4190400 (W.D. Wash. Nov. 20, 2007), *aff'd sub nom. U.S. ex rel. Lummi Nation v. Dawson*, 328 Fed. Appx. 462 (9th Cir. 2009); *see also Board of Regents of the University of and State Colleges of Ariz. v. Cannon*, 86 Ariz. 176, 342 P.2d 207 (1959). No reasonable basis was provided by Dr. Greene to support her conclusion that 70 percent of the national Hopi population will live on reservation or that half of the people now living off the reservation will eventually move on to the reservation.

Finding of Fact No. 182. Insufficient facts and data exist in the evidentiary record to support Dr. Greene's opinion that 70 percent of the nationwide Hopi population will live on the reservation at some point more than a century in the future.

Finding of Fact No. 183. The projected future population of people living on the Hopi Reservation of 52,016 does not rise above the level of speculation.

The demographers called by the other parties, Drs. Tayman, Swanson, and Chang, used different demographic tools to project a future population. [COF Exh. 38 at 12-13 (PDF 13-14); Hopi Exh. 4417 at 4; ASLD Exh. 11 at 17] Their chosen methodologies are not as data intensive as the CCM and do not provide the same latitude to incorporate assumptions. [COF Exh. 38 at 12-13 (PDF 13-14)] Drs. Tayman and Swanson's projections or forecasts generated similar results. [020321:105 AM (Tayman); Hopi Exh. 4417 at 7-9; COF Exh. 38 at 22-23 (PDF 23-24)] Dr. Tayman performed four independent population projections using the following methods: Autoregressive Integrated Moving Average ("ARIMA"), linear extrapolation, shift-share, and share of growth. [020321:17, 30 AM (Tayman); COF Exh. 38 at 22-23 (PDF 23-24)] The ARIMA model does not necessarily require age-sex data to generate a reliable result where information is more limited. [100520:18-19 AM (Swanson)] It does require population data for each unit of time (e.g., one year) over an extended time period. [COF Exh. 38 at 22, fn.6] The projections used historical data for a base period 1998 through 2016. [*Id.* at 22]

Dr. Tayman calculated population projections through 2050 using all four forecasting methods. [COF Exh. 38 at 22-23 (PDF 23-24)] The average of Dr. Tayman's four projections through 2050 is 10,967. He also generated population projections through 2110 using the linear extrapolation and ARIMA methods but due to modeling constraints did not prepare projections using the shift-share and share of growth methods. The ARIMA projection, at a 95 percent confidence interval, determined a future population in 2110 between 14,928 and 21,624. [020321:61-62 PM (Tayman); COF Exh. 38 at 24 (PDF 25)] The average of Dr. Tayman's projections through 2110 is 18,255 people. [020321:32 AM (Tayman); COF Exh. 38 at 23 (PDF 24)] Dr. Tayman explained that using the average of projections from multiple projection methods generally produces more accurate results than running a projection using a single projection method. [020321:20 PM (Tayman)]

Finding of Fact No. 184. Dr. Tayman's population projection of 18,255 people living on the Hopi Reservation in 2110 based on historic data and appropriate demographic models is reliable and suitable to serve as the basis for quantifying federal reserved water rights to water for the Hopi Reservation for DCMI use.

Dr. Chang testified that the Office of Employment Opportunities ("OEO") projects a 2050 population of 8,155 for both the Hopi Reservation and off-reservation trust land. [ASLD Exh. 11 at 18 (PDF 18)]. He also testified that although the OEO's projections do not extend beyond 2050, the on-reservation and off-reservation trust populations are projected to decline beginning in the early 2040s.

Finding of Fact No. 185. The OEO projections support Dr. Tayman's lower projection based on historical data unique to the Hopi population as compared to the projection generated by Dr. Greene's model with its assumptions of economic development contrary to the actual economic situation for the first decade of the model and unsupported for the remainder of the projection period.

The Hopi Tribe makes the alternative argument that the relevant population for calculating DCMI use on the reservation is not the number of people living on the reservation in the future but it is the nationwide enrolled Hopi tribal membership. It argues that *Gila V* did not limit the consideration of future population to the population living on the reservation. Hopi FOF 289-290. Dr. Swanson modelled the future Hopi tribal membership based on historical tribal membership data. He forecasted that by 2100, there would be 19,084 Hopi tribal members living on the Hopi Reservation, 23,338 Hopi tribal members living off the Hopi Reservation, and 1,058 non-Hopi individuals living on the Hopi Reservation. [Hopi Exh. 4417 at 4 (PDF 4)]. More specifically, the forecast produced prediction intervals with 95 percent confidence that the 2100 on-Reservation population will be between 18,834 and 19,335. [100520:104-05 AM (Swanson); Hopi Exh. 4417 at 12-13] Dr. Tayman's projections corroborate Dr. Swanson's determination of the future on-reservation population of enrolled tribal members. Thus, the issue presented by the Hopi Tribe's submission of Dr. Swanson's expert report is whether federal reserved water rights for use on the Hopi reservation can be measured by a population that does not live on the reservation. The *Gila V* Court explicitly stated: "We therefore hold that the purpose of a federal Indian reservation is to serve as a 'permanent home and abiding place' for the Native American people living there." 201 Ariz. at 315, ¶25, 35 P3d at 76.

Conclusion of Law No. 41. Federal reserved water rights are quantified to provide water for DCMI use for the people living on or reasonably expected to live on the reservation over the reasonably foreseeable future.

Moreover, as the LCR Coalition argues, the adoption of such a method would violate the *Gila V* standard that federal reserved water rights must be tailored to a reservation's minimal need. As demonstrated by Dr. Swanson's calculation, the entire Hopi tribal membership will not live on the reservation in 100 years. *Gila V*, 201 Ariz. at 312 ¶ 11. No expert in this case generated a projection in support of the proposition that the entirety of the Hopi population would live on the reservation. The Hopi Tribe's proposed population would result in a water right in excess of the minimal need standard due to the methodology that the United States and the Hopi Tribe selected to quantify future DCMI use on the reservation. That methodology generates a quantity of water not just for the residential population, but for municipal services, commercial, and industrial uses for that population. The inclusion of a future population not reasonably expected to live on the reservation would result in excess quantities of water for municipal, commercial, and light industrial uses.

The methodology chosen by the parties limited to the reasonably projected future population of people living on the Hopi Reservation does account for the water needs of people who are not full-time residents of the reservation. As demonstrated by the City of Flagstaff's ability to provide water for the large number of people in Flagstaff who do not qualify as residents for purposes of the U.S. Census, the amount of water quantified for the resident population can provide for the DCMI needs of people who return to the reservation for ceremonies, visits, events, or to farm the land on weekends during the growing season. COF FOF 244 -245.

2. Daily Water Usage Rate

The second component of the methodology accepted by the parties to quantify a federal reserved right for future DCMI water use is the appropriate per-person water rate of use or gallons per capita per day ("gpcd") figure. All parties agree that federal reserved water rights should be based on a gpcd rate greater than the current or past gpcd rate now used by people living on the Hopi Reservation. Current water use on the Hopi Reservation is constrained by the infrastructure in place.

Finding of Fact No. 186. Most of the community water systems on the Hopi Reservation were built between the 1950s and 1980s and were designed to deliver the amount of water needed for basic domestic use; they were not sized to also deliver water for commercial, municipal, and industrial use. [100720:61–62 AM (Hanemann); Hopi Exh. 4580 at 23–24, 26; Hopi Exh. 175 at 54]

Finding of Fact No. 187. The current water supply and water platform does not provide the water needed for future commercial, municipal, and industrial development, nor does it provide for additional growth in demand for domestic water. [100720:61–63 AM (Hanemann); Hopi Exh. 4580 at 15, 20; Hopi Exh. 185 at 2]

Finding of Fact No. 188. The existing community water systems are undersized. These systems have insufficient storage capacity, broken pipes, underpowered electric motors, and operational problems with wells and pumps. The problems are exacerbated during times of peak demand during the summer months and religious and cultural ceremonies. [Hopi Exh. 4580 at 26]

Finding of Fact No. 189. The community water systems do not provide for fire protection. Although some villages have fire hydrants, these cannot be used for fire suppression. Rather, they are only used to flush out the water supply lines. [Id.; 110520:50–51 PM (Selwyn Sekaquaptewa); Hopi Exh. 185 at 1; Hopi Exh. 4580 at 26]

Finding of Fact No. 190. The Hopi Reservation has water quality issues that affect the demand for water for domestic uses. Portions of the Hopi Reservation have experienced water quality problems related to elevated levels of arsenic as well as pH and total dissolved solids levels in excess of accepted standards. Improved water quality should result in higher DCMI water usage in the future because the public water supply can be put to a wider range of uses. [U.S. Exh. 944 at 8 (PDF 11)]

Finding of Fact No. 191. As the economy on the Hopi Reservation expands, water usage on the Hopi Reservation is expected to rise. [100720:59–60 AM (Hanemann); 091720:14–15, 67 AM (Hamai); U.S. Exh. 944 at 8-9 (PDF 11-12)]

Finding of Fact No. 192. Past and current gpcd rates do not provide an adequate basis upon which to quantify a federal reserved water right for DCMI use.

Finding of Fact No. 193. When greater quantities of water are consistently provided, DCMI usage on the Hopi Reservation is expected to increase because people will increase water usage for indoor and outdoor domestic use and for commercial uses. [Hopi Exh. 175 at 60]

The parties dispute the future gpcd rate and they dispute the appropriate method to determine the correct future gpcd rate. The Hopi Tribe, supported by the Navajo Nation, claims a future gpcd rate of 160. The United States, joined by all the objectors except the City of Flagstaff, claims a gpcd rate of 150. The City of Flagstaff argues that the rate should not exceed 100 gpcd.

The *Gila V* Court reaffirmed that "determining the amount of water necessary to accomplish a reservation's purpose is a 'fact intensive inquir[y] that must be made on a reservation-by-reservation basis.' " 201 Ariz. at 6 318, 38, 35 P.3d at 79 (citing and quoting *In re General Adjudication of All Rights to Use Water in the Gila River System & Source*, 195 Ariz. 411, 420, 31, 989 P.2d 739, 748 (1999), *cert. denied sub nom. Phelps Dodge Corp v. United States*, 530 U.S. 1250 (2000). The appropriate method to determine a future gpcd rate must focus on the future needs of the people living on the Hopi Reservation and the facts and circumstances applicable to those people to quantify a minimal water need.

The Hopi Tribe rejects both the *Gila V* requirements that quantification must be dictated by facts unique to the Hopi Reservation and that federal reserved water rights must be quantified as the minimal amount necessary to meet those needs. Instead, it introduces the concept of parity that focuses on water uses outside of the reservation to quantify federal reserved water rights on the reservation. The United States similarly advocates a parity approach while also relying upon evidence of the unique characteristics of the reservation and water needs of the Hopi people. The drawbacks of the parity approach, or quantifying by analogy, are well illustrated by the Claimants' experts' reaction to City of Flagstaff's population growth rates and gpcd rate. Dr. Greene points to the high historic growth rate of City of Flagstaff as a basis for her belief in a high population growth rate for the Hopi Reservation. [U.S. Exh. 1114 at 4 (PDF 8)] Dr. Hanemann, in contrast, argued that the City of Flagstaff is not comparable to the Hopi Reservation so its low gpcd rate should not be used to set the gpcd rate for the reservation. COF FOF 231.

The concept of "parity" as put forth by the Hopi Tribe assumes that reservation life in the future will resemble non-reservation communities, and further assumes that the Hopi Tribe's DCMI water usage will resemble its non-native neighbors both as the Hopi Tribe engages in similar levels of economic development and as the infrastructure and housing stock develops to resemble non-reservation communities. Hopi FOF 637–640. The Hopi Tribe cites *Gila V* for the proposition that "Hopi tribal members are entitled to enjoy the same style of evolution and benefits of modern civilization that non-tribal members presently enjoy in their communities." Hopi Tribe's Closing Written Brief at 15. According to the Hopi Tribe , it will only be able to grow, develop, and modernize if it receives a decreed allocation of water so it can use amount of water amounts equal to amounts of water used in non-reservation communities.

Assuming that the concept of parity does not run afoul of the *Gila V* dictate to focus on the needs of the reservation, it presents the very real question of which information is relevant and which communities the Hopi Tribe expects to duplicate on the reservation in the future. The first issue presented by the Hopi's approach is the age of the data used as the controlling comparison. In general, the gpcd rates for DCMI water use in Arizona have decreased over the past 20 years. [091720:16-17, 27, 74 AM (Hamai); U.S. Exh. 944 at 11 (PDF 14)] This trend is due, at least in part, to water conservation efforts. [091720:23, 74-75 AM (Hamai); U.S. Exh. 944 at 20 (PDF 23)]. The continuation of this downward trend can be seen in the eight percent decline in the gpcd rate between 2010 and 2015 statewide. Arizona Department of Water Resources compiled data for eight towns in the Little Colorado River Watershed that demonstrated a nine percent decline from 2006 to 2017. [LCRC Exh. 1159 at 2] Between 2015 and 2017, the gpcd rates declined by approximately one percent. [*Id.*] The fact that gpcd rates continued to decline in recent years suggests that the gpcd rates for communities with higher rates may decline in the future thereby causing a further decline in the average future gpcd use. Arguments based on data and water planning documents from more than a decade ago are not persuasive because they ignore the results of the efforts undertaken by Arizona residents, businesses, and government to conserve a scarce resource. Given that much of the infrastructure, housing and business facilities that will be used on the Hopi Reservation in the future will also be built in the future, it is reasonable to conclude that these facilities will be built using technology that minimizes water use and will more likely operate with less water than similar facilities have used in the past.

Finding of Fact No. 194. A federal reserved water right cannot be based upon historically higher rates of water usage for DCMI purposes reported in surrounding communities.

In addition to a need to have temporal similarity, there must also be location similarity. The Hopi Tribe presented the gpcd rates for all 15 Arizona counties for 2010 and 2015 to argue that the data supports a 160 gpcd rate. [Hopi Exh. 4580 at 41-42] The gpcd rates for the counties are not uniform. The gpcd rates range from 106.8 in Yavapai County to 243.6 in Mohave County. [*Id.*] The Hopi Tribe's claimed rate exceeded the 2015 gpcd rates for 60 percent of the Arizona counties: Apache, Cochise, Coconino, Gila, Graham, Navajo, Pima, Santa Cruz, and Yavapai. [Hopi Exh. 4580 at 41-42] Mr. Hamai testified that rather than examining the average rate for all county residents, "the 3-County Average provides a more direct and appropriate comparison to future conditions on the Hopi Reservation." [091720:16-17 AM (Hamai)] The average gpcd rate for Apache, Coconino, and Navajo counties in 2015 was 148. [U.S. Exh. 944 at 11 (PDF 14)] Thus, the 160 gpcd rate claimed by the Hopi would provide more water per capita, not a similar amount, to the population of the Hopi Reservation than the residents of a majority of Arizona's counties and more than the residents of the three immediately surrounding counties.

Finding of Fact No. 195. A federal reserved water right cannot be based upon either the average state water usage for DCMI purposes or the water usage reported by all of the counties in the state.

The Hopi Tribe argues that the county gpcd rates that it collected from the United States Geological Society ("USGS") and introduced into evidence are too low because the USGS calculates those rates based on the amount of water diverted from surface and groundwater to supply DCMI uses. Hopi FOF 647. The difference between the amount diverted and the amount used in this context relates to a community's willingness and ability to apply water that has flowed through the municipal system to a second use. Communities that are willing to clean and reuse municipal water do not need to pump as much groundwater or divert as much surface water as communities that do not clean and reuse water but in engage in the same activities. [Hopi Exh. 4580 at 42] Dr. Hanemann, like Dr. Greene, collected federal data and then adjusted it upward to claim a federal reserved right to a greater amount of water. According to Dr. Hanemann, the correct measurement of gpcd should be the amount supplied by municipal systems as reported by USGS, increased by the amount of treated wastewater used for other purposes. Obviously, if the non-reservation municipality's secondary use is not a DCMI purpose and the intent is to provide the Hopi Reservation with an amount of water similar to the municipality's gpcd rate for DCMI use, the amounts of treated wastewater should not increase the quantity of DCMI for this calculation. Many of the municipalities examined by the Hopi's economist used reclaimed water for non-DCMI purposes such as crop irrigation or wetlands, which are non-DCMI purpose. [LCRC Exh. 1019 at 3; LCRC Exh. 1474 at 13, 54; LCRC Exh. 1031 at HOPI_075678 (PDF 4); LCRC Exh. 1046 at 3; LCRC Exh. 1059 at 3; LCRC Exh. 1073 at 3; LCRC Exh. 1007 at 4; 100720:110-12 PM (Hanemann); 091720:54 AM (Hamai); 091720:70-71 PM (Hamai)]

Finding of Fact No. 196. Dr. Hanemann's adjustment of data to account for reclaimed water used for non-DCMI purposes was improper for purposes of quantifying a federal reserved water right and does not justify a water use rate of 160 gpcd.

There are municipalities in the Little Colorado River Watershed that do recycle municipal water to support additional DCMI uses. For example, Flagstaff uses recycled municipal water to support a golf course. [020421:97-99 AM (Hill); COF Exh. 124 at 51 (PDF 59); COF Exh. 25 at 9, 54] [LCRC Exh. 1014 at PDF 7, LCRC Exh. 1002 at PDF 7; 011142:31, 46 AM (Kopp)] To accept the Hopi's argument that the recycled water must be added into the total water used to calculate DCMI would mean that parity, as defined by the Hopi Tribe , would entitle the United States to federal reserved water rights to pump more groundwater and divert more surface water for a DCMI use than a similarly situated community that is willing to recycle water for use on a golf course or municipal use such as landscaping.

Conclusion of Law No. 42. The use of reclaimed wastewater effluent as a source of water to accomplish a DCMI purpose does not constitute an increased DCMI use for purposes determining an appropriate gpcd rate for the Hopi Reservation based on a parity argument.

Focusing more locally, the Hopi Tribe points to eight communities and two utilities in and around the Little Colorado River Basin for which ADWR provided data for more than a decade. [LCRC Exh. 1159 at 2] According to the data produced by ADWR, the annual average gpcd rates over that period ranged from 111 gpcd to 272 gpcd, indicative of significantly different circumstances and different water management among the ten entities.

Finding of Fact No. 197. The rate claimed by the Hopi exceeds the annual average gpcd rate for seven of the ten entities. [LCRC Exh. 1159 at 2]

Finding of Fact No. 198. Assuming that parity was the appropriate standard, a gpcd rate of 160 would not constitute parity.

Gila V allows the trier of fact "latitude" to consider any information "it deems relevant." 201 Ariz. at 320, ¶ 49, 35 P.3d at 81. Latitude, however, cannot be stretched to such an extent that no consideration is given to specific future needs on the reservation or to an assessment of the minimal amount needed to accomplish both the changes the Hopi Tribe intends to implement on the reservation and the traditions it intends to retain. As the City of Flagstaff properly argues, a strict parity approach is contrary to *Gila V's* mandate of a reservation-specific minimal need analysis for each water right claim. City of Flagstaff's Closing Response Brief at 17 (August 27, 2021)

Conclusion of Law No. 43. A future gpcd rate cannot be based solely on the current uses of communities in the area surrounding the reservation.

Finding of Fact No. 199. A gpcd rate of 160 is not supported by evidence in the record as the minimal amount needed for DCMI use in the future on the Hopi Reservation.

The United States also bases its claim for a 150 gpcd rate on parity but it also considers facts relevant to the Hopi Reservation. Mr. Hamai relied on current data, did not adjust reported data, and focused on surrounding communities in the Little Colorado River Basin. Mr. Hamai described the method used as follows:

> For purposes of determining a future water use rate, it is assumed that water use on the Reservation in the long-term will be similar to that currently seen for neighboring communities with consideration given to various factors [that influence water demand]. The premise of this assumption is that as the Reservation economy develops and reaches a level on par with its neighbors, DCMI water use by the Hopi Tribe will grow accordingly. As discussed previously, a rate of 160 gpcd for the Hopi Tribe was established based on a comparison with regional non-Indian communities (HDR, 2003). However, this rate is slightly higher than recent public supply use in the three northeastern Arizona counties . . . and by northern Arizona communities at similar elevation . . . . Further, many places appear to be experiencing reductions or even reversals in the upward trend of water use rates, which may be due in part to water conservation efforts (USGS; USBR, 2001). Therefore, although 160 gpcd is a reasonable estimate, one might expect future Hopi DCMI use to grow significantly but stop somewhat short of the 160 gpcd rate.

[U.S. Exh. 944 at 20 (PDF 23)]

Mr. Hamai also provides evidence about future gpcd rates that demonstrate consideration of the climate affecting the Hopi Reservation and the surrounding communities. He examined nine northern Arizona communities and testified that communities located at colder temperatures tend to use less water, particularly for outdoor residential use due to lower temperatures and irrigation requirements. [091720:49 PM (Hamai); U.S. Exh. 944 at 16 (PDF 19; U.S. Exh. 1446 at 10]

Mr. Hamai determined that elevation can serve as a proxy for climate and is an important factor to consider when comparing water use rates of various communities.

Community	2018 Population	2018 Water Demand (gpcd)	Elevation*
Flagstaff	74,736	96	6910
Winslow	9,577	144	4850
Holbrook	5,228	207	5082
Snowflake	6,010	226	5682
Taylor	4,382	171	5761
Springerville	2,028	89	6967
Show Low	13,400	161	6345
Eagar	4,995	115	7080
St. Johns	3,561	145	5686
Raw average		150	
Weighted average		122	

*Elevations from Wikipedia, 2018

Table 5.

Elevation is correlated with temperature, which has a significant effect on water use. *See* Table 5. [U.S. Exh. 944 at 16 (PDF 19); U.S. Exh. 1446 at 9]

Finding of Fact No. 200. An inverse relationship exists between elevation and water use among the identified communities with communities at higher elevations tending to report less water use than communities at lower elevations.

Mr. Hamai determined that the Hopi villages—where most of the people on the Hopi Reservation are projected to live and, thus where most of the DCMI water use is projected to occur—range in elevation from 4,777 feet (Moenkopi) to 6,296 feet (Bacavi and Hotevilla). [U.S.

Exh. 944 at 17 (PDF 20); U.S. Exh. 1446 at 10; 091720:52-53 PM (Hamai)] The northern Arizona communities that Mr. Hamai determined to be located at comparable elevations include: Holbrook, Snowflake, Show Low, St. Johns, Taylor, and Winslow. [U.S. Exh. 944 at 17 (PDF 20); U.S. Exh. 1446 at 11] Eager, Flagstaff, and Springerville are at significantly higher elevations, as shown in Table 5, and have the lowest DCMI water use. [091720:20 AM (Hamai)] Mr. Hamai opined that "the range of current water use rates for the northern Arizona communities does provide a measure of reasonableness for a claimed DCMI rate for the Tribe." [U.S. Exh. 1446 at 12]

Finding of Fact No. 201. In 2018, water use rates in Holbrook, Show Low, Snowflake, St. Johns, Taylor, and Winslow ranged from 144 gpcd to 226 gpcd. [U.S. Exh. 1446 at 11]

Conclusion of Law No. 44. The range of water use rates in the six northern Arizona communities is relevant to the determination of the appropriate gpcd rate for the Hopi Reservation.

Another approach to estimating a future DCMI usage rate is a "sectoral demand approach" in which the domestic, commercial, municipal, and industrial categories are disaggregated and water demands separately estimated. [120820:37-28 PM (Liechty); NN Exh. 767 at 5] As shown by Table 6, prepared by the Hopi Tribe, the surrounding communities track the individual components of the DCMI use. With the exception of System Losses that appear to be a fairly uniform ten percent of the gpcd rate, the allocation of water use among the components varies from community to community.

Community	2018 gpcd	Domestic	Commercial / Industrial	Municipal	System Losses
Eagar	115	71 %	16 %	6 %	7 %
Holbrook	207	45 %	23 %	22 %	10 %
Show Low	161	64 %	18 %	8 %	10 %
Snowflake	226	51 %	6 %	33 %	10 %
Springerville	89	62 %	37 %	1 %	0 %
St. Johns	145	53 %	26 %	10 %	11 %
Taylor	171	69 %	19 %	7 %	5 %
Winslow	144	49 %	23 %	18 %	10 %

Table 6. Listing of eight communities that includes gpcd rate and allocation of municipal water among DCMI uses. Flagstaff has been excluded from this table. In 2018 it reported a gpcd rate of 96 with 51 percent (49/96) used for residential use, 38 percent (36/96) for non-residential use and 11 percent ((96-85) /96) allocated to system-related uses such as flushing, leaks, and water meter inaccuracies. [COF Exh. 101]

Source: Hopi FOF 677

Finding of Fact No. 202. The breakdown of DCMI usage rates between domestic, commercial, municipal, and industrial uses can vary substantially from community to community. This variation is borne out when comparing the breakdown of DCMI usage in 2018 of eight cities and towns in the Little Colorado River Basin. Hopi FOF 677

The advantage of applying a sectoral demand approach to the determination of the gpcd rate for the Hopi Reservation is that it permits an analysis of future domestic use on the reservation, with respect to those components reflective of the existing and future domestic needs and cultural uses of water on the Hopi Reservation. Although the reports produced by Mr. Hamai did not expressly examine the individual components of domestic use, they do include information that Mr. Hamai judged to be useful with respect to factors affecting inside and outside domestic use.

Mr. Hamai cited studies that examined indoor residential use. A 1984 study of residential water use assuming low-flow toilets and showers and, taking into account toilet leakage, concluded that on average people used 59.7 gpcd, shown in Table 7. A later California study found the average three-bedroom household used 40.5 gpcd as shown in Table 8. Mr. Hamai testified that the California study was not particularly relevant because it was a single study and not founded on anything specific to this region of the state. [091720:31 PM (Hamai)] Given that the majority of the housing on the Hopi Reservation expected to exist in the future will be built in the future, and no testimony exists in the record that houses plumbed in the future will be plumbed differently than those houses in the surrounding areas, it is reasonable to expect that such housing will contain water conserving plumbing fixtures and that indoor residential uses will require a water supply of 40.5 – 60 gpcd.

Fixture	Water Use (gpcd)	% of Total
Toilets (low-flow)	14	23%
Clothes Washers	12.6	21%
Faucet	8.5	14%
Showers (low-flow)	8.2	14%
Toilet Leakage	8	13%
Baths	7	12%
Dishwasher	1.4	2%
Total	**59.7**	-

Table 7

Fixture	Water Use (gpcd)	% of Total
Shower	20.0	49%
Faucets	10.4	26%
Clothes Washer	5.2	13%
Toilets	4.8	12%
Total	**40.5**	-

Table 8

Outdoor residential use is the second driver of domestic use. In 2018, Flagstaff reported that 49 gpcd of its overall DCMI gpcd was attributable to residential use. [COF Exh. 101] Springerville, another town at a high elevation, used 55 gpcd for residential use (0.62 x 89). *See* Table 6. A review of the nine communities generally shows the trend indicated by Mr. Hamai that lower gpcd rates for the residential component of DCMI use can be found in towns at higher elevation. This result is consistent with Mr. Hamai's explanation that elevation affects the DCMI because it affects the outdoor-residential use: "[C]limactic conditions were found to have a significant impact on outdoor uses, with residential outdoor use ranging from 11 percent of residential indoor use in cool, wet climates to 250 percent in or more in hot, dry climates." [U.S. Exh. 944 at 19 (PDF 22)] He testified that "[c]limate through its effect on irrigation requirements is an influential factor in outdoor DCMI water use [citation omitted]." [U.S. Exh. 944 at 8 (PDF11)] He also testified that the arid climate found on the Hopi Reservation will result in relatively high annual irrigation requirements for gardens because in northern Arizona, as elevation decreases, temperature and water use increases. [U.S. Exh. 944 at 8, 16 (PDF 11, 19)]

Uncontrovertibly, the people living on the reservation plant and harvest their own food. They plant crops in the fields and they maintain gardens. People maintain gardens where a consistent of supply of water is available such as a municipal supply or a spring. [Hopi Exh. 4595 at 45 (Sidney)] "After water systems were developed in Hopi villages in the 1960s, many families started small household garden adjacent to their residences that are irrigated using garden hoses. Chile, onions, melons, and corn are popular corps in these gardens and other vegetables are grown as well. [figure omitted] Many families also have planted peach trees in the yards of their houses." [Hopi Exh. 3883 at 60 (PDF 68)]

Under *Gila V*, the quantification of federal reserved water rights must be based on the culture, practices, and religion of the people living on the reservation. The Hopi people are quintessentially farmers and gardeners. {Hopi Exh. 4595 at 27 (Sidney)] Gardens provide a wide variety of vegetables such as beets, carrots, lettuce, cucumbers, chard, kale, squash, beans, and watermelon. [110520:43 (Susan Sekaquaptewa)] Mr. Hamai acknowledged that municipal water systems will provide the water for large family gardens. [091720:65-66 PM Hamai; LCRC Exh. 583 at 1; LCRC Exh. 583 at PDF 1–2, 5–6] In 2003, a determination was made that 45 gpcd was an appropriate rate for an outdoor garden based on the assumption that each family would have a garden of approximately one-tenth of an acre that would require two acre-feet of water per acre or 0.02 acre-feet per garden. [LCRC Exh. 583 at PDF at 5] Assuming that the garden is a smaller .05 acres and requires 3.2 acre-feet of water per acre for irrigation, [110520:44 (Susan Sekaquaptewa)] and further assuming a household size of 3.4, then the outdoor component of a domestic use would be 42 gpcd. Municipal water can also be expected in the future to provide water for watering livestock stabled near the home and for livestock on the range during times when stockponds, springs, and wells are dry. [091720:65-66 PM Hamai]

Finding of Fact No. 203. The domestic component of gpcd for the Hopi reservation will not be less than 82 gpcd.

The nine communities listed above, on average, use 57 percent of the gpcd rate for domestic use. Flagstaff used 51 percent of its gpcd rate for domestic use in 2018. Applying these two percentages would result in a DCMI rate of 143 gpcd to 160 gpcd to provide for municipal, commercial, and system uses. Given that the people living on the reservation have not traditionally used water for landscaping, it is likely that the municipal use on the reservation will be less than municipal use in the surrounding communities. [U.S. Exh. 944 at 12] Thus, applying the *Gila V* standard, the gpcd rate proposed by the United States is more appropriate than the gpcd rate proposed by the Hopi Tribe.

Flagstaff contests the United States' claim for a DCMI rate of 150 gpcd. Its primary argument is that the rate does not take into account best water management practices and does not incorporate the use of reclaimed water. Mr. Hill, called by the City of Flagstaff, is clearly an expert in good water management practices. Flagstaff has won awards for its water management practices. COF FOF 158. Mr. Hill's testimony presents two issues. First, Mr. Hill focused on the practices that the Flagstaff has put into operation to make the town better able to meet the demands of its quickly growing population. Mr. Hill testified that he did not consider the minimal needs of the Hopi Reservation. [020420: 31 AM (Hill)] Second, Mr. Hill's recommended use of recycled water for DCMI use, while acceptable in Flagstaff, is not as accepted by the Hopi people. The Hopi Tribe has historically resisted the use of reclaimed water for domestic and ceremonial purposes. [See 102720:44–45 PM (Onsae) (testifying that there are cultural concerns with the use of reclaimed water for human consumption)]; *see also Hopi Tribe v. Ariz. Snowbowl Resort Ltd. P'ship*, 430 P.3d 362, 407–08 ¶¶ 45–49 (Ariz. 2018) (Bales, C.J., dissenting) (discussing the Hopi Tribe's claims for public nuisance based on the Snowbowl ski resort's use of reclaimed wastewater on the San Francisco Peaks and the Tribe's concerns that the use of reclaimed water would destroy and desecrate some of their most sacred lands and interfere with their cultural and religious practices). Given the Hopi Tribe's cultural aversion to using wastewater, it is much more likely that Hopi villages would use treated effluent for non-DCMI purposes than for DCMI purposes. [091720:40 PM (Hamai); *see also* 120120:51 PM (Honahnie)] Pursuant to the strictures of *Gila V*, cultural and religious views and practices must be taken into account in quantifying federal reserved water rights.

Finding of Fact No. 204. The Hopi have a cultural and religious aversion to the reuse of water that has flowed through the municipal water system making it unlikely that in the future there will be treated municipal water will be used for DCMI purposes.

Finding of Fact No. 205. A 150 gpcd rate of use for future DCMI is the amount necessary for the Hopi Reservation to serve as a permanent home and abiding place tailored to the minimal need of the Reservation.

Conclusion of Law No. 45. Federal reserved water rights for DCMI purposes should be quantified as 3,069.3 acre-feet annually of water based on a future population of 18,255 and a per capita water use rate of 150 gpcd. The quantity and quality of surface water on the Hopi Reservation is insufficient to provide the amounts of water needed for domestic, commercial, municipal, and industrial uses that satisfy the minimal needs of a permanent homeland.

Conclusion of Law No. 46. Groundwater is necessary to provide water for domestic, commercial, municipal, and industrial uses necessary to ensure that the Hopi Reservation serves as a permanent homeland for the Hopi.

Conclusion of Law No. 47. The quantity of water required for future DCMI usage necessary to effectuate the purpose of the reservation tailored to the reservation's minimal need, is greater than the quantity of past and current use and thus, claims based on past and present use are subsumed within the claim for future DCMI use.

VII. Agricultural Use

Irrigation for farming constitutes the largest use of water on the Hopi Reservation. [Hopi Exh. 7 at 6] Among the factors that must be considered to quantify a federal reserved water right under G*ila V* are a people's history, past water uses, culture, and religion, and the physical landscape of the reservation. Each of those factors support federal reserved water rights for the Hopi Reservation to enable the people currently living on the reservation, and those living on the reservation in the future, to be able to continue a long farming tradition.

Dr. E. Charles Adams, who holds a Ph.D. in anthropology and serves as the curator of archeology at the Arizona State Museum at the University of Arizona, reported that based on archeological findings and historical documents, the Hopi were farming in the valleys, floodplains, and dune lands surrounding the mesas and villages by the 1300s. [Hopi Exh. 387 at 83 (PDF 88)] Rock alignments from the 14th and 15th centuries in the area suggest the existence of border gardens, terraces, check dams, and windbreak features for sand dune fields. [Hopi Exh. 387 at 86 (PDF 91)] Other archeological investigations indicate that the Hopi farmer situated their fields to take advantage of runoff from the mesa rim and seepage from formations underlying the sandstone cap of the mesas. [*Id.*] Dr. Adams testified that the view of land occupied by the Hopi Tribe from a hypothetical hot air balloon in the 1500s, would have been a dense patchwork of extensive fields, continuous washes stretching five or more miles, and extensively planted sand dunes filled with corn and cotton. Over Moenkopi one would have seen hundreds of miles of irrigated farmland. [100118:17–18 AM (Adams)]

Dr. Adams also described the farming methods that involved the diversion of wash water to irrigate the fields. [100118:49-50 AM (Adams)] Historical accounts from the 16th century describe the Hopi farmers growing corn, beans, squash, and other vegetables, as well as cotton.

[Hopi Exh. 87 at 104-105 (PDF 116–117); Hopi Exh. 3872 at 113-114 (PDF 118–119); Hopi Exh. 3883 at 144-145 (PDF 152–153)] In the 1800s, the United States Army reported on visits to the Hopi Mesas that included descriptions of terrace gardens and immense fields under cultivation. [Hopi Exh. 3883 at 147 (PDF 155)]

Finding of Fact No. 206. The Hopi Tribe has extensively farmed land in the Little Colorado River basin for hundreds of years.

Finding of Fact No. 207. The Hopi farmers have historically used the surface water flowing on the landscape to irrigate crops and gardens.

Farming continues to be important today as a source of food and as part of the Hopi culture and religion. [101818:15 AM (Honyumptewa); 101018:13 PM (Selestewa); 110920:92 AM (Tenakhongva); 100218:32 AM (Puhuyesva); 100418:56 AM (Loma'omvaya); 100518:29 AM (Elmer); 100818:26-27 AM (Nuvangyaoma); 100808:60 PM; 100918:16 AM (Honanie); 110520:50 AM (Sekaquaptewa)] The Hopi farmers provide crops and produce for their families and to share with the community. [Hopi Exh. 4580 at 56]

Corn, one of the primary crops grown on the reservation, is a staple of the Hopi diet and is used in religious ceremonies and traditional practices as discussed more fully in Section V. [100918:26 PM (Talayumptewa); 100418:68-69 AM (Loma'omvaya); 100818:38 AM (Nuvangyaoma); 100818:60 PM (Youvella)] At a young age, children are taught the traditional methods to plant and care for corn plants. [100218:31-32 AM (Puhuyesva); 100418:55-56 AM (Loma'omvaya); 100518:29 AM (Elmer); 100818:26-27 AM (Nuvangyaoma); 100808:60 PM (Youvella); 100918:16-17 AM (Honanie)].

The Hopi Tribe describes the importance of farming:

> Hopi farming knowledge represents a special technology of creating bountiful crops from an arid environment and is respected

> worldwide as the best dry farming method. Farming is a primary focus for all Hopi who are to remain committed to the guidelines for Hopi stewardship. The restoration and creation of field areas benefit the community by promoting farming by individual households and clans, thereby planting the seeds of knowledge for future generations.

[Hopi Exh. 3878 at 11 (PDF 18)]

Finding of Fact No. 208. Corn and the planting, growing, and harvesting of the corn plant have traditional and cultural significance to the Hopi.

Finding of Fact No. 209. Farming is embedded in Hopi traditions and is an integral part of Hopi culture and religion.

Finding of Fact No. 210. Water diverted for agricultural use including planting, growing, and harvesting crops and vegetables is an aboriginal use of water.

Gila V also requires consideration of geography, the topography, and the natural resources found on the reservation to adjudicate a federal reserved water right. The Hopi Reservation provides water sources along a broad continuum ranging from perennial flows in the Northern Washes to precipitation. [Hopi Exh. 3883 at 42-43 (PDF 50-51)] The Hopi farmers use the various sources alone and in combination to cultivate four different types of fields: (1) fields watered by rainfall, (2) fields watered by underground seepage, (3) irrigated fields on alluvial fans and floodplains using surface and flood flows *(*also known as akchin farming), and (4) irrigated fields using water from springs and reservoirs. [*Id.*; *see also* 101218:23–24 PM (Ferguson); 092518:15–17 PM (Camilli); 100218:132 PM (Puhuyesva); 100918:13 AM (Honanie); Hopi Exh. 3883 at 43 (PDF 51); Hopi Exh. 3895 at 26 (PDF 7)] The dominate type of field used by Hopi farmers are the fields dependant on flood flows. [Hopi Exh. 3895 at 27 (PDF 8)] These fields are:

> always located in a water course or adjacent to a water course, in such a position that during a flood large quantities of water will pass over the field, but not so rapidly as to wash out the crop. In the Hopi

> country the water courses are dry arroyos or washes which flow after every large rain in their drainage area, but which are dry between rains. … The peak flood in a large arroyo in the Hopi county occurs some time after the beginning of the rain and water will flow for several hours after the rain cease because of the excess of water that has seeped into the ground. The larger washes may flow for several days after a heavy rain. A field located so as to catch part of the flood of an arroyo will thus receive a larger quantity of water and be soaked for a much longer than any piece of ground not in a water course or on a floodplain.

[Hopi Exh. 3895 at 26 (PDF 7)]

Finding of Fact No. 211. The Northern Washes and minor tributaries provide the primary source of water for irrigation. U. S. FOF 194.

Finding of Fact No. 212. Water flows from the headwaters of the Northern Washes north of the Hopi Reservation, across the Hopi Reservation, and over its southern border and drain to the Little Colorado River. [092618:81-82 PM (Ley) 120920:25 P.M. (Leeper); NN Exh. 761 at 2 (PDF 4); Hopi Exh. 35 at 7-5 (PDF 5)**]** "All [washes] are tributaries of the Little Colorado River, and flow in a generally northeast to southwesterly direction." [Hopi Exh. 3878 at 14 (PDF 21)] The average estimated natural annual flow for the Northern Washes is 29,941 acre-feet with a range of 7,161 acre-feet to flood flows of 91,320 acre-feet per year. [U.S. Exh. 564 at 5-1 (PDF 58), 5-2(PDF 59)]

Springs provide additional sources of water for irrigation. At each of the Hopi Mesas, there are communal gardens irrigated from springs. [Hopi Exh. 3883 at 56 (PDF 64)] The spring-irrigated gardens are located on mesa slopes, where terraces have been built to provide level places for planting. The gardens are called "terrace gardens." [*Id*. at 65] The spring-irrigated gardens are used to grow chile peppers, onions, apples, peaches, asparagus, cabbage, cantaloupes, watermelons, carrots, corn, cucumbers, grapes, green beans, pinto beans, potatoes, squash, pumpkins, tomatoes, and zucchini**. [**110220;7-8 (Gashwazra); Hopi Exh. 3883 at 67]

On Moenkopi Island, the Hopi farmers use a ditch irrigation system that delivers water to fields on the alluvial floor of Moenkopi Wash. The Hopi irrigate fields by diverting water from the wash into long supply ditches along the base of the canyon wall and from there to fields planted on alluvial terraces on the canyon floor. [Hopi Exh. 3895 at 34-36 (PDF 12–14)] The Hopi also use water from a reservoir in Pasture Canyon. [Hopi Exh. 3883 at 61 (PDF 69)] Pasture Canyon Reservoir remains in use today. [*Id.*]

Finding of Fact No. 213. The geography and topography of the Hopi Reservation provide land and the Northern Washes, minor tributaries and springs provide sources of water for irrigated fields and gardens for crops and plants.

A. Source of Water for a Federal Reserved Water Right

The United States and the Hopi Tribe, as claimants, have the burden of proof to establish the elements of the claimed federal reserved water right. *Arizona II*, 460 U.S. at 637. A claimant that fails to meet its burden of proof is not entitled to a water right. *Id.* One of the elements of a federal reserved water right is a source of the water. The Hopi Tribe claims a right to 91,282 acre-feet of water per year to provide a full-supply of water to irrigate 33,808 acres of land. Hopi Tribe's Sixth Amended Statement of Claimant at 29. Hopi Tribe's Seventh Amended Statement of Claimant at 33. Hopi Tribe's Eighth Amended Statement of Claimant at 33. In its Statements of Claimant, the Hopi Tribe described the potential sources in general terms as surface water and groundwater.

The Hopi Tribe retained Todd Umstot, who holds a Master of Science in Hydrogeology, to calculate the full-supply irrigation requirements of crops grown on the reservation using a surface water model known as the Deficit Irrigation Supply Model ("DISM"). As discussed in greater detail below, the United States developed the DISM based on the deficit irrigation practices found on the reservation to quantify its claim for irrigation water supplied by the natural flow through the Northern Washes. Mr. Umstot ran an unlimited supply of water through the DISM in place of the realistic supply of water that flows through the Northern Washes. Mr. Umstot reported that the model was otherwise unchanged. The purpose of the change was to create a "full-supply irrigation demand [that] considers the irrigation requirement of the crops with an unlimited supply of water." [Hopi Exh. 4398 at 2 (PDF 5)]

Mr. Umstot testified that he "didn't calculate where the surface water would be diverted or what other sources of water would be used for that demand." [100620:32 AM (Umstot)] The demand analysis exceeded the available water supply and Mr. Umstot testified that he did not know "where all that water would come from". [100620:30 AM (Umstot)] As Mr. Umstot acknowledged, his computer exercise was simply, and nothing more than, a demonstration of the full amount of water that could be used by crops planted on 33,801 acres. [100620:29 AM (Umstot)] A hypothetical maximum water supply does not support a claim for a federal reserved water right for 91,282 acre-feet of water annually.

In its Closing Brief, the Hopi Tribe identified the Northern Washes and their minor tributaries as the source of the 91,282 acre-feet of water. The Hopi Tribe's Closing Written Brief at 24. It provided no citations to the record that would support a factual finding that this source of water could provide 91,282 acre-feet of water each year. The average estimated natural annual flow for the Northern Washes is 29,941 acre-feet. [U.S. Exh. 527 at 3-27 (PDF 49)]

Finding of Fact No. 214. The annual flow of the Northern Washes does not provide sufficient water to allow the Hopi farmers to divert 91,282 acre-feet of surface water each year to irrigate fields for crops and vegetables. [NN Exh. 761 at 13-14 (PDF 15-16)]

Conclusion of Law No. 48. A federal reserved water right cannot be adjudicated for a hypothetical water source.

Conclusion of Law No. 49. The Hopi Tribe failed to meet its burden to establish a source of water for a claimed 91,282 acre-feet to irrigate fields on the reservation.

The Hopi Tribe points to no evidence in the record that provides any description of the manner in which flows from any unidentified source, equivalent to the most significant flooding of the Northern Washes during the period 1949 to 2014, could be managed and constructively used to irrigate 33,801 acres of land. Mr. Umstot did not examine any existing irrigation infrastructure to determine whether it could deliver the calculated flow. [100620:28 AM (Umstot)] Mr. Umstot did not analyze any engineering proposals that would capture an available water supply and deliver 91,282 acre-feet of water each year to 33,801 acres of land. [100620:28-29 AM (Umstot)]

Finding of Fact No. 215. The evidence is insufficient to support a finding that an irrigation project on the Hopi Reservation using 91,282 acre-feet of surface water each year, if it existed, is practically and economically feasible.

Conclusion of Law No. 50. The Hopi Tribe did not meet its burden to establish that 91,282 acre-feet of water each year to irrigate 33,801 acres of land is necessary to provide a permanent homeland for the Hopi Tribe tailored to the minimal needs of the Hopi Reservation.

B. Quantification of Federal Reserved Water Rights

1. All Water Flow

The Hopi Tribe claims that it is entitled to all water flowing in the Northern Washes and minor tributaries for agricultural uses. Hopi Tribe's Closing Brief at 22. As discussed in Section III, federal reserved water rights must be quantified by an objective measurement. *Gila V*, 201

Ariz. at 313 ¶ 14; *see also Gila III*, 195 Ariz. at 421 ¶ 32 n.10. This standard is consistent with federal law applicable to federal reserved water rights. *See, e.g., Arizona v. California*, 376 U.S. 340 (1964). The quantification asserted by the Hopi Tribe is not a permissible standard under federal law to quantify a federal reserved water right.

Conclusion of Law No. 51. Under *Gila V*, a federal reserved water right must be quantified by a specific and objective measurement. An "all" measurement cannot quantify a federal reserved water right to the water from the Northern Washes and minor tributaries for irrigation use.

In support of its proposed standard, the Hopi Tribe points out that historically it has made use of the wash water to irrigate fields and to irrigate land to increase forage. Hopi FOF 509. No dispute exists that the farmers use, and have historically used, water from the Northern Washes on the reservation. Use of water from a particular source, however, does not translate into total consumption of the resource. Extensive amounts of infrastructure such as reservoirs, dams, and conveyance structures that do not exist and have not been proposed would be needed to capture the entirety of the wash flow. [120920:25-26 AM (Leeper); 100620:81 AM (Umstot)]

Finding of Fact No. 216. The Hopi Tribe did not establish that an irrigation project that would divert the entirety of the flow in the Northern Washes and tributaries is economically feasible or practically sound.

Finding of Fact No. 217. The Hopi Tribe did not meet its burden to establish that the entirety of the flow in the Northern Washes and its tributaries, as properly quantified, is the amount needed to irrigate that quantity of land necessary to provide a homeland and abiding place for the Hopi Tribe tailored to the minimal need of the reservation.

The Hopi Tribe also argues that no need exists to further quantify the flow because there is no evidence that the water from the Northern Washes flow into the Little Colorado River and therefore has no impact on water users outside the Hopi and Navajo Reservations. To the extent that this argument is relevant, the testimony and evidence on the record demonstrates that the Northern Washes drain to the Little Colorado River. [092618:81-82 PM (Ley) 120920:25 P.M. (Leeper); NN Exh. 761 at 2 (PDF 4); Hopi Exh. 35 at 7-5 (PDF 5)] "All [washes] are tributaries of the Little Colorado River, and flow in a generally northeast to southwesterly direction." [Hopi Exh. 3878 at 14 (PDF 21)] According to an ADWR report that the Hopi Tribe introduced into evidence, "[t]he LCR [Little Colorado River] collects runoff from the Hopi Washes and flows downgradient of the Reservation from southeast to northwest before joining the Colorado River in Grand Canyon National Park". [Hopi Exh. 35 at 7-5 (PDF 5)]

Finding of Fact No. 218. Credible evidence exists that flow from the Northern Washes has reached and does reach the Little Colorado River.

Conclusion of Law No. 52. A federal reserved water right quantified as "all" cannot attach to water in the Northern Washes and minor tributaries for the Hopi Reservation**.**

2. Maximum Historic Use

The United States submits that the appropriate quantity for a federal reserved water right for an irrigation purpose is the maximum historical use of irrigation water on the Hopi Reservation. United States' Objections to the Draft Report of the Special Master on Past and Present Water Uses on the Hopi Reservation at 21 (September 20, 2019). The United States defined its claim to irrigate 13,032 acres of land using with a "maximum annual diversion of 18,897 acre-feet yearly, based on the maximum annual irrigation depletions of 13,760 acre-feet yearly, estimated using the Deficit Irrigation Simulation Model." United States Fifth Amended Statement of Claimant at 21.

The LCR Coalition, joined by the Arizona State Land Department, agrees that a federal reserved water right for irrigation use should be quantified in the amounts calculated by the United States. LCR COL at 260, ¶28 (June 25, 2021). Although the Navajo Nation agrees with the legal premise of the United States' position, it disputes the method used to calculate the maximum historic use. Navajo Nation's Objections to Draft Report of the Special Master on Past and Present Water Uses on the Hopi Reservation at 15, fn. 24 (September 30, 2019).

Water used for irrigation was not directly measured or gaged for the fields or pastures on the Hopi Reservation, so contemporaneous records do not exist reporting the amounts of water used each year to irrigate land on the Hopi Reservation. [Hopi Exh. 36 at 8-2 (PDF 2); 110118:12 PM (Leeper)] The Arizona Department of Water Resources investigated the claims that had been filed by the United States and the Hopi Tribe before the issuance of the HSR in December 2015. Arizona Department of Water Resources concluded that the Hopi Tribe irrigated a maximum of 9,553 acres in any single year in the past. It identified the relevant time period as 1954 - 1955. HSR at 5-5. Arizona Department of Water Resources further analyzed the irrigation methods to calculate appropriate water duties. It applied a 4.33 acre-feet per acre water duty for the 424 acres it considered to be farmed using modern methods, and a 0.93 acre-feet per acre water duty to the 9,129 traditionally farmed acres. Arizona Department of Water Resources recommended a water use of 10,325 acre-feet annually based on current and past irrigation uses. *Id.* Table 9 summarizes ADWR's conclusions regarding historic irrigation use on the Hopi Reservation.

General Location	**Acres**	**Water Use (Acre-feet Annually)**
District 6	6,293	6,129
Hopi Partitioned Land	2,625	2,442
Moenkopi	635	1,754
Total	**9,553**	**10,325**

Table 9

The United States and the Hopi Tribe objected to ADWR's conclusion. They contested the number of irrigated acres and the applicable water duty used in ADWR's formula. They offered methodologies to compute the number of irrigated acres on the Hopi Reservation using historical photographs. The Hopi Tribe also offered an alternative approach that uses historical population as a proxy for irrigated acreage.

The United States quantified its claim for irrigation use based on historic water use demonstrated primarily by photographs taken in the mid-1950s. James Ian Ebert, an archeologist, anthropologist and forensic scientist, testified that the United States retained his firm to conduct a photographic analysis of historical aerial photographs to locate irrigated and non-irrigated fields on the Hopi Reservation. [092418:15 AM (Ebert)] The historical aerial photographs confirmed past use at an identified time and the areal extent of the past use. [Hopi Exh. 3882, Appendix B]

The aerial photographs consisted of a series of photographs taken in 1934, photographs taken by the USGS in 1952 of the Moenkopi extension, photographs taken by the United States Army in 1954 of the southern two-thirds of the Hopi Reservation and in 1955, of the northern one-third of the reservation, and photographs taken in 1980. [092418:126, 130 PM (Camilli); 092518:53, 68 (Camilli)] Eileen Camilli, an archeologist and anthropologist, used a process known as photogrammetry to analyze the aerial photographs. Dr. Ebert defined photogrammetry as the combined art, science, and technology of recording, measuring, and interpreting photographic images and patterns of electromagnetic radiant energy and other phenomena to obtain reliable information about physical objects and the environment. [092418:9 AM (Ebert)]

Dr. Camilli explained that she examined the photographs of the reservation to locate the areas of land that had been cultivated, meaning that the land had been planted or harvested. [092418:41 AM (Camilli)] Fields were identified in the aerial photographs by the presence of crops and contextual criteria and the recognition of shape, tonal, and textural characteristics of irrigation projects. [092418:30 AM (Ebert); 092518:90 PM (Camilli); 092618:12 AM (Camilli)] Dr. Camilli also examined the photographs of the fields to determine whether the topography of the land blocked surface flow from adjoining land, thereby limiting the possible sources of water to the rain that fell within the boundaries of the field. [092518:29, 79 PM (Camilli)] This type of field was characterized as precipitation farming. [092418:25 (Ebert); [092418:42 AM (Camilli)] Precipitation can provide sufficient water for corn, melons, squash, and beans. [102020:9 PM (Lomayestewa)] If the topography permitted supplemental water to flow on to the land, the land was considered irrigated land. [*Id.*]

The characterization of fields as either irrigated or precipitation-dependent significantly impacts the historical quantification of water used for irrigation. Using the 1954-1955 aerial photographs, Dr. Camilli identified approximately 7,859 irrigated acres of farmland[16] and 2,912 acres of irrigated pasture. *See* Table 10. Fields located in sand dunes on the tops of mesas are generally regarded as dependent solely on precipitation. [Hopi Exh. 3895 at 32 (PDF 10)] The United States excluded most orchards and gardens planted on mesa tops because precipitation alone, not supplemental irrigation, provided the water for the trees and plants. [092418:25 AM (Ebert); 092418:69 AM (Camilli)] The United States identified 733 acres dependent solely on precipitation.

The Navajo Nation argues that the amount of acreage classified as solely dependent on precipitation is too small and contrary to historical records. Dr. Adams gave his opinion that during the 16th and 17th centuries, the amount of farmland dependent on precipitation was approximately 50 percent. [100118:49-50 AM (Adams)] By the 1900s, precipitation-dependent

[16] Total land for 1954-1955 was 9165.8+1605.73=10771.53 – 2912.31 rangeland = 7,859 acres.

farming had fallen to less than 27 percent of the Hopi fields according to a paper published in 1942. [101218:43 (Ferguson); Hopi Exh. 3895 at 33-34 (PDF 11-12)] Beginning in the mid-1940s, large-scale farming projects were developed at Wepo Wash, Polacca Wash, and Oraibi Wash. [Hopi Exh. 3883 at 173 (PDF 181). According to Dr. Camilli, "by the mid-20th century, irrigation projects and water spreading systems on the Hopi Reservation supplied more farm and range land water than did traditional irrigation methods." [U.S. Exh. 582 at 19 (PDF 24)]. By the time of Dr. Camilli's study, when the Hopi Reservation was in the midst of a drought, the precipitation-dependent fields had fallen to 13 percent of the farmland.[17] *See* FOF 20 above.

Finding of Fact No. 219. The combination of drought and large-scale irrigation projects caused the percentage of farmed land dependent solely on rain to decline as a percentage of total cultivated land.

The Navajo Nation also argues that the United States mischaracterized precipitation-dependent fields in its historic analysis as irrigated acres. The Navajo Nation retained John Leeper, who holds a Ph.D. degree in civil engineering, and James McCord, who holds a Master of Science in Hydrology and a Ph.D. in Geoscience, to evaluate the claims made by the United States and the Hopi Tribe. [NN Exhs. 163, 162] Drs. Leeper and McCord opined that thousands of acres identified by Dr. Camilli as irrigated land should be reclassified as precipitation-dependent land. They focused on two groups of acreage that Dr. Camilli had subclassified as "native irrigation" and "seasonal irrigation." The Navajo Nation's experts testified that the native irrigation acreage should be reduced by approximately 57 percent, and the seasonal acreage not associated with Bureau of Indian Affairs project, should also be reduced by 57 percent. They testified that the reductions are necessary to properly differentiate fields that received water from irrigation and

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[17] Total farmland excludes range/pasture and land seasonal land identified in Table 10.

precipitation from the precipitation-dependent fields. [103018:30-31, 34, 36 PM (Leeper); 102918:136 PM (McCord); NN Exh. 194] The basis of the 57 percent reduction is a 2005 Survey Report prepared by ADWR. [102918:56 (McCord)] The purpose of the 2005 Survey Report was to estimate the amount of land cropped by the Hopi Tribe and the riparian vegetation acreage. [Hopi Exh. 53 at 1 (PDF 6)]

In 2005, ADWR identified a total of 5,613 acres of agricultural land under cultivation on the Hopi Reservation and physically inspected 514 fields covering 651 acres. [Hopi Exh. 53 at 2, 11, (PDF 7, 16); 110118:73 PM (Leeper)] Individual field reports were prepared by ADWR for each field included in the sample that identified the "irrigation method" for the field. Dr. Leeper testified that he reviewed the completed individual field reports to analyze the fields based on ADWR characterizations of water sources. [110118:81, 87 PM (Leeper)] As an example of ADWR's analysis of a water source, ADWR labelled a field as receiving water from precipitation but noted that the "Wash enters field at west side." [110118:83 PM (Leeper)] Based on ADWR characterizations, Dr. Leeper determined that 292 fields, or 57 percent of the sample fields, used precipitation as the exclusive source of water. [NN Exh. 761 at 10-11 (PDF 12-13)]

Dr. Leeper concluded that the "ADWR Field Survey provides a reasonable proxy for determining irrigated versus precipitation farmed fields." [NN Exh. 761 at 11 (PDF 13)] The reasons for this determination were that "ADWR's methodology in this matter appears sensible … and because ADWR had a much greater amount of time and was able to survey a much greater number of fields." [NN Exh. 761 at 10-11 (PDF 12-13)] The validity of a methodology to support a particular conclusion depends upon the purpose of that methodology. The 2005 Survey Report was intended to quantify the amount of currently cropped acreage. The purpose was not to identify and differentiate agricultural land dependent solely on precipitation from land watered by multiple sources. No evidence appears in the record to support a determination that the sample chosen in 2005 is sufficiently representative of the entire population of fields catalogued 50 years earlier to provide meaningful conclusions about sources of water used to cultivate land on the Hopi Reservation. [110118:73-74 (Leeper)]

Finding of Fact No. 220. The 2005 ADWR Survey Report as used by the Navajo Nation does not provide a reasonable basis on which to conclude that a total of 4,861 acres included in the United States' inventory should be reclassified as precipitation-dependent land.

Finding of Fact No. 221. The United States' classification of 733 acres included in the historical inventory made by the United States' expert as precipitation-dependent land was reasonable.

As discussed above, Dr. Camilli classified irrigated land into subcategories. *See* Table 10. The irrigation categories were originally developed by the Bureau of Indian Affairs. [092418:18-19 AM (Ebert); 092418:39, 69, 127 (Camilli); U.S. Exh. 582 at 1 (PDF 9)] The largest classes, by acreage claimed, are native irrigation, seasonal irrigation, and range and pasture irrigation. The combined acreage in these three classes account for 12,568 acres or 96.4 percent of the land identified by Dr. Camilli. The remaining claimed acreage fits within the perennial irrigation, spring irrigation, and well irrigation categories. She found that a total of 13,031.64 acres of land had been historically irrigated on the Hopi Reservation as shown in Table 10.

Irrigation Class	Photo/Imagery Year										Acres	Percent[1]
	1934	1952	1954	1955	1974	1980	2010	2012	2013	2014		
Perennial		226.24	4.60		10.31	10.11	0.14	2.40	0.38	9.60	263.78	2.02
Seasonal	240.49	179.04	2,347.15	665.66		678.53	108.12	18.35		56.93	4,294.27	32.95
Range/Pasture			2,912.31			570.86					3,483.17	26.73
Native	11.71	5.94	3,834.46	938.48							4,790.59	36.76
Well			15.75	1.59							17.34	0.13
Spring		25.79	51.53		0.63	99.77	2.55	1.74	0.05	0.43	182.49	1.40
Totals	**252.20**	**437.01**	**9,165.80**	**1,605.73**	**10.94**	**1,359.27**	**110.81**	**22.49**	**0.43**	**66.96**	**13,031.64**	
Precipitation-Dependent Farms and Orchards			**723.59**	**9.35**							**732.94**	

Table 10
Source U.S. Exh. 582 (Table 1)

Perennial irrigation supplied by springs is the first of the six classifications of irrigated land. Based on the historical record, perennially available spring water conveyed from and stored in a permanent structure is used to irrigate 263.78 acres irrigated. [092418:45-46 AM (Camilli), U.S. Exh. 582 Table 1] Farming using this type of irrigation depends on small reservoirs or impoundments constructed by the farmer that store spring water conveyed to the terrace gardens and fields as well as the Pasture Canyon/Reservoir Canyon Irrigation Project. [U.S. Exh. 582 at 4 (PDF 9)]

Finding of Fact No. 222. There are 264 acres of land (inclusive of the 11 Allotments) located on Moenkopi Island irrigated by springs and the Pasture Canyon/Reservoir Irrigation project.

Seasonal irrigation uses temporary or permanent structures, which are primarily irrigation projects built by the federal government, to divert and spread flow from intermittent and ephemeral surface water on to farmlands using dams, canals, water spreading berms, and retention levees. [092418:22-23 AM (Ebert); 092418:45, 54 AM (Camilli); 092418:48 PM (Camilli); U.S. Exh. 582 at 4] Fields that received water from the canal system and the diversion dam built as part of the Jeddito Irrigation Project are examples of the 4,294.27 acres included in this irrigation class. [092418:54 AM (Camilli)] Other federal projects that diverted water to the acreage included in this irrigation class are the Upper Kerley Valley, Phillips Farm, and Sand Springs Irrigation Project. Dr. Camilli also included acreage on tributary washes that received water due to the construction of water spreading projects. [U.S. Exh. 582 at 61 (PDF 66)] Fields included in the seasonal irrigation class are stationary field systems due to their use of fixed, exterior diversion structures located outside of the exterior field boundaries. [092418:65-66 PM (Camilli); 092618:38 AM (Camilli)] Dr. Camilli primarily identified acreage from the 1954 photographs, but she did locate additional acres in the project that had not been visible in earlier photo years. [092618:16 AM (Camilli); U.S. Exh. 582 at 21 (PDF 26), 61 (PDF 66)]

The third category of irrigated acreage, Range and Pasture land, includes land used for forage for livestock and not crops. Dr. Camilli evaluated 1954 and 1955 photos to identify 2,912.31 acres of land within this class. She used photographs from 1980 to identify another 570.86 acres of land irrigated by spreaders constructed after 1954. [U.S. Exh. 582 at 9 (PDF 14), 15 (PDF 20)] The land was located within four water spreading systems on Jeddito, Oraibi, and Polacca Washes on the main Hopi Reservation. [092418:58 PM (Camilli); U.S. Exh. 582 at 16 (PDF 21)] Irrigation of the land resulted from diversion of flow by earthen berms or spreaders on to land to encourage the growth of forage. [U.S. Exh. 582 at 5 (PDF 10)] The inclusion of this land is consistent with the methodology followed by Dr. Camilli of locating land within the 1954-1955 photo set for which supplemental water was applied and only adding to that acreage when an additional water spreader was located.

The Hopi Tribe argues that the United States included too little land in this category. It cites to reports prepared in the decades before the photographs were taken that Dr. Camilli examined to show that hundreds, and, in some cases, thousands of acres received supplemental water due to the water spreading structures. [092518:9-15 AM (Camilli)] The identification of land in this case is not for the purpose of identifying all land that has been flooded or irrigated at any time on the Hopi Reservation. The identification of land is part of an integrated two-step process to determine the amount of water used by the Hopi Tribe in a single time period to quantify federal reserved water rights measured in acre-feet per year. Accordingly, Dr. Camilli should only identify land that could have received irrigation within the same time period and, in this category, only include land that had demonstrated photographic evidence of a water spreading area. In order not to overstate the amount of land, Dr. Camilli imposed the constraint that irrigated acreage had to be observed in a defined set of photographs that also provided a check against counting the same acreage twice.

The Navajo Nation argues that the United States included too much land in this category. Drs. Leeper and McCord analyzed the 3,483.17 acres characterized as Range and Pasture land. They testified that the land should not be included as irrigated acreage because the diversions were not primarily for irrigation. [102918:119 (McCord)] The purpose of this adjudication is to determine the amount of water necessary to maintain the Hopi Reservation as a permanent homeland. Thus, water that furthers this purpose needed to be quantified regardless of whether the water was diverted to grow crops or diverted to improve pasture Given its methodology to determine the maximum amount of water used to irrigate land on the Hopi Reservation in a tightly defined period, the United States acted consistently by including 3,483 acres of Range and Pasture land for which water had been diverted to improve forage for cattle to calculate a historic water use.

The irrigation of rangeland establishes that water can be diverted from the washes to irrigate land on the Hopi Reservation. It further demonstrates that the washes can provide a sufficient source of water, that can be diverted to a defined place of use and the willingness of the federal government to install structures to divert water to irrigate rangeland.

Native irrigation, the largest of the six categories of irrigation types, occurs when a Hopi farmer strategically locates a field so that it captures flow from adjacent washes such as the Dinnebito Wash. [092418:23 (Ebert); 092418:63 (Camilli); 092618:28 AM (Camilli); U.S. Exh. 582 at 5 (PDF 10)] Water spreads across a field due to planting design, ditches, small berms, or furrows created in the field or by the manual efforts of the farmer. [092418:63 AM (Camilli); 092618:29 AM (Camilli); 110218:10 PM (Leeper)] Water can also spread out due to the land formation where the field is located relative to a water channel, such as an arroyo, which ceases due to past deposits of silt that create a smooth fan across the area. [092518:22 PM (Camilli)] A field in this location is referred to as an *akchin* field. [*Id.*] The multiple small fields that are cultivated, fallowed or abandoned over periods of time form a "shifting field system" that has been described as follows:

> Shifting field systems by definition go to where the water is, or where it is expected to be, at a particular moment in time and then shift or expand as conditions change. The borders of fields can change position depending upon water availability and other physical, technological or economic factors that can impact farming from year to year. . . . . changes in the positions, shapes and sizes of individual fields can occur multiple times over a given period of time and they also shift in and out of active and fallow states, which affects their visibility from the air. …

[Hopi Exh. 3882 at 21 (PDF 27)]

An example of a shifting field system consisting of 13.3 acres evidencing cultivated acreage in close proximity in six different years over a 62-year period is shown in *figure 5*.

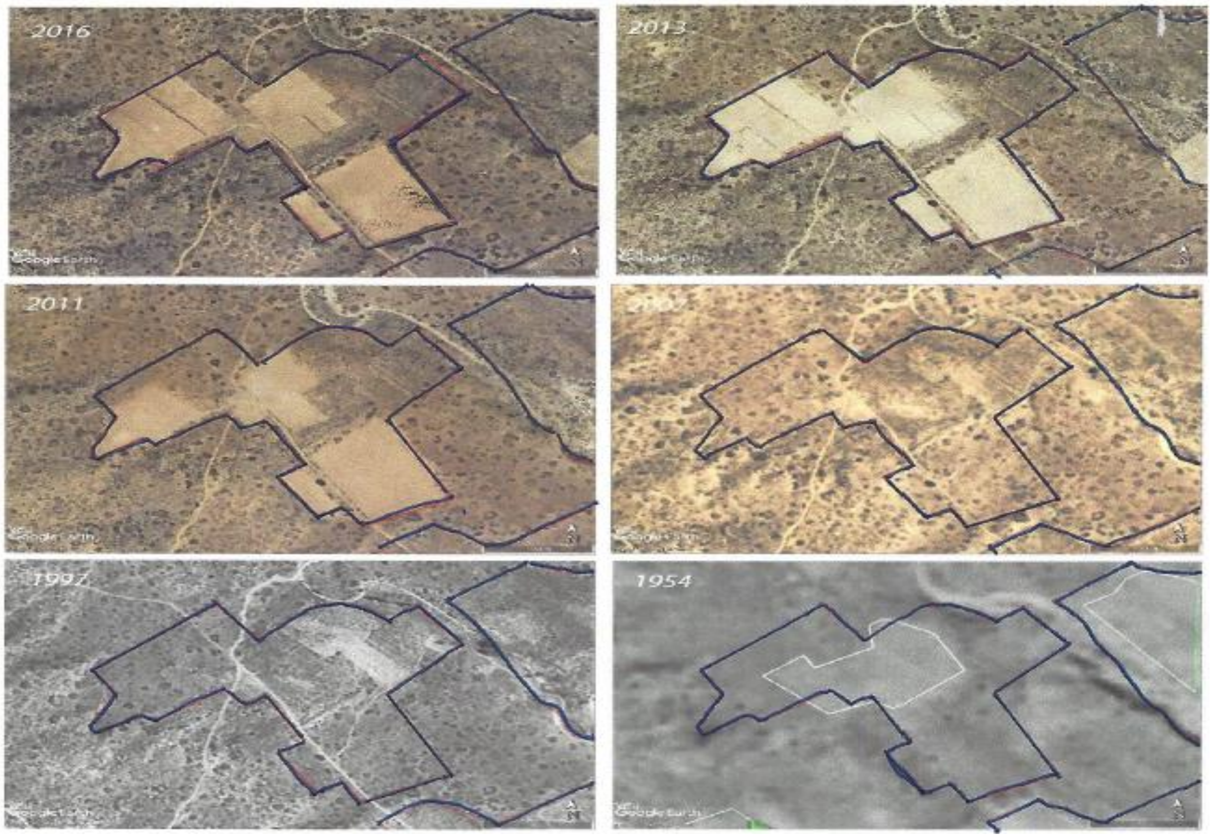

Figure 5. Discrete fields planted in separate years within a 13.3 acre area.
Source: Hopi Exh. 3882 at 17.

Dr. Camilli relied exclusively on the photographs taken by the United States Army in 1954 and 1955 of the Hopi Reservation to inventory the land farmed using native irrigation (with the exception of approximately 17 acres identified from photographs taken in 1934 and 1952). [092418:18 AM (Camilli); 092518:25-26 AM (Camilli); 092518:89 PM (Camilli); U.S. Exh. 582 at 15 (PDF 20)] She compiled her inventory of that acreage based on the single set of photographs because farmers, dependent on native irrigation, change the location of the land they choose to plant in response to changes in the environment that affect surface flow. [092518:41 AM; 092518:84 PM (Camilli)] Dr. Camilli concluded that due to the practice of changing field boundaries and locations, the inclusion of all fields reliant on native irrigation located in all of the photo sets would overrepresent the acreage in the native class. [092518:87 PM (Camilli)] The

1950s photographs were chosen because the photo sets provided full coverage of the reservation that showed distinct fields that did not overlap. [092618:14 AM Camilli)]

Dr. Leeper generally criticized the inclusion of acreage classified as native irrigation because, among other reasons, he did not consider that acreage to be irrigated. Dr. Leeper's definition of irrigated land requires a showing that the irrigated land receives water from a demonstrated source subject to human control. While the definition is not unreasonable, it cannot be accepted for purposes of adjudicating federal reserved water rights on the Hopi Reservation because it does not take into account the unique facts and circumstances of the Hopi Reservation. The source of water is the variable flow in the Northern Washes and minor tributaries. The quantification of a water right in this case must recognize that the source of the water it is not a well-regulated irrigation ditch nor a large, dependable river. As a consequence, the definition of water for irrigation use cannot be so narrowly defined as to exclude needed surface water from the Northern Washes and the minor tributaries. Dr. Leeper also testified that fields within the course of the flow should not be treated as irrigated fields because the crops do not deplete the flow beyond the amount that would be depleted by other vegetation growing in the area. [103118:55 AM (Leeper); 103018:71 PM (Leeper)] The fact that fields are situated to minimize diversion losses does not eliminate the need for the flow for the crops or the right to a recognized use of the flow to irrigate strategically located fields.

Finding of Fact No. 223. Irrigation occurs when supplemental water, i.e., not precipitation that falls directly on to the land, flows on to a field that has been strategically located to receive the water or when supplemental water is diverted on to a field to provide water for crops or a pasture to improve forage for livestock.

The two remaining classes of irrigation, Wells and Springs, account for 17 and 182.49 acres, respectively. They provide water from the stated sources without an intermediary storage facility present for the acreage classified as perennial. [092418:66, 68 (Camilli)]

Finding of Fact No. 224. There are two existing wells used for irrigation purposes, as shown on Table 11. [U.S. Exh. 738] These wells are existing points of diversion and provide water for 17 acres of perennial irrigation. Other waters on the reservation are inadequate to provide the necessary irrigation for the land shown in Table 11.

US Label	Name	Plate	Easting	Northing	QQ	Sec	Township/Range	Aquifer
W0812	03K-311	8	516713	3982855	NESE	22	30N 14E	N
W132		13	523581	3942882	L 6	28	26N 15E	

Table 11
Source U.S. Exh. 738

Finding of Fact No. 225. The United States' methodology of identifying land historically irrigated was consistent and reasonably designed to limit the acreage claimed to acreage that could have been irrigated within the same time period.

3. Calculation of Amount of Water Used to Irrigate Land

Having cataloged the historically irrigated acreage, the next step in the quantification of water for irrigation use is to determine the amount of water used on the irrigated land. Arizona Department of Water Resources recommended the use of a water duty to quantify the past use of irrigation water. A water duty, or the amount of water diverted to support a plant, is based on several factors. A water duty varies depending upon the types of crops being irrigated. A water duty can increase or decrease depending upon the amount of rain that falls as the crops grow.

Finally, the amount of a water duty will change depending upon the amount of water that is lost as it flows from the source of the irrigation to the crops where the water is used. In more technical terms, a water duty equals the net irrigation requirement (NIR), which is based on the composite irrigation requirement, determined by the types of crops and available precipitation, divided by the overall irrigation efficiency:

$$Water\ Duty = \frac{NIR}{Irrigation\ Efficiency}$$

The NIR equals the composite irrigation requirement reduced by the annual effective precipitation. The composite irrigation requirement is the amount of water required by the different types of crops, weighted by their percentage in the crop mix. Arizona Department of Water Resources determined the composite irrigation requirement by evaluating the mix of crops grown on the Hopi Reservation, variations in climate, and existing farming practices. HSR at 4-14.

The second variable in the equation, Irrigation Efficiency, accounts for the loss of water that occurs during the conveyance, distribution, and application of irrigation water to and on the field. [U.S. Exh. 527 at 3-3 (PDF 25)] Arizona Department of Water Resources applied a 0.55 irrigation efficiency to the irrigation of acreage that the United States had classified as perennial and spring irrigation. It applied a much greater irrigation efficiency factor to traditionally farmed acreage because virtually no water is lost as it is conveyed to the field due to the proximity of the fields to the sources of water. Arizona Department of Water Resources concluded that the conveyance efficiency applicable to traditional acres in the aggregate should not be less than 90 percent. HSR at 4-16. It also elevated the on-farm efficiency factor due to the type of crops planted which can access water, that in other settings, would percolate too deeply into the soil. Arizona Department of Water Resources calculated an irrigation efficiency of 0.72 for traditional farming. It concluded that appropriate water duties for modern farming and traditional farming are 4.33 acre-feet per acre and 0.93 acre-feet per acre, respectively.

The United States calculated a water duty based on climate data, assumed periodic water shortages, and applied a higher irrigation efficiency in its calculation of a water duty. It analyzed the diversion and depletion amounts separately for each wash. It claimed a right to divert 775 acre-feet and deplete 698 acre-feet to irrigate 424 acres, which is substantially less than ADWR's calculation that applied a 4.33 acre-foot per acre water duty to 424 acres. [U.S. Exh. 527 at 3-64 (PDF 86) – 3-67 (PDF 89)]

Finding of Fact No. 226. The method used by the United States that relied on specific data applicable to the unique conditions of irrigated acreage in each wash provides a reliable method to determine the quantity of water used for irrigated acreage in the perennial, spring and well classifications.

Finding of Fact No. 227. A federal reserved water right for 775 acre-feet of water per year is the quantity needed to irrigate 424 acres of land with perennial water sources is the amount necessary for a permanent homeland and abiding place for the Hopi Tribe tailored to the minimal needs of the reservation.

In contrast to the situation where there is a perennial or substantially perennial water source, irrigation use from an intermittent supply becomes more a function of the amount of water available during the growing season than the amount of the water required by the crop. [092718:107 AM (Ley)] Consequently, a water duty is not the preferred method to calculate irrigation usage from an intermittent supply. [092718:107 AM (Ley)]

The intermittent flow in the Northern Washes resulting from rain, snowmelt, and runoff provide the sources of water for the native irrigation, seasonal, and range and pasture classes of irrigation use. [092618:19, 20 (Ley)] Unlike the assumption that Mr. Umstot made in his "full-supply irrigation demand" calculation that an unlimited water supply exists, the Northern Washes do not consistently supply surface water flows sufficient for irrigation diversions that meet the full water demand of a crop. [US Exh. 527 at 3-4 (PDF 26)] Reliance on these intermittent and ephemeral sources of water leads to deficit irrigation that has been defined as:

> [i]rrigation that does not supply the potential water use for crop ET [evapotranspiration] and leaching requirements. Deficit irrigation results from under-irrigation and non-uniformity of irrigation application. Seasonal flows result in under-irrigation because the flows are irregular and do not meet full irrigation requirements.

[U.S. Exh. 527 at 3-2 (PDF 24)]

Due to the deficit irrigation conditions for lands included in the three classes of irrigation use, the United States elected to forego a water duty approach in favor of two computer models. One computer model calculated the amount of water available in the Northern Washes based on verifiable data. The second computer model used the available water to quantify the amount of diversions and depletions from the deficit irrigation of the native, seasonal, and range and pasture acreage classes. [092718:26 AM (Ley); U.S. Exh. 564 at 4-7 (PDF 50)]

Brent Cody, Ph.D., a civil engineer retained by the United States, programmed the first computer model, known as the Precipitation Runoff Modeling System (PRMS), to estimate natural daily flow through the Northern Washes for each day of each year from 1949-2014. [091818:46, 83 PM (Cody); U.S. Exh. 564 at 5-1 (PDF 58); 102918:16 AM (McCord)]. He produced a continuous record of estimated water movement at 30 to 50 sites within each wash for a total 174 sites throughout the Northern Washes. [U.S. Exh. 564 at 2-2 (PDF 11), 2-3 (PDF 12), 3-1 (PDF 30); 091818:83, 85-86 (Cody)]. He also used the program to compute the water depletion from the basin during periods when little or no precipitation occurred, and to account for evapotranspiration, percolation and total surface flow. [U.S. Exh. 564 at 3-1 (PDF 31), 3-2 (PDF 32); 091818:87 PM (Cody)]

The PRSM required precipitation and climate data to determine surface flow, infiltration, evaporation, and transpiration. [091818:107 PM (Cody); 102918:17 AM (McCord)] Dr. Cody used precipitation and air temperature datasets compiled by researchers at Oregon State University. [U.S. Exh. 564 at 2-4 (PDF 13)] Climate data was also obtained from the National Climatic Data Center's gage records for nine climate gages in and near the Northern Washes, and from 69 other stations to complete those portions of the data sets for which data for the nine selected gages was not available. [091818:89, 95 PM (Cody); U.S. Exh. 564 at 2-5 (PDF 14)-2-8 (PDF 17), 5-1 (PDF 58); [091818:89, 95 PM (Cody)]. Dr. Cody used data supplied by the National Climatic Data Center to determine daily solar radiation,[18] necessary for the calculation of evaporation. In addition to the acquisition of hydrological and climatological data, Dr. Cody used other government databases to obtain information about environmental characteristics, referred to in the model as parameters, such as elevations, area, soil types and characteristics, and vegetation. [U.S. Exh. 564 at 3-9 (PDF 38), 3-14 (PDF 43)] Based on the output from the PRMS, Dr. Cody testified that he found that precipitation patterns and average temperatures were similar across the Northern Washes, but the total amount of flow differed due to the different sizes of the catchment areas. [091818:107-108 PM (Cody)]

To test the validity of the valuations chosen for the parameters and the validity of the model overall, Dr. Cody used Coal Mine Wash as the test case. [U.S. Exh. 564 at 4-1 (PDF 44)] Coal Mine Wash had the benefit of USGS and PCWW stream gages that permitted the use of one gage for purposes of calibration, and the other gage for verification of natural flow because it was not

[18] Solar radiation was calculated for each day and is a function of the latitude of the site, day of the year, dew point temperature and total sky cover. [U.S. Exh. 564 at 2-19 (PDF 28); U.S. Exh.564 at A-1]

subject to significant human depletions. [*Id.*] Dr. Cody calibrated the model for potential evapotranspiration (PET) and for streamflow using the Coal Mine data. Although the parameters estimated in the streamflow calibration process were applied across the Northern Washes, the PET calibration process was performed for each wash. [U.S. Exh. 564 at 5-1 (PDF 58)]

After the model calculated runoff and other lateral flow into the stream channels, reduced by losses from seepage and evaporation, the model routed the water downstream to the outlet of the basin. Results were tabulated for the average monthly and annual flow for the 1949-2014 time period for each wash. [U.S. Exh. 527 at 3-10 (PDF 32)] The average estimated annual flow for the Northern Washes amounted to 29,941 acre-feet with a range of 7,161 acre-feet to 91,320 acre-feet per year. [U.S. Exh. 564 at 5-1 (PDF 58)- 5-2 (PDF 59)] Flow did not occur evenly among the five washes. The average annual flow ranged from a low of 2,356 acre-feet in Dinnebito Wash to a high of 16,176 acre-feet in Moenkopi Wash. [U.S. Exh. 564 at 5-1 (PDF 58)]

Dr. McCord reviewed the PRMS model and concurred that a computer model was necessary to estimate the water supply from the Northern Washes and agreed that the PRMS was an appropriate model for that purpose. [102918:22, 40, 45 (McCord)] He offered two general criticisms of the PRMS model. Dr. McCord testified that because the model, designed for a 5,000 square mile watershed, was calibrated using a 137 square kilometer subwatershed, the model did not fully reflect the conditions of the dryer southern portions of the watershed. [102918:32-33 AM (McCord)] Dr. McCord did not quantify the extent of any deficiency caused by using the Coal Mine Wash to calibrate the model. [102918:44 PM (McCord)] He also testified that because the PRMS model used natural flows, it did not take into account flow depletions that occurred upstream of the Hopi Reservation. [102918:32-33 AM (McCord)] Dr. McCord stated that the failure to reduce the natural flows by the amount diverted on the Navajo Reservation could result in an over-estimation of the amount of water used historically on the Hopi Reservation. [102918:38-40 AM (McCord)] No evidence was offered to quantify the possible reduction in the initial calculated upstream flow.

An upstream diversion for irrigation use does not necessarily translate into an equivalent reduction in downstream flow. As water flows through a natural channel, water evaporates from the surface and seeps into the sides and bottom of the channels. When irrigation diverts water, the remaining streamflow has less surface area so there is less evaporation and less seepage into the channel. [092618:90 PM (Ley)] A comparison of natural flow with and without irrigation for the Northern Washes demonstrated that a natural flow of 46,016 acre-feet per year had channel losses of 16,075 acre-feet per year for an outflow of 29,941 acre-feet per year. If, however, 8,407 acre-feet of water for irrigation were diverted from the flows, the outflow would be 22,661 acre-feet, which is 7,280 acre-feet less the natural outflow, not 8,407 acre-feet less than the original outflow. [U.S. Exh. 527 at 3-27 (PDF 49)]

Finding of Fact No. 228. The PRSM is an acceptable model to calculate the amounts of available water from the Northern Washes and the choice of parameters and calibration were reasonable.

Data from the PRMS model supplied the information used in the second computer model, the Deficit Irrigation Supply Model ("DISM"). The United States used the DISM to quantify the amount of water used for deficit irrigation of land along the Northern Washes. Thomas W. Ley, who holds a Master of Science in agricultural engineering and a Ph.D. in irrigation engineering, was engaged by the United States to estimate the amount of water used to irrigate 13,027 acres of land located in Land Management District 6 (8,768 acres), the Hopi Partitioned Lands (3,535 acres), and in Moenkopi (724 acres). [092718:38 AM (Ley); U.S. Exh. 528] Dr. Ley created the

DISM model that provided estimates of depletion of the streamflow from irrigation based on the fields identified by Dr. Camilli, crop information, a set of assumptions about farming practices, as well as the available supply of water estimated by the PRMS model. [092618:133 PM (Ley); 102918:41 (McCord); U.S. Exh. 527 at 3-1 (PDF 23), 3-5 (PDF 27), 3-13 (PDF 35), 3-14 (PDF 36)]

The DISM operates by dividing the Northern Washes into sub-basins to allow modeling of stream reaches and streamflow in multiple locations within the wash drainage areas, and to incorporate the climatic data unique to those locations, such as temperature and precipitation, types of crops grown, and planting dates. [U.S. Exh. 527 at 3-6 (PDF 28), 3-11 (PDF 33)] Conceptually, the model links the sub-basins with the outflow from one basin entering the next basin augmented by flow originating in that basin. The model accounts for the impact of evaporation, precipitation, and seepage on the amount of streamflow, as well as reductions attributable to diversions and depletions from irrigation and the crops. [*Id.*]

Dr. Ley testified that the key factors affecting the amount of depletion from irrigation use are the volume of the flow, the duration of the flow, and the timing of the flow. [092618:101 PM (Ley)] The importance of these elements given the need to match usable flow with crop demands during the different crop growth stages that occur during March through October, can be shown by a comparison of different flow patterns estimated by DISM for calendar years 1972 and 1988. The model calculated (in acre-feet) the monthly flow, the annual outflow, and the depletion of the outflow from irrigation use shown in Table 12. The average outflow resulted in a depletion of approximately 28 percent of the total flow. In contrast, high flood flows, while allowing for slightly higher absolute depletion, showed a lower percentage (10 percent) of the total flow to be depleted by irrigation. Thus, large flood flows, three times as great as the average flows, do not necessarily provide three times the benefit and, in fact, may be very damaging.

Year	Jan	Feb	Mar	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Out-flow	Depletion
1972	13	3	0	149	156	3108	2888	4638	4929	68592	3016	3825	91317	9096
1988	200	692	54	11221	10	5068	324	8566	2370	310	2194	109	31118	10646
Avg.	1219	1612	1682	1428	1124	668	3960	5441	4993	4555	2008	1252	29941	8392

Table 12
Source U.S. Exh 527 at G-2 – G-5

Dr. McCord, the expert called by the Navajo Nation to critique DISM, agreed that in the absence of data about actual water use, a computer model is an appropriate method to estimate water use. [102918:22 AM (McCord); 102918:13, 41 PM (McCord)] He also confirmed that the DISM is a defensible model. [102918:14 PM (McCord)] He disagreed with Dr. Ley about the underlying decision incorporated into the DISM that concerned crop characteristics and farming practices. The crop characteristics at issue are crop coefficients, which are used to calculate the amount of water used by the plants, and the rooting depth of the plants, which affects the ability of the soil to retain water in storage for use by the plant. The farming practice dispute arises from an assumption made by Dr. Ley about a farmer's ability to optimally manage water on the fields.

One of the factors used to calculate the amount of water used by a crop is the amount of crop evapotranspiration (ET), which is the amount of water that evaporates from the soil and transpires from the leaves of the plant. The DISM used a crop ET based on evapotranspiration from a field of actively growing, adequately watered alfalfa, also known as a "reference crop." [U.S. Exh. 527 at 3-65 (PDF 87)] The reference crop ET is adjusted to the desired crop ET by the application of a crop coefficient. [U.S. Exh.527 at 3-9 (PDF 31)] Dr. Ley applied crop coefficients for corn and grazed pasture in the DISM. [U.S. 527 at 3-16 (PDF 33)] He adjusted the crop coefficients downward by multiplying the crop coefficient by a factor of 0.7 due to lower plant density, decreased plant vigor due to harsh conditions, and lower soil moisture. [*Id.* at 3-17 (PDF 39)] Dr. McCord testified that the crop coefficient should have been reduced by a factor of 0.2 to 0.3 to account for the spacing of the corn plants. [102918:58-59 AM (McCord)] He estimated that the change in the factor applied to the crop coefficient would decrease depletion by about 27.7 percent. [102918:47 PM (McCord)] He also stated that the DISM model did not account for the root depth of the plants. A greater root depth would increase depletion of the irrigation water. He estimated that his proposed change would increase depletion by about 15.3 percent. [*Id.*] Dr. McCord did agree that his suggested improvements to the two parameters would not make much of a difference to the final depletion number. [102918:48 PM (McCord)]

Dr. McCord concluded that his concerns about the DISM primarily center on the acreage rather than the design of the model. [102918:8 PM (McCord)]. He ran the DISM model, without making any changes to the parameters of the program other than a 65 percent reduction in the amount of the claimed irrigated acres to support the irrigation claims made by the Navajo Nation

Finding of Fact No. 229. The DISM is a reasonable model to calculate depletion.

Finding of Fact No. 230. The maximum amount of water diverted in the past from the Northern Washes to irrigate 13,027 acres of land on the Hopi Reservation was 18,897 acre-feet resulting in a maximum depletion of 13,760 acre-feet.

As discussed in Section III, a demonstrated historical use that is no longer in use does not support a federal reserved water right. *See Colville Confederated Tribes v. Walton*, *supra*. The United States' inventory of irrigated land includes water uses for federal projects that the Bureau of Indian Affairs developed at Wepo Wash, Polacca Wash, and Oraibi Wash between 1944 and 1952. [U.S. Exh. 582 at 19 (PDF 24); Hopi Exh. 3883 at 173 (PDF 181)] The Navajo Nation challenges the inclusion of these projects amounting to more than 5,000 acres because they were subsequently abandoned and therefore the acreage should not be included because it was not practical, feasible or a traditional Hopi practice. NN FOF ¶91. It also claims that Dr. Camilli's study was inaccurate because she included projects that were no longer in use. The Navajo Nation also points to the inclusion of 95 acres related to the Hardrocks/Oraibi project that was idled by excessive silt. [U.S. Exh. 582 at 47]

As the Navajo Nation recognized, the dates of abandonment of some of these government irrigation projects are unclear. NN FOF 87. Thus, no finding of fact can be made regarding whether those projects were operational during the time of Dr. Camilli's study. It is, however, undisputed that there are projects included in Dr. Camilli's study that are not currently operational.

Finding of Fact No. 231. By 1959, the Phillips Farm project was no longer operational due to flood damage. [US Ex. 821 at 61; Hopi Exh. 38 at 30]

Finding of Fact No. 232. The Lower Dinnebito project, which accounted for 121.88 seasonal acres was reported by ADWR as operational from 1940 to 1945 and is now out of repair. [Hopi Exh. 38 at 30]

Conclusion of Law No. 53. This finding of historic past use must be taken into consideration to quantify a federal reserved water right under *Gila V*, but past use does not vest the federal government with that maximum quantity under the *Winters* doctrine absent additional evidence that the amount claimed is necessary for the permanent homeland tailored to its minimal need.

The Hopi Tribe, like the United States, has argued that a federal reserved water right for current and future use can be properly quantified based upon maximum historical water uses. It quantified the maximum historical use based on the population of the Hopi Tribe from centuries in the past. It relied on archeological studies and historical documents to estimate historic populations. It multiplied those population numbers by an estimated acreage per capita number to determine the amount of irrigated acreage farmed in the past. Extrapolating from historical population estimates, the Hopi Tribe claimed that "the total annual irrigated acreage conservatively ranged from 21,900 to 35,040 acres." Hopi Fifth Amended Statement of Claimant at 29. This approach proved problematic due to the lack of sufficiently reliable archeological and historical population data. Dr. Adams opined that the average Hopi population on the Hopi Mesa totaled 6,500 in the 1400s. [Hopi Exh. 3872 at 82] The Navajo Nation's expert, Dr. Gilpin testified that the Hopi population has been as high as 8,000 people in the 1500s. [110918:30 AM (Gilpin)] Fred Anderson retained by the Arizona Department of Water Resources, prepared a paper titled *Historical Research for a Hydrographic Survey Report of the Hopi Reservation* (April 2008) in which he stated:

> Given the long intervals between reports, the overall paucity of information, and the wide variation in the estimates of these Spanish visitors, it is impossible to say with any exactitude how many people lived on the Hopi Mesas or in the region that would one day become the Hopi Reservation. Most of the believable estimates fall somewhere between 2,000 and 10,000 residents.

[Hopi Exh. 87 at 117-118]

T. J. Ferguson, who holds a Ph.D. in anthropology and is a professor of anthropology at the University of Arizona, researched the Hopi population in the 1800 and 1900s. He testified that he considered the first reasonable population estimate to have occurred in 1846 when the Hopi population totaled 2,450. [101218:52 (Ferguson)] An opinion provided in a published research paper concurred, stating that: "It is difficult to reach any firm conclusions on the population of the Hopi villages prior to the census of 1890-1. Nearly all the early estimates are much too high." [Hopi Exh. 3889 at 61 (PDF 26)]

In addition to an inability to determine population numbers from centuries in the past with any certainty, uncertainty is also associated with the amount of acreage farmed in the past. The Hopi Tribe claims the Hopi farmed 2.5 acres per capita based on an archeological paper. [Hopi Exh. 3889] In 1971, Maitland Bradfield, an anthropologist, published a paper entitled *The Changing Pattern of Hopi Agriculture,* based on his research in the Oraibi Valley. In that paper, he calculated the number of acres the Hopi farmed per person. [*Id.*] Dr. Bradfield estimated that prior to 1906, 24 bushels of corn per person were necessary for all purposes, meaning consumption, storage, and trade and further estimated that two acres of land would be necessary to produce the desired corn crop. [Hopi Exh. 3889 at 21 (PDF 11)] He further approximated the need for land for vegetables and orchards as "about ½ acre person." [*Id.*] Evaluating the total agricultural needs, Mr. Bradfield made the following summary statement: "We may conclude, then, that in the traditional Hopi economy an average of 2½ acres of cultivated land was required per person, that a household of 5 to 6 persons needed about 12 acres to support itself, ..." [*Id.*] Using the household number of five to six people and a total of 12 acres results in acreage per person of 2 to 2.4 acres prior to 1906. Dr. Bradfield subsequently states that the number of persons per household for the Hopi as a whole in 1960 was 5.8. [*Id.* at 63 (PDF 28)] Assuming 12 acres of crops to support a household and further assuming the average household of 5.8 persons in 1960 was the same as the average household size prior to 1906, the average acres farmed is 2.07 acres per person.

The Hopi calculated that between 1880 and 1961, based on population and crop data, the Hopi farmed an average of 2.19 acres per capita. Hopi FOF 463. Table 13 provides a summary of historical population and cultivated acreage.

Year	Population	Acres Cultivated	No. of Acres per Person
1880	1790	3700	2.07
1884	1813	6,500	3.59
1886	1919	1000	0.52
1887	2206	6000	2.71
1890	2200	4800	2.18
1890	1996	6600	3.3
1893	2029	5600	2.76
1913	2318	4000	1.73
1936	3111	6076	1.95
1936	2900	5916	2.04
1936	2779	5916	2.18
1940	3444	6092	1.77
1946	3452	7130	2.06
1956	5134	9553	1.86
1961	5134	9330	1.82
1974	7500	6335	0.84
1986	9,454	7800	0.82
2000	10750	9000	0.83
2005	6904	5613	0.81

Table 13
Sources: Hopi Exh. 87 at 166,167, 169, 171-173 (PDF 178, 179, 180, 183-185); NN Exh. 615 at 2, 3, 9; 101218:49-50, 55, 112-113 PM (Ferguson); US Exh. 950 at 6 (PDF 10); Hopi Exh. 7 at 4-13 (PDF 14); Hopi Exh. 945 at 13 (PDF 17), 41 (PDF 41); Hopi Exh. 3878 at 15 (PDF 22); Hopi Exh. 53 at 11.

Of more relevance to the quantification based on the amount of the water necessary for the reservation is Dr. Bradfield's conclusion that by 1931, the total acreage farmed per person in Orabi was 1.75 acres including vegetables and "at this point there set in an absolute decline in the total area cultivated." [*Id.* at 31 (PDF 15)] Dr. Bradfield attributed the decline to an increase in sheep herds and to the availability of food from outside sources, making it "less necessary for them to grow a surplus against crop failure." [Hopi Exh. 3889 at 30 (PDF 14)]

Conclusion of Law No. 54. The use of population numbers derived from archeological studies or historical population records, which are deemed unreliable, combined with an estimated per capita acreage rate of 2.5 acres, which is not supported by an analysis of the calculations used to reach that quantity, does not provide a sufficient foundation on which to quantify a federal reserved right to water for irrigation use.

The next quantification approach proposed by the Hopi Tribe begins by looking to the past and concludes by looking to the future. The Hopi Tribe claims a federal reserved water right to annually divert 26,687 acre-feet to irrigate in a single year the total acreage included in an inventory of all land cultivated on the reservation over many years. The Hopi Tribe retained B. Sunday Eiselt, who holds a Ph.D. in anthropology and is currently an associate professor at Southern Methodist University and the Director of the Southern Methodist University Archeological Research Program Collections. [Hopi Exh. 92] Dr. Eiselt produced a report represented as "a comprehensive and non-overlapping inventory of all past and present irrigated lands from the 1930s to the present." She generated an inventory of 33,808.24 acres of cultivated land. [Hopi Exh. 3882 at PDF 1, 3; 101118:28, 48 PM (Eiselt)] The Hopi Tribe had Mr. Umstot use the DISM with a water supply estimated by the PRMS model to calculate the amount of water needed to irrigate the land included in Dr. Eiselt's inventory. Mr. Umstot concluded that the maximum diversion necessary for the acreage is 26,687 acre-feet per year and 19,624 acre-feet of depletion per year.

To conduct the study that generated the inventory of historically cultivated acreage, Dr. Eiselt used high-resolution satellite imagery available in Google Earth dated 1997, 2007-2010, 2011-2012, 2013-2014, and 2015-2016. She described Google Earth as a "virtual globe and geographic information program. Google Earth maps the earth by the superimposition of images obtained from satellite imagery, aerial photography, and GIS 3D Globe using digital elevation model (DEM) data." [Hopi Exh. 3882 at 8 (PDF 14)] The specific methodology employed by Dr. Eiselt to inspect the Hopi Reservation employed real-time satellite motion to facilitate "the rapid identification and interpretation of fields relative to topographic and other contextual data, including objects identified by ADWR and U.S. experts [citations omitted]. Replicate survey sessions ensured that the entire study area was scanned a minimum of four times and that all available historical images within this survey universe were examined at least twice." [Hopi Exh. 3882 at 16 (PDF 22)]

Finding of Fact No. 233. The acres identified by Dr. Eiselt were not farmed in the same year.

Dr. Eiselt identified fields by the presence of crop growth (crop rows or clumps of plants); field furrows; evidence of plowing or land leveling activities; field shapes, colors, and textural characteristics; the presence of wells, springs, and water impoundment structures; and the proximity to fields identified by the United States. [Hopi Exh.3882 at 13 (PDF 19)] The final inventory created by Dr. Eiselt of all fields showing evidence of cultivation over a twenty-year period totaled 1,452 fields encompassing 13,856 acres. [Hopi Exh. 3882 at 20 (PDF 26)] Dr. Eiselt compared the 13,856 acres to the acreage previously identified by the United States and verified, in whole or in part, by ADWR as evidencing prior agricultural use. [Hopi Exh. 3882 at 18-22 (PDF 4–28)] She testified that the final inventory did not include the 730 acres identified by Dr. Camilli as dependent on precipitation and an orchard. [101118:13-15 PM (Eiselt)] She reported that she identified more than 7,000 acres not previously identified, 87 percent of which she classified as native irrigation. [Hopi Exh. 3882 at 21 (PDF 27)]

Dr. Eiselt testified that the satellite imagery did not permit her to determine whether a particular parcel of land received supplemental water in a particular year. [101118:15 PM (Eiselt)] She testified that she conducted her survey based on the assumption that a supplemental water source must exist for each cultivated field located on Google Earth, reasoning that a field would not exist absent an irrigation source. [101118:15-16, 50 (Eiselt)] The determination of the source of water for cultivated land is important in this case because irrigated acreage can be used to quantify the amount of water subject to a federal reserved water right whereas acreage dependent solely on precipitation cannot be used in that calculation. Dr. Eiselt's approach may identify all land used for farming over a lengthy period but it does not support a quantification tailored to meet the minimal needs of the reservation.

Finding of Fact No. 234. Dr. Eiselt made no assessment about whether the land included in her final inventory relied on precipitation alone or a combination of precipitation and any other source of water. [101118:13-15 PM (Eiselt)]

Finding of Fact No. 235. The acreage inventoried by Dr. Eiselt consists of cultivated land was not limited to irrigated acreage.

Finding of Fact No. 236. The sum of the amounts of water used for irrigation over a period of years does not accurately state the amount of water used in a single year for irrigation uses.

The Hopi Tribe offers the 33,808.10 acre inventory to support the argument that it demonstrates that there are 33,808.10 acres on the Hopi Reservation that have been irrigated and can be irrigated and that it would be a "reasonable estimate of the amount of acreage that may be used by the Hopi Tribe in the future to continue the agriculture practices of the Hopi Tribe." Hopi FOF No. 504. The Hopi Tribe supports this claim by referencing the future population as devised by Dr. Greene and calculating a per capita acreage amount of 0.65, which it states is less than its interpretation of the anthropological estimate of the amount of land farmed historically. Hopi FOF 503. Similarly, in its Sixth Amended Statement of Claimant, the Hopi Tribe argued that consideration must be given to "future population and acreage projections" and performed calculations assuming per capita rates of 2.5 and 0.8 acres. Sixth Amended Statement of Claimant at 28; Seventh Amended Statement of Claimant at 32; Eighth Amended Statement of Claimant at 32.

Just as population, based on solid data, reasonable assumptions, and accepted methodologies, is an appropriate factor to consider in the determination of future DCMI use, it should also be an appropriate factor to consider in the quantification of the amount of land that will be irrigated in the future. The future population has already been the subject of an in-depth discussion in Section VI. The future population for calculating acreage to be irrigated is the projected 2100 population of 18,255 people. The next question is the amount of acreage that will

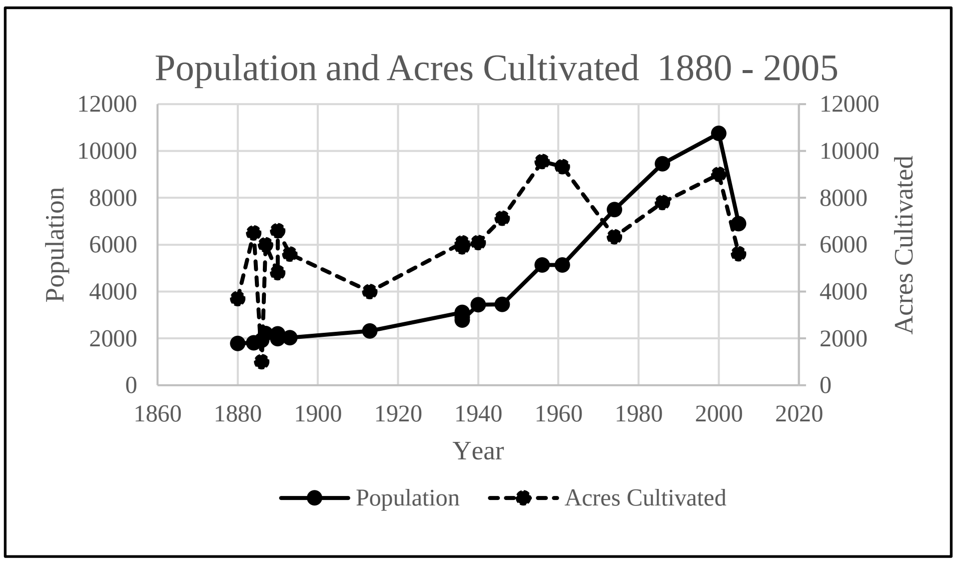

***Figure 6*:** The chart shows the reported changes in population (the solid line) compared to changes in number of acres under cultivation (the dashed line) from 1880 – 2005.

Source. Table 13.

be irrigated in the future for each person living on the reservation. As shown by *figure 6*, the trend on the Hopi reservation is that the rate of population growth exceeds the rate of growth of cultivated farmland. Consequently, the per capita rate of farmed acreage per capita has continued to decrease from the 1.75 acres per person that Dr. Maitland found in the early 1930s. For the last fifty years, the data available shows that the range of acres cultivated per person is 0.84 to 0.81 acres per person, which is consistent with the amount that the Hopi Tribe included in its amended Statements of Claimant. *See* Table 13.

Applying a projected population of 18,255 and allocating 0.8 acre per person, the total farmed acreage in the future would be 14,604. Historically, farmland consists of acreage irrigated by perennial sources, springs, wells, and the Northern Washes and minor tributaries. Based on Dr. Camilli's report, perennial water sources exist for approximately 464 acres. Little dispute exists that the 464 acres were irrigated historically, the United States has demonstrated that the sources to irrigate 464 acres exist and specifically identified them. It provided legal descriptions for the land irrigated by those sources and calculated that 853 acre-feet is the amount of water needed to irrigate the 464 acres of land.

Finding of Fact No. 237. 464 acres of land irrigated from perennial water sources in the past is reasonably expected to be irrigated in the future.

The source of water for the remaining 14,140 acres (14,604 - 464) is a combination of precipitation alone or precipitation combined with water from the other sources on the reservation such as the Northern Washes and minor tributaries. Based on Dr. Camilli's work, approximately 13 percent of that farmland is solely dependent on precipitation, leaving 12,302 acres requiring irrigation. The United States has presented the calculations to quantify the amount of water needed to irrigate 12,568 acres of land irrigated by tributaries and washes, for a total of 13,032 acres. It calculated that 18,045 acre-feet per year diverted from the Northern Washes and minor tributaries will irrigate 12,568 acres. While it is true that several irrigation projects from the 1950s that Dr. Camilli found on the reservation are no longer operational, it does not necessarily mean that the absence of those projects reduces the quantity of water needed to irrigate land in the future. In the case of water for agricultural use, the maximum historic use of water is supported by evidence of a future need. In the 1950s, the Hopi population on the reservation consisted of approximately 5,000 people. The Hopi population is expected to exceed 18,000 people within one hundred years. Given the importance of agriculture on the Hopi Reservation, a sufficient amount of water must be available for that future population to continue to farm. The two percent difference in acreage based on assumed future irrigated acreage and future population and the historical amount calculated by the United States is not material.

Finding of Fact No. 238. 18,045 acre-feet of water per year diverted from the Northern Washes and minor tributaries is the amount of water necessary for the current and future irrigation of land for 12,568 acres along the Northern Washes and minor tributaries to provide a permanent homeland tailored to the minimum needs of the reservation.

Finding of Fact No. 239. 853 acre-feet of water per year diverted from springs, wells and impoundments to provide perennial irrigation for 464 acres of land is the amount of water necessary to provide a permanent homeland tailored to the minimum needs of the reservation.

Finding of Fact No. 240. Springs and impoundments do not provide an adequate source of water for the perennial irrigation needed to accomplish the purpose of a reservation.

Conclusion of Law No. 55. The United States and the Hopi Tribe are entitled to federal reserved rights to groundwater to provide water for perennial irrigation in an amount, when added to perennial irrigation provided by springs and impoundments does not exceed 853 acre-feet per year. *Gila III*, 195 Ariz. at 420, 989 P.2d at 748.

Having defined attributes for irrigation water by type of use, source, and quantity, the remaining attributes are places of use and points of diversion. The points of diversion for the land irrigated by perennial sources can be specified by reference to the source. The places of use of that water will be substantially the same as the point of diversion. The points of diversion and places of use for the remaining irrigation water from the Northern Washes and minor tributaries must accommodate the farming techniques developed by the Hopi farmers. As discussed above, the Hopi farmers strategically locate fields along the Northern Washes and minor tributaries to capture water. Given that these water rights will be held by the Hopi Tribe as the beneficial owner and the United States as the legal owner, no reason exists to designate specific places of use or points of diversion along the Northern Washes and minor tributaries where there are no intervening water users. Accordingly, the place of use and points of diversion will be made by reference to each wash and its tributaries to allow Hopi farmers to follow their traditional practice of siting fields in optimal locations to benefit from the wash water. To provide more certainty to the federal reserved water right, the quantity of water will be further defined by the permitted amount of depletion and by a requirement that conveyance losses from the point of diversion from the wash or tributary to the place of use do not exceed ten percent of the water diverted. [HSR at 4-16]

C. Ceremonial and Subsistence Gardens

The Hopi Tribe claimed federal reserved water rights to 9,471 acre-feet of groundwater to develop a new irrigation project. The project is intended to provide irrigation for enough plots of land so that approximately one-quarter to one-third of the nationwide Hopi population, who will live on the reservation in the future and are expected to farm, can grow the same amount of produce on each plot that a Moenkopi farmer harvests from a typical field. [Hopi Exh. 3965; Hopi Exh. 4580; 102020:5–6 AM (Whittington)] The Hopi Tribe refers to the plots of land, each of which will be between 0.7 and 0.9 acres, as "ceremonial and subsistence gardens" ("C&S Gardens") The United States does not claim water for the proposed C&S Gardens. [U.S. 6th SOC at 15-16 (PDF 15-16)].

Finding of Fact No. 241. The proposed C&S Gardens are not a currently existing water use.

The Hopi Tribe must provide sufficient evidence to prove each of the necessary attributes of a water right for the C&S Gardens. As with any other claim, it must satisfy the basic standard set forth in *Gila V* and, given that the C&S Gardens is a new irrigation project, it must also meet the PIA standard that requires a showing of economic feasibility and that the land is practicably irrigable. Finally, due to the choice of groundwater as the source of the irrigation, the Hopi Tribe must satisfy the *Gila III* test that allows federal reserved water rights to groundwater only "where other waters are inadequate to accomplish the purpose of a reservation." *Gila III,* 195 Ariz. at 748, ¶31, 989 P. 2d at 420.

Dr. Whittington identified approximately 2,890 acres of land, which have been irrigated in the past located generally within a two-mile radius of the village centers, as possible locations for the proposed C&S Gardens. [102020:131 AM (Whittington); Hopi Exh. 4580 at 66-72 (PDF 66-72)]. This area is subject to the Hopi's complex system of land ownership and control that requires village or clan approval for certain activities within the Hopi Reservation. [102720:22-23 PM (Onsae); 102020:112-13 AM (Whittington)] No detailed site plans for the fields were developed. [102020:50 AM (Whittington)] The engineer retained by the Hopi Tribe to design the water infrastructure to support this program stated: "It is currently unknowable where each C&S Garden will be." [Hopi Exh. 3946 at 30] The lack of specificity of the location of the program created disputes about whether the generally defined places of use overlap with historically irrigated acreage and, therefore, duplicate the general claim to surface water for irrigation use. NN FOF 129.

Finding of Fact No. 242. The Hopi Tribe did not adequately identify the location of C&S Gardens creating the probability that the claim for water duplicates, in part, the general agricultural claim discussed above based on historically irrigated acreage.

Dr. Whittington envisioned that the C&S Gardens would be "well-designed," provided with a steady source of water, and more productive than traditional fields. [Hopi Exh. 4580 at 60; 102020:16 PM (Whittington)] He reached an opinion about the probable amount of water needed for the proposed C&S Gardens based on a set of assumptions and a three-part methodology. First he created an equation to relate seven factors. Two of the factors were water duties for land in Moenkopi Island and land outside Moenkopi Island. He assumed that 3.83 acre-feet per acre was the appropriate water duty for the Moenkopi area and 3.39 acre-feet per acre was the appropriate water duty for the 1882 Reservation. [Hopi Exh. 4402 at 16; 101920:62 PM (Westfall)]

Dr. Whittington testified that he did not choose an irrigation method for the proposed C&S Gardens because the method of irrigation should be decided by the farmer, the village or the clan. [102020:114-15 AM (Whittington)]. The type of irrigation can affect the amount of water required for each plot of land. For example, flood irrigation is much less efficient than drip irrigation [101920:86-87 AM (Westfall)] Gary Mortimer, a farmer and rancher in Dewey, stated that he farms 150 acres at Mortimer Farms in Dewey, Arizona. [012521:11-12 PM (Mortimer)] Most of the water used at Mortimer Farms is delivered using drip irrigation, with a small amount delivered using flood irrigation. [012521:12 PM (Mortimer)]. Mr. Mortimer testified, in his experience, using drip irrigation saves 50 percent of the water otherwise needed for most crops for flood irrigation. [012521:13 PM (Mortimer)]

Finding of Fact No. 243. The type of irrigation materially impacts the assumed water duties incorporated into the formula. The failure to consider the type of irrigation precludes a realistic assessment of the amount of water needed to irrigate the individual plots.

In addition to water duties, Dr. Whittington considered five additional factors. A completed list of the factors (with the symbols used by Dr. Whittington in his equation) is as follows:

1. The proportion of households living of the Hopi Reservation who want to cultivate a plot included in this plan (**βl**);
2. The proportion of the Hopi Tribe's nationwide population living on the reservation (**β2**);
3. The proportion of the Hopi Tribe's population living in Moenkopi (**β3**);
4. The size of the average Hopi household living on the Hopi Reservation (**HHSize**);
5. The size of the individual plots (**PLOT**);
6. The water duty in Moenkopi (**CIR2**); and,
7. The water duty on plots located outside Moenkopi (**CR1**)

Using the symbols listed above, Dr. Whittington created the following equation to determine a probable amount of water (in acre-feet per year) needed for the C&S Gardens for the future Hopi population:

$$Amount\ of\ Water\ \ (acre\ feet\ per\ year) = Future\ Hopi\ Population\ x$$
$$\left\{\left[\frac{[\beta 1 \times \beta 2 \times (1 - \beta 3)]}{HHSize} \times CIR_1\ x\ Plot\ Size\right] + \left[\frac{[\beta 1 \times \beta 2 \times \beta 3]}{HH\ Size} \times [CIR_2]\right]\ \ x\ Plot\ Size\right\}$$

[Hopi Exh. 4580 at 59]

As the second step in his process to arrive at an opinion about the amount of water needed for the C&S Gardens, Dr. Whittington created a range of values for five of the variables in the equation: the percentage of households living of the Hopi Reservation who want to cultivate a plot included in this plan; the percentage of the Hopi Tribe's total population living on the reservation; the percentage of the Hopi Tribe's population living on Moenkopi Island; the average size of the Hopi household living on the Hopi Reservation; and the size of the individual plots of land involved in the program. For example, with respect to the plot size, Dr. Whittington did not assume that all plots would be 0.8 acres. He increased and decreased the acreage by more than ten percent to create a range of plot sizes from 0.7 to 0.9 acres. He did not vary the values for the water duties to account for more and less efficient methods of irrigation.

The third step in the process was to apply a Monte Carlo simulation to the variables and the equation. [102020:10–12, 20 AM (Whittington)] A Monte Carlo simulation is a basic technique used to calculate the probability that an event or scenario will occur. It relies on a computer to randomly generate a large set of numbers, here 10,000 sets of numbers, between defined limits to create 10,000 scenarios. Dr. Whittington had the computer generate a set of numbers for five of the variables used in the equation. He set upper and lower bounds on each of the five variables and had the computer vary the numbers uniformly within set bounds, which means that Dr. Whittington considered that any number within the set bounds was as likely to occur as any other. Using plot size again as an example, Dr. Whittington had the computer randomly create 10,000 plot sizes from 0.7 to 0.9 acres. Thus, one scenario generated by the program could calculate the needed water based on a 0.7-acre plot of land and another scenario could calculate the needed water based on a 0.85-acre plot. In all scenarios, the number of acres would be between 0.7 acres and 0.9 acres. [Hopi Exh. 4580 at 60] Using the results of the 10,000 scenarios, Dr. Whittington formed an opinion about the amount of water needed based on the probability of the amounts needed in the future based on his chosen variables. [Hopi Exh. 4580 at 58–62; 102020:10–11, 19–20 AM (Whittington)]

Among the numerous assumptions included in the formula is Dr. Whittington's assumption, represented by **β2** in the formula, that between 60 and 90 percent of the nationwide Hopi population would live on the Hopi Reservation in the future. [Hopi Exh. 4580 at 60] Dr. Whittington is not a demographer and is not qualified to make population projections or offer opinions on the percentage of the Hopi population that will live on the Hopi Reservation in the future. [102020:41-43 PM (Whittington)] Dr. Swanson, who is a qualified demographer, projected that 45 percent of the enrolled tribal population of the Hopi Tribe will live on the Hopi Reservation in the future.

Finding of Fact No. 244. No reasonable basis exists for Dr. Whittington's opinion that between 60 and 90 percent of the future nationwide Hopi population will live on the reservation in the future. [102020:14, 121–122 AM (Whittington)]

Finding of Fact No. 245. The results generated by the model do not provide a reasonable basis to determine the probable amount of water needed for the C&S Gardens.

The Hopi Tribe also bears the burden to show that this new irrigation project is practically and economically feasible. *Gila V*, 201 Ariz. at 319 ¶44, 35 P.3d at 80. Dr. Whittington did not evaluate the practical or economic feasibility of the proposed C&S Gardens. [102020:114-17, 150 AM (Whittington)]. Similarly, Mr. Kunkel, the engineer retained by the Hopi Tribe to design the infrastructure for the project, did not evaluate the economic feasibility of the proposed C&S Gardens. [Hopi Exh. 3946 at 1-36 (PDF 5-40)]. Dr. Leeper, on behalf of the Navajo Nation, testified that the proposed C&S Gardens would not be practically or reasonably feasible. [120920:22-23 AM (Leeper); Navajo Exh. 763 at 4-11 (PDF 6-13)]. He opined that high infrastructure costs and limitations on available, affordable water render the proposed C&S Gardens economically unsound. *Id*.

Finding of Fact No. 246. The Hopi Tribe failed to meet its burden to prove that the proposed C&S Gardens project is economically sound.

The Hopi Tribe does not dispute the lack of any PIA analysis but argues that the project is not subject to that type of analysis because the project is needed to maintain Hopi cultural and religious traditions.

Conclusion of Law No. 56. *Gila V* did not create an exception to the PIA requirement for new, large-scale irrigation projects, necessarily duplicative of surface water irrigation and intended to provide an alternative source of water if, in the future, some portion of surface water is not available for an extended period of time.

The final aspect of this claim for a new irrigation project is the source of water. The Hopi Tribe claims a right to groundwater to irrigate the land**.** Hopi FOF 543; United States' and Hopi Tribe's Joint Responses to the LCR Coalition's Proposed Finding of Fact and Conclusions of Law at 117 (August 27, 2021).

Finding of Fact No. 247. Sufficient surface water is available to meet the Hopi Tribe's current and future agricultural uses.

While there was testimony that climate change will adversely affect the surface water on the Hopi Reservation, insufficient evidence was introduced to reasonably permit any determination about whether the magnitude of that future impact of climate change would cause the available surface water to be inadequate to meet the agricultural needs of the reservation thereby giving rise to a federal reserved water right to groundwater. *Gila III* only permits a federal reserved water right to appurtenant groundwater for use on a reservation when other waters are inadequate to accomplish the purpose of a reservation.

Conclusion of Law No. 57. Federal reserved water rights to 9,471 acre-feet of groundwater annually for irrigation uses is not permitted because the Hopi Tribe did not meet its burden to prove that surface water is inadequate for that purpose.

D. State Law Appropriative Rights

After ADWR issued the final Hopi Reservation HSR, the Hopi Tribe asserted that it had a right under state law to water for use on Moenkopi Island. In its Sixth Amended Statement of Claim, and repeated in the Seventh and Eighth Amended Statement of Claimant, the Hopi Tribe states:

> F. In the alternative to the Hopi Tribe's claims based on aboriginal use and occupancy and the federal reserved rights doctrine, the Hopi Tribe claims rights in Moenkopi Island under state law based on the Hopi Tribe's appropriation and beneficial use of water in Moenkopi prior to the creation of the 1934 Reservation.

Sixth Amended Statement of Claimant at 19 (January 18, 2019).

The claim addressed here concerns rights asserted under state law to irrigate portions of 20 five-acre tracts to the south of the Village of Lower Moencopi referred to as the "Murphy Tracts". [Hopi Exh. 44 at 43] More specifically, the Hopi Tribe claims the right to divert 132.1 acre-feet of water annually to irrigate 68.880 acres in Section 4 Township 31N Range 11E and Section 33 Township 32N Range 11E, with a priority date no later than January 1, 1865. Hopi COL No. 51. After providing proposed statements of fact about events that occurred before 1865, the Hopi Tribe offered the following proposed facts about water use in the claimed area:

> **Finding of Fact No. 536.** When Mormon missionary parties encountered the Hopi in 1858 and 1873, they found Oraibi Hopis farming along

> Moenkopi Wash. [Hopi Exh. 3902 at 7; Hopi Exh. 3903 at 9, 21; *see also* Hopi Exh. 3883 at 141] Between 1858 and 1873, when the early Mormon settlers permanently settled in the area, Mormon diaries indicated that the Hopi continuously farmed in the Moenkopi area. [Hopi Exh. 3902 at 7–8]
>
> **Finding of Fact No. 537**. In 1888, according to a map drawn by Indian Bureau Agent Inspector H.S. Welton, there were at least seven Hopi houses at Moenkopi, and the Hopi were farming a stretch of Moenkopi Wash measuring 1.75 miles in length. [Hopi Exh. 3903 at 21, 23] Hopis exclusively farmed the Moenkopi Wash area below the Village of Lower Moencopi. [*Id*.]
>
> **Finding of Fact No. 538**. [statements about Allotments]
>
> **Finding of Fact No. 539**. [statements about Allotments]
>
> **Finding of Fact No. 540**. Interspersed with the Allotments were twenty tracts, five acres apiece, located south of the Village of Lower Moencopi, and north of the Moenkopi Wash, (Table 15).
>
> **Finding of Fact No. 541.** Within these same township, range, and sections (and excluding the allotment lands), Dr. Camilli found Hopi irrigating 104 acres in aerial photography from the 1950s, (Table 16).
>
> **Finding of Fact No. 542.** Pre-historically and historically, these tracts diverted water from Moenkopi Wash. After the creation of the Reservoir Dam, water was diverted from Pasture Canyon and Moenkopi Wash for these tracts.

The recitation of statements includes a table based on information compiled by the United States from information gathered in the 1950s. [U.S. Exh. 582 at 211-14]

A water right under state law may be initiated or perfected prior to 1919 by persons that own or possess arable land who appropriated water and put it to beneficial use on a particular tract of land. *Parker v. McIntyre*, 47 Ariz. 484, 56 P.2d 1337 (1936); *In re Determination of Relative Rights, to Use of Waters of Pantano Creek in Pima County,* 45 Ariz. 156, 173, 41 P.2d 228, 235

(1935); *Slosser v. Salt River Val. Canal Co.*, 7 Ariz. 376, 338-339, 396, 65 P. 332 (1901). In addition to proving ownership or possession of the land, a person claiming a pre-1919 state water right must prove that there was "an appropriation of unappropriated waters, and then the extent thereof; that is, the amount or quantity of water beneficially used and the specific lands upon which the waters were used." *Gillespie Land & Irr. Co. v. Buckeye Irr. Co.*, 75 Ariz. 377, 384, 257 P.2d 393, 397 (1953). The evidence presented only shows that in the late 1800s there were Hopi farmers either living or farming on land on Moenkopi and, that in all probability, used water from Moenkopi Wash to irrigate farmland. Located in the same area of the Murphy Tracts, there are another 220 acres that are the subject of Allotments discussed in Section X, as well as land that was neither included in a Murphy Tract or an Allotment. [Hopi Exh. 44]

The establishment of a state law water right requires specificity about each of the elements necessary to prove it. The evidence presented about activities that occurred over a 50-year period on an area consisting of more than 300 acres of land is insufficient to establish a right to water under pre-1919 state law. There is no evidence about the date that a specific quantity of water was appropriated for beneficial use on a particular parcel of land. Information about irrigation use on land in Moenkopi more than 85 years after the claimed priority date does not suffice to establish a pre-1919 water right.

Finding of Fact No. 248. The evidence presented does not establish a credible date when water was appropriated for the Murphy Tracts after 1865 and before 1919.

Finding of Fact No. 249. The evidence presented does not establish the amount of water appropriated for irrigation or the specific lands upon which the waters were used after 1865 and before 1919.

Arizona Revised Statutes §45-182 requires all persons who were using and claiming the right to withdraw, divert, or make beneficial use of public waters of the state based on state law to file a statement of claim (as distinct from a Statement of Claimant required by A.R.S. §45-254) no later than 90 days before the director of ADWR files a final report pursuant to the A.R.S. §45-182 for the subwatershed. The law further provides that if a person fails to timely file a Statement of Claim, the person shall have "waived and relinquished any right, title or interest in that right." A.R.S. §45-184.

Finding of Fact No. 250. The Hopi Tribe did not file a Statement of Claim pursuant to §45-182 prior to the issuance by ADWR of the Hopi Reservation HSR.

Conclusion of Law No. 58. The Hopi Tribe has waived and relinquished any claims to a water right under state law for 20 five-acre tracts in Section 4 Township 31N Range 11E and Section 33 Township 32N Range 11E.

Conclusion of Law No. 59. The Hopi Tribe does not have an appropriative right under state law to irrigate the twenty tracts below the Village of Lower Moencopi (the Murphy Tracts) with a priority date no later than January 1, 1865.

Notwithstanding the language in its amended Statements of Claimant, the Hopi Tribe does not claim that water rights under state law for the Murphy Tracts still exist. The Hopi Tribe asserts that once federal reserved water rights attached to the land, the federal rights preempted any state water rights except that the priority date established under state law becomes the priority date for the Murphy Tracts. The Hopi Tribe asserts that the Murphy Tracts have federal reserved water rights with a priority right date set by state law. [093021: 70-71 (Campbell)] When state and federal law conflict, the state court must apply federal law to define a federal reserved water right. *Arizona v. San Carlos Apache Tribe*, 463 U.S. 545, 571 (1983) ("State courts, as much as federal courts, have a solemn obligation to follow federal law."); *see also Navajo Nation v. U.S. Dep't of the Interior*, 26 F.4th 794, 802 (9th Cir. 2022) ("[Federal reserved water] rights are determined by federal, not state law.") *Winters* requires the priority date for a federal reserved water right to be set by the date of the reservation. In contrast, any state water right would have a priority date tied to an initial beneficial use if it could have been proven. Given the conflict between federal and state laws that govern priority date, federal law must control.

Conclusion of Law No. 60. The priority date for the federal reserved water rights applicable to the Murphy Tracts is the date established under federal law.

Conclusion of Law No. 61. The priority date for the federal reserved water rights applicable to the Murphy Tracts cannot be set by state law.

VIII. Livestock and Wildlife Use

Consistent with its approach of employing standards tied to superlatives to quantify federal water rights, the United States claimed federal water rights for the maximum number of livestock that the entirety of the land in the Hopi Reservation could support assuming optimal rangeland conditions. [092121:15, 19, 50 (Lucero). It quantified that amount as 1,067 acre-feet of water annually. United States Closing Brief at 36. The Hopi Tribe claimed a right to the "reasonable use of the D Aquifer underlying the Hopi Reservation to provide a sufficient amount for the present and future livestock herd. Alternatively, it claims 1,070 acre-feet of water for livestock use." Hopi Closing Brief at 32. In addition, the United States and the Hopi claim the right to divert 3,576 acre-feet of water per year from Moenkopi Wash, Dinnebito Wash, Oraibi Wash, Polacca Wash, and Jadito (or Jeddito) Wash and their tributaries for storage in 1,050 impoundments for livestock watering. Hopi Tribe's Sixth Amended Statement of Claimant at 35, Hopi Tribe's Seventh Amended Statement of Claimant at 39-40, Hopi Tribe's Eighth Amended Statement of Claimant at 39-40. Finally, the Hopi Tribe claims in excess of 12,000 acre-feet of groundwater annually to develop a beef value chain.

A. Stock and Wildlife Watering

The Hopi have a long history of grazing livestock on the land now included in the reservation. Before the arrival of Europeans in the 1500s on land that is now included in northern Arizona, the Hopi Tribe relied upon wild game and domesticated turkeys as food sources. [112618:30-31 PM (Whitely)]

Finding of Fact No. 251. Hopi have raised livestock on the lands surrounding the Hopi Mesas since the sixteenth century, when the Spanish introduced sheep to the area. [Hopi Exh. 3877 at 11 (PDF 7); Hopi Exh. 3872 at 37]

Conclusion of Law No. 62. Water for livestock and wildlife watering on Land Management District 6 is an aboriginal use of water. *Adair*, 723 F.2d at 1414.

The Hopi Tribe is entitled to a water right under federal law for that quantity of water necessary to provide water for livestock and wildlife on the Hopi Reservation. Ranching is currently the most extensive land use activity on the Hopi Reservation. [Hopi Exh. 4467 at 143 (PDF 148)] Approximately 1.4 million acres of the Hopi Reservation, divided into non-uniform tracts of range land known as range units, are used for grazing livestock. [U.S. Exh. 1368 at PDF 41; Hopi Exh. 69 at 4 (PDF 10), 13 (PDF 19)] The Hopi Tribal Council has enacted ordinances to govern cattle operations on the reservation, overseen by the Hopi Office of Range Management. [100519:51-53 AM (Pavatae)]

The Hopi Office of Range Management establishes the carrying capacities and stocking rates on each range unit, subject to approval of the Hopi Tribal Council. [Hopi Exh. 69 at 14 (PDF 20)] A stocking rate is the number of animal units that can be grazed on each range unit under prevailing conditions consistent with sustained-yield principles of range management. [Hopi Exh. 69 at 4 (PDF 10)] The carrying capacity of a designated area is the maximum number of animal units able to sustainably graze the area over the long-term without degrading the rangeland vegetation or soil resources. [011121:13-14 AM (Lowman); 092120:53 AM (Lucero)].

Water needs for livestock are calculated based on an "animal unit" measurement. This form of measurement was developed to aid in range management. Different types of livestock or even the same type of animal but at different stages of life make different demands on the land and water supplies. The adoption of a single unit of measurement applicable to all grazing animals facilitates the management and administration of range land. One animal unit is used to designate the amount of forage and water needed by a cow with a calf up to six months of age. [092121:39 AM (Lucero); 012121:23 AM (Judy Prosser)] Priscella Pavatea, Director of the Office of Range Management, testified that a sheep is one-quarter of an animal unit, which means that four sheep constitute an animal unit. [100518:52 AM (Pavatea)].

Livestock	**Conversion Factor from Animal to Animal Unit**
Bull	1.25
Horse	1.25
Cow and calf	1.00
Goat	0.20
Sheep	0.25
Yearling Heifer	0.70
Yearling Steer	0.70

Table 14.
Source: [091718: 31 AM (Banet); 100518:52 AM (Pavatea); Hopi Exhibit 69

Finding of Fact No. 252. The conversion factors applicable to specific types of animals are shown in Table 14.

As of 2019, permits were issued to 346 to ranchers to graze thousands of head of cattle on the range units. [*Id.*] The Hopi raise cattle for supplemental income, personal consumption, or to satisfy a social obligation. [*Id.*] "For example, a Hopi individual may start and raise a small herd of cattle over a two- or three-year period for the express purpose of sponsoring a ceremony or feeding a wedding party." [*Id.*]

Finding of Fact No. 253. The reservation has approximately 1.4 million acres of land suitable for rangeland for livestock, including horses, cattle, sheep, and goats, and to support wildlife.

Finding of Fact No. 254. Livestock provides an economic and social benefit to the Hopi ranchers and the Hopi Tribe.

Conclusion of Law No. 63. The United States, as trustee of the Hopi Tribe, and the Hopi Tribe are entitled to a federal reserved water right for that quantity of water necessary to maintain wildlife on the Hopi Reservation and to support ranching to satisfy the present and future needs of the reservation.

Christopher Banet, a Trust and Resources and Protection Manager for the Bureau of Indian Affairs who holds a Master of Science in Plant and Soil Science, testified that each animal unit requires 12 gallons of water per day. [091418:85 (Banet)] Mr. Banet arrived at the 12-gallon figure by assuming that the source of the water would come from a well and calculated the amount of water that must be produced by a typical well and stored in a tank or stockpond. After factoring in losses due to transmission, leaks, spills, seepage, and evaporation, he concluded that a well must produce 20 gallons, which is pumped into a storage facility, for each animal unit for each day.

All parties stipulated to a factual determination that the appropriate measure of water for each animal unit is 20 gallons per day. Hopi FOF No. 947; Stipulation of the parties 091718:110-111; Joint Pretrial Statement ¶6, at 2 (May 18, 2020). The parties further stipulated that the United States, as trustee for the Hopi Tribe, and the Hopi Tribe should be decreed a right to 824 acre-feet of water annually for stock and wildlife consumption uses on the Hopi Reservation. Stipulation Re: Livestock and Wildlife Watering at 1 (March 29, 2022).

Finding of Fact No. 255. The Hopi Tribe allocates 25 percent of the carrying capacity of the Hopi Reservation to wildlife, which on the Hopi Reservation includes, elk and deer, big game, rabbits, jack rabbits, squirrels, and chipmunks. SRP FOF 272; Hopi FOF 921. Wildlife consumes the same sources of vegetation or forage as Hopi livestock. [102820:64 AM (Honyumptewa); 092120:47-48 AM (Lucero)]

Finding of Fact No. 256. 824 acre-feet of water annually is the minimal amount necessary to support ranching and maintain wildlife on the reservation that can serve as a permanent homeland for the Hopi Tribe.

As discussed above, the Hopi Tribe administers livestock operations undertaken by the individual ranchers based on a system of range units at specific locations with a specific number of acres. These range units are the places of use for stock watering.

Finding of Fact No. 257. The range units and total grazed acres within Land Management District 6 are listed in Table 15.

Table 15: Range Units in District 6

Range Unit	Total Acres	Exclusion Areas Total	Exclusion Types			Grazed Acres[b]	Sections
			Farming	Rip.	Misc.[a]		
Tovar	37,660	0	0	0	0	37,659	58.84
Burro Springs	57,030	0	0	0	0	57,050	89.14
Polacca Wash	48,985	26,735	26,735	0	0	22,244	34.75
Talahogan	47,599	644	0	0	644	46,959	73.37
Hardrock	63,353	11,603	11,603	0	0	51,749	80.85
Toreva	25,767	12,868	12,868	0	0	12,901	20.15
Shonto	37,090	658	658	0	0	36,443	56.94
Bluepoint	22,210	233	135	0	98	21,977	34.34
E. Dinnebito	40,503	20,004	18,278	517	1,209	20,500	32.03
W. Dinnebito	17,107	4,701	4,701	0	0	12,403	19.38
North Oraibi	52,868	37,849	37,849	0	0	15,017	23.46
Upper Polacca	58,861	588	0	0	588	58,280	91.06
Five Houses	72,833	38,502	37,997	68	437	34,287	53.57
South Oraibi	32,520	32,520	19,726	0	12,794	0	0
Shongopovi	35,481	35,481	35,481	0	0	0	0
Total	**649,867**	**222,387**	**206,032**	**585**	**15,770**	**427,469**	**667.92**

[a] Miscellaneous exclusion areas include topography (e.g., slopes > 60 percent, cliffs, tops of mesas), culturally sensitive (e.g., historic, sacred), and other areas not accessible to livestock
[b] Area inventoried in 2015–2016

[Hopi Exh. 4519 at 10 (PDF 17); 102820:13–14 PM (Pavatea)]

Finding of Fact No. 258. The places of use for water for livestock purposes in Land Management District 6 are in the sections and on the acreage listed in Table 15.

Finding of Fact No. 259. The range units, acreage, and number of sections within the Hopi Partitioned Lands are listed in Table 16.

Location	Range Unit	Total Acres	Sections
HPL	251	32,174	50.27
	252	53,288	83.26
	253	50,504	78.91
	254	25,091	39.20
	255	80,620	125.97
	256	36,669	57.30
	257	49,588	77.48
	258	9,988	15.61
	259	31,799	49.69
	260	23,553	36.80
	261	24,628	38.48
	262	28,029	43.80
	263	53,831	84.11
	351	27,456	42.90
	451	12,147	18.98
	551	54,240	84.75
	552	34,802	54.38
	553	35,439	55.37
	554	30,069	46.98
	555	36,508	57.04
	556	9,325	14.57
	557	7,736	12.09
	558	11,872	18.55
	559	27,423	42.85
	560	--	0.00
	561	--	0.00
	562	22,605	35.32
	563	21,808	34.08
	564	3,026	4.73
	565	14,302	22.35
	566	6,466	10.10
	567 568	13,161	20.56
	569 570	15,274	23.87
	571	6,831	10.67

Location	Range Unit	Total Acres	Sections
	572	9,896	15.46
	573	7,715	12.05
	Total	**907,863**	**1418.54**

Table 16. Hopi Exh. 996 at 20–21; *see also* Hopi Exh. 12 at 43; 102820:20–21 PM (Pavatea)]

Finding of Fact No. 260. The place of use for water for livestock watering purposes in Hopi Partitioned Lands is on the acreage in the range units set forth in Table 16.

Conclusion of Law No. 64. Water used for cattle, livestock, and wildlife on Hopi Partitioned Lands does not have a time immemorial priority date but has the priority date attached to the land established in *In re Hopi Priority*.

Finding of Fact No. 261. The single range unit in Moenkopi has 60,518 acres and is the place of use to water livestock and wildlife. [Hopi Exh. 996 at 56]

Conclusion of Law No. 65. Water for cattle, livestock, and wildlife in Moenkopi does not have a time immemorial priority date but has the priority date attached to the land established in *In re Hopi Priority*.

Finding of Fact No. 262. The place of use for water for wildlife use is the Hopi Reservation.

Livestock requires multiple sources of water because the amounts available, if any, from sources such as springs and impoundments, vary seasonally and annually, and the availability of sources vary across the reservation where livestock are permitted to graze. [091418:73, 78 PM (Banet)] The United States identifies 378 springs on the Hopi Reservation. [U.S. Exh. 739] With the exception of two springs located in Moenkopi, all of the springs are designated as sources of water for multiple uses. The United States claims that 365 of the springs provide a source of water for livestock. [U.S. Exh. 739] While earlier Statements of Claimant filed by the United States quantified the flow of the springs as either four gallons per minute or 19 gallons per minute, its

Fifth Statement of Claimant and the list of springs that the United States introduced into evidence do not provide any measurements of flow from the springs. As reported by the Hopi Tribe, the quantities of past or present flow at specific springs on Hopi Tribal lands are generally unknown. See Section IV (D). The Hopi Tribe's Eighth Amended Statement of Claimant at 39. The majority of the springs are dry. [101821:51 AM (Honyumptewa)] Springs are also not uniformly distributed among the range units. [091418:78 (Banet)]

Finding of Fact No. 263. The springs do not provide sufficient water for livestock and they are not sufficiently distributed on the reservation to support the livestock on the grazing land. [101821:49 AM (Honyumptewa); 00218:21 PM (Puhuyesva); 100818:48 AM (Nuvangyaoma); 091418:78 PM (Banet)]

Impoundments are another source of water for livestock. They provide an additional source of water used to extend the rangeland that wildlife and livestock may forage, but the impoundments and stockponds are susceptible to drought. [Hopi Exh. 4516 at 3 (observing 99 percent of earthen dams on the reservation are dry); Hopi Exh. 4561 at 24 (PDF 25) (Keams Canyon reporting more than 75 percent of ponds in region dry); 012621:48 AM (Coleman) (testifying stockponds are "not dependable for permanent water")]

Finding of Fact No. 264. Seeps, wetlands, impoundments, and washes are inadequate to provide a sufficient and reliable source of water for livestock and wildlife.

Conclusion of Law No. 66. The United States and the Hopi Tribe are entitled to federal reserved rights to groundwater to provide water for livestock and wildlife. *Gila III*, 195 Ariz. at 420, 989 P.2d at 748.

Wells are the primary source of water for livestock on the Hopi Reservation because groundwater is the most reliable source of water. [091418:74 PM (Banet)] Mr. Banet testified that he surveyed the 198 wells that the United States identified as a source of water for livestock on the Hopi Reservation, and of the wells that could be located, determined that a typical well is powered by a windmill. [091718:11, 14, 76 (Banet)] Based on his statistical analysis, Mr. Banet determined that the median production of these wells was 1.43 acre-feet per year. [091718:20 (Banet); U.S. Exhibit 761] Assuming losses as a percent of production ranging from 24 percent to 57 percent, [U.S. Exhibit 761] these wells could produce collectively in the range of 121 to 215.18 acre-feet per year if they were all operational.

The wells draw primarily from the shallower aquifers on the reservation. [091318:37–38 PM (Blandford); Hopi Exh. 4579 at 40–41] (identifying locations of existing livestock wells)] Mr. Blandford testified that the more than 1,000 acre-feet of water can be supplied each year by existing and future wells tapping local, shallow groundwater sources that occur in the region. [Hopi Exh. 4579 at 34 (PDF 41)] Mr. Blandford testified that the Hopi Tribe is primarily using groundwater from the D aquifer to support livestock. [092920:77-78 AM (Blandford)].

Finding of Fact No. 265. The 824 acre-feet per year for livestock and wildlife watering can be supplied by springs and the existing and future wells dispersed across the 1882 Reservation and Moenkopi Island, primarily from the D aquifer. [Hopi Exh. 4579 at 34 (PDF 41)].

B. Stockponds

The United States and Hopi Tribe make a separate claim for water to fill impoundments or stockponds based on the storage capacity of itemized stockponds. The stockponds mostly fill via surface water from washes. They extend the range that livestock may forage on the Hopi Reservation and have been used for livestock in the past. [*See* 091418:78-82 (Banet)]. The impoundment claims made by the United States and Hopi Tribe are based on the storage capacity of the stockponds. Arizona Department of Water Resources investigated the claims and verified the existence of 993 impoundments and calculated the combined volume of the impoundments as 3,167 AFA. [Hopi Exh. 8 at 5-7 (PDF 8)] No party disputes the storage capacity of stockponds on the Hopi Reservation.

Finding of Fact No. 266. The capacity of the impoundments listed in United States Exhibit 740, total 3,572 AFA. The existing impoundments used for livestock purposes are included in the inventory of impoundments and identified with "STOCK" in the use column.

Finding of Fact No. 267. The right to store water in the impoundments is a separate water right from livestock consumption and is necessary so that the stockponds can exist on the Reservation for livestock, irrigation, and riparian purposes. [091418:83–84 PM (Banet)]

Finding of Fact No. 268. These impoundments are existing points of diversion and places of use for the Hopi's overall livestock water right.

C. Beef Value Chain

The Hopi Tribe makes an additional claim for a federal reserved water right to more than 12,000 acre-feet of groundwater to expand its cattle operations to create a beef value chain. This claim for federal reserved water rights to support a future beef value chain is separate from the Hopi Tribe's claim for future livestock consumption uses. [102620:58 AM (Ciepiela-Kaelin)]. The United States claims no water for the Hopi Tribe's proposed beef value chain. United States Fifth Amended Statement of Claimant at 24-25.

Cattle operations can be divided into three phases. The first phase includes the ownership and breeding of cows and raising the calves until they are weaned. Breeding takes place from May to September, with calving beginning in early spring. [121620:65 PM (Brophy)]. During this stage, all animals depend on the forage on the reservation range land. [102620:61 AM (Ciepiela-

Kaelin)]. Almost 90 percent of the calves owned by the Hopi ranchers are sold at auction in October/November. [*Id.* at 15] Operations that sell the calves at this stage are referred to as cow-calf operations. [121620:59 PM (Brophy)] The current cattle operations on the Hopi Reservation primarily fit within the cow/calf category. [Hopi Exh. 3912 at 14-15]

Finding of Fact No. 269. Water necessary for the cow-calf operation is included in the parties' stipulated 824 acre-feet per year quantity for livestock and wildlife watering.

The second phase of a cattle operation occurs after a calf is weaned and separated from its mother, and it is known as "backgrounding". [102620:21 AM(Ciepiela-Kaelin)] The backgrounding operation, which necessarily involves more costs, prepares the weaned calves for the feedlot, provides veterinary services, third-party verification services, and supplemental feed. [102620:68 AM (Ciepiela-Kaelin); 121620: 67 (Brophy); 122220:8-9 AM (Crosby); Hopi Exh. 3912 at 25] The third phase is the feedlot where backgrounded steers and heifers are taken to be fed until they reach 1,200 to 1,350 pounds at which point the animals are "finished" and can be processed, meaning butchered for sale. [121620:69, 95 PM (Brophy)] A typical feedlot provides feedstuffs such as corn, hay, protein supplements, and other micro ingredients to create a ration for each animal that is nutritionally balanced and intended to fatten an animal to slaughter weight. [121620: 86, 91 (Brophy)] A feedlot must be able to process approximately 25 pounds of feed per day per animal to enable the animal to gain a targeted three pounds per day. [121620:85 (Brophy)]

The Hopi Tribe retained Cecilia Ciepiela-Kaelin to develop an economic development strategy to expand its livestock operations to include backgrounding and a feedlot. [Hopi Exh. 3912] Ms. Ciepiela-Kaelin holds a Master of Professional Studies in Sustainable Urban Planning. [102620:8–9 AM (Ciepiela-Kaelin); Hopi Exh. 3915] She has served as a senior official at the

U.S. Agency for International Development (USAID) and as vice president for economic growth at AECOM International, a Fortune 500 company. [Hopi Exh. 3912 at 4; Hopi Exh. 3915; 102620:8–10 AM (Ciepiela-Kaelin)] She currently serves as the president of AIS Development Corporation.

According to Ms. Ciepiela-Kaelin, the Hopi Tribe's proposed expanded cattle operations could generate a profit because the premium realized on the sale in high quality markets will exceed the added costs incurred for feed, water, and veterinary services. [Hopi Exh. 3912 at 18] Ms. Ciepiela-Kaelin recommends that the Hopi Tribe and the Hopi ranchers focus on the high-quality beef market as opposed to the general commodity market because the latter "will continue to experience the volatility associated with the cattle cycle" while the high quality beef market should "provide a more stable potential market opportunity." [Hopi Exh. 3912 at 11] She testified that the Hopi should incrementally expand their operations to build-up a herd that meets the standards necessary to market Hopi branded beef, to allow for the development of market demand, and improve range and pasture conditions and herd and feed management. [102620:35 AM (Ciepiela-Kaelin; Hopi Exh. 3912 at 25–26] Ms. Ciepiela-Kaelin anticipated an average annual increase in production of about one percent in the cattle operations over fifty years to ultimately bring 6,265 animals into the new operations. [Hopi Exh. 3912 at 25-26]

1. Backgrounding Operation

The Hopi Tribe proposes the future development of an on-reservation backgrounding operation that would retain 5,357 animals, which otherwise would have been sold at auction after being weaned, for an additional 60 to 90 days. [102620: 50, 71–72, 75, 80–81 AM (Ciepiela-Kaelin); Hopi Exh. 3912 at 5]. Ms. Ciepiela-Kaelin did not perform an economic feasibility analysis of a backgrounding operation on the Hopi Reservation. [102620:77 AM (Ciepiela-

Kaelin)] She examined the backgrounding operations of the neighboring Hopi Three Canyon Ranch and reported revenues from that operation in terms of sales prices for animals backgrounded, the gross revenue received, and difference between market price and price received. [Hopi Exh. 3912 at 18-19] As to costs, Ms. Ciepiela-Kaelin offered the general conclusion that a backgrounding program would only be feasible if there were better range, pasture, herd, feed management, and more fencing. [102620:84 AM (Ciepiela-Kaelin)] Essentially, Ms. Ciepiela-Kaelin assumed that a backgrounding operation would be feasible based on the economic results of the Hopi Three Canyon Ranch' operation. [Hopi Exh. 3912 at 18]

Finding of Fact No. 270. Mrs. Ciepiela-Kaelin did not calculate any specific costs of a background operation on the Hopi Reservation. [102620:77 AM (Ciepiela-Kaelin)]

Finding of Fact No. 271. Ms. Ciepiela-Kaelin's analysis did not establish that a backgrounding operation on the Hopi Reservation would be economically feasible. [102620:77 AM (Ciepiela-Kaelin)]

The description of the proposed backgrounding operation provided by Ms. Ciepiela-Kaelin leaves many specific details of the proposed operation unanswered including the source of food for the backgrounded animals and the proposed physical location of the backgrounding operation. She operated on the assumption that "the calves will be raised to 500 lbs. on pasture, with a portion of the crop sent to [Hopi Three Canyon Ranch] for wintering to 750 pounds." [Hopi Exh. 3912 at 25] At trial, Ms. Ciepiela-Kaelin confirmed that the location of the backgrounded animals would be "pretty wide ranging." [102620:69 AM (Ciepiela-Kaelin)] She testified that the backgrounded animals would be kept together and it was "most likely" that they would be in an area on the Hopi Reservation separate from the animals in the cow-calf operation. [102620:69-70 AM (Ciepiela-Kaelin)] Using the stocking rate for Hopi Three Canyon Ranch, the background operation would graze four animals per section, meaning the projected 5,327 animals would require 852,320[19] acres of grazing land or 60 percent of the rangeland on the Hopi Reservation.

The amount of rangeland required to support the proposed backgrounding operation demonstrates the problems encountered when a place of use for a particular type of use is not specified. The cow-calf and the backgrounding operations both require rangeland and they cannot simultaneously occupy the same rangeland. Consequently, a federal reserved water right cannot be quantified based on a simultaneous cow-calf operation and backgrounding operation on a substantial percentage of the range land.

The parties have stipulated to 824 acre-feet of water per year for livestock and wildlife watering. Assuming that 25 percent of that water will be used by the Hopi Tribe for wildlife [Hopi FOF 921], then 618 acre-feet remains available for livestock, whether for a backgrounding operation or a cow-calf operation. At 20 gallons per animal unit per day, the 618 acre-feet will support more than 27,000 animal units for a year on 1.4 million acres of rangeland which translates into a stocking rate of 12 animal units per section. No additional water is needed to support a backgrounding operation.

Finding of Fact No. 272. The claim for additional water to support the backgrounding operation on the Hopi Reservation to raise weaned calves to 500 pounds is part of, and therefore duplicative of, the claim for federal reserved water rights for stock watering which has been resolved by stipulation of the parties as to the quantity of water.

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[19] $5327\ animals\ x\ \frac{section}{4\ animals} x \frac{640\ acres}{section} = 852{,}320\ acres$

2. Feedlot

The third phase of the proposed commercial cattle operation is a feedlot for steers and heifers to be fed and watered until the animals reach approximately 1,200 pounds, at which time they will be shipped to slaughterhouses for processing and packing. [Hopi Exh. 3912 at 26] The Hopi Tribe claims federal reserved rights for 59 acre-feet annually to water 5,357 head of cattle in a feedlot and an additional 12,008 acre-feet of groundwater to annually irrigate 2,800 acres of land known as the Orabi Delta Farm to produce alfalfa for the feedlot. [Hopi Exh. 3912 at 32; Hopi Exh. 3946 at 34-35][20]

Ms. Ciepiela-Kaelin represented that the "Hopi Tribe has been exploring investments to support its broader economic development strategy, including the potential to increase the productivity and value generated by the cattle and beef sector by investing in value chain infrastructure for finishing and harvesting." [Hopi Exh. 3912 at 6] In accordance with that statement, Ms. Ciepiela-Kaelin proposed a future expansion of cattle operations on the Hopi Reservation to include the development of a feedlot operation with a 6,265 maximum stocking rate to be achieved in fifty years. [102620:85 AM (Ciepiela-Kaelin)] She opined that "[a] feedlot operation on the reservation would incorporate the finishing of beef cattle into the Hopi value chain, bringing several advantages. It would allow Hopi stockmen and H3CR to profitably retain ownership of their backgrounded animals through their finished weight, enabling them to capture a greater return on their investment through higher premiums at final sale." [Hopi Exh. 3912 at 20; Hopi FOF 1254]

[20] The Hopi do have a history of growing alfalfa, albeit in more limited amounts. In 1917, historical records show that 56.5 acres were planted in Moenkopi using surface water. [Hopi Exh. 3903 at 57] This alfalfa farm proposed in this section is of a completely different magnitude and with a different source of water.

Ms. Ciepiela-Kaelin expected that the proposed feedlot would generate 4.5 full time jobs and she included calculations in her report to demonstrate the increased net returns that Hopi ranchers would receive from the sale of animals at slaughter weight would represent a "significant margin for Hopi stockmen." [Hopi Exh. 3912 at 27] A determination that a proposed future water use is "reasonably feasible" requires that the claimant prove that such operation is (1) "achievable from a practical standpoint" and (2) "economically sound." *Gila V*, 201 Ariz. at 320, ¶ 49, 35 P.3d at 81.

Historically beef feedlots have operated along the Lower Little Colorado River, but those lots have now closed. There are no feedlots in Coconino, Apache, or Navajo Counties. [102620:101-102 AM (Ciepiela-Kaelin; NN Exh. 833); 122621: 91, 93 AM (Brophy)] The Hopi Three Canyon Ranch does not operate a feedlot. [102620:12 PM (Ciepiela-Kaelin)] Currently, only three cattle feedlots exist in Arizona, with the smallest having a 47,000-head capacity. [121620:92 PM (Brophy); 121720:22 PM (Brophy)]

The shift in Arizona from small feedlots to large feedlots is consistent with the nationwide trend, identified by the United States Department of Agriculture, that the cattle industry "continues to shift toward a small number of very large, specialized feedlots". [LCRC Exh. 813 at 2] Feedlots with less than 1,000 head capacity market a relatively small share of fed cattle. [Hopi FOF 1284] In contrast, feedlots with a capacity of 32,000 head or more market approximately 40 percent of fed cattle. [LCRC Exh. 813 at 2] Mr. Brophy testified that the small cattle feedlots in Arizona became obsolete because they could not compete with larger feedlots. [121620:91 PM (Brophy)]. He explained that feedlots in the United States today are located near supplies of grain and near a place that can process the beef for a retail store. [121620:92 PM (Brophy)]

The parties agree that the cost of feed is the key element of a feedlot economic analysis. [102720:34 AM (Ciepiela-Kaelin); 121620:92-96, PM (Brophy)] Ms. Ciepiela-Kaelin determined that the feedlot would use alfalfa as the primary source of feed. She described the project as "developing a feedlot operation on the reservation for finishing beef cows from 500 to 1200 lbs., or from 750 to 1200 lbs., with alfalfa produced on the reservation for feed." [Hopi Exh. 3912 at 26; *see also* Hopi Exh. 3912 at 27] Initially, Ms. Ciepiela-Kaelin calculated the cost of a ton of alfalfa based on a model for a hay farm in Pinal County developed by the University of Arizona Cooperative Extension. The model is known as the Pinal County Alfalfa Hay ration model "(Pinal County model"). The Pinal County model itemized the costs spent to grow and harvest alfalfa into three categories as shown in the first column of Table 17. The Harvest and Non-Harvest Costs include labor costs which account for 20 percent and 25 percent of the costs in those categories, respectively. [Hopi Exh. 3912, Appendix 5]

Category	**Percentage of Cost of Ton of Hay**
Harvest Costs	21 percent
Non-Harvest Costs	35 percent
Capital Investment	44 percent

Table 17

Ms. Ciepiela-Kaelin initially determined that alfalfa produced at a cost of $277.00 per ton would be the price at which the feedlot would "breakeven" [Hopi Exh. 3912, 26, Appendix 5][21] She subsequently opined that the Hopi tribal government could break even if the costs of alfalfa were $365 per ton for animals held in the feedlot from 500 to 1,200 pounds or $380 per ton for animals held in the feedlot from 750 pounds to 1,200 pounds. [102620:39–40 AM (Ciepiela-

[21] Although Ms. Ciepiela-Kaelin identified the $277 per ton cost of alfalfa as the breakeven cost, she stated: "For an on-reservation feedlot supporting the current maximum cash crop of 3,838, based on a 500 lb. feeder calf cost of $1.70/lb. (based on historical H3CR sales), a finished calf of $1.65/lb. (based on local market prices), feed costs of $277/ton (based on University of Arizona alfalfa cost calculations) and about 2.5% in losses due to performance or culling,the operation would achieve a net return of $169/head, or about $1 million in total." [Exh. 3912 at 27]

Kaelin); 102720:34–35 AM (Ciepiela-Kaelin); Hopi Exh. 3914] Thus, according to Ms. Ciepiela-Kaelin, the feedlot would not be economically feasible if the cost to produce a ton of alfalfa exceeds $380.

The Pinal County model used by Ms. Ciepiela-Kaelin depended on surface water to irrigate the alfalfa crop. [Hopi Exh. 3912 at 26-27] Groundwater pumped from the C aquifer would serve as the source of water for the Hopi Tribe's feedlot thereby necessitating the cost of installing a well field and pumping groundwater. The Hopi Tribe retained Craig Kunkel to calculate the costs to produce alfalfa for the feedlot. Mr. Kunkel holds a bachelor's degree in civil engineering and has spent his career focused on municipal engineering projects. [100120:39-40 AM (Kunkel)]. He estimated production costs for alfalfa grown on the Orabi Delta based on an irrigation infrastructure that would use twenty-one center pivots that would each irrigate approximately 132 acres from 21 wells, each of which would be drilled to a depth on 2,100 feet. [Hopi Exh. 3946 Appendix C, Hopi Exh. 4582 at 14–15; 093020:51 PM (Kunkel)] Mr. Kunkel concluded that the construction of the alfalfa farm on the Hopi Reservation would cost $36,385,874. Of that cost, $24,387,300 was attributed to well installation costs. [100120:17-18 AM (Kunkel); Hopi Exh. 3946 at 31 (PDF 35), Appendix C]

Mr. Kunkel estimated annual operating expense for an Orabi Delta farm at $2,327,035.[22] [Hopi Exh. 3946 at 32 (PDF 36); 093020:51 PM (Kunkel)]

Finding of Fact No. 273. Mr. Kunkel included no costs for labor associated with the planting, harvesting or maintenance of the fields. [Hopi Exh. 3946 at 32 (PDF 36)]

Finding of Fact No. 274. Mr. Kunkel included an annual cost for maintenance of equipment based on three percent of the capital costs in accordance with industry standards but he

[22] Operations and maintenance = 2812 acres x ($312 planting and harvesting + $428.56 well electric costs + $11.42 sprinkler costs + $40.47 maintenance) + $98,525 transport alfalfa from fields to feedlot.

limited the capital costs to the per acre costs for the sprinkler system, which were $1,348.85[23]. [Hopi Exh. 3946, Appendix C; Hopi Exh. 3913 at 6]

Mr. Kunkel included a total cost for fencing the alfalfa farm at Oraibi of $330 at $2.50 per acre. Mr. Kunkel included no costs associated the initial capital investments, most notably the installation of the well field, in his computation of the cost of ton of alfalfa. [Hopi Exh. 3946, Appendix C] Mr. Kunkel determined that the cost to produce a ton of alfalfa on the Orabi Delta would be $172. [100120:18-19 AM (Kunkel); Hopi Exh. 4582 at 22 (PDF 25)].

Finding of Fact No. 275. $172 is not a reasonable estimate of the cost to produce a ton of alfalfa on the Hopi Reservation using water pumped from the C Aquifer.

Peter Gallegos, retained by the LCR Coalition, testified about the cost to construct the infrastructure needed for an alfalfa farm on the Oraibi Delta on the Hopi Reservation. [121720:29 PM (Gallegos); LCRC Exh. 139; LCRC Exh. 468]. Mr. Gallegos is a private natural resources consultant who provides recommendations for irrigation projects, including planning, engineering, and installation. [121720:27 PM (Gallegos)] Mr. Gallegos also works for Robins Construction providing quotes and bids for irrigation infrastructure such as pumps, pipelines, reservoirs, and sprinklers. [121720:28 PM (Gallegos)] Mr. Gallegos testified that throughout his career he has personally worked on at least 400 center pivot systems. [121720:28 PM (Gallegos)]

Mr. Gallegos, like Mr. Kunkel, based the irrigation system on a center pivot system. [121720:29, 67 PM (Gallegos); LCRC Exh. 139 at 2] Mr. Gallegos concluded that Orabi Delta Farm would require 22 central pivot sprinkler systems that would each water 126 acres of land. [121720:30-31 PM (Gallegos); LCRC Exh. 139 at 3] He further concluded that each center pivot

[23] The per acre sprinkler system consists of the center pivots ($364.00), pumps ($757.58), and connecting equipment ($227.27). $1,348.85 x 0.03 = $40.47. Mr. Kunkel reported maintenance expenses based on capital costs at $40.47. [Hopi Exh. 3946 at 31 (PDF 35), Appendix C]

system would require 1,280 gallons of water per minute. [LCRC Exh. 139 at 3] Mr. Gallegos determined that due to the water demands of the system, two wells would be required to provide sufficient water for each of the 22 pivots. He estimated that the construction of the alfalfa farm on the Hopi Reservation would cost $63,367854 with annual operating expenses of $3,116,484.54. [LCRC Exh. 468]

Finding of Fact No. 276. Mr. Gallego's estimated annual operating expense included: planting and harvesting costs; labor; annual electrical costs; maintenance expenses equal to three percent of the cost of fencing for the farm ($876,799.44), sprinklers, pumps, and wells; and capital costs of the irrigation infrastructure.

The estimate includes no financing costs or interest on the capital required for well casings and equipment, which represents $51,097,200 of the total $63,367,854 capital expense. [LCRC Exh. 468] Mr. Gallegos concluded that the cost of alfalfa produced on the Hopi Reservation would be $459.82 per ton. [LCRC Exh. 468].

Finding of Fact No. 277. This cost for a ton of alfalfa exceeds the cost that Ms. Ciepiela-Kaelin represented would allow the operation to be economically feasible.

The Hopi challenges Mr. Gallegos' cost estimate focusing primarily on the number of wells he determined would be required for each pivot. Mr. Gallego relied on five factors to determine the correct number of wells:

- a conversion factor,
- the peak evaporation rate for alfalfa (d),
- the number of acres irrigated (A),
- the efficiency of the irrigation system (E), and
- the number of hours the system would operate each day (T)

[121720:31-32 PM (Gallegos); LCRC Exh. 139 at 3] The factors combine and produce the needed water supply in gallons per minute for each pivot system as shown in the following equation:

$$\frac{453dA}{ET} = \text{ Water supply (gallons per minute)}$$

Mr. Gallegos testified that he used a peak evaporation rate (d) of .37 based on the rate observed in Albuquerque, New Mexico, which has an elevation and latitude similar to the area of the Hopi Reservation. *Id*. He explained that he assumed a 75 percent system efficiency (E) because that was the value used by the Hopi Tribe's experts. [121720:32 PM (Gallegos)] Mr. Gallegos testified that in his experience, the wells should be expected to operate 22 hours a day (T) rather than 24 hours a day because an assumption of 24 hours would not allow for a well that breaks or a sprinkler that gets stuck. [121720:33-34 PM (Gallegos); LCRC Exh. 139 at 3 (PDF 3)]. Based on the foregoing, Mr. Gallegos concluded that each center pivot required 1,280 gallons per minute [122120:14 AM (Gallegos)].

$$\frac{453(.37)(126)}{.75(22)} = 1280\ gallons\ per\ minute$$

Brian Westfall, who holds a Master of Science in Agricultural and Irrigation Engineering, testified on behalf of the Hopi Tribe that he believed a more accurate assumptions would be an 80 percent system efficiency rather than a 75 percent efficiency which he characterized was "quite low for a new, well designed modern pivot. [101920:65-67 (Westfall); Hopi Exh. 4403 at 2] In his expert report, Mr. Westfall also challenged the assumed peak evaporation rate used by Mr. Gallegos stating that it should be 0.34 rather than 0.37 based on Mr. Westfall's analysis of weather data for the Orabi area. [Hopi Exh. 4403 at 2] Assuming that the assessments offered by Mr. Westfall are more reasonable, the substitution of those two values results in a needed supply of

1,103 gallons per minute.[24] Mr. Westfall also testified that he would estimate cost on the assumption that the system would operate 23 hours per day rather than 22 to "build in an hour of downtime because stuff always happens, sprinklers blow off, fuels flow out." [101920:67 (Westfall)]

Finding of Fact No. 278. In light of Mr. Gallegos' experience with the daily operations of many irrigation systems, the fact that the wells for this proposed farm are pumping water from more than 2,000 feet below the surface and the lack of any historical operational experience with an irrigation well on the Hopi Reservation drilled into the C Aquifer, it is reasonable to accept Mr. Gallegos' more conservative assessment about the amount of time that should be allowed for equipment malfunctions.

Mr. Blandford testified that it would be a reasonable expectation that the C Aquifer well production rate for the Oraibi Delta could be 1,055 gallons per minute. [093020:78-80 AM (Blandford); Hopi Exh. 4582 at 16 (PDF 19)] He based this opinion on two test wells constructed near Leupp that pumped at rates of 745 gallons per minute and 775 gallons per minute. He concluded that "higher rates of pumping are possible." [Hopi Exh. 4352 at 28 (PDF 31)] Mr. Blandford further opined that the "specific capacity of the Moenkopi C aquifer well indicates that pumping capacities greater than those of the C aquifer Leupp wells may be attainable." [*Id.*] Mr. Blandford completed his analysis, stating: "[I]f the full yield were not obtained from a single well, a supplemental well could service at least two, or more likely three pivots." [*Id.*] Mr. Gallegos testified that he would not recommend using fewer than two wells for each pivot to supply the necessary amount of water to keep the alfalfa appropriately irrigated. [121720:46-47 PM

[24] $\frac{453(.34)(126)}{.80(23)} = 1102.64 \; gallons \; per \; minute$

(Gallegos)] Mr. Gallegos also rejected the idea of splitting wells between center pivots because such a configuration would require a storage system or automated system to control the flows, making the system too complex and hard to manage. [*Id*.]

Finding of Fact No. 279. Mr. Gallegos provided a credible and well-reasoned analysis for his opinion that two wells would be needed to support each irrigation pivot.

Finding of Fact No. 280. Forty-four wells would be required to operate an irrigation system with 22 pivots on the Orabi Delta Farm to grow 2,800 acres of alfalfa.

The source of water to irrigate the proposed alfalfa fields presents another cost that must be considered in evaluating the cost of a ton of alfalfa. Both Mr. Kunkel and Ms. Ciepiela-Kaelin testified that if the water pumped from the C Aquifer required treatment before it could be used on the alfalfa fields, the cost per ton of alfalfa would significantly increase. [100120:25 AM (Kunkel); 102620:60-61 PM (Ciepiela-Kaelin)]. C Aquifer water with total dissolved solids of 3,600 milligrams per liter would need to be treated before it could be used for agricultural irrigation of crops. Water with such a high TDS content could significantly affects crop yields. [093020:75 AM (Blandford); 101920:15-16, 20-21 PM (Westfall); 121020:17-18 AM (Leeper)]

Finding of Fact No. 281. Neither Mr. Kunkel nor Mr. Gallegos included the cost of treating saline groundwater in their estimates of the costs of alfalfa production. [100120:22 AM (Kunkel); 121720:49 PM (Gallegos)]

Mr. Blandford evaluated the potential quality of C aquifer water pumped on the Hopi Reservation. [093020:65 AM (Blandford)] Mr. Blandford's best estimate, based on the evidence he reviewed in this case, is that the water pumped from all three C aquifer well fields on the Hopi Reservation would have total dissolved solids of roughly 3,600 milligrams per liter. [093020:65-66 AM (Blandford)]. The evidence reviewed by Mr. Blandford included academic papers authored by Cooley, Mann, and McGavock and Edmonds. [093020:66-68 AM (Blandford); LCRC Exh. 933; U.S. Exh. 1015; U.S. Exh. 1016; U.S. Exh. 1017; U.S. Exh. 1018; U.S. Exh. 1019] Mr. Blandford testified that it is his expectation that water pumped from the C Aquifer beneath the Oraibi Delta on the Hopi Reservation could only be used to grow alfalfa if the water quality is better than anticipated, or if treatment methods become more economical. [093020:74-75 AM (Blandford)]

Finding of Fact No. 282. It is not probable that water pumped from the C Aquifer underlying the Orabi Delta will be of adequate quality to irrigate alfalfa without additional treatment.

Mr. Westfall explained that it is typically not feasible to treat groundwater for irrigation because the cost is too high. He testified as follows:

> Q. It's possible for a source of groundwater to have so many dissolved solids that it needs to be treated in some fashion before it can be used for agriculture, right?
>
> A. I would say it's typically infeasible, economically infeasible, to treat water for irrigation. It's just - - maybe in the Mideast where they desalinate - - using desalination plants, but you, typically, do not treat irrigation water. It's just not done - -
>
> Q. It's just - -
>
> A. To my knowledge.
>
> Q. It's just way too expensive, right?
>
> A. Too expensive.
>
> Q. But you don't know whether the C aquifer water below the Hopi Reservation is so salient that it would require some sort of treatment, do you?

A. Again, I have no knowledge of that. If - - if it was, it wouldn't be probably feasible to use at the required treatment.

[101920:8-9 PM (Westfall)].

Dr. Leeper also concurred that treating highly saline water for use on the proposed alfalfa operation would be expensive and that, in his experience, it is not cost effective to treat water for use on alfalfa. [120920:18 AM (Leeper)].

Finding of Fact No. 283. The lack of good quality irrigation water in the C Aquifer for irrigation will substantially increase the cost of alfalfa grown on fields dependent on the C Aquifer as a source of water.

Finding of Fact No. 284. The cost to grow a ton of alfalfa on the Orabi Delta Farms will not be less than $400 per ton.

Ms. Ciepiela-Kaelin suggested that the Hopi should produce the alfalfa on the Hopi Reservation because it "would eliminate the cost of transporting feed." [Hopi Exh. 3912 at 20] This reason makes growing alfalfa for the feedlot economically feasible only if the difference between the cost to grow alfalfa on the Hopi Reservation is less than the sum of the cost to buy alfalfa from a location off the reservation plus the cost of transportation to the reservation. She also contends that the alfalfa farm should be created because it could protect Hopi ranchers from the risk of prohibitive alfalfa prices. [Hopi Exh. 3912 at 20, 27: 102620:29-30 AM (Ciepiela-Kaelin).

Finding of Fact No. 285. Ms. Ciepiela-Kaelin provided no projection or estimate of the future price of alfalfa for the cattle feedlot. [102620:126 AM (Ciepiela-Kaelin)]

Alfalfa is a warm season crop – the lower the elevation, the warmer it is, the longer the growing season, the more alfalfa will be grown. [011921:111 AM (Hauser)] The economics of alfalfa production change depending on the region in which it is grown. Alfalfa is primarily grown in southern Arizona. In 2017, 95 percent of the alfalfa grown in Arizona was grown in Maricopa, Pima, Pinal, Cochise, Yuma, La Paz, Santa Cruz, and Greenlee Counties with the remaining five percent grown in Mohave, Coconino, Yavapai, Gila, Navajo, and Apache Counties. [LCRC Exh. 856 at 30 (PDF 33)] During the period 2005 through 2018, the cost of alfalfa has averaged $171 per ton. As shown in *figure 7*, the price has varied between a high of $225 a ton to a low of $121 a ton. [LCRC Exh. 344 at 12 (PDF 14), 345 at 14, 346 at 12 (PDF 14), 347 at 11 (PDF 14), 349 at 17] Mr. Kunkel concluded that it would be less expensive to grow the needed alfalfa on Hopi land in southern Arizona using surface water and pay to transport that alfalfa to the reservation than to grow all of the alfalfa on the Hopi Reservation. [Hopi Exh. 3946 at 31 (PDF 35)]

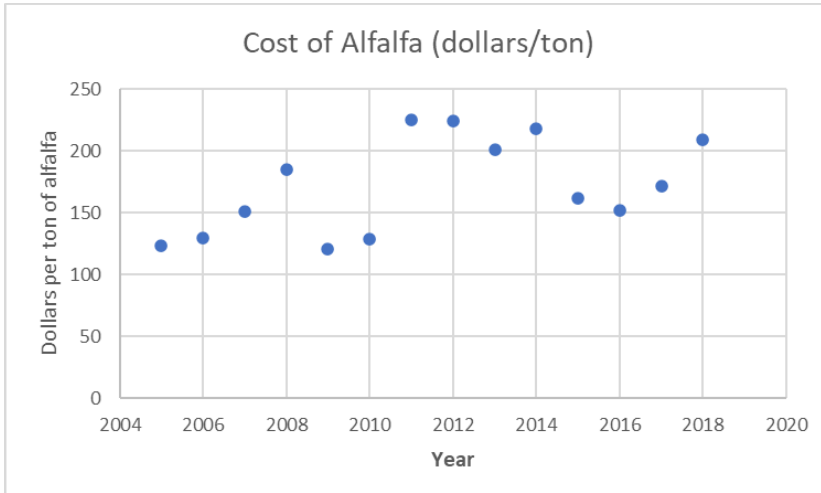

Figure 7. The cost of a ton of alfalfa 2005-2018.

Two ranchers operating in areas surrounding the Hopi Reservation testified that despite the transportation costs, it is less expensive to buy alfalfa from southern Arizona rather than grow alfalfa on their land in Northern Arizona. Mr. Brophy, who farms 3,000 to 3,500 acres in Navajo County at Dry Lake, no longer grows alfalfa on Dry Lake because it does not make economic sense. [121620:77-79 PM (Brophy)] When alfalfa was grown at Mr. Brophy's farm at Dry Lake in Navajo County, the farm produced three to four cuttings per year, with a yield of roughly one ton per acre per cutting. [121620:78 PM (Brophy)] Mr. Brophy buys alfalfa from southern Arizona to feed to his cattle on his rangeland at Dry Lake. [121620:81 PM (Brophy)] Mr. Brophy testified that his most recent delivery of alfalfa cost $160 per ton delivered from Dateland, which is located in Yuma County west of Gila Bend, approximately 450 miles from Dry Lake. [121620:81-82 PM (Brophy)] Mr. Brophy testified that it makes more sense to grow feed in southern Arizona, where there is a longer growing season and cheap water, and haul it to northern Arizona, than to fight the growing conditions in northern Arizona. [121720:9 PM (Brophy)]

Similarly, Robert Prosser testified that that he does not grow alfalfa at Hay Lake in northern Arizona because at that elevation the growing season is short, and he was only getting two cuttings per year. [012021:35 PM (Robert Prosser)] Mr. Prosser buys his alfalfa from a farm located between Buckeye and Maricopa. [012021:35-36 PM (Robert Prosser)] Mr. Prosser testified that he can buy alfalfa hay cheaper than he can raise it at Hay Lake located at an elevation of 7,000 feet. [012021:31-32 PM (B. Prosser)]

The Hopi Tribe counters by arguing that alfalfa is grown throughout the Little Colorado River Basin for both commercial and personal use implying that it would be an economically viable crop on the Hopi Reservation. [Hopi FOF No. 1298] As shown in Table 18, none of the witnesses identified by the Hopi Tribe use groundwater that must be pumped thousands of feet to the surface to irrigate the alfalfa.

Witness	Location of Alfalfa Field	Source of Water
Ramsey	St. Johns	Surface water [011221:43AM (Ramsey)]
Westover	Winslow, AZ	Treated effluent [011221:45 (Westover)]
Peters	Taylor, AZ	Treated effluent [011421:39 (Peters)]
Hauser	Hauser Farms	Surface water from Little Colorado River [011921:79 AM (Hauser)]
Richards	Snowflake, AZ	Surface water from Silver Creek [011921:79 AM (Hauser)]
Harrison	Holbrook, AZ	Treated effluent [LCRC Exh. 1474 at 35]
Whiting	Springerville,	Treated efflued [LCRC Exh. 1474 at 35]

Table 18

The proposed use of alfalfa as the primary feed for the feedlot would create additional costs because it increases the amount of time that the animals would be required to be held in the feedlot prior to sale. A diet of alfalfa, or primarily alfalfa, is not typically given to animals in feedlots because it does not cause the animal to reach slaughter weight within the amount of time to realize the best price for the animal. The expected rate of gain in a feedlot is three pounds per head per day. [121620:91 PM (Brophy)] To achieve that goal, the typical feed ration for cattle in a feedlot is 80 to 82 percent corn or another high-energy grain, 12 to 15 percent alfalfa hay, and the remining balance consists of micronutrients. [121620:89 PM (Brophy); 122220:32 AM (Crosby); 012021:20-21 PM (Robert Prosser)] The most common term used to evaluate the nutritional quality of feedstuffs for cattle is total digestible nutrients (TDN). [121620:89-90 PM (Brophy)] Corn has an average TDN of 92 percent. [*Id.*] The TDN for alfalfa is roughly 55 percent, meaning that 55 percent of its weight is digestible nutrient available to the animals. [*Id.*]

Mr. Brophy testified that feedlots use a mix of feed instead of 100 percent alfalfa. A typical mix of feed will cause the desired weight gain of approximately three pounds per head per day whereas a 100 percent alfalfa ration would produce 1.5 to two pounds per head per day. [121620:91 PM (Brophy); 012021:21 PM (B. Prosser)] Mr. Crosby testified that feeding cattle solely alfalfa would be like a person trying to get fat on a diet limited to asparagus. [122220:32-33 AM (Crosby)] Thus, the decision to run a feedlot primarily dependent on alfalfa increases the costs associated with each animal because a greater amount of an expensive feed is used to achieve the necessary weight gain. Slow weight gain could also reduce the price ultimately realized on sale of an animal when it finally reached slaughter weight. Older animals can be discounted heavily in the market. [122220:32-33 AM (Crosby)] Animals over 30 months are discounted because they are not eligible for export to some major foreign markets. [122220:43-44 PM (Crosby)] Ms. Ciepiela-Kaelin agreed at trial that a 100 percent alfalfa diet is not a realistic assumption. [102620:51 PM (Ciepiela-Kaelin)]

Finding of Fact No. 286. A finishing feedlot could not operate economically based on a 100 percent alfalfa feed ration.

Finding of Fact No. 287. It is not reasonable to assume that alfalfa grown on the Hopi Reservation could be used as the exclusive or primary source of food in a feedlot operation.

Ms. Ciepiela-Kaelin also suggested that alfalfa grown on the Hopi Reservation could be sold to "procure lower cost, protein-rich ingredients necessary for a feedlot finishing ration." [Hopi Exh. 3912 at 20] She included no discussion of the alternative ration ingredients, their costs, the costs of transporting those ingredients, or the available market for alfalfa grown on the Hopi Reservation. The itemization of future costs included in Ms. Ciepiela-Kaelin's report does not itemize costs for any feed other than alfalfa. [Hopi Exh. 3912 at 45; *see also* Hopi Exh. 3912, Appendix 3, Appendix 4]

Finding of Fact No. 288. Alfalfa is the only cost for cattle feed that Ms. Ciepiela-Kaelin included in her analysis of the feedlot operation.

The Hopi Tribe subsequently explained that it does not propose a 100 percent alfalfa diet for the animals in the feedlot operation notwithstanding its claim for federal reserved water rights to 12,008 acre-feet of groundwater per year to produce enough alfalfa to feed the animals in the feedlot. United States and Hopi Joint Response to Salt River Project's Proposed Finding of Fact at 174, Hopi FOF No. 1263. The Hopi Tribe argues that it is appropriate to make a claim for water to grow feed based on alfalfa crop peak evapotranspiration rate because a water right based on that rate would allow farming of corn, grains, and other crops. [Hopi FOF No. 1283] The Hopi Tribe's strategy to claim water based on a crop that it does not intend to grow either in whole, or in part, leaves a dearth of evidence upon which to base a decision. No expert report in this case involved a project growing grain, oats, barley, or rye on the Oraibi Delta. [122120:10 AM (Gallegos)] No expert report in this case evaluated growing any crop other than alfalfa in the Oraibi Delta. [*Id*.] No expert report in this case evaluated how much land would be needed to grow grain necessary for a feedlot. [122120:10 AM (Gallegos)] No expert report in this case evaluated the economics of growing grain. [122120:10 AM (Gallegos)]

Finding of Fact No. 289. The Hopi Tribe based its claims on and relied on the use of alfalfa as the source of feed to be used in the feedlot. Insufficient evidence was introduced to permit an evaluation of the economic feasibility of a feedlot reliant on a different type of feed.

Finding of Fact No. 290. The proposed on-reservation feedlot operation dependent on alfalfa grown on the Hopi Reservation would not be feasible, practical, or provide economic benefits to the Hopi Tribe.

Finding of Fact No. 291. Ms. Ciepiela-Kaelin's quantification approach for the proposed feedlot and alfalfa farm is unreliable and cannot be used as a basis for a decreed water right.

Finally, Ms. Ciepiela-Kaelin argued that the Hopi Tribe "is responsible for the economic, social, and environmental well-being of its people and land" and that profitability should not be the sole criteria to evaluate the feasibility of the proposed project. [Hopi Exh. 3913 at 3; 102620:27 AM (Ciepiela-Kaelin)] Other than opining that the feedlot will generate four and one-half full-time equivalent jobs and that profits may be realized from a commercial feedlot and the sale of alfalfa, Ms. Ciepiela-Kaelin offers no other economic, social, or environmental benefits from an operation that entails the feeding and watering of more than 6,000 animals, that will need tens of millions of dollars in capital investments, and will require the Hopi Tribe to pump more than 12,000 acre-feet of groundwater from beneath the reservation each year. In fact, if the feedlot were to operate at "breakeven," meaning that the costs of the animals equaled the sales price received, the Hopi ranchers who participated in the feedlot operation would suffer economic hardship. Currently, Hopi ranchers sell their calves once the animals are approximately six months old. Ms. Ciepiela-Kaelin recognized that these animals "represent stores of value and liquidity for Hopi Stockmen that contribute to managing short- to medium-term cash flow for Hopi families." [Exh. 3912 at 20] Retention of the animals through the feedlot process would eliminate the liquidity inherent in the cow-calf operation until the animals could be sold at a later date assuming that the animals could still generate the same amount of profit after being fed with alfalfa until they reached the necessary slaughter weight.

Finding of Fact No. 292. 12,005 acre-feet of groundwater to irrigate alfalfa for cattle feed is not necessary to make the Hopi Reservation a permanent homeland nor is it tailored to the minimal needs of the reservation.

IX. Water for Development of Coal Resources

Pursuant to *Gila V*, the natural resources, history, and economic base of a reservation must be considered in the adjudication of a claimed federal reserved water right for a proposed use. Coal is one of the primary natural resources on the reservation available to the Hopi Tribe. An estimated 21.3 billion tons of coal exist within the Black Mesa Basin, which lies entirely within the Navajo and Hopi Reservations. [LCRC Exh. 515 at 21 (PDF 25); 091718:36 AM (Banet); Hopi Exh. 62 at 6 (PDF 10)] "[A]bout 980 million tons within the Wepo and Dakota Formations are considered economically recoverable by conventional mining techniques." [Hopi Exh. 62 at 6 (PDF 10)] That relatively extractable coal has a low sulfur and ash content and has a very high average energy content as measured in British Thermal Units, or BTUs, of around 21 to 22 million per ton. [101420:34-36 AM (Horner); 101320:77 PM (Luneke); *see also* LCRC Exh. 515 at 21-22 (PDF 25–26); U.S. Exh. 1445 at 2 (PDF 4)] The remaining coal deposits that have been located and quantified are described as "potential resources." [Hopi Exh. 62 at 6 (PDF 10)]

The Hopi Tribe has a past history, discussed in Section VI and in part A of this Section, demonstrating the Hopi Tribe's willingness to use its coal resources, along with groundwater, to generate revenue for the Hopi Tribe. Coal revenue has supported tribal programs, jobs, and educational opportunities. Over the past decades, coal has served as the primary source of revenue for the Hopi Tribe, which in turn, has provided jobs and opportunities for people living on the reservation. [Hopi 4277 at 6 (PDF 19)] Annual revenues for 2001 to 2008 along with the amount of water pumped to support the PWCC mining operation are shown in Table 19.

Year	Annual Payment	Groundwater Pumped (acre-feet)
2001	$15,100,000	4,530
2002	$13,900,000	4,640
2003	$13,600,000	4,450
2004	$16,200,000	4,370
2005	$17,800,000	4,480
2006	$24,400,000	1,200
2008	$10,900,000	1,170

Table 19
Source. Hopi Exh. 4277 at 8 (PDF 21); Hopi Exh. 1372 at (PDF13)

The closure of the generating stations that provided the market for coal mined on the Navajo and Hopi Reservations has created economic difficulties for the Hopi Tribe, as discussed in Section VI, due to the loss of payments from PWCC and loss of jobs. The Chairman of the Hopi Tribe testified the the closure of the Navajo Generating Station has created an "existential economic crisis for the Hopi Tribe." [120320:28-31 AM (Nuvangyaoma)] As the State Demographer, Dr. Chang testified: "I know a lot of people are working very hard to help the tribe to try to replace these jobs, but these are large numbers. And trying to rebuild an economy and bringing new jobs, that's a very noble cause, and I, you know, I wish them every success. But this is a monumental job. This is hard." [21021:23 AM (Chang)] The Hopi Tribe intends to continue to seek alternative ways to utilize its coal resources. [Hopi Exh. 4467 at 93]

Coal mining is the basis of the claim made by the United States, on behalf of the Hopi Tribe, to federal reserved water rights for 1,462 acre-feet of groundwater per year. This amount represents the maximum historical water use by PWCC in a single year multiplied by 30.84 percent which is the percentage of the land leased by PWCC from the Hopi Tribe. U.S. FOF ¶1230. The Hopi Tribe claims that it is entitled to 2,367 acre-feet per year, which is one-half of the maximum historical water use by PWCC in single year, based on the terms of its lease with PWCC. Hopi

FOF ¶1010. In the alternative, the Hopi Tribe claims that its historical use should be quantified at 1,056.1 acre-feet annually based on a formula that relates water use to its share of income from PWCC's coal sales over the period 1970 to 2018. *Id.* at ¶1011 [Hopi Exh. 3907]

With respect to the future, federal reserved rights to groundwater are claimed to develop three coal projects. The determination of whether the proposed future coal operations meet the *Gila V* feasibility standard that they are practically achievable and economically sound should be undertaken with the recognition that the relevant time frame is decades not years. The projects must also be evaluated to determine whether the amounts of water claimed are both necessary to accomplish the homeland purpose and are tailored to the minimal need of the reservation.

The three proposed heavy industrial future uses of coal are as follows:

Project	**Quantity of Water Claimed**	**Claimant**
1800-megawatt supercritical pulverized coal-fired, dry cooled electrical power generation plant and supporting surface coal mine	6,500 acre-feet annually	United States Hopi Tribe
Coal liquefaction/gasification facility	20,600 acre-feet annually	Hopi Tribe
Hybrid coal-fired and solar electrical power generation plant		Hopi Tribe
600-MW plant	2,300 acre-feet annually	Hopi Tribe
1800-MW plant	6,320 acre-feet annually	Hopi Tribe
1500-MW plant	4,900 acre-feet annually	Hopi Tribe

A. Coal Mining

Since at least the thirteenth century, the Hopi Tribe has used Black Mesa coal for domestic fuel and for firing pottery. Total early coal production is estimated to have exceeded 100,000 tons mined from shallow trenches. [Hopi Exh. 62 at 6 (PDF 10); U.S. Exh. 128 at 18 (confirming that the Hopi mined small quantities of coal for their own use since the thirteenth century and continued to dig it in limited quantities from exposed seams)] Hopi pottery was fired using coal mined from rich seams exposed near pottery-producing villages. [Hopi Exh. 3872 at 98 (PDF 103)] Coal was also used for heating the homes, as evidenced by the presence of coal residues throughout the rooms excavated by the Peabody Museum at Awat'ovi in the 1930s. [Hopi Exh. 3872 at 103] People living on the Hopi Reservation continue to use coal to heat their homes. [101018:8 PM (Selestewa); *see also* Hopi Exh. 1279 at 9 (PDF 13)]

Finding of Fact No. 293. The Hopi Tribe has used the coal resources on the land included in the reservation for hundreds of years for domestic purposes, predating the 1882 Reservation.

Finding of Fact No. 294. No claim for a federal reserved water right was made for water to mine coal to meet the domestic needs on the reservation and no evidence was introduced to establish the amount of water needed to mine coal for the domestic use of heating homes.

Finding of Fact No. 295. Other than very limited personal use of coal to heat homes, the role of coal on the reservation is to provide a source of revenue.

In 1964, PWCC leased federally reserved land on Black Mesa to mine coal from the Wepo Formation. [NN Exh. 611; NN Exh. 613; U.S. Exh. 830 at 3 (PDF 7)] PWCC did not begin pumping water from the leased land until 1968. [U.S. Exh. 845 at PDF 4] The leases between

PWCC and the Hopi Tribe and the Navajo Nation cover 64,858 acres and permit PWCC to mine the coal reserves located on the Navajo and Hopi Reservations at the Black Mesa Mine and the Kayenta Mine. [091718:37, 40-41 AM (Banet)]

The mining operation covered three separate areas of land on the Navajo and Hopi Reservations. Each area is the subject of a separate lease that required the approval of the federal government. [091718:40-41 AM (Banet), U.S. Exh. 751; NN Exhs. 607, 608, 609] One mining lease, lease number ending in 8580, exists between PWCC and the Navajo Nation for 24,858 acres. [U.S. Exh. 753] The Navajo Nation has the exclusive interest to the coal mined from that site. [*Id.*] Two separate leases to mine coal exist between: (1) PWCC and the Navajo Nation, lease number ending in 9910, for 33,863 acres of land on the Navajo Reservation; and (2) PWCC and the Hopi Tribe, lease number ending in 5743, for 6,137 acres of land on the Hopi Reservation. [091718:40 AM (Banet); U.S. Exh. 753] The Navajo Nation and the Hopi Tribe own undivided one-half interests in the coal mined from the land subject to lease numbers 9910 and 5743. [U.S. Exh. 753] Revenues have been generated from the coal mined by PWCC from land leased under leases ending in 8580 and 9910. [Hopi Exh. 3907]

Finding of Fact No. 296. PWCC separately negotiated lease terms with each tribe. PWCC agreed to make payments to the Navajo Nation and the Hopi Tribe based on the acreage leased, the amount of water pumped, and the amount of coal and uranium sold. [NN Exhs. 607-610]

Finding of Fact No. 297. The leases authorize PWCC to drill wells on the property leased from the Hopi Tribe and Navajo Nation and pump water from the N and D Aquifers beneath those lands. [091718:49-50 (Banet); 110818:39 (Zaman)]

Finding of Fact No. 298. The rates paid by PWCC to the Navajo Nation and the Hopi Tribe for pumped groundwater have not always been the same. [091818:24, 27 PM (Banet)] Between 1987 and 2015, PWCC paid the Navajo Nation and Hopi Tribe equal amounts for each acre-foot of water pumped from the well field. [091818:28 AM (Banet); *see also* 091718:57 AM (Banet)]

Finding of Fact No. 299. The amounts and criteria used to determine payments from PWCC pursuant to the leases have been amended over the lease term. [*Id.*]

Conclusion of Law No. 67. No reasonable basis exists to use the terms of the leases to allocate past water usage between two lessees to quantify federal reserved water rights.

Finding of Fact No. 300. PWCC drilled seven wells on the Navajo Reservation that were first put into use during the period 1968 through 1980. [U.S. Exh. 757; U.S. Exh. 831 at 3] PWCC completed the well field by drilling a well on the Hopi Reservation, labelled as PCWW 9, which was put into use in 1983. [U.S. Exh. 845 at 4; NN FOF ¶143]

Finding of Fact No. 301. The wells have formed cones of depression that intersect with each other and lead to mutual drawdown at each location in accordance with pumping rates and other hydrogeological factors. [091318:75 PM (Blandford)]

Finding of Fact No. 302. PWCC did not pump uniform amounts from each well. The choice made by PWCC about which well to pump and the amount of water pumped varied from month to month and has varied over the years. [091718:41,53 AM (Banet); 110818:89 (Zaman); U.S. Exh. 845 at 4] The wells were used interchangeably by PWCC to supply water for mining operations on any place within the combined leasehold. [091718: 53 AM (Banet); 110818:42 (Zaman)]

Finding of Fact No. 303. The water withdrawn from these wells has been used to create a coal slurry for purposes of transport, for drinking, sanitation, dust suppression, fire suppression, road reclamation, coal preparation, blasting, and watering of reclaimed areas. [091718:44, 52 (Banet)]

Finding of Fact No. 304. Approximately 75 percent of the groundwater pumped each year until 2005 was used to transport the mined coal to the Mohave Generating Station through the slurry line. [110818:46 (Zaman)] More technically, the water was mixed with pulverized coal to create a coal slurry that was pumped through a pipeline crossing the Hopi Reservation to the Mohave Generating Station. [091718:33, 091818:12 (Banet); 110818:46 (Zaman)]

Finding of Fact No. 305. According to a published report from the United States Geological Survey ("USGS"), which monitored the withdrawals from these wells, PWCC pumped an average of 3,634 acre-feet of groundwater per year during the 1968 – 2005 time period. [Hopi Exh. 1372 at 5 (PDF 13)]

Finding of Fact No. 306. The single highest annual withdrawal of groundwater by PWCC occurred in 1982 when the slurry line was in operation. PWCC pumped 4,740 acre-feet of groundwater from the well field in that year. [Hopi Exh. 1372 at 5 (PDF 13); 091718:7 (Banet); U.S. Exh. 845 at 4-6]

Finding of Fact No. 307. The slurry pipeline has not been used since 2005. [101018:25 AM (Pavinyama)] Neither the Hopi Tribe nor the United States propose future heavy industrial uses that involve the use of a slurry line.

Finding of Fact No. 308. For the period 2006-2011, after the closure of the coal slurry line to the Mohave Generating Station, PWCC pumped the following amounts (in acre-feet) in each year: 1,200, 1,170, 1,210, 1,390, 1,170, and 1,390. [101018:25 PM (Pavinyama); Hopi Exh.

1372 at 5 (PDF 13)] The maximum amount pumped in one year was 1,390 acre-feet and the average amount pumped each year was 1,244 acre-feet of groundwater.

Finding of Fact No. 309. The Hopi Tribe has a 50-year history of leasing land to a third party and permitting the mining of coal on the reservation for commercial sales. [101320:41 PM (Luenke)]

Conclusion of Law No. 68. Commercial coal mining and coal transport undertaken by PWCC does not constitute an aboriginal use of coal or a modern expression of an aboriginal use of coal by the Hopi Tribe prior to the creation of the 1882 Reservation.

The total amount of groundwater pumped during the heavy industrial mining operations by PWCC or its predecessor-in-interest is known. The USGS monitored and recorded the amounts of groundwater PWCC pumped each year for its mining operations. PWCC, at its discretion, pumped groundwater stored under both reservations and used the water in its mining operations. PWCC controlled the well field that spanned both reservations, controlled the pumping of the wells, and controlled the use of the pumped water in the mining operations. Water from the Hopi Reservation was used in mining operations on land in both reservations, in the slurry pipeline to transport coal across the Hopi and Navajo Reservations, in mines in which the Hopi Tribe had an undivided 50 percent interest in the coal, and in mine operations where the Hopi Tribe had no interest in the coal. Similarly, water pumped from the Navajo Reservation was used on both reservations, in the slurry pipeline, and in the mines in which the Navajo Nation had an undivided 50 percent interest in the coal and in mine operations in which it had a 100 percent interest in the coal.

According to the methodology urged by the United States, the parties' relative interests in the acreage leased to PWCC should be used as a proxy to allocate the groundwater for mining purposes. PWCC leased a total of 64,858 acres in which the Hopi Tribe holds an undivided one-half mineral interest in 40,000 acres. The United States calculated that the Hopi Tribe's past and present use equaled 30.84 percent ((0.5 x 40,000)/64,858) x 100) of the maximum amount of 4,740 acre-feet of groundwater withdrawn in 1982. [Hopi Exh. 1372 at 5 (PDF 13)] It claims that the Hopi Tribe should be allocated a past use of 1,461.82 acre-feet of water per year for mining based on the year of maximum pumping.   The United States' formula has the advantage of preventing the sum of the amounts allocated to each reservation from exceeding the maximum amount pumped during any one-year period. Its formula has the disadvantage of relying on a historic method to transport coal that is no longer in operation.

Conclusion of Law No. 69: The maximum use of water caused by PWCC's decision to transport coal by a slurry line that is no longer operational does not evidence a baseline minimal need for water on the reservation necessary to make it a permanent homeland.

The Navajo Nation proposes two methods, both of which, like the United States rely on a single year of maximum use. The Navajo Nation argues that the Hopi Tribe's federal reserved water rights should be quantified at 749 acre-feet of water because that amount is the maximum amount of water pumped from the well that PWCC located on the Hopi Reservation. Navajo Nation's Objections to Draft Report of the Special Master on Past and Present Water Uses on the Hopi Reservation at 17 (September 30, 2019) ("Navajo Objections").   The Navajo Nation further asserts that the same formula should be applied to it, entitling the Navajo Nation to receive federal reserved water rights to groundwater equal to the maximum amount pumped from the wells located on the Navajo Reservation in a single year. *Id.* at 19, fn. 27. The greatest amount pumped by the wells on the Navajo Reservation occurred in 1982 because the well on the Hopi Reservation was not operational in 1982. [U. S. Exh. 845 at 4]

Finding of Fact No. 310. The Navajo Nation's method would result in the quantification of federal reserved water rights for the United States in an amount that exceeds the amount of groundwater used for heavy industrial mining purposes in any single year.

Conclusion of Law No. 70. A legal fiction will not be devised to find an amount of water used in a given time period that is greater than the amount of water actually pumped in that defined time period.

Conclusion of Law No. 71. Quantification of a federal reserved water right in excess of the amount demonstrably necessary to mine coal to support a permanent homeland violates the *Winters* doctrine.

Alternatively, the Navajo Nation proposed a methodology to allocate the pumped groundwater between the two parties based on coal production and coal sales. [110818:44 (Zaman)] Coal sales that attribute mined coal to each lessee serve as a better proxy for the water pumped to mine the coal than general leasehold interests. The Navajo Nation again used a single year to apply this methodology. Akhtar Zaman testified that in 1982 a total of 12,567,890 tons of coal were produced in which the Hopi Tribe had a 50 percent interest in 3,073,842 tons of coal. [110818:35 (Zaman)] The application of this method based on the 1982 data results in an allocation of 12.2 percent, as compared to the 30.8 percent proposed by the United States, of the groundwater pumped to the Hopi Tribe.[25] Under this method, the Hopi Tribe would be allocated 580 acre feet of groundwater for coal mining operations.

In response, the Hopi Tribe prepared a schedule that identified the amount of coal sold by PWCC during the time period 1972-2011 and calculated the percentage attributable to the Hopi Tribe's interest in the coal sales in each year. [Hopi Exh. 3907] Because the amount pumped for

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[25] $\frac{3{,}073{,}842 \text{ x } .5}{12{,}567{,}890} = 0.122$

each year is known, an allocation of the pumped groundwater can be calculated for each year by multiplying the percentage of coal sales attributable to the Hopi Tribe by the amount of the groundwater pumped by PWCC for that year. The formula can be applied to each year during the time period 1972-2011 to create a complete data set. The most appropriate statistic is the median use over the time period so that the result is not skewed by the years the slurry line was in operation.

Finding of Fact No. 311. The median annual amount of groundwater needed to mine the coal in which the Hopi Tribe had an undivided 50 percent interest during 1972-2011 was 1,056.1 acre-feet.

The Navajo Nation objects to the expansion of its proposed method from the year of maximum coal production and revenues to the entire period of record. It argues that adoption of the Hopi Tribe's additional data was an erroneous use of its method to derive the maximum use for the Hopi Tribe. The method was not adopted to compute a maximum amount. PWCC's decision to pump 4,740 acre-feet of groundwater forty years ago does not quantify an annual federal reserved water right to groundwater for mining purposes. No standard adopted by any federal court to quantify a federal reserved water right could reasonably be interpreted to countenance an annual amount equal to a maximum use from a record of water use spanning almost 50 years without further support for such a quantity. The method was adopted to assess the historic amounts necessary to mine coal in which the Hopi Tribe had an undivided 50 percent interest for the purposes of quantifying federal reserved water rights for heavy industrial operations on the Hopi Reservation in accordance with *Gila V*.

The Navajo Nation also objects to the above quantity because the Hopi Tribe has no claim to groundwater pumped from the wells on the Navajo Reservation because, under state law, a landowner does not own groundwater until the groundwater is actually captured. *Town of Chino*

Valley v. City of Prescott, 131 Ariz. 78, 638 P.2d 1324 (1981). A landowner's usufructuary right to groundwater arises once the landowner withdraws the groundwater from the common supply. Town of Chino Valley, 131 Ariz. at 82, 638 P.2d at 1328. Assuming that state law governing ownership of groundwater applies to claims for federal reserved water rights, then the Navajo Nation's proposed formula based on the water pumped in 1982 cannot be accepted. No water was pumped from a well on the Hopi Reservation in 1982 meaning that the Hopi Tribe had no beneficial ownership in any water pumped by PWCC in that year under state law. [U.S. Exh. 845 at 4] Given that water was pumped for decades from the Hopi Reservation, it is clear that if a formula is to be adopted to allocate groundwater pumped by PWCC, that formula cannot be used to adjudicate no water to the Hopi Tribe and all of the water to the Navajo Nation. The highest year of pumping from wells on both reservations occurred in 2002 when PWCC pumped 4,645 acre-feet. [*Id.*] In 2002, the Hopi Tribe was entitled to 28.02 percent of the revenues. [Hopi Exh. 3907] Using these numbers, the Hopi Tribe would be allocated 1,302 acre-feet of water for purposes of quantifying its federal reserved water rights.

As demonstrated by the formulas focusing on a single data point from dozens of established data points, the historic amounts should be based on an assessment of the entire record in the absence of a compelling reason to focus on a single maximum point. In this case, no compelling reason exists. The operation of the slurry line drove the large quantities of pumped groundwater. Once the slurry line ceased operations, the quantity of groundwater fell to 1,200 acre-feet on average each year, as large amounts of groundwater were no longer needed for the mining operations.

Finding of Fact No. 312. The median amount of water pumped by PWCC for the mining operations attributable to the revenue received by the Hopi Tribe was 1,056.1 acre-feet annually.

Finding of Fact No. 313. 1,056.1 acre-feet annually of groundwater from the N and D Aquifers is the amount necessary for mining operations to mine coal in which the Hopi Tribe has a mineral interest to generate revenues required to support a permanent homeland.

Finding of Fact No. 314. Mining coal on the Hopi Reservation on the land leased to Peabody Coal is practically achievable and economically sound.

Salt River Project, the LCR Coalition, and the Arizona State Land Department, support federal reserved water rights for the Hopi Reservation to mine coal in the amount of 1,056.1 acre-feet. LCRC Consolidated Response Brief at 47 (August 14, 2021); The City of Flagstaff supports 1,056.1 acre-feet of water for past use subsumed into future economic development.

B. Coal-Fired Power Plant

The United States claims federal reserved water rights to pump water from the N Aquifer to mine coal and operate an 1800-MW supercritical pulverized coal-fired, dry-cooled electrical power generation plant ("Coal-Fired Power Plant"). [U.S. 6th Amended SOC at 14; U.S. Exh. 878 at 2 (PDF 6)] The mine and the Coal-Fired Power Plant would be constructed in the northeastern corner of the Hopi Reservation. [U.S. Exh. 878, figure 1-2] The water demand for the Coal-Fired Power Plant consists of 6,000 acre-feet annually to operate the electrical power plant and 500 acre-feet annually to mine the needed coal. [092320:81-82 AM (Bass)]. The purpose of the Coal-Fired Power Plant is to generate revenue for the Hopi Tribe from selling the electric power onto the western power grid. [092320:95 PM (Bass)] The Hopi Tribe supports the United

States' claim for federal reserved water rights for a Coal-Fired Power Plant. The Hopi Tribe's Sixth Amended Statement of Claimant at 37; The Hopi Tribe's Seventh Amended Statement of Claimant 41; The Hopi Tribe's Eighth Amended Statement of Claimant at 42

The United States presented evidence of the availability of the water supply for the Coal-Fired Power Plant. Mr. Ward, the United States' expert hydrogeologist, used a groundwater model of the N Aquifer to develop his opinion about the availability of groundwater to support a well field for the Coal-Fired Power Plant. He modified the groundwater model so that characteristics of groundwater flow could be more precisely represented in the proposed location of the wells by reducing the area represented by each set of equations from one mile to an eighth of a mile. [092220:15 AM (Ward)] Mr. Ward testified that he made this change to "facilitate placement of individual wells." [*Id.*] Mr. Ward concluded that the N Aquifer could meet the water demand of the Coal-Fired Power Plant for its expected 40-year lifespan, recommended the development of a well field that included eight wells, and calculated the costs of the well field. [092220:16-17 AM (Ward)] No other party submitted an expert report or offered testimony in opposition to Mr. Ward's opinion regarding whether there is an adequate water supply for the Coal-Fired Power Plant. [092220:20 AM (Ward)]

Finding of Fact No. 315. The N Aquifer on the Hopi Reservation can supply sufficient water from an 8-well well field to operate a Coal-Fired Power Plant.

The United States also presented evidence about the transmission lines necessary to carry the electricity from the Hopi Reservation to market. The Navajo Nation argues that the Coal-Fired Power Plant, as well as other generating plants, is not viable because of the Hopi Tribe's need to access or build transmission lines to connect the plant to future customers. The transmission lines will cross land included within the boundaries of the Navajo Reservation because the Navajo

Reservation completely surrounds the Hopi Reservation. The Navajo Nation contends that no electrical transmission line for the proposed project can be built on the Navajo Reservation without its consent. NN FOF 148, 149, NN COL 52. The siting process for transmission lines for this or any other project that generates electricity will undoubtedly involve discussions with many landowners, including the Navajo Nation. Those discussions will involve negotiations, settlements, and potentially litigation. If the Navajo Nation and the Hopi Tribe cannot reach an agreement about a utility easement in the future, the Navajo Nation can test its legal theories in the appropriate forum to resolve that dispute. This case is an adjudication of water rights; it is not the appropriate forum to resolve a future property rights issue in the abstract.

In 2009, the Hopi Tribe retained a consulting firm to determine the best use of the Hopi Tribe's coal resources. [Hopi FOF 1014] The consulting firm concluded that a coal-fired power plant provided the highest use of coal and greatest benefits to the Hopi Tribe under then existing market conditions. [Hopi FOF 1016-1017] The 2008 market conditions were favorable for coal due to high oil and natural gas prices. At that time, oil prices and natural gas prices were at record levels of $99.3 per barrel and $8.89 per MMBtu. [LCRC Exh. 515 at 42 (PDF 46)] The consultant stated that Hopi coal could be delivered to the power plant at a cost that was 92 percent less than natural gas fuel, which the consultant explained was important "because coal power plant capital and environmental costs are higher than those for natural gas power plants and coal plants are attractive only where there is sufficient fuel cost savings to offset these disadvantages." [*Id.*]

At the time that the Hopi's consultant reached its conclusion, the Energy Information Administration, an office within the United Department of Energy, ("EIA") projected that natural gas prices would rise to $130 per barrel in 2030, which according to the Hopi consultant's analysis, would continue to make coal a competitive source of energy. [LCRC Exh. 1342 at 2 (PDF 10)]

Although EIA expected that electricity generated by coal-fired generating plants would decline from 49 percent of all electricity generated in 2007 to 47 percent in 2030, the EIA projected in its "Annual Energy Outlook 2009" that coal would continue to provide the largest share of energy for U.S. electricity generation and that existing plants would "continue to be used intensively." [LCRC Exh 1342 at 71 (PDF 79)]

Since the receipt of the 2009 report, the economic environment for coal-fired power plants has changed. [U.S. Exh. 1445 at 7 (PDF 9)] By 2018, the 2009 EIA predictions that coal would dominate the supply of energy from which to produce electricity had been proven false. [100820:69–83 PM (Bauer)] The EIA did, in contrast, accurately predicted the slowing growth in demand for electricity. In 2009, the EIA reported that "[f]rom 2000 to 2007, increases in electricity demand averaged 1.1 percent per year. The slowdown in demand growth is projected to continue over the next 23 years." [LCRC Exh. 1342 at 71 (PDF 79)] In 2019, the EIA reported that the growth rate of the demand for electricity declined

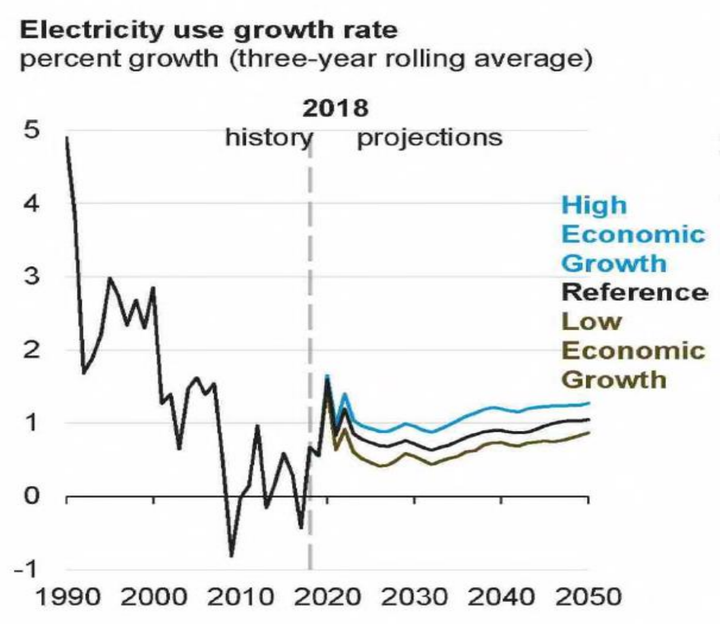


***Figure 8*. US Exh 1434 at 45 (PDF 89)**

below one percent annually through 2019 and projected that growth would remain at one percent or less through 2050. [U.S. Exh. 1434 at 89 (PDF 45] *See figure 8.* It further anticipated that the future demand would be met by electricity generated from natural gas, wind, and solar photovoltaic energy. It stated that "[p]ersistent low natural gas prices have decreased the competitiveness of coal-fired power generation. The 2017 coal-fired generation level was only about three-fifths of its peak in 2005. With relatively low natural gas prices throughout the projection period in the Reference case, natural gas-fired generation grows steadily and remains the dominant fuel in the electric power section through 2050." [*Id.* at 92 (PDF 46)]

Finding of Fact No. 316. The current energy environment is not favorable to existing coal-fired plants.

The United States retained Jason Bass, a natural resource economist with experience evaluating energy-related projects, to evaluate the feasibility of developing the Coal-Fired Power Plant [092320:17-18 AM (Bass); U.S. Exh. 1445 at 1 (PDF 3)]. The LCR Coalition retained Judy Chang, who holds a Master of Public Policy, worked as an energy consultant and policy expert advising energy companies on regulatory and financial issues, and is the current undersecretary of energy for the Commonwealth of Massachusetts, to evaluate the Coal-Fired Power Plant. [LCRC Exh. 134 (PDF 49); 121420:10 AM (Judy Chang)]

Mr. Bass' December 2017 expert report evaluates the economic feasibility of the proposed Coal-Fired Power Plant project. [U.S. Exh. 1445 at 1 (PDF 3)]. Under the approach taken by Mr. Bass in his December 2017 report, a "project is deemed economically feasible if its anticipated future economic benefits exceed its anticipated future economic costs after appropriately adjusting for anticipated differences in the relative timing of those benefits and costs." [*Id.*] The last clause of Mr. Bass' definition refers to the use of a discount rate in the analysis to adjust the different costs and benefits that occur at different times during the life of the project to a present-day value. [092320:52-53 AM (Bass); U.S. Exh. 1445 at 11 (PDF 13)] Mr. Bass used a discount rate equal to the 2.1 percent 30-year Treasury Bond interest rate. [092320:58 AM (Bass)]

Ms. Chang explained that an analysis of economic soundness entails an assessment of the expected costs, demand for the products, market conditions, and risks that might affect the product sales and revenues and, thus, the likely returns from that specific investment. [LCRC Exh. 134 at 4 (PDF 7)]. She stated that a discount rate of 5.3 percent based on a weighted-average cost of capital would be more appropriate than the 30-year bond rate of 2.1 percent assumed in Mr. Bass's December 2017 report. [LCRC Exh. 134 at 26 (PDF 29)].

Mr. Bass considered two categories of benefits associated with the proposed power plant project: (1) revenue derived from the sale of power; and (2) a "labor" benefit which is a portion of the salaries paid to Hopi Tribe members working on the project. [092320:16 PM (Bass)]. He set the revenues based on the 15-year average wholesale spotmarket price of $50.05/MWh at the Palo Verde Hub. [LCRC Exh. 134 at 27 (PDF 30)]. Mr. Bass estimated the total annualized benefit of the Coal-Fired Power Plant, including power revenues and labor benefits as $52.22 per megawatt hour.

The capital investment costs can be classified into four groups:

Project Element	**Cost (in 2016 dollars)**	**Reference**
Coal-fired electrical generation plant	$5,900,000,000	[092320:68 AM (Bass); U.S. Exh. 1445 at 14 (PDF 16)]
Surface Coal Mine	$ 62,325,474	[U.S. Exh. 1445 at 16 (PDF 18)].
Transmission lines to export power generated by the plant	$1,675,635,819	[092320:87 AM (Bass); U.S. Exh. 1445 at 17 (PDF 19)]
Well fields and associated pipelines to provide the power plant and mine with water	$ 129,104,473	[092320:90-92 AM (Bass); U.S. Exh. 1445 at 18 (PDF 20)]
Total	**$7,767,065,766**	

Mr. Bass calculated the annualized costs, the capital investment attributed to each year of the expected 20 to 50-year economic useful life of the components of the project, and the operation and maintenance costs. He determined that the annual cost would be $4,424,405 which translates into $38.40 per megawatt hour produced. [U.S. Exh. 1445 at 18 (PDF 20)] The cost calculation did not include any royalties payable to the Navajo Nation on the approximately 15,400 tons of coal required by the coal plant each day. [092320:85 AM (Bass); U.S. Exh. 1445 at 15 (PDF 17); 092320:46-47,86 AM (Bass)] All coal produced by the PWCC to date has been joint use area coal; no Hopi-exclusive coal has been commercially produced. [092320:84 PM (Bass); LCRC Exh. 515 at 23 (PDF 27)] Mr. Bass did not evaluate whether there is sufficient coal on the Hopi Reservation outside the joint use area to operate a coal-fired power plant for 45 years. [092320:47 PM (Bass)] Mr. Bass testified that he is not aware of any plans for the development of coal mining operations in an area on the Hopi Reservation outside of the joint use area. [092320:86 PM (Bass)]

An 1800-megawatt coal-fired power plant would emit 37,000 tons of carbon dioxide per day and other particulates such as mercury. [092320:114 AM (Bass); 101320:76 AM (Luneke); Hopi Exh. 4277 at 49 (PDF 62)] The current policy governing new coal plants requires the use of technologies to control greenhouse gas emissions. [121420:15-16 AM (Judy Chang)]. The Environmental Protection Agency through its Standards of Performance for Greenhouse Gas Emissions From New, Modified, and Reconstructed Stationary Sources: Electric Utility Generating Units (the "New Source Rule") subjects coal plants to strict requirements for air pollutant emissions, storage regulations, and greenhouse gas emissions, primarily carbon dioxide, from new fossil fuel generators. [LCRC Exh. 134 at 19 (PDF 22)]. The New Source Rule adopted 1,400 pounds of carbon dioxide per megawatt-hour gross as the standard of performance for newly constructed fossil fuel-fired steam generating units. [LCRC Exh. 289 at 64513 (PDF 5)].

Ms. Chang testified that the only way a coal plant can be built today is if it emits as little greenhouse gas emissions as a natural gas combined cycle plant. Necessarily, therefore, a coal operation will incur costs for carbon capture and storage, the terminology for the technologies that capture carbon dioxide and other elements from plant emissions and store them to prevent them from entering the atmosphere. A natural gas plant emits about half of the amount of greenhouse gases per unit of power production as a coal plant. [121420:15-16 AM (Judy Chang)]. Mr. Bass did not include costs of carbon capture and storage in his operating cost analysis. [U. S. Exh 1115 at 10] Ms. Chang offered the opinion that the omission of carbon capture and storage costs from Mr. Bass's analysis understates the capital and operations and maintenance costs of the proposed facility by as much 50 percent. [LCRC Exh. 134 at 24 (PDF 27)]

Finding of Fact No. 317. Significant costs associated with the operation of a Coal-Fired Power Plant were omitted in the analysis of the price at which electricity would have to be sold to make the project economically feasible.

The current market prices, regulatory conditions, the continuing decline in natural gas prices, and increasing renewable electricity generation have caused wholesale electricity prices to decline, causing operating losses for a large number of baseload generators, which is a generator that can provide a continuous supply of electricity. [092320:34 PM (Bass); LCRC Exh. 134 at 6 (PDF 9), 10 (PDF 13)] Mr. Bass stated that due to current wholesale power prices and the costs for carbon capture and storage, the proposed coal plant project is economically infeasible at present. [U.S. Exh. 1115 at 10] He explained that the Coal-Fired Power Plant is not currently feasible based on current market, technological, and regulatory conditions [092320: 122 AM (Bass); U.S. Exh. 1115 at 10]

Finding of Fact No. 318. The Coal-Fired Power Plant is not currently economically feasible.

Mr. Bass's opinion that the proposed coal plant project may become economically feasible relies on future conditions that are more favorable for the construction and operation of the proposed plant than current market, technological, and regulatory conditions. [092320:122 AM (Bass)]. As shown in *figure 9,* wholesale energy prices have fallen since the Hopi consultant prepared the 2009 report primarily due to the development of technologies that reduced the costs of natural gas and made it more abundant in the United States' marketplace. [092320:35 PM (Bass)] Since 2009, the wholesale price of energy has not consistently and dependably exceeded $40 per megawatt hour except for brief periods in 2014, 2018, and 2019. One of the technologies that has made natural gas cheaper and more abundant is hydraulic fracturing, also known as fracking. [092320:35 PM (Bass)]

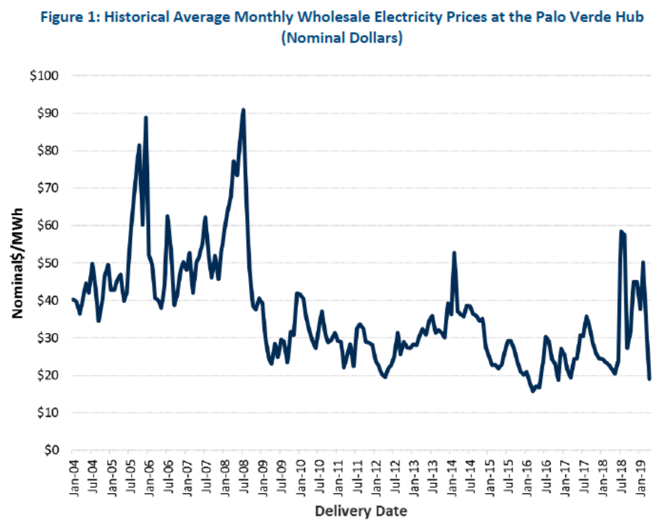


Figure 9.
Source. LCRC Exhibt 134 at 6 (PDF 9), figure 1

Beginning around 2008, energy companies began extensive fracking operations. [121420:41-42 AM (Judy Chang)] Proven reserves of natural gas in the United States have nearly doubled in roughly 20 years primarily due to the emergence of hydraulic fracturing. [LCRC Exh. 134 at 12 (PDF 15)]. It is likely that additional reserves of natural gas and oil will be found over the next 15 years. [101420:68 AM (Horner)]. Ms. Chang testified that fracking has changed the way North America produces oil and natural gas. [121420:42 AM (Judy Chang)]. Prior to the advent of fracking, the availability of natural gas was strongly coupled to the availability of crude oil. [101420:13-15 AM (Horner)] The Hopi Tribe's expert witness Richard Horner testified that fracking decoupled natural gas and crude oil and "completely revolutionized the energy and petrochemical industry," causing a move to natural gas. [101420:16 AM (Horner)]

In 2008, at the time of the Hopi consultant's report, natural gas prices averaged over $8 MMBtu. [LCRC Exh. 134 at 10 (PDF 13)] Since 2008, natural gas prices have been decreasing with delivered natural gas prices falling to around $3/MMBtu in the past two to three years. [*Id.*] According to Ms. Chang, "low natural gas prices has been widely cited as a significant contributing factor in the declining contributions of coal-fired power to the U.S. electricity sector." [*Id.*] The United States Energy Information Administration (EIA) issued its "Annual Energy Outlook 2019 with Projections to 2050" that confirmed this assessment and the expected continuing impact of low natural gas prices on the viability of coal operations:

> The power sector experiences a notable shift in fuels used to generate electricity, driven in part by historically low natural gas prices. Increased natural gas-fired electricity generation; larger shares of intermittent renewables; and additional retirements of less economic existing coal and nuclear plants occur during the projection period.
>
> The continuing decline in natural gas prices and increasing penetration of renewable electricity generation have resulted in lower wholesale electricity prices, changes in utilization rates, and operating losses for a large number of baseload coal and nuclear generators.

[LCRC Exh. 134 at 10 (PDF 13)] Mr. Bass and Ms. Chang agreed that current projections in the energy section are that natural gas prices will remain low for some time into the future. [U.S. Exh. 1115 at 6 (PDF 6); 121420:13-14, 44 AM (Judy Chang)].

Renewable solar and wind-generated energy also creates competition for coal-fired electrical plants. [092320:6 PM (Bass)] Renewable energy generation costs have decreased dramatically over the last decade. [121450:13,41, 47-48 AM (Judy Chang) The United States Department of Energy projects that solar, wind, and combined-cycle gas power plants will increase in number over the coming decades. [121420:20 Am (Judy Chang); LCRC Exh. 134 at 15-16 (PDF 18-19)] Ms. Chang expressed the opinion that the costs of solar photovoltaic energy and wind energy are lower than the costs of new coal plants, "thus leaving coal plants out of favor from a resource planning perspective." [LCRC Exh. 134 at 19 (PDF 22)] Ms. Chang testified that "some shifts are permanent and game-changers, such as technology breakthroughs (i.e., fracking, [solar photovoltaic energy] cost reductions) that cannot be unlearned or reversed." [LCRC Exh. 134 at 23 (PDF 26)]. Ms. Chang testified that the decreases in costs for natural gas production and solar and wind generation, putting downward pressure on wholesale electricity prices, are both irreversible. [121420:38-40 AM (Judy Chang)]

As Ms. Chang explained, the energy market of today is irrevocably different than the energy market in which the Coal-Fired Power Plant was first proposed. The Mohave Generating Station, located in Laughlin, Nevada, and the Navajo Generating Station, the coal-fired power plants supplied by coal from the Hopi and Navajo Reservations, have closed. [101320:89 AM (Luneke); U.S. Exh. 1445 at 3 (PDF 5); U.S. Exh. 1445 at 3 (PDF 5)] The two coal-fired power plants located near St. Johns, Arizona – the Coronado Generating Stations and the Springerville Generating Stations - are scheduled to close within the next eleven years. [011221:85-86 AM (Ramsey)]

Finding of Fact No. 319. The coal-fired power plants surrounding the Hopi Reservation have closed or are scheduled to close.

Finding of Fact No. 320. All coal power plants in California have ceased operations. [121620:13 PM (Judy Chang)]

Finding of Fact No. 321. Over the fourteen western states in the Western Electricity Coordinating Council (WECC), about 15 percent of installed coal capacity has been retired since 2008 and an additional 8,500 megawatts (or an additional 21 percent of installed coal capacity as of 2008) are expected to retire through 2025. [LCRC Exh. 134 at 15 (PDF 18)]

Finding of Fact No. 322. All coal-fired power plant projects scheduled to become operational between 2014 and 2022 in the WECC have been cancelled including the Bowie Power Station and the Cholla Station in Arizona and no new coal plants have been proposed. [LCRC 134 at 17 (PDF 20)]

Finding of Fact No. 323. Arizona utilities' current resource plans show that coal plants are being retired, and proposed new facility additions include gas-fired power plants and solar PV, and no coal-fired plants. LCRC Exh. 134 at 35 (PDF 38)]

Finding of Fact No. 324. No coal-fired power plants are currently under construction in the United States. [100820:32 PM (Bauer)]

In 2019, the Office of Energy Analysis, United States Department of Energy, forecast that between 2020 and 2050 no new coal powered electric generating facilities will begin operations and during that same time period a significant number of existing coal plants will be retired. [U.S. Exh. 1434 at 93 (PDF 47)] Based on these facts, if coal-fired plants became economical in the future, it is clear that the Hopi Tribe would face a very competitive market from plants still in operation, plants that had been retired but may be brought back into operation, and plants that have already been through the planning process.

Finding of Fact No. 325. The $7.6 billion-dollar 1800-megawatt supercritical pulverized coal-fired, dry cooled electrical power generation plant and supporting surface coal mine requiring 6,500 acre-feet of groundwater is not economically feasible.

C. Additional Coal Operations

The Hopi Tribe proposes to develop two additional heavy industrial coal operations on the reservation to generate revenue and economic opportunities. [Hopi Exh. 4277 at 66 (PDF 79)] Specifically, it proposes the development of a Coal Liquefaction/Gasification Facility that will necessitate the pumping of 20,600 acre-feet of groundwater from the aquifers under the Hopi Reservation each year and a Concentrated Solar/Thermal power plant, which depending upon its size, will use 2,300 to 6,320 acre-feet of groundwater each year.

The Hopi Tribe retained David Luneke and Said Amali to analyze the projects. Mr. Luneke is a registered civil and environmental engineer. [101320:17-19 AM (Luneke); Hopi Exh. 4280; Hopi Exh. 4277 at PDF 11–12] Dr. Amali holds a Master of Science in Soil Science, and a Ph.D. in Environmental Soil Physics. [101520:9–11 AM (Amali); Hopi Exh. 4279; Hopi Exh. 4277 at PDF 11] Mr. Luneke and Dr. Amali are collectively referred to as "Akana".

1. Coal Liquefaction / Gasification Facility

The Hopi Tribe proposes to construct a $2.1 billion coal liquefaction/gasification operation ("CLG") plant that would "introduce a major industrial complex to the reservation, similar to that of a major oil refinery." [Hopi Exh. 4277 at 48, 117, Table 25 (PDF 61, 130)]. It would be located near the coal mine in the Black Mesa region of the Hopi Reservation on a 50-acre site. [101320:19 AM (Luneke); Hopi Exh. 4277 at 77-78 (PDF 90-91)] The CLG plant would process 5,100 tons of coal per day into its chemical components to be sold to manufacturers of synthetic fuels and industrial products. [Hopi Exh. 4277 at 14 (PDF 27), 66 (PDF 79)] The United States did not assert a claim for a federal reserved water right to the groundwater that would be necessary to operate such a facility.

One of the disadvantages of coal liquefaction is that it uses significant quantities of water relative to other applications. [101420:97 AM (Horner); 101320:79 PM (Luneke)] The Hopi Tribe claims federal reserved water rights to pump 20,600 acre-feet of groundwater each year to operate the CLG facility. The Hopi Tribe proposes to pump 6,500 acre-feet of groundwater annually from the N Aquifer in the northwest corner of the reservation and pump the remaining 14,100 acre-feet annually from the C Aquifer in the southwest corner of the Hopi Reservation. [Hopi Exh. 4277 at 83 (PDF 96)] Akana modified its report to include a phased development of the CLG operation beginning with a smaller operation that would pump 6,500 acre-feet of water annually from the N Aquifer and process 1,500 tons of coal per day. Over time, the operation would be scaled up to its final size that would process 5,100 tons of coal per day using 20,600 acre-feet of groundwater. [101320:23-24 AM (Luenke);101520:27-28, 44-45 AM (Amali); Hopi Exh. 4277 at 15 (PDF 28), 66 (PDF 79); LCRC Exh. 551 at 1]

A coal liquefaction/gasification operation mixes coal with steam and oxygen at elevated temperatures and moderate pressure to produce a mixture of hydrogen, carbon monoxide, and carbon dioxide gas. [LCRC Exh. 1293 at 15-16 (PDF 47-48)] A gas consisting mainly of hydrogen and carbon monoxide is called synthesis gas. The synthesis gas, also known as syngas, is sent through a process designed to reduce sulfur compounds to near-zero concentrations and separate carbon dioxide into a highly concentrated stream. [*Id.*] The cleaned gas is catalytically converted into a mixture of hydrocarbons used to produce synthetic fuels and industrial products such as synthetic diesel and gasoline, naphtha from the gasoline/octane product grouping, and industrial waxes (paraffin). [LCRC 1293 at 16-17 (PDF 48-49); Hopi Exh. 4277 at, 90–94, 110-114 (PDF 123–127), 117 (PDF 130)] The expected construction of the project would take eight to ten years. [101320:14-15 PM (Luneke)]

Akana expects that CLG products would be sold in regional and commercial markets with long-term contracts. [Hopi Exh. 4277 at 116 (PDF 129)] Thus, one issue is whether the anticipated products produced from syngas would be competitive. Syngas, which is the starting point for the majority of products that CLG facilities produce, can be produced at a lower cost using natural gas and petroleum feedstocks instead of coal feedstock. [LCRC Exh. 134 at 37 (PDF 40)]. According to the Department of Energy's National Energy Laboratory, an operation reliant on coal would be successful only in an environment of high oil prices and high natural gas prices. [LCRC Exh. 134 at 38 (PDF 41)] Ms. Chang concurred that the market prospects for coal-based fuels and other products in the United States are not likely to be cost-competitive given competition from low-cost natural gas and petroleum, and expects that such costs will remain low for the foreseeable future. [121620:99-100 AM (Judy Chang)] The technologies involved in producing oil and natural gas have evolved and driven down the costs of both for the foreseeable future. [121420:23 AM (Judy Chang)].

The 2020 Annual Energy Outlook projects coal consumption to decline through 2050 while natural gas and hydrocarbon gas liquids (HGL) consumption will grow quickly, indicative of relatively low prices. [LCRC Exh. 494 at 133 (PDF 67)] Ms. Chang concluded that, based on her assessment of market conditions for CLG investment, she does not expect the Hopi Tribe's proposed CLG facility to be economically feasible under current and expected future market conditions. [LCRC Exh. 134 at 38 (PDF 41)]

In 2006, the Hopi Tribe had engaged coal mining consultant, Marston, to evaluate potential economic opportunities. [*See* Hopi Exh. 4282 ("Marston Report")] The Marston Report stated that that gasification and liquefaction are tied to the price of oil and concluded that a coal to liquids approach would be "high risk to Hopi." [101320:44 PM (Luneke); Hopi Exh. 4282 at PDF 106]. Thus, even considering the coal supply available to the Hopi Tribe and before the advent of fracking and lower cost natural gas, Marston had recommended against a CLG operation.

Mr. Luneke was aware of only one coal liquification/gasification plant currently in operation in the United States. It was built in the early 1980s. [101320:38 PM (Luneke)]. Before this case, Mr. Luneke had worked on six projects involving coal liquefaction, two in Montana and four in the eastern United States. [101320:39 PM (Luneke)]. None of the six prior coal liquefaction projects Mr. Luneke worked on were actually implemented. [101320:39-40 PM (Luneke)]. Akana states that as of 2014, there were twenty-two CLG projects initiated in the United States. [Hopi Exh. 4277 at 89 (PDF 102)] Thirteen of the listed projects have a status as of March 2019 of "Delayed/Cancelled". One of those 22 listed projects, in the planning stages without secured financing, relies on synthetic crude, not coal. Another project relies on gasoline as well as coal for the initial fuel. An additional two projects are marked as Active even though as of 2019, there has been no new information available since 2011. Two projects in Kentucky are marked as "Active".

Ms. Chang testified that, in addition to competition in product markets, there is a lack of interest among investors in developing CLG facilities. She attributes the lack of interest to the high and uncertain capital costs of those facilities. [LCRC Exh. 134 at 37 (PDF 40)] She concluded that due to the "high capital requirements and risks involved in such development, the proposed facility is highly unlikely to be able to obtain financing at a cost that would allow its products to be cost-competitive." [LCRC Exh. 134 at 36 (PDF 41)]

The costs of the construction of a CLG plant are significant. Akana estimated the initial capital costs for the proposed plant is $2.1 billion. The cost to build the smaller plant is $660 million dollars. *See* Table 20. [Hopi Exh. 4277 at 117 Table 25 (PDF 130)]. Akana separately assessed the components of the CLG plant such as the costs associated with using coal as a feedstock, the costs of developing a coal mine,

Annual Cost/Revenue Element	1,500 TPD	5,100 TPD
Synthetic Diesel ($/Year)	$68,000,000	$227,000,000
Naphtha ($/Year)	$32,000,000	$107,000,000
Industrial Wax ($/Year)	$354,000,000	$1,180,000,000
Electricity ($/Year)	$19,000,000	$63,000,000
CO_2 ($/Year)	$67,000,000	$223,000,000
Total Annual Revenue	$540,000,000	$1,800,000,000
Capital Cost	$660,000,000	$2,116,000,000
Operations Costs ($/Year)	$102,000,000	$340,000,00
Coal Cost ($/Year)	$10,000,000	$33,000,000
Water Cost ($/Year)	$2,000,000	$7,000,000
Total Operations Cost ($/Year)	$114,000,000	$379,000,000
Net Margin	**$426,000,000**	**$1,421,000,000**

Table 20
Source. Hopi Exh. 4277 at 117 Table 25

and the costs of obtaining and delivering water to the CLG facility. [101320:15–16 PM (Luneke)] The estimated total annual operations costs are forecast to be $379 million and $114 million, respectively. [Hopi Exh. 4277 at 117 Table 25 (PDF 130)] The annual costs do not include costs attributable to royalties that may be owed to the Navajo Nation for the mined coal. [101320:75 PM (Luneke)] The annual costs also do not include payment debt service or financing costs of the proposed CLG facility. [101320:27, 34 AM (Luneke)]

Akana offered the opinion that the CLG plant was financially feasible based on its economic analysis. Ms. Chang reached a contrary conclusion based on current and expected future market conditions, high capital requirements, risks involved in such development, and probability that financing would be not obtainable at a cost that would allow its products to be cost-competitive.

Finding of Fact No. 326. The Hopi Tribe did not carry its burden to establish that a CLG operation would be economically feasible.

The Hopi Tribe also has the burden to establish that the amount of water claimed for the CLG plant is the amount necessary to accomplish the homeland purpose tailored to minimal need. Akana concluded that the 5,100 TPD facility would generate a net annual margin of $1,421,000,000. The net annual margin is the amount of earnings that the Hopi Tribe would realize before expenses for interest, taxes, depreciation, and amortization [101320:26–27 AM (Luneke); Hopi Exh. 4584 at 13] The smaller plant could generate a net annual margin of $426,000,000. *See* Table 20. These heavy industrial projects would use substantially more water than PWCC pumped even when operating the slurry line. They will also generate revenues that vastly exceed the revenues the Hopi Tribe received from PWCC. Even the smaller version of the CLG plant generates almost ten times more revenue per capita than PWCC generated and would pump six times more water than PWCC pumped after it ceased the slurry line operation. Absent a showing that the claimed groundwater use does not exceed the minimal standard set by *Gila V*, the Hopi Tribe is not entitled to a federal reserved water right for groundwater to operate the plant.

Finding of Fact No. 327. The Hopi Tribe did not establish that the claimed groundwater to develop a CLG operation was necessary to accomplish the homeland purpose tailored to the minimal need of the reservation.

2. Hybrid Coal-Fired and Concentrated Solar Power Generator

The Hopi Reservation is in an area with some of the highest solar energy potential in the United States. [101320:29–30 AM (Luneke); Hopi Exh. 4277 at 24 (PDF 37), 32-33 (PDF 45–46), 35-36 (PDF 48–49); 121420:104–105 PM (Judy Chang)] There are Hopi villages pursing solar photovoltaic power projects. Ivan Sidney reported that planning is underway to develop a 2,000 acre solar farm. [Hopi Exh. 4595 at 101-102] The City of Flagstaff and the Hopi Economic Development Corporation have entered into a Memorandum of Understanding for the sale of power from a Hopi-owned renewable power project. [COF Exh. 62] The City of Flagstaff proposes that a federal reserved water right be adjudicated for 450 acre-feet of water per year for a solar photovoltaic power generation similar to an operation on the Moapa Reservation. City of Flagstaff Closing Brief at 48 (June 25, 2021). Neither the United States nor the Hopi Tribe asserted a claim to water for a solar photovoltaic power generation plant.

The Hopi Tribe proposes to construct a hybrid plant that will generate electricity using a hybrid concentrated solar power ("CSP") plant and a conventional coal-fired power plant supplied by a coal mining operation. [Hopi Exh. 4277 at 11 (PDF 14)] The Hopi Tribe claims a federal reserved water right to pump 2,300 to 6,500 acre-feet of groundwater to operate the plant depending upon its configuration. The coal mining operation will require 500 acre-feet of the claimed groundwater per year. [Hopi Exh. 4277 at 22 (PDF 35)]

The hybrid plant operates by using CSP technology to concentrate solar energy using mirrors or lenses to gather and focus solar rays to produce heat. This energy would then be transferred to a medium such as oil or salt brine that is sent to heat exchangers to produce steam that powers the turbines that generate electricity. [101320:28 AM (Luneke); Hopi Exh. 4277 at 16-17 (PDF 29–30), 21-22 (PDF 34–35), 74-75 (PDF 87–88); LCRC Exh. 216 at 11-12 (PDF 22–23)] At night and at other times when there is insufficient solar energy, coal, coal-derived synthesis gas, or coal-bed methane gas will be used to drive the turbine generators. [Hopi Exh. 4277 at 21-22 (PDF 34–35); Hopi Exh. 4584 at 3–4] The facility will incorporate a dry cooling process for the solar portion of the facility that will require 80 gallons of water per megawatt hour and the coal gasification portion of the facility will require 150 gallons per megawatt hour. [*Id.*]

The Hopi Tribe presents two proposals. The first option involves an 1,800-megawatt hybrid plant developed in two separate phases. Phase 1 is a 600-megawatt plant requiring 2,300 acre-feet of water annually. [101320:49 AM (Luneke); 101320:81 PM (Luneke); Hopi Exh. 4277 at 25-26 (PDF 38–39)] The 600-megawatt plant would supply the Hopi Reservation's power needs, which are anticipated to be 16 megawatts for the next ten to fifteen years. [101320:49 AM (Luneke); 101320:83 PM (Luneke)] Mr. Luneke initially proposed that excess power could be sold to Central Arizona Project to replace the power previously obtained from the Navajo Generating Station. [101320:49-50 AM (Luneke); Hopi Exh. 4277 at 25 (PDF 38)] This option requires the construction of a new connecting 345-kV transmission line and new connecting 69-kV lines. [Hopi Exh. 4277 at 99 (PDF 112)] Phase 2 adds an additional 1,200 megawatts of capacity and requires an additional 4,020 acre-feet of groundwater annually. [101320:50 AM (Luneke); 101320:81 PM (Luneke); Hopi Exh. 4277 at 25-26 (PDF 38–39)] The addition of Phase 2 generates additional power for sale, primarily to markets in California. [101320:50 AM (Luneke)] At full scale, the plant would require a total of 6,320 acre-feet of groundwater.

In Scenario 2, the Hopi Tribe proposes to construct a single-phase, 1,500-megawatt hybrid plant. It would sell electricity to the California markets via the proposed Centennial West Clean Line transmission line and would require 4,900 acre-feet of groundwater. [101320:33, 51, 57–58, 67 AM (Luneke); Hopi Exh. 4277 at 25-26 (PDF 38–39), 61-63 (PDF 74–76)]

Finding of Fact No. 328. The Centennial West Clean Line transmission line has not been built. [101320:69 AM (Luneke)]

Finding of Fact No. 329. Akana located a sixty square mile area south of SR 264 and west of Dinnebito Wash that would accommodate the twenty-seven square miles necessary for the full sized 1,800-megawatt CSP facility. [Hopi Exh. 4277 at 70-74 (PDF 83–87); *see also id.* at 42 (PDF 55) (map showing land slope), 43 (PDF 56) (map showing land orientation)]

Finding of Fact No. 330. There is a sufficient amount of coal available on the Hopi Reservation to supply a hybrid plant. [Hopi Exh. 4277 at 27-31 (PDF 40–44)] There are no substantial obstacles in terms of land availability and siting, including issues related to land use, land slope, plant location, plant layout, road layout, and water transmission pipeline layout. [101520:19–23 AM (Amali); Hopi Exh. 4277 at 38-44 (PDF 51–57), 60 (PDF 73), 72-73 (PDF 85–86), 79 (PDF 92)]

Finding of Fact No. 331. Akana concluded that a twelve-well C Aquifer well field could be located onsite to supply the 6,500 acre-feet annually. Akana determined that wastewater treatment and disposal facilities could also be located on the proposed site. [*Id.* At 77-78 (PDF 90–91)]

The Hopi Tribe contends that the proposed hybrid plant is feasible because solar thermal power stations have been built across the world, listing 40 locations globally. [Hopi Exh. 4277 at 17-21 (PDF 30-34)] A CSP facility is currently operating near Gila Bend, Arizona. The Gila Bend facility is a Solana 280 MW parabolic trough plant that was completed in 2013. (LCRC Exh. 134 at 34 (PDF 32)] In 2014, 1,800 megawatts of electricity was produced in the United States using concentrated solar power. [101320:10-11 PM (Luneke)] In 2018, the National Renewable Energy Laboratory determined that the Hopi Reservation was one of the fifteen tribal lands with the highest technical potential for concentrating solar power electricity generation.[26] [LCR Exh. 216 at 15 (PDF 26)]

Hybrid plants combining CSP and fossil fuels exist. [LCRC Exh. 1137 at 13 (PDF 16)] Existing CSP/fossil plants result from the addition of a CSP component to an existing fossil-fueled plant or from CSP plants that use natural gas as a backup/supplemental fuel. [LCRC Exh. 134 at 31-32 (PDF 34-35)]. It is feasible from a technical and engineering perspective to build a hybrid CSP plant. [101320:28-29 AM (Luneke); 101320:116 PM (Luneke); Hopi Exh. 4277 at 30–35; Hopi Exh. 4584 at 3; LCRC Exh. 1137]

Finding of Fact No. 332. The proposed hybrid plant is technically feasible.

The LCR Coalition argues that the CSP technology competes with solar photovoltaic ("PV") technology and is not economically feasible. Ms. Chang testified that the "first and foremost reason that a proposed CSP/coal plant is not economically feasible is because CSP is much more expensive than solar PV." [LCRC Exh. 134 at 28 (PDF 31)]. Historically, solar PV and concentrated solar had comparable costs. [121420:21-22 AM (Judy Chang); LCRC Exh. 134 at 28 (PDF 31)] During the last decade, costs of solar PV technology have decreased, making it less expensive to implement than concentrated solar power. [121420:21-22 AM (Judy Chang); LCRC Exh. 134 at 28 (PDF 31)] All of the proposed CSP projects in the WECC have been cancelled. [LCRC Exh. 134 at 29 (PDF 32)] According to Lawrence Berkeley National Lab's recent assessment of utility-scale solar, there are no CSP projects under construction or under developments in the United States. [LCRC Exh. 134 at 28 n.33 (PDF 31)]

[26] The Hopi Reservation is also one of the fifteen tribal lands with the highest technical potential for photovoltaic electricity generation.

In 2019, the National Renewable Energy Laboratory reported that the Department of Energy recently established cost targets for 2030. With respect to CSP-based systems, the 2019 Report stated:

> For CSP-based systems, the new targets correspond to a [levelized cost of electricity] in 2030 of $0.05/kWh for a dispatchable, high-capacity factor CSP-TES plant configuration (baseload in Figure ES-2) (DOE 2016). This aggressive target would have been unimaginable a decade ago. However, building on the previously described reduction in CSP-TES costs over the past decade, recent announcements suggest that the next phase of projects will continue this downward trend through lower installation costs, attractive financing, longer-duration PPAs, and the ability to capitalize on the value that the flexibility of storage can bring CSP

[Hopi Exh. 4333 at vii (PDF 8)] The 2019 Report also targeted lower solar PV costs than CSP costs.

The Hopi Tribe counters that solar PV is not in competition with its proposed plan because the hybrid plant is designed to fulfill demand from a single long-term customer for baseload power. [Hopi 4278 at 3] Akana explains that the pricing for the electricity sold by the Hopi Tribe would not be sold on the spot futures market but would be priced in accordance with the amount paid by a long-term customer to replace its baseload capacity:

> The pricing analysis provided by Akana reflects how utilities blend costs of generation to arrive at published prices. Utilities do not often pay spot prices for forward contracts. Future contract prices are normally sold to power customers that have forecasted a shortfall that is a relatively small percentage of their capacity, due to growth in demand or maintenance outages for their primary generation sources. The Hopi CSP proposal would be competing in a different market customer category. It would sell power to long term customers to [replace] their baseload capacity, which would be within the pricing ranges noted by the California Public Utility Commission.

[*Id.* at 5]

Based on pricing ranges found in 2016 California rate filings, Akana calculated the revenue that the proposed plant, in its different configurations, could realize based on an assumed price of $80 per megawatt hour. [101320:36-37 AM (Luneke); Hopi Exh. 4277 at 102-103 (PDF 115–116)] As shown in Table 21, the operation of 600-megawatt hybrid plant would generate a net $23,000,000 more in revenue than in costs.

Annual Cost/Revenue Element	Scenario 1 Phase 1	Scenario 1 Phase 2	Scenario 1 Totals	Scenario 2
CSP Plant Size (MW)	600	1,200	1,800	1,500
Electrical Revenue @ $80/MWh	$349,000,000	$698,000,000	$1,047,000,000	$872,000,000
Incentive Revenue	$15,000,000	$30,000,000	$46,000,000	$38,000,000
Total Revenue	$364,000,000	$728,000,000	$1,093,000,000	$910,000,000
Operations Cost	$122,000,000	$244,000,000	$366,000,000	$305,000,000
Water Operations Cost	$700,000	$1,000,000	$2,000,000	$1,500,000
Debt Service (40years @ 4%)	$195,000,000	$389,000,000	$578,000,000	$483,000,000
Transmission Operations Cost	$1,000,000	$1,000,000	$2,000,000	$1,500,000
Coal/CBM Cost	$22,000,000	$44,000,000	$66,000,000	$55,000,000
Net Margin	$23,300,000	$49,000,000	$79,000,000	$64,000,000
25 -Year Net Present Value:	$5,522,000,000	$10,050,000,000	$16,567,000,000	$13,812,000,000

Table 21
Source: Hopi Exh. 4277

Table 21 also shows Akana's estimated costs and revenues associated with the CSP plant based on a forty-year life. According to Akana, these types of projects are often financed through power purchase agreements with a major utility. [101320:36 AM (Luneke)]

Finding of Fact No. 333. The "debt service" entry on Table 21 includes the financing costs for the plant that includes payments for principal and interest associated with the original capital cost. [101320:34 AM (Luneke)]

Assuming receipt of a $80 megawatt hour price, the ability to operate at the anticipated capacity, with no other costs included in the analysis, the proposed plant would generate a positive cash flow for the Hopi Tribe. There are unknown costs, such as the compliance and regulatory costs associated with mitigating the environmental impact of the project. The Hopi Tribe called Carl Bauer to testify about the current research into technologies affecting coal and the future of coal as an energy source. Mr. Bauer is the former Managing Director of the U.S. Department of Energy's National Energy Technology Laboratory and is a member of the Energy Resources Council that oversees the School of Energy Resources at the University of Wyoming. Mr. Bauer testified about federal policy that recognized the importance of a national energy strategy to assure a diverse and sufficient supply of electricity that is economically affordable. [100820:24 AM (Bauer)] That policy motivates federal funding to develop technologies to address environmental concerns, and more specifically carbon capture. [*Id.* at 25; 101320:109 PM (Luenke)] For example, Congress provided more than $1 billion in funding to the United States Department of Energy between 2010 and 2017 to research carbon capture and sequestration technologies. [LCR Exh. 278 at 12] For fiscal years 2019 and 2020, DOE's budget for carbon capture research and development was $200 million. [100820:22–23 AM (Bauer); 100820:54–55 PM (Bauer)] Given the many areas in the country that have benefitted economically in the past from coal revenue, funding for these research efforts can reasonably be expected to continue. Mr. Bauer testified that, in his expert opinion, carbon capture technology is "getting to be feasible" and once it does become economically feasible, will cause coal to a "be a major source of energy for the United States." [1010820:83-84 PM (Bauer)] As a practical matter, the hybrid plant proposed by the Hopi Tribe will not be built and operational in less than eight to ten years. [101320:89 AM (Luneke)] Additional facts affecting the timing of construction are the schedules of utilities, the potential buyers of the electricity, who plan for sources of energy well into the future. [101320:65-

66 AM (Luneke)] Thus, in a longer time frame it is reasonable to anticipate that a technological solution will be found to make carbon capture economically feasible.

Ms. Chang testified that the hybrid plant is essentially a coal plant with roughly 20 percent CSP generation. [121620:27-28 PM (Judy Chang)]. The proposed hybrid plant has notable differences from the Coal-Fired Power Plant. It will generate lower greenhouse gas emissions compared to a conventional coal-fired power plant, and the smaller 600-megawatt facility would emit less carbon dioxide than the other proposed options. [101320:87 PM (Luneke)] Environmental costs to comply with regulations of greenhouse gas emission will be lower. The hybrid plant, because it can generate solar power and serve as a baseload provider offers a benefit not available from a generating plant dependent exclusively on coal or reliant solely on solar power.

The 600-megawatt hybrid plant proposed in Scenario 1 differs from the proposed 1800 MW Coal Fired Power Plant in that it will not be directly competing with existing plants or other power plants long into the planning process to sell electricity on the spot market. According to the testimony provided by Mr. Luneke, it will, in all likelihood, be built in conjunction with a utility provider that needs such an energy source in its portfolio.

Gila V requires consideration of the reservation's economic base as part of the evaluation of a project. Akana projected that the first phase of Scenario 1 would create 300 new jobs, generate $22,231,000 in annual payroll, and a $55,578,00 in community re-spend, which represents the economic result of the additional payroll injected into the local economy. [Hopi Exh. at 103] The proposed hybrid plant provides an additional economic benefit for the reservation. Arizona Public Service (APS) and the NTUA provide electrical services on the Hopi Reservation through the Hopi Utilities Corporation. Approximately 65 percent of Hopi homes have electricity, the majority of which are served by a single 69-kilovolt transmission line from Holbrook (through the Navajo Nation) to a substation west of Keams Canyon. From the substation, two 21-kV lines branch off—one east to Keams Canyon and one west to First Mesa, Second Mesa, and Third Mesa. [Hopi Exh. 4467 at 68; 102720:94–96 AM (Onsae)] Electrical service on the reservation is characterized by frequent "brown out" power issues that may last for several days. As a result, many villages must rely on back-up generators to provide for continuous access to drinking water. [Hopi Exh. 4467 at 63 (PDF 68); *see also* Hopi Exh. 4581 at 15; 102720:95 AM (Onsae)] Thus, the development of a hybrid power plant to generate electricity for use on the Hopi Reservation serves the additional purpose of lessening reliance on outside sources of electricity and providing an additional supply to meet future demand.

Finally, the *Gila V* minimal needs analysis limits federal reserved water rights to the minimal amount needed to achieve a permanent homeland. The 600-megawatt hybrid plant requires 2,300 acre-feet of groundwater. It would provide sufficient electricity for the anticipated short-term future demand as well as provide a source of electricity for demand farther into the future when the population is expected to triple. It also offers sufficient capacity to allow the Hopi Tribe to sell electricity to generate revenue. According to Mr. Luneke's projections, the hybrid plan could generate $23.3 million in income, which is more than the total royalties that the Hopi Tribe received from the mining of coal used at the Mohave and Navajo Generating Stations during six of the seven years between 2001 and 2007. [101320:86 PM (Luneke)] According to Mr. Luneke, those revenues also would be more than the amount that the Hopi Tribal government normally obtains from outside sources for its programs and operations. [101320:87 PM (Luneke)]

Finding of Fact No. 334. A 600-megawatt hybrid plant satisfies the criteria of *Gila V* based on considerations of the available natural resources, the historical industrial use of coal, the amount of groundwater required, and the need for a stronger economic base to maintain self-reliance on the reservation.

Finding of Fact No. 335. The 600-megawatt hybrid plant includes water for a coal mining operation. The amount of water determined to have been used for past coal mining operations is subsumed within the quantity of water needed for the development of the hybrid plant and coal mining operation.

Finding of Fact No. 336. A federal reserved water right for 2,300 acre-feet of water for heavy industrial use for coal mining and the development of a 600-megawatt hybrid plant is the amount of water minimally necessary to provide a permanent homeland tailored to the minimum needs of the reservation.

Finding of Fact No. 337. There is not a sufficient supply of surface water or other water to operate the 600-megawatt hybrid plant.

Finding of Fact No. 338. The source of the water is groundwater pumped from the PWCC #9 or other well in the general location of the PWCC #9 well on the Hopi Reservation that withdraws water from the N Aquifer. The remaining source of water is groundwater pumped from the C Aquifer from the well field at the location along the western border of the Hopi Reservation that the Hopi Tribe proposed for the project.

X. Allotments

The United States claims federal reserved water rights for 11 Hopi Allotments located within Moenkopi Island (the "Hopi Allotments") for irrigation, livestock, and DCMI purposes. U.S. FOF at 2. The Hopi Tribe joins with the United States and represents that it has a beneficial interest in nine of the Hopi Allotments. The Navajo Nation agrees that federal reserved water rights should attach to the Hopi Allotments but disputes the method of quantification proposed by the United States and the Hopi Tribe. Navajo Nation's Memorandum of Points and Authorities Addressing the Standards for Quantifying Water Rights for the Hopi Allotments at 4 (filed January 10, 2022) ("Navajo Memorandum"). The LCR Coalition, together with the City of Flagstaff, the Arizona State Land Department, and Salt River Project, oppose the grant of federal reserved water rights for the Hopi Allotments.[27]

In 1887, Congress passed the General Allotment Act, Pub. L. No. 49-105, 24 Stat. 388, that authorized the creation of Allotments. Its enactment represented a shift in federal objectives toward "assimilation of Indians into non-Indian culture and society" by conveying land ownership to individuals rather than to a tribe. *Colville Confederated Tribes v. Walton,* 647 F.2d at 49. The General Allotment Act authorized the creation of individual Allotments of lands included in a reservation created for a tribe. 24 Stat. 388 §1 ("Section 1 Allotments"). It also provided for allotment of federal land located outside of a reservation to individuals:

> Sec. 4. That where any Indian not residing upon a reservation, or for whose tribe no reservation has been provided by treaty, act of Congress, or executive order, shall make settlement upon any surveyed or unsurveyed

[27] The United States asserted that objections had not been raised to the claims for the Allotments until late in the case. Salt River Project and the Navajo Nation filed objections that raised issues with respect to water rights for the Allotments at the initial stage of this case. Objection filed by Salt River Project on June 10, 2016 at 2; Objection filed by the Navajo Nation on June 14, 2016 at 7. The LCR Coalition explicitly raised the issue in the Joint Pretrial Statement filed on May 18, 2020 at 71.

> lands of the United States not otherwise appropriated, he or she shall be entitled, upon application to the local land office or the district in which the lands are located, to have the same allotted to him or her, and to his or her children, in quantities and manner as provided in this act for Indians residing upon reservations; and when such settlement is made upon unsurveyed lands, the grant to such Indians shall be adjusted upon the survey of the lands so as to conform thereto; and patents shall be issued to them for such lands in the manner and with the restricts as herein provided.

24 Stat. 388 §4.

Congress passed the General Allotment Act to convert tribal land (in the case of Section 1 on-reservation allotments) and federal land (the subject of Section 4) into fee simple parcels, fully alienable and free of all encumbrances. General Allotment Act, §5; *see also Healing v. Jones,* 210 F. Supp. 125, 150 (D. Ariz. 1962), *aff'd per curium,* 373 U.S. 758 (1963). The Hopi Allotments were created pursuant to 24 Stat. 388 §4 (Section 4 Allotments).

The United States asserts that federal court decisions "confirm that Allotments are entitled to federal reserved water rights". United States' Memorandum Re Federal Reserved Water Rights on Hopi Allotments at 6 (January 10, 2022). It cites four federal decisions for this legal proposition: *United States v. Powers,* 305 U.S. 527, 532-33 (1939); *Skeem v. United States,* 273 F. 93 (9th Cir. 1921); *United States ex rel. Hibner*, 27 F.2d 909 (D. Idaho 1928); *Colville Confederated Tribes v. Walton*, 647 F.2d 42 (9th Cir. 1981). In each case, the federal government granted allotments created from lands that it had previously reserved for a tribe (Section 1 Allotments) where no dispute existed that federal reserved water rights had attached to the reservation land later transformed into allotments. In *United States v. Powers*, the court dealt with allotments from an 1868 reservation created for the Crow Indians. The Ninth Circuit ruled on federal reserved water rights for allotments from land included in the Fort Hall Reservation in *Skeem v. United States* and *United States ex rel. Hibner.* The most recent case cited, *Colville*

Confederated Tribes v. Walton, concerned allotments from the Colville Indian Reservation. While each of the cited cases establish that federal reserved water rights attach to allotments created from reservation lands after the federal government has reserved land for a tribe or groups of tribes, none of these cases stand for the proposition that federal reserved water rights attach to allotted federal land not previously included in a reservation, *i.e.*, Section 4 Allotments.

The LCR Coalition contends that no federal reserved water rights can attach to the Hopi Allotments because there was no reservation of land by the federal government. LCR Coalition's Memorandum Regarding the United States' Claim to Federal Reserved Water Right for the Hopi Allotments at 9-10 (January 10, 2022) ("LCR Coalition Memorandum"). The United States may acquire a federal reserved water right to water appurtenant to its land when it withdraws its land from the public domain and reserves the land for a public purpose. 231 Ariz. at 13, ¶20, 289 P.3d at 941.

The Hopi Allotments involve a mixed question of law and fact about whether the federal government withdrew federal land for the Hopi Allotments and sufficiently reserved that land for a public purpose to enable it to exercise its constitutional authority to reserve water for the land. The determination of the issue requires an examination of the circumstances surrounding the creation of the Hopi Allotments, including the terms that apply to the Hopi Allotments, and the sequence of events that occurred after the filing of the applications for the Hopi Allotments.

In the late nineteenth century, settlors had moved into the Moenkopi area where the Hopi farmed. Disputes subsequently arose over the use of land. [091118:64, 72 PM (Norton); U.S. Exh. 281] After the passage of the General Allotment Act, one Hopi woman and ten Hopi men filed applications on July 18, 1899, for the Hopi Allotments for agricultural use in the Moenkopi area. [091118:58–59, 62-63 PM (Norton); Hopi Exh. 1315-1325] Less than six months later, while the Hopi Allotment applications were pending, President William McKinley issued an Executive Order, dated January 8, 1900, to withdraw a parcel of land that included the Moenkopi area and the Hopi Allotments from sale and settlement. [091118:71 PM (Norton)] The Executive Order accomplished a withdrawal of the land that included the Hopi Allotments from the public domain. 2013 Special Master Report, Conclusion of Law No. 19 at 47. The Executive Order did not constitute a reservation of land. It was an intermediate step to maintain the *status quo* and avoid further complications that would be caused by new settlors moving on to the land before a plan could be developed for the area. The Secretary of the Interior explained at the time that further entry and settlement in the Moenkopi area must be halted "so that possible locations thereon may be prevented and consequent complication with other settlers avoided pending Congressional action." [LCRC Exh. 1 at 3]

The legal consequence of a withdrawal of land from the public domain is that the federal government retains ownership of the land but the land cannot be transferred. Normally, the withdrawn lands become unavailable for settlement, public sale, or other disposition under the federal public land laws. Allotments of withdrawn land may be prohibited. *See Akootchook v. United States*, 747 F2d 1316 (9th Cir. 1984). In the case of the Hopi Allotments the federal government moved forward with the applications for the Hopi Allotments. Two years after the land had been withdrawn from the public domain, the United States issued 11 patents for the Hopi Allotments for parcels ranging from 20 acres to 80 acres. [Hopi Exh. 1315-1325] Five years after the land had been withdrawn from the public domain, the federal government cancelled the original patents for the Hopi Allotments due to errors and issued 11 new patents with different legal descriptions that included fewer total acres. [LCRC Exh. 5-15]

Pursuant to the General Allotment Act, the United States retained legal title to the Hopi Allotments for twenty-five years and restrained the alienation of the land. As explained by the *Colville* Court, the 25-year trusts for allotted lands evidenced a Congressional intent to protect Indians by preventing transfer of those lands. *Colville Confederated Tribes v. Walton*, 647 F.2d at 50. Notwithstanding the terms of the General Allotment Act, the trusts did not expire in the designated twenty-five years. In 1934, the trusts were extended indefinitely. In *Yankton Sioux Tribe v. Podhradsky*, 606 F.3d 994, 1009 (8th Cir. 2010), the court observed: "It is worth noting that the eventual expiration of the allotments was never a foregone conclusion. The Dawes Act allowed the president to extend the allotment period, which Presidents Wilson, Coolidge, and Hoover each did. The allotments were then indefinitely extended under the 1934 Indian Reorganization Act, 48 Stat. 984 (1934) (codified at 25 U.S.C.A. §§ 5101 to 5129 (formerly 25 U.S.C.A. §§ 461 to 479))." The Indian Reorganization Act, which basically abolished the General Allotment Act, effectively imposed a permanent trust on the Hopi Allotments along with restrictions on alienation and bureaucratic oversight. *See also* Jessica A. Shoemaker, *No Sticks in My Bundle: Rethinking the Indian Land Tenure Problem*, 63 U. Kan. L. Rev. 383, 413–14 (2015). In 1934, the Hopi Allotments were formally incorporated within the external boundaries of the Hopi Reservation, distinguishing them from the many public domain allotments that exist outside reservations. 2013 Special Master Report at 46-51. Thus, by 1934 the federal government held legal title to the Hopi Allotments unlimited by a temporal constraint.

Subsequent litigation between the Navajo Nation and the Hopi Tribe over the land reserved by the 1934 Act resulted in a decision that the United States holds the lands of Moenkopi Island in trust for the Hopi Tribe and the Hopi Trust has jurisdiction over the Hopi Allotments. *Masayesva v. Zah*, No. CIV 74-842 PCT EHC (D. Ariz.) Thus, due to the actions taken by the federal government in 1934, as subsequently ruled upon by the federal courts, the Hopi Allotments continue to be held in trust by the United States and will continue to be held in trust indefinitely as the beneficial interest continues to splinter into hundreds of individual interests. As the Arizona Supreme Court recognized, "[a]lthough the individual allottee enjoys beneficial ownership of the land, legal title is held by the United States, as trustee. In this respect, the legal status of allotted trust land, with respect to alienation by sale, lease, or easement, is virtually the same as that of tribally-held trust land." *Salt River Pima-Maricopa Indian Cmty. v. Rogers*, 168 Ariz. 531, 533, 815 P.2d 900, 902 (1991).

In 2021, the Sixth Circuit Court of Appeals addressed the question of whether land occupied by members of the Little Traverse Bay Bands of Odawa Indians constituted allotted land or a reservation. *Little Traverse Bay Bands of Odawa Indians v. Whitmer*, 998 F. 3d 269 (2021). The court found that the United States and the tribes had entered into a treaty that provided that land would be "withdrawn from sale for the benefit of said Indians" and that the land "was held by the Federal Government in trust for the benefit of the [tribe]." 998 F. 3d at 281. As the next step in its analysis, the court found that a reservation requires land to be set aside and affirmatively used for Indian purposes which it defined as follows: "Land used for Indian purposes will be owned with 'restraints on alienation or significant use restrictions.' [citation omitted] If a tribe is free to use the land for non-Indian purposes, courts 'must conclude that the federal set aside requirement is not met.'" *Id.* at 282. The court found that the "[t]reaty created an arrangement closer to a land allotment system than a reservation." *Id.* It relied on the facts that the federal government held a limited ten-year restraint on alienation, the land not allotted in the given period would be sold like all other public lands, and the parties intended that the members of the tribe would receive title to the land so they could use the land "as they pleased." *Id.* at 283. The court concluded that the land was not a reservation.

Here, the trusts are not limited to a ten-year period or even the original twenty-five year period. The federal government holds legal title to the Hopi Allotments in trust, with no time limitation, that has now lasted more than a century. The Hopi Allotments were taken from land withdrawn from sale or settlement and not returned to the public domain subject to sale as would have been the case in *Little Traverse Bay Bands of Odawa Indians.* The Hopi Allotments were subsequently encompassed within the boundaries of the 1934 Reservation, and additional restraints were imposed by the terms of the 1934 Act. Further, unlike the tribal members in *Little Traverse Bay Bands of Odawa Indians* who negotiated the treaty and were reported as favoring allotment and holding fee title to individual parcels of land, the Hopi Tribe has not favored allotment. In general, the land on the Hopi Reservation is controlled by a clan or village rather than an individual. [091118:60 PM (Norton)] Unlike many Indian reservations, the Hopi Reservation is comprised entirely of trust lands held on behalf of the Hopi Tribe. There are no inholdings of fee land owned by non-members because the 1882 Reservation was never allotted.

The result of the federal government's actions with respect to the Hopi Allotments is the antithesis of the policy motivating Section 4 of the General Allotment Act. The Navajo Nation described the goals of Section 4 as affording "Indian settlers upon public lands the same privilege of entering such lands as white settlers … Indian settlers under [General Allotment Act §4] are on practically the same footing as white settlers on the public lands, … So that the practice, rules and decision governing white settlers on the public lands are, with certain reasonable modifications … equally applicable to Indian settlers.' *Lacey v. Grondorf, et al. (Indian Allotment- Sec. 4, Act of February 8, 1887 – Reinstatement)* (Apr. 12, 1910), 38 Pub. Lands D. 553, 555 (D.O.I.)." Navajo

Memorandum at 4. Unlike white settlors, the beneficial owners of the Hopi Allotments are subject to significant restraints on alienation.

The determination of whether the Hopi Allotments are more like allotments or a reservation for purposes of federal reserved water rights should also be viewed in the context of the situation presented in *Pittsburgh & Midway Coal Mining Company v. Yazzie,* 909 F.2d 13857, 1394-1396 (10th Cir. 1990). In that case, the federal government took action to protect Navajo stockmen from the "encroachment of white and Mexican stockmen who were appropriating the limited water holes" and grazing areas for their sheep. 909 F.2d at 1387, 1406. Like the Hopi, the Navajo stockmen needed less rather than more interaction with the surrounding land users. Unlike the Hopi, the federal officials were concerned that the nomadic Navajo would not qualify for Section 4 Allotments. Ultimately, the decision was made to issue an Executive Order that withdrew from sale and settlement "certain lands in New Mexico and Arizona to the east and south of the Navajo Reservation and setting them apart 'as an addition to the present Navajo reservation.'" *Id*. at 1391. The court concluded that the circumstances surrounding the issuance of the Executive Order "establish that the 709/744 area was withdrawn from the public domain in order to allot land to off-reservation Indians needing protection from white encroachment on their water holes and grazing area." *Id.* at 1406. The court found that a federal purpose to support a reservation existed when the United States took deliberate action to exercise the power of the federal government to protect the Navajo stockmen. In the case of the Hopi farmers, the United States did not demonstrate a similar singularity of purpose in 1900 when it withdrew land or in the later years when it issued and re-issued patents. In 1934, the federal government did manifest the same level of purpose toward the Hopi Tribe that it had demonstrated three decades earlier toward the Navajo stockmen when it reserved the land that is now referred to as Moenkopi Island.

Conclusion of Law No. 72. The United States actions in 1934 to extend the trusts for the Hopi Allotment indefinitely and to confer permanent reservation status on land, the boundaries of which encompass the Hopi Allotments, and to further restrict the alienation of the Hopi Allotments demonstrated that the United States intended to reserve the land for an Indian purpose.

Conclusion of Law No. 73. The extent of the United States' legal ownership of the Hopi Allotments in 1934 combined with its intent that the land be used for Indian purposes was sufficient for the government to exercise its constitutional authority to reserve water appurtenant to the land to accomplish the purposes of the 1934 Act.

The Hopi Tribe agrees that federal reserved water rights attach to the Hopi Allotments but argues that the priority date for the federal reserved water right should be based on a claimed water right under state law. The merits of any claim for a right under state law for water for the Hopi Allotments is not addressed by this Report as stated in Section II above. The exclusion of this issue from the current proceeding does not preclude resolution of the legal question posed by the Hopi Tribe concerning the priority date that attaches to a federal reserved water right. When state and federal law conflict, the state court must apply federal law to define a federal reserved water right. *Arizona v. San Carlos Apache Tribe*, 463 U.S. 545, 571 (1983) ("State courts, as much as federal courts, have a solemn obligation to follow federal law."); *see also Navajo Nation v. U.S. Dep't of the Interior*, 26 F.4th 794, 802 (9th Cir. 2022) ("[Federal reserved water] rights are determined by federal, not state law.") *Winters* requires that the priority date for federal reserved water rights for land in Moenkopi Island to be based on the date of the creation of the 1934 Reservation. In contrast, any state water right would have a priority date tied to an initial beneficial use if it could have be proven. Given the conflict between federal and state laws that govern priority date, federal law must control.

Conclusion of Law No. 74. The priority date for the federal reserved water rights applicable to the Hopi Allotments is the date established under federal law and cannot be set by state law.

The United States argues that the priority date applicable to reserved water rights for the Hopi Allotments is either the date the applications were filed or time immemorial. Federal law, as established by *Winters*, does not recognize either date as the appropriate date for a federal reserved water right. A reservation of the Hopi Allotments did not occur at the time the Hopi farmers filed their applications for the Hopi Allotments. At a minimum, a reservation requires affirmative action by the federal government. A time immemorial date only applies to aboriginal federal water rights. *See* Section III. The Navajo Nation argues that the appropriate date is the date of the patents. At the time of the issuance of the patents, the land was to be held in trust for twenty-five years and then be conveyed to the beneficial owner. The grant of the patents alone was not sufficient to vest the federal government with constitutional authority to reserve appurtenant water for the land.

Conclusion of Law No. 75. The priority date for federal reserved water rights for the Hopi Allotments is June 14, 1934.

This determination that the Hopi Allotments are entitled to federal reserved water rights is not intended to affect any rights or interests that existing allottees have or may acquire in the future to the Hopi Allotment land by virtue of the patents. It is simply a determination that the federal government retained sufficient ownership and exercised enough control over the property to accomplish a federal purpose that it may properly exercise its powers granted under the constitution to reserve water appurtenant to the Hopi Allotments for use on that land.

The United States relies on section 7 of the General Allotment Act, 24 Stat. 390, codified at 25 U.S.C. §381, to quantify the federal reserved water right as a "just and ratable share of the Hopi Tribe's water right for DCMI, livestock, and irrigation purposes." United States Closing Brief at 14. That section provides:

> Sec. 7. That in cases where the use of water for irrigation is necessary to render the lands within any Indian reservation available for agricultural purposes, the Secretary of the Interior be, and he is hereby, authorized to prescribe such rules and regulations as he may deem necessary to secure a just and equal distribution thereof among the Indians residing upon any such reservation; and no other appropriation or grant of water by any riparian proprietor shall be authorized or permitted to the damage of any other riparian proprietor.

24 Stat. 388 §7.

The Navajo Nation agrees with the United States and Hopi Tribe that federal reserved rights should attach to the Hopi Allotments but disputes the applicability of Section 7 of the General Allotment Act. Navajo Memorandum at 3. It argues that Section 7 is limited to land allotted out of a reservation under Section 1 of the General Allotment Act and that it only permits water to be granted for purposes of irrigation under Section 7 of the General Allotment Act.

Conclusion of Law No. 76. The Hopi Allotments were allotted pursuant to Section 4 of the General Allotment Act and are not entitled to a just and equal distribution of the water reserved by the federal government for the Hopi Reservation.

The Navajo Nation supports a grant of water for domestic, livestock watering, and irrigation for the Allotments based on a practicably irrigable standard. The United States also argues in the alternative that water rights for the Hopi Allotments should be based on demonstrated historical water use for irrigation. United States Memorandum at 11. The record demonstrates that the allotted land continues to be farmed and thus federal reserved water rights for irrigation use are appropriate. As the Hopi Allotments were granted to provide a home for the allottees, water for domestic use should also be included in an allocation. The absence of any stockponds on the land demonstrated that the land was intended for and continues to be used for agriculture use. The United States presented evidence that the land has been historically irrigated at a rate of 1.54 acre-feet per year per acre. [U.S. Exh. 582]

Finding of Fact No. 339. Based on the record presented in this case, 182.16 acre-feet per year is the amount necessary to accomplish the agricultural and domestic purposes of the Hopi Allotments located in the Moenkopi Drainage Basin to be allocated among the 11 Hopi Allotments as follows:

Allotment No.	Tract Id.	Acre-feet Per year
39	969	17.06
40	969	15.67
41	969	10.02
42	969	6.00
43	964, 969	22.55
44	964, 970, 971	21.64
45	964, 967	19.26
46	964	18.66
47	964,984, 986	25.24
48	964 , 984	19.83
49	964	6.23

XI. Keams Canyon Recreational Area

Keams Canyon has a small dam creating a recreational impoundment in Keams Canyon known as Keams Lake. Keams Lake is a riparian area. [100218:59 PM (Puhuyesva)] The Hopi Tribe claims the right to continuously fill Keams Lake for recreational purposes, such as camping and fishing, to its maximum storage capacity of 8.3 acre-feet and 17.7 acre-feet for evaporation. [Hopi Tribe's Fifth Amended Statement of Claimant at 46] The United States claimed Keams Lake as an impoundment with an area of 2.94 acres and volume of 6.065 acre-feet. [Hopi Exh. 3948 at 1; *see also* 092618:75–76 PM (Ley); U.S. Exh. 740 at 13 (entry I1130); *see also* Hopi Exh. 7 at 37 (HSR at 4-36)] The United States did not claim an evaporation rate for impoundments. [092618:78 PM (Ley)]

Arizona Department of Water Resources investigated the claim for Keams Lake that the Hopi Tribe had included in its Third Amended Statement of Claimant and the United States had also claimed as an impoundment. It analyzed both the surface area of Keams Lake and the claimed evaporation rate. [Hopi Exh. 7 at 36, 37 (HSR at 4-35, 4-36)] Subsequently, the Hopi Tribe retained Mr. Kunkel to calculate an updated lake capacity and evaporative loss for Keams Lake. [Hopi Exh. 3948] Based on review of Google Earth three-dimensional image, Mr. Kunkel determined that the lake surface area is 3.86 acres. [*Id.*] He calculated a storage capacity of 8.3 acre-feet and an evaporative loss of 17.7 acre-feet. [*Id.*] No party objected to any Proposed Finding of Fact presented by the Hopi Tribe with respect to Keams Canyon Recreational Area.

Finding of Fact No. 340. 26 acre-feet of water, which includes 17.7 acre-feet for evaporation, is that amount of water necessary to fulfill the purposes of the reservation tailored to its minimal need.

Finding of Fact No. 341. The source of water for Keams Lake is Keams Canyon in the Polacca drainage.

XII. Additional Objections to the Hopi Reservation HSR

In addition to the objections filed by the parties who have actively litigated this case since 2016, there were other persons who filed objections. A number of those objections were dismissed as follows:

Objectors Name	**Date Filed**	**Date of Dismissal**
Atkinson Trading Co	6/13/2016	9/27/16
Bear Ridge Resort LLP	6/16/2016	9/15/16
Charles & Jacqulyn Bebee	6/24/2016	9/15/16
William Bollin	6/15/2016	11/14/16
Chelcey & Lynda Fowler, Fowler Family Living Trust	5/25/2016	11/14/16
Lois Hunt	5/31/2016	11/14/16
Leo Maestas	6/13/2016	12/21/16
The New Sundance LLP	6/16/2016	9/15/16
David & Diane O'Grady	5/31/2016	11/14/16
Thora B Perkins	not dated	11/14/16
Charles Pugh	6/2/2016	11/14/16
Philip & Rebecca Rohkohl	5/31/2016	11/14/16
Richard Rush & Mary Shoemaker	6/8/2016	11/14/16
Kenneth & Carol Taylor	not dated	11/14/16
Raymond Turley	6/24/2016	9/15/16
Dennis & Sande Wagner	5/61/16	11/14/16

Objections filed by Paul H. and Florence Ann Anspach and Melvin and Nancy Hatley concern the priority dates, which was the subject of *In re Hopi Priority* and were not the subject of the Hopi HSR, and are dismissed pursuant to A.R.S. §45-256(B). The objections raised by Marilyn M Coy in her representative capacity are general in nature and explicitly asserted to protect Statements of Claimant filed by the Objector. As stated in Section I, this case solely concerns the claims filed by the Hopi Tribe and the United States for water rights on the Hopi Reservation. The Statements of Claimant filed by Marilyn M Coy on behalf of Tante MMC LLLP and Michelbach Livestock, Inc. and Michelbach Investment Ltd. Partnership are not at issue in this case and will be fully adjudicated at a later date. Accordingly, the objection is dismissed. Arizona Public Service and Tri-State Generation and Transmission Association filed objections, and like all other objectors had an opportunity to present evidence in support of their objections. The objections listed were also raised by other parties and are addressed in this Report.

XIII. Filing Dates for Objections and Responses

Any claimant in the Little Colorado River Adjudication may file a written objection to this Final Report, which includes the Recommended Decree, on or before **November 21, 2022**. Responses to objections must be filed on or before **January 5, 2023.** All objections and responses must be filed with the Clerk of the Apache County Superior Court, P. O. Box 365, St. Johns, Arizona 85936.

A copy of all papers filed with objections and responses shall be served on all persons listed on the Court approved mailing list for the contested case In re Hopi Reservation HSR, No. CV 6417-203. The list is posted on the General Adjudication website at http://www.superiorcourt.maricopa.gov/SuperiorCourt/Adjudications/mailingLists.asp.

Susan W. Harris

Susan Ward Harris
Special Master

On May 25, 2022, the original of the foregoing was mailed to the Clerk of the Apache County Superior Court for filing and distributing a copy to all persons listed on the Court approved mailing list this contested case.

Cheryl Kee

Cheryl Kee

XIV. Recommended Decree

Based on the foregoing, it is recommended that the water rights decreed under federal law should be decreed as set forth in the Proposed Form of Decree attached to this Report and by this reference made a part of the Report. The recommended quantities for the separate types of uses are as follows:

Type of Use	**Federal Reserved Rights Quantity (acre-feet per year)**
Agriculture – (including allotted land)	18,898
Alfalfa fields	0
C&S Gardens	0
Domestic, commercial, municipal, and light industrial uses	3,069.3
Coal-fired electrical power generating plant	0
Coal liquefaction/gasification facility	0
Hybrid coal-fired and solar electrical power generating plant and coal mining operation	2,300
Keams Canyon Recreational Area	26
Pasture Canyon	286.8
Springs for cultural, religious, and domestic uses	See Exhibit A
Stockponds	3,572
Stock and wildlife watering	824
White Ruin Canyon	12.39

RECOMMENDED DECREE

THE COURT ADJUDICATES AND DECREES that the Hopi Tribe and the United States, as trustee for the Hopi Tribe and the Allottees, shall have the following decreed rights to water under federal law for use on the Hopi Reservation, defined below.

Definitions

For purposes of this Decree, the Court adopts the following defined terms:

1. "1882 Reservation" means those lands set aside by the Executive Order of December 16, 1882 and is comprised by "Land Management District 6" and the "Hopi Partitioned Lands."

2. "Aboriginal" use means a use of water that predates the establishment of the 1882 Reservation.

3. "AFA" means acre-feet of water annually.

4. "Agricultural Irrigation" uses means any use of water for the irrigation or watering of crops and plants, that are not reliant solely and exclusively on precipitation, and that are not otherwise included in this Decree as part of DCMI uses, defined below.

5. "Allotments" are those 11 parcels of land included within the exterior boundaries of the reservation created by the Act of June 14, 1934, 48 Stat. 960 that are held in trust by the United States.

6. "Allottees" means those persons or entities who have a beneficial ownership in one or more of the Allotments.

7. “Cultural, ceremonial, and religious uses” means uses of spring water in accordance with traditional practices that use minimal amounts of water and primarily use water from the spring *in situ* without significant improvements to transport the water.

8. “DCMI” use means any use of water for Domestic, Commercial, Municipal, and Light Industrial Use on the Hopi Reservation.

a. Domestic means residential water uses both inside and outside the home, for cleaning, bathing, crafts, gardens, landscaping, including lawns, trees and other plants, and domestic animals, including pets and livestock, kept in facilities adjacent to a household.

b. Commercial uses include water for restaurants, hotels, and businesses.

c. Municipal uses include irrigation of schools, governmental buildings, landscaping, lawns, trees, and other plants adjacent to municipal buildings on the Hopi Reservation, as well as water for hospitals, medical clinics, schools, and governmental buildings.

d. Industrial uses include manufacturing uses generally supplied by a municipal system that does not constitute heavy industrial uses such as coal mining and coal operations.

9. “Heavy Industrial” use means water used in coal operations including mining.

10. “Hopi Partitioned Lands” or “HPL” is that land within the Hopi Reservation more specifically described as set forth in Stipulation re: Legal Descriptions of Hopi Reservation Lands, dated May 19, 2021, and filed May 20, 2021, with the Clerk of the Apache County Superior Court at Docket No. 1534.

11. “Hopi Reservation” refers to the two non-contiguous geographic areas known as the 1882 Reservation and Moenkopi Island.

12. “Land Management District 6” or “District 6” is that land within the Hopi Reservation more specifically described as set forth in Stipulation re: Legal Descriptions of Hopi Reservation Lands, dated May 19, 2021, and filed May 20, 2021 with the Clerk of the Apache County Superior Court at Docket No. 1534.

13. “Moenkopi Island” is land reserved by the United States pursuant to the Act of June 14, 1934, 48 Stat. 960, that is more specifically described as set forth in Stipulation re: Legal Descriptions of Hopi Reservation Lands dated May 19, 2021 and filed May 20, 2021 with the Clerk of the Apache County Superior Court at Docket No. 1534.

14. “Recreational” uses means impoundments of water used primarily for recreational purposes, including fishing, boating and swimming.

15. “Stock and Wildlife Watering” uses means water for consumption by livestock or wildlife. Stock and Wildlife Watering uses include consumption of water directly from surface water, springs, or stockponds, or from watering troughs filled by surface water, springs, or wells pumping groundwater.

16. “Stockponds” means impoundments of water used by livestock and wildlife.

17. “Time Immemorial” means the priority assigned to aboriginal uses of water.

Sources of Water

18. The Court has previously determined that the United States and the Hopi Tribe shall have no rights under this Decree to divert or withdraw and use any water from any source that does not abut or transverse the Hopi Reservation. *See* Minute Entry, Case No. CV-6417 (March 2, 2009) (Ballinger, J.)

19. All water that is diverted or withdrawn and used by or on behalf of the United States, the Hopi Tribe or the Allottees, pursuant to rights set forth in this Decree, shall be diverted or withdrawn from sources within the boundaries of the Hopi Reservation.

Priority Dates

20. Any water diverted or withdrawn by or on behalf of the United States or the Hopi Tribe on the 1882 Reservation within Land Management District 6 for aboriginal uses, shall have a time immemorial priority date. *See* Report of the Special Master; Motion for Adoption of Report; and Notice of Filing Objections to the Report, at 4, 19, Contested Case No. CV 6417-203 (April 24, 2013) ("Priority Report"), *approved as modified by* Minute Entry (Jan. 25, 2016) (Brain, J.); Order Granting in Part and Denying in Part, LCRC Motions for Partial Summary Judgment, at 11, 14, Contested Case No. 6417-203 (April 13, 2020) ("April 2020 Order").

21. Any water diverted or withdrawn by or on behalf of the United States or the Hopi Tribe on the 1882 Reservation, except as provided in paragraph 20 above, shall have a priority date of December 16, 1882 unless the land was not owned by the federal government on December 16, 1882, in which case the priority date is the date the land was reacquired by the United States. Order Denying Reconsideration at 5-8. The dates of reacquisition are indicated in Appendix 1 to Special Master's Sept. 26, 2016 Report.

22. Any water diverted or withdrawn by or on behalf of the United States or the Hopi Tribe on Moenkopi Island shall have a priority date of June 14, 1934. *See* Priority Report, at 4, 51.

23. Any water diverted or withdrawn by or on behalf of the United States or the Allottees on the Allotments shall have a priority date of June 14, 1934.

Water Rights for Cultural, Ceremonial, and Religious Uses

24. For Cultural, Ceremonial, and Religious Uses, the United States and the Hopi Tribe shall have the right to use the amount of flow from each spring as shown on **Exhibit A**. Spring water diverted for such uses must be diverted from springs at points of diversion located within the boundaries of the Hopi Reservation.

25. The attributes and maps of water rights decreed to the United States and the Hopi Tribe for Cultural, Ceremonial, and Religious Uses are set forth in **Exhibit A** attached hereto.

Water Rights for DCMI Uses

26. For DCMI Uses, the United States and the Hopi Tribe shall have the right to divert or withdraw and use 3,069.3 AFA. The sources of water for such use shall be limited to groundwater and springs on the surface on the Hopi Reservation. Groundwater withdrawn for such uses must be withdrawn through wells located on the Hopi Reservation. Spring water diverted for such uses must be diverted from springs at points of diversion located within the boundaries of the Hopi Reservation.

27. The attributes and maps of water rights decreed to the United States and the Hopi Tribe for DCMI Uses are set forth in **Exhibit B** attached hereto.

Water Rights for Agricultural Irrigation Uses

28. For Agricultural Irrigation Uses, the United States and the Hopi Tribe shall have the right to divert 18,617 acre-feet annually to irrigate 12,849.84 acres of land.

a. 345.40 acres are located outside the boundaries of the Allotments on Moenkopi Island and are irrigated with 670.84 AFA from perennial sources such as wells, springs and perennial stream flow.

b. 12,568 acres are irrigated with 18,045 AFA flowing in Northern Washes and minor tributaries on the surface of the Hopi Reservation.

29. Water diverted for Agricultural Irrigation uses must be diverted from those washes and springs at points of diversion located within the boundaries of the Hopi Reservation.

30. The attributes of water rights and a map showing the points of diversion and places of use for Agricultural Irrigation decreed to the Hopi Tribe, the United States and the Allottees, are set forth in **Exhibit C** attached hereto.

Water Rights for Livestock and Wildlife Watering Uses

31. Livestock and Wildlife Watering Uses includes any use of water for purposes of the consumption by livestock or wildlife on the Hopi Reservation. Livestock and Wildlife Watering use includes the consumption of water by livestock or wildlife directly from a wash, spring, stockpond, or from a trough or other receptable filled by water from a wash, spring or well.

32. For Livestock and Wildlife Uses, the United States and Hopi Tribe shall have the right to 824 AFA. The sources of water for such uses shall be limited to groundwater, water flowing in springs and washes on the surface, and stockponds. Groundwater withdrawn for such uses must be withdrawn through wells located on the Hopi Reservation that access the alluvial, T, or D Aquifers. Spring water diverted for such uses must be diverted from springs at points of diversion located within the boundaries of the Hopi Reservation.

33. The attributes of water rights and a map showing the points of diversion and places of use for Livestock and Wildlife Watering decreed to the United States and the Hopi Tribe are set forth in **Exhibit D** attached hereto.

<u>Water Rights for Stockponds</u>

34. Stockponds are impoundments used for watering livestock and wildlife. Although livestock and wildlife directly consume some quantity of the water stored in Stockponds, that quantity and the resulting duplication of rights is deemed negligible. Therefore, the water rights decreed herein for Stockpond use are in addition to the water rights decreed in Paragraphs 31 through 33 for Livestock and Wildlife Watering uses. The water rights decreed for Stockponds are intended to account for the storage, evaporation, and seepage of water in Stockponds.

35. For Stockpond Uses, the United States and the Hopi Tribe shall have the right to divert or withdraw and store water in Stockponds on the Hopi Reservation having a combined total storage capacity of 3,572.0 acre-feet, with continuous fill. The sources of water for such use shall be limited to groundwater primarily from the D Aquifer and water flowing in washes and springs on the surface that is collected in the impoundments. The right to continuous fill with groundwater is limited to the replacement of evaporation and seepage. Groundwater withdrawn for such uses must be withdrawn through wells located on the Hopi Reservation. Spring, surface and groundwater diverted for Stockpond use must be diverted from points of diversion located within the boundaries of the Hopi Reservation.

36. The attributes of water rights and maps showing the points of diversion and places of use for Stockpond Uses decreed to the United States and the Hopi Tribe for are set forth in **Exhibit E** attached hereto

Water Rights for Keams Lake Recreation Uses

37. Keams Lake Recreation Uses includes any *in situ* water used for the enjoyment of Keams Lake on the Hopi Reservation.

38. The water rights decreed for Keams Lake Recreation *in situ* use are to 8.3 acre-feet of water, with continuous fill, and 17.7 AFA for evaporative loss. The source of water to replace evaporation losses shall be spring water and surface water within the Polacca Wash sub-basin.

39. The attributes of water rights and map showing the points of diversion and places of use for Keams Lake Recreational Uses decreed to the United States and the Hopi Tribe are set forth in **Exhibit F** attached hereto

Water Rights for Pasture Canyon and White Ruin Canyon

40. "Riparian and Wetland Habitat" use includes water needed for the consumption requirements of vegetation in natural riparian areas and wetlands on the Hopi Reservation in Pasture Canyon and White Ruin Canyon.

41. The water rights decreed for Pasture Canyon are to 286.8 AFA.

42. The water rights decreed for White Ruin Canyon are to 12.39 AFA.

43. The attributes of water rights and map(s) showing the points of diversion and places of use for Riparian and Wetland Habitat decreed to the United States and the Hopi Tribe are set forth in **Exhibit G** attached hereto.

Water Rights for Mining and Heavy Industrial Uses

44. The United States and the Hopi Tribe shall have the right to withdraw and use 2,300 AFA for mining and for the development and operation of a hybrid coal-fired concentrated solar powered electrical generating plant.

45. The attributes of water rights and maps showing the points of diversion and places of use for Mining and Industrial Uses decreed to the United States and the Hopi Tribe are set forth in **Exhibit H** attached hereto. No more than 1,800 AFA may be withdrawn from the C Aquifer for the project. 500 AFA, or more, up to the maximum amount allowed for mining and heavy industrial use, 2,300 AFA, may be withdrawn from the N Aquifer.

Water Rights for Allotments

46. The United States and the Allottees shall have the right to withdraw from Pasture Canyon and use a total of 182.16 AFA for domestic and irrigation uses. The specific amounts for each Allotment are set forth on **Exhibits I** attached hereto.

47. The attributes of water rights and maps showing the points of diversion and places of use decreed to the United States on behalf of the Allotees of each Allotment are set forth in **Exhibit I** attached hereto.

Modification, Enforcement, and Binding Effect

48. Any requests for modifications to decreed attributes for the rights described in this Decree shall be addressed under the generally applicable provisions to be adopted by this Court

for modification of the final Decree in the Little Colorado River General Stream Adjudication (Case No. CV 6417).

49. Any enforcement or administration action brought pursuant to this Decree shall fall under the continuing jurisdiction of the Little Colorado General Stream Adjudication Court. *See* A.R.S. 45-257(B)(3).

50. The provisions of this Decree shall bind, and insure to the benefit of the United States, the Hopi Tribe and Allottees, and all parties to this general stream adjudication.

List of Exhibits and Appendix

EXHIBIT A

Attributes of Rights for Cultural, Ceremonial, and Religious Use

Priority Date	See paragraphs 20 through 23 of Recommended Decree
Type of use	Cultural, Ceremonial, and Religious Uses
Source of water	Springs on the Hopi Reservation See attached schedule
Points of diversion	See attached schedule Maps of springs are attached as Appendix A
Places of use	See attached schedule
Flow rate	See attached schedule
Period of use	Year-round
Owners	Hopi Tribe United States acting in its capacity as trustee for the Hopi Tribe

Schedule of Points of Diversion and Place of Use for

Cultural, Ceremonial, and Religious Uses

US Label	Name	Plate	Easting	Northing	QQ	Sec	Lndkey	Use	Land Status	Quantity
S012	Kai Si Kato	1	517767	4017773	SWSE	35	AZ14T0340N0140E	C/D/S	HPL	4
S0224	Red Willow	2	540580	4019378	SWSE	30	AZ14T0340N0170E	C/D/S	HPL	2
S029	Kydestea	2	529432	4020566	NENE	25	AZ14T0340N0150E	C/D/S	HPL	3
S036	4M-190A	3	554795	4029046	L 3	27	AZ14T0350N0180E	C/D/S	HPL	2
S041	3A-15	4	484408	3994456	NWSW	1	AZ14T0310N0110E	C/D/S	Moenkopi	2
S0416	Moenkopi School, Susungva	4	480126	3996029	L 2	33	AZ14T0320N0110E	C/D/S/PS/IRR	Moenkopi	8-45
S043	3A-25	4	477971	3980889	L 1	20	AZ14T0300N0110E	C/D/S	Moenkopi	0.2–0.5
S049	Tonali	4	478048	3984250	NENW	8	AZ14T0300N0110E	C/D/S	Moenkopi	0.8-3
S0513	Lower Badger	5	511997	3989101	NESE	31	AZ14T0310N0140E	C/D/S	HPL	<0.01-1.8
S0518	Willow	5	519362	3996663	SWSE	1	AZ14T0310N0140E	C/D/S	HPL	6
S052	Nee De Miso Bito	5	500861	4009736	SWSW	30	AZ14T0330N0130E	C/D/S/IRR	HPL	<0.2-5
S0522	Muddy Water	5	504212	3996819	SWSW	4	AZ14T0310N0130E	C/D/S	HPL	15
S055	Sand	5	506283	4002775	NENW	22	AZ14T0320N0130E	C/D/S	HPL	0.1-2
S0615	Sweet Water	6	536881	4009999	NESW	26	AZ14T0330N0160E	C/D/S	HPL	<0.01-10
S0623	Cottonwood, White Cave	6	531411	3988388	L 4	5	AZ14T0300N0160E	C/D/S	HPL	0.1-1
S0625	Tis-Ya-Toh	6	524875	3992209	SESE	21	AZ14T0310N0150E	C/D/S	HPL	0-1.5
S0630	4M-142	6	533513	3992078	SESW	21	AZ14T0310N0160E	C/D/S	HPL	0.8
S0632	4M-146	6	533352	4005194	NESW	9	AZ14T0320N0160E	C/D/S	HPL	1
S065	Cottonwood	6	525072	4001669	SWSW	22	AZ14T0320N0150E	C/D/S	HPL	0.5
S0714	4M-130	7	547670	3986229	NWSW	12	AZ14T0300N0170E	C/D/S	District 6	2
S073	Crooked Finger	7	561478	3987399	SESE	5	AZ14T0300N0190E	C/D/S	HPL	0.5
S075	Under Rock	7	562271	3988513	L 3	4	AZ14T0300N0190E	C/D/S	HPL	<0.1-0.5
S077	Rough Rock	7	561667	3989002	SESE	32	AZ14T0310N0190E	C/D/S	HPL	0.3-0.5
S079	4M-103	7	562493	3988280	SENW	4	AZ14T0300N0190E	C/D/S	HPL	0.5
S0810	Sweetwater	8	505151	3957383	SWNW	10	AZ14T0270N0130E	C/D/S	HPL	2
S086	Hock	8	508365	3967593	NWNW	12	AZ14T0280N0130E	C/D/S	HPL	1-2
S0911	Grooming, Naftakinva	9	542974	3962524	NWNE	28	AZ14T0280N0170E	C/D/S	District 6	<0.01-1
S0912	Brown Rock	9	542176	3962575	NWNW	28	AZ14T0280N0170E	C/D/S	District 6	0.1-0.8
S0917	Sueiva	9	542525	3963474	NESW	21	AZ14T0280N0170E	C/D/S/IRR	District 6	0.2-4
S0920	6H-24	9	544476	3965437	SWNE	15	AZ14T0280N0170E	C/D/S	District 6	0.5
S0924	Ruins	9	542851	3967999	SWSE	4	AZ14T0280N0170E	C/D/S	District 6	<0.01-0.5
S0929	Siwukva	9	528761	3973260	NESW	24	AZ14T0290N0150E	C/D/S	District 6	3
S093	Bacavi, Paaqavi	9	530656	3975401	NWNE	18	AZ14T0290N0160E	C/D/S/IRR	District 6	0-15
S0933	Unnamed	9	540352	3980905	SWSE	30	AZ14T0300N0170E	C/D/S	District 6	3

US Label	Name	Plate	Easting	Northing	QQ	Sec	Lndkey	Use	Land Status	Quantity
S0940	6M-59 or Siwukva	9	529374	3972839	SESE	24	AZ14T0290N0150E	C/S	District 6	2
S095	Hotevilla	9	529406	3976057	SESE	12	AZ14T0290N0150E	C/D/S/IRR	District 6	1.72
S1012	Donkey	10	559395	3977186	NENW	7	AZ14T0290N0190E	C/D/S	District 6	0.2-0.5
S1015	Cat	10	566663	3982178	NENE	26	AZ14T0300N0190E	C/D/S	District 6	2
S1016	Lemova	10	546611	3962413	SENE	26	AZ14T0280N0170E	C/D/S/IRR	District 6	2
S1019	Aqwda	10	545580	3964254	NWNW	23	AZ14T0280N0170E	C/D/S	District 6	1
S1025	Flower, Wuko'kwantukwi, Siipa	10	556265	3966828	NESE	11	AZ14T0280N0180E	C/D/S/IRR	District 6	<0.01-1
S1028	Buhu Va	10	563145	3960944	SWNW	34	AZ14T0280N0190E	C/D/S	District 6	1
S1029	06M-04	10	566180	3961213	NWNW	36	AZ14T0280N0190E	C/S	District 6	4
S103	Onion	10	546295	3983831	NENW	23	AZ14T0300N0170E	C/D/S	District 6	0.1-2
S1030	Sacatone, Weekebe	10	567248	3964931	SWSE	13	AZ14T0280N0190E	C/D/S	District 6	0.5
S1031	Weni Bah, Wingva, Wiinpa, Standing Water	10	560998	3970080	NESW	32	AZ14T0290N0190E	C/D/S/IRR	District 6	0.2-0.5
S1036	6H-6	10	556672	3970207	NWSE	35	AZ14T0290N0180E	C/D/S/IRR	District 6	0.5
S1038	6K-310S	10	545384	3982559	SWSE	22	AZ14T0300N0170E	C/D/S	District 6	2
S1039	6M-12	10	565285	3959503	L 3	2	AZ14T0270N0190E	C/D/S	District 6	2-4
S105	Sand Hill, Parveckpah	10	558853	3971975	L 2	30	AZ14T0290N0190E	C/D/S/IRR	District 6	0.5-0.8
S1058	Hoecevi	10	545470	3965098	NWSW	14	AZ14T0280N0170E	C/S	District 6	3
S106	Wepo South, Cottonwood, Cohoivaka	10	556938	3971976	SENE	26	AZ14T0290N0180E	C/D/S/IRR	District 6	2.7-25
S1064	6M-5	10	563575	3961719	SESW	27	AZ14T0280N0190E	C/D/S	District 6	2
S107	Wepo, Wipho, Cattail, Reed	10	557189	3972104	SWNW	25	AZ14T0290N0180E	C/D/S/IRR	District 6	1.5-30
S108	Unnamed	10	557732	3972631	NENW	25	AZ14T0290N0180E	C/D/S/IRR	District 6	<0.01-0.8
S1111	Baptist Church	11	572462	3963542	NWSW	22	AZ14T0280N0200E	C/D/S	District 6	<0.01-0.5
S1112	Chili	11	573223	3962729	NWNE	27	AZ14T0280N0200E	C/D/IRR	District 6	0.1-3
S1113	06K-01S	11	574080	3962638	NWNW	26	AZ14T0280N0200E	C/D/PS	District 6	1.5-10
S1115	06K-02S	11	575211	3963357	SESE	23	AZ14T0280N0200E	C/D/S	District 6	3-5
S1116	06K-03S	11	575313	3963415	NESE	23	AZ14T0280N0200E	C/D	District 6	0.7-10
S1117	06K-14S	11	575725	3963623	NWSW	24	AZ14T0280N0200E	C/D	District 6	0.6
S1118	06K-13S	11	575835	3963713	NWSW	24	AZ14T0280N0200E	C/D	District 6	0.5
S1119	06K-07S	11	576937	3964741	SESE	13	AZ14T0280N0200E	C/D/S	District 6	50
S1121	06K-308S	11	574890	3967321	SWNE	11	AZ14T0280N0200E	C/S	District 6	0.5
S1123	06A-21A	11	576456	3969117	L 7	1	AZ14T0280N0200E	C/D/S	District 6	0.28-2
S1135	D.Lalo	11	576934	3969565	L 1	1	AZ14T0280N0200E	C/D/S	District 6	0.8
S1137	6K-11S	11	575888	3964013	SENW	24	AZ14T0280N0200E	C/D	District 6	1.5
S1138	6K-12S	11	575808	3963932	SWNW	24	AZ14T0280N0200E	C/D	District 6	8.5
S115	07H-06	11	586835	3973698	SWNE	24	AZ14T0290N0210E	C/D/S	HPL	0.5-0.8
S118	Bluebird, Tsorva	11	568464	3960821	SWNE	31	AZ14T0280N0200E	C/D/S/IRR	District 6	2-25
S1210	5M-73	12	510470	3949651	L 3	6	AZ14T0260N0140E	C/D/S	HPL	1

US Label	Name	Plate	Easting	Northing	QQ	Sec	Lndkey	Use	Land Status	Quantity
S123	Sand (multiple)	12	506349	3952682	SENE	27	AZ14T0270N0130E	C/D/S/IRR	HPL	3
S127	Whiskey	12	505437	3955791	SENW	15	AZ14T0270N0130E	C/D/S/IRR	HPL	.12-4
S128	05M-04	12	505639	3955421	NESW	15	AZ14T0270N0130E	C/S/IRR	HPL	<0.01-2
S131	Shonto	13	523078	3948047	NENW	9	AZ14T0260N0150E	C/D/S	District 6	0.67-2
S1311	Rock Ledge, Phillips Farm	13	540287	3947409	NESE	7	AZ14T0260N0170E	C/D/S/IRR	District 6	2
S1312	Pautsvi, Burro2	13	527501	3950572	NWSW	36	AZ14T0270N0150E	C/S	District 6	0-0.5
S132	06M-33	13	525882	3947711	SWNW	11	AZ14T0260N0150E	C/D/S	District 6	0.2-0.5
S134	Burro, Honani, New Pa'utsv	13	527740	3950571	NWSW	36	AZ14T0270N0150E	C/S	District 6	0.2-1
S136	Coyote	13	539432	3945576	SESW	18	AZ14T0260N0170E	C/D/S/IRR	District 6	1-15
S138	Little Burro	13	538834	3948185	L 1	7	AZ14T0260N0170E	C/S	District 6	3
S141	Ponsi Adams	14	561353	3952830	SWNW	28	AZ14T0270N0190E	C/D/S	District 6	0.5
S1410	Ram	14	563666	3931985	SENW	34	AZ14T0250N0190E	C/D/S	HPL	0.1-0.5
S1411	Shontah	14	564087	3934176	SESE	22	AZ14T0250N0190E	C/D/S	HPL	0.5-1
S1413	Horse	14	561745	3936749	SENW	16	AZ14T0250N0190E	C/D/S	HPL	0.5-1
S1414	Belle Butte	14	559227	3935616	SWSE	18	AZ14T0250N0190E	C/D/S	HPL	0.2-1.2
S1416	Trickle, Yatcakpa	14	564920	3954397	SWNW	23	AZ14T0270N0190E	C/D/S/IRR	District 6	0.2-1.5
S142	Awat ovi	14	565259	3953511	SESW	23	AZ14T0270N0190E	C/D/S	District 6	0-2
S143	Talahogan	14	565423	3954783	NWNE	23	AZ14T0270N0190E	C/D/S/IRR	District 6	0.88-2
S145	Kalbito #1	14	551863	3931146	SWSW	33	AZ14T0250N0180E	C/D/S	HPL	1.5-5
S146	Comar	14	552922	3932018	NENE	33	AZ14T0250N0180E	C/D/S	HPL	8
S147	Seba Delkai	14	553941	3937898	NESW	10	AZ14T0250N0180E	C/D/S	HPL	1
S148	Lukai	14	559127	3931137	SWSE	31	AZ14T0250N0190E	C/D/S	HPL	0.2-1

Use Key:

C- Cultural

D - Domestic

S - Stock

IRR - Irrigation

PS - Public Supply

Schedule of Points of Diversion and Places of Use for

Cultural, Ceremonial, and Religious Use

US Label	Name	Easting	Northing	QQ	Sec	Lndkey	Use	Land Status	Acres Irrigated
S104	Sheep, Kanelva	557184	3970362	SWNW	36	AZ14T0290N0180E	C/D/S/IRR	District 6	3.5925
S119	Nu'vatotshba, Snowbird	569991	3962591	NWNE	29	AZ14T0280N0200E	C/D/S/IRR	District 6	0.3442
S1017	Toreva, Twisted Curve	545284	3962452	SWNW	26	AZ14T0280N0170E	C/D/S/IRR	District 6	0.0775
S137	Unnamed	540993	3946827	SESW	8	AZ14T0260N0170E	C/D/S/IRR	District 6	2.2035
S1417	Hail, Lemova	565997	3955454	NESE	14	AZ14T0270N0190E	C/D/S/IRR	District 6	0.06338

Use Key:

C- Cultural

D - Domestic

S - Stock

IRR - Irrigation

PS - Public Supply

EXHIBIT B

Attributes of Rights for DCMI Uses

Priority Date	See paragraphs 20 through 23 of Recommended Decree
Type of use	Domestic, commercial, municipal, and light industrial
Source of water	Groundwater and springs on the Hopi Reservation
Points of diversion	Wells and springs on the Hopi Reservation that have historically been used for DCMI uses and listed on the attached schedules. Maps of wells, springs, and impoundments are attached as Appendix A to the Recommended Decree. Wells planned to pump the N Aquifer as shown on the attached map within the Turquoise Trail, Central, and Northwest well fields. The current well drilled into the C Aquifer, labeled as MC-1 on attached map on Moenkopi Island.
Places of use	Water from all wells currently pumping water for domestic use may be used on the Hopi Reservation. Water pumped from the Turquoise Trail, Central, and Northwest well fields on the 1882 Reservation may be transported to and used on Moenkopi Island for DCMI use. The current well drilled into the C Aquifer on Moenkopi Island may not be used to withdraw more than 774 acre-feet per year and may only be used on Moenkopi Island.
Volume	3069.3 acre-feet per year
Period of use	Year-round
Owners	Hopi Tribe United States acting in its capacity as trustee for the Hopi Tribe

Schedule of Points of Diversion from Wells for DCMI Uses

US Label	Name	Plate	Easting	Northing	QQ	Sec	Lndkey	Use	Land Status
W011		1	518500	4025870	SWSW	001	AZ14T0340N0140E	D/S	HPL
W013	01A-72	1	502183	4011923	SENE	019	AZ14T0330N0130E	D	HPL
W014	SIDE ROCK WELL	1	501983	4011800	NWSE	019	AZ14T0330N0130E	D/S	HPL
W021	04K-387	2	539248	4016419	NESE	001	AZ14T0330N0160E	D/S	HPL
W022	04-380	2	542209	4022085	NENE	020	AZ14T0340N0170E	D/S	HPL
W023	02T-503	2	534499	4025026	SENE	009	AZ14T0340N0160E	D/S	HPL
W024		2	522821	4019656	NWSE	029	AZ14T0340N0150E	D/S	HPL
W031	SAGE BRUSH WELL	3	554960	4028644	NWNE	034	AZ14T0350N0180E	D/S	HPL
W032	OWL WELL	3	549776	4015802	NENW	007	AZ14T0330N0180E	D/S	HPL
W033	ANGRY MAN WELL	3	549720	4016470	NESW	006	AZ14T0330N0180E	D/S	HPL
W034	04T-406	3	554271	4019432	SESW	027	AZ14T0340N0180E	D/S	HPL
W035	04T-405	3	552369	4025610	NWNW	009	AZ14T0340N0180E	D/S	HPL
W037	4K-380, 362152110204801	3	558550	4024570	NESE	012	AZ14T0340N0180E	D/S	HPL
W03HW9	Hopi Well 9	3	552191	4027646	SWSW	033	AZ14T0350N0180E	D/M	HPL
W041		4	482733	3981130	NWNW	023	AZ14T0300N0110E	D/S	Moenkopi
W0410	Moenkopi Well #3	4	480325	3997445	L 7	028	AZ14T0320N0110E	M	Moenkopi
W0411	Moenkopi "C" Well	4	481349	3995828	SESW	034	AZ14T0320N0110E	M	Moenkopi
W0412	Moenkopi Well #2	4	480403	3997465	L 7	028	AZ14T0320N0110E	M	Moenkopi
W042		4	486893	3982941	SESE	007	AZ14T0300N0120E	D/S	Moenkopi
W043		4	481270	3988189	NWSW	027	AZ14T0310N0110E	D/S	Moenkopi
W044		4	492482	3990175	SWNW	023	AZ14T0310N0120E	D/S	Moenkopi
W045		4	479928	3996972	NENW	033	AZ14T0320N0110E	D/S	Moenkopi
W046	Moenkopi Well #1	4	480515	3997464	L 8	028	AZ14T0320N0110E	D/S	Moenkopi
W047	CRATER WELL	4	478990	3993318	SENE	008	AZ14T0310N0110E	D/S	Moenkopi
W0511	JUA2-8-844B	5	521500	3991245	SENE	030	AZ14T0310N0150E	D/S	HPL
W0512	03K-344	5	517695	3992500	NWSE	023	AZ14T0310N0140E	D/S	HPL
W0513	03M-156	5	511941	3994000	NESE	018	AZ14T0310N0140E	D/S	HPL
W0514		5	514848	3997227	NESE	004	AZ14T0310N0140E	D/S	HPL
W052	NEW WELL	5	508250	4011309	SWSE	023	AZ14T0330N0130E	D/S	HPL
W053	NADSAT IT-239	5	506754	4007304	SWNE	003	AZ14T0320N0130E	D	HPL
W054	JUA2-7-345	5	509682	4001053	NWNE	025	AZ14T0320N0130E	D/S	HPL
W055	BLUE CYN WELL	5	511081	4001023	SENW	030	AZ14T0320N0140E	D/S	HPL
W057	03K-345	5	508461	3997138	NESE	002	AZ14T0310N0130E	D/S	HPL
W058	03K-330	5	503739	3992606	SENE	020	AZ14T0310N0130E	D/S	HPL
W059	TOH HA HA CLAH	5	521967	3984530	NWSW	017	AZ14T0300N0150E	D/S	HPL
W061	04K-391	6	526202	3999977	SESE	027	AZ14T0320N0150E	D/S	HPL
W0610	04M-138	6	527304	3996923	SWSE	002	AZ14T0310N0150E	D/S	HPL
W0611		6	536656	3986243	SENW	011	AZ14T0300N0160E	D/S	HPL
W062	4T-515	6	527711	4001600	SESE	023	AZ14T0320N0150E	D/S	HPL
W063	2/11/01	6	535750	3999518	NENE	034	AZ14T0320N0160E	D/S	HPL
W064	04K-384	6	535637	4002691	NWNE	022	AZ14T0320N0160E	D/S	HPL
W065	BENALLY WELL	6	543514	4006394	SWSE	004	AZ14T0320N0170E	D/S	HPL
W066	JUA2-5-1	6	541999	4009683	SWSE	029	AZ14T0330N0170E	D/S	HPL
W067	H-3-NO-3	6	533674	3987094	SESW	004	AZ14T0300N0160E	D/S	HPL
W068		6	525858	3989624	SWNE	034	AZ14T0310N0150E	D/S	HPL

US Label	Name	Plate	Easting	Northing	QQ	Sec	Lndkey	Use	Land Status
W069	HK-383	6	528643	3994901	NENW	013	AZ14T0310N0150E	D/S	HPL
W071	4T-395	7	551579	4006530	SWSE	005	AZ14T0320N0180E	D/S	HPL
W0710	Hamp Well No. 3	7	548892	3985831	SESE	012	AZ14T0300N0170E	M	District 6
W073	04M-89A	7	550485	3992751	SENE	019	AZ14T0310N0180E	D/S	HPL
W074	04M-87	7	557380	3986447	SWNW	012	AZ14T0300N0180E	D/S	HPL
W075	ROUGH NECK WELL	7	561297	3988229	SWNE	005	AZ14T0300N0190E	D/S	HPL
W076	4M-89	7	550052	3992728	SWNE	019	AZ14T0310N0180E	D/S	HPL
W077	TURQUOISE TRAIL	7	546174	3989773	SWNW	035	AZ14T0310N0170E	D/S	HPL
W078	06-1H4	7	548457	3984144	SWSE	013	AZ14T0300N0170E	D/S	District 6
W079	Hamp Well No. 2	7	547674	3986700	NWNW	012	AZ14T0300N0170E	M	District 6
W081	03M-176A	8	502324	3979356	NESE	031	AZ14T0300N0130E	D/S	HPL
W0810	06H-55	8	518105	3978076	NWSE	002	AZ14T0290N0140E	D/S	District 6
W0812	03K-311	8	516713	3982855	NESE	022	AZ14T0300N0140E	D/S/IRR	HPL
W0813	SWEET WATER WELL	8	505788	3957640	NWNE	010	AZ14T0270N0130E	D/S	HPL
W0814	O3A-153	8	501318	3960965	NWNE	031	AZ14T0280N0130E	D/S	HPL
W0815	MOENKOPI MONUMEN	8	503224	3965001	NESE	017	AZ14T0280N0130E	D/S	HPL
W0816	3K-320	8	505958	3965865	NWNE	015	AZ14T0280N0130E	D/S	HPL
W0817	3M-175	8	502370	3969438	SESE	031	AZ14T0290N0130E	D/S	HPL
W0818	06M-44	8	516502	3961781	NWSW	026	AZ14T0280N0140E	D/S	District 6
W0819	6-11A	8	517554	3967497	NENE	011	AZ14T0280N0140E	D/S	District 6
W082	DRY WELL	8	509360	3978514	L 3	001	AZ14T0290N0130E	D/S	HPL
W0822	06K-321	8	515058	3956970	NESW	010	AZ14T0270N0140E	D/S	District 6
W0824	06M-50	8	518568	3965562	SENW	013	AZ14T0280N0140E	D/S	District 6
W0825	06K-322	8	521096	3967335	NWNW	008	AZ14T0280N0150E	D/S	District 6
W0826	06M-174	8	515662	3969734	NWSW	034	AZ14T0290N0140E	D/S	District 6
W0827	3M-176	8	502242	3979419	NESE	031	AZ14T0300N0130E	D/S	HPL
W0829	HOTVL COMMUNITY/PM3	8	522123	3982189	SESW	020	AZ14T0300N0150E	M	HPL
W083	03K-332	8	507780	3976681	SENW	011	AZ14T0290N0130E	D/S	HPL
W084	BEETSO WELL	8	506536	3973195	NWSE	022	AZ14T0290N0130E	D/S	HPL
W087		8	521644	3978195	SENE	006	AZ14T0290N0150E	D/S	District 6
W089	06M-183A	8	514045	3975826	SWSW	009	AZ14T0290N0140E	D/S	District 6
W091	06M70	9	525397	3976036	SESW	010	AZ14T0290N0150E	D/S	District 6
W0910	06M-52A	9	532874	3965080	NESW	016	AZ14T0280N0160E	D/S	District 6
W0912	FLUTE WELL	9	532033	3969870	NESW	032	AZ14T0290N0160E	D/S	District 6
W0913	06M-302B	9	534545	3969228	L 7	003	AZ14T0280N0160E	D/S	District 6
W0915	6K-305-95	9	538129	3957817	NWNE	012	AZ14T0270N0160E	D/S	District 6
W0916	6K-309A	9	529810	3975111	L 2	018	AZ14T0290N0160E	D/S	District 6
W0918		9	532517	3971545	NWSE	029	AZ14T0290N0160E	D	District 6
W0919		9	532523	3971521	NWSE	029	AZ14T0290N0160E	D	District 6
W092		9	530506	3976823	SENW	007	AZ14T0290N0160E	D/S	District 6
W0920		9	532620	3971369	NESE	029	AZ14T0290N0160E	D	District 6
W0921		9	523527	3971547	NWSW	028	AZ14T0290N0150E	D	District 6
W0922	6M-61	9	540263	3977758	SWSE	006	AZ14T0290N0170E	D/S	District 6
W0923	6-NO1	9	537353	3976964	SWNE	011	AZ14T0290N0160E	D/S	District 6
W0924	6H-32, Toreva P. S.	9	544490	3961416	SWSE	027	AZ14T0280N0170E	M	District 6
W0926	6K-302, Oraibi D. S.	9	534465	3970306	SENE	033	AZ14T0290N0160E	M	District 6
W0928	USPHS ORAl	9	534591	3970152	SENE	033	AZ14T0290N0160E	D	District 6
W0929	Shongopovi	9	542433	3962665	NENW	028	AZ14T0280N0170E	M	District 6

US Label	Name	Plate	Easting	Northing	QQ	Sec	Lndkey	Use	Land Status
W093	06M-60	9	537435	3973768	NENE	023	AZ14T0290N0160E	D/S	District 6
W0930	Kykotsmovi PM1/Yoyokie Well	9	534654	3970152	SWNW	034	AZ14T0290N0160E	M	District 6
W0931	Kykotsmovi PM3/ Hopi Day School Well	9	534979	3970338	SWNW	034	AZ14T0290N0160E	M	District 6
W0932	Hopi Cultural Center	9	542719	3966829	NESW	009	AZ14T0280N0170E	M	District 6
W0933	Hotevilla PM1/Hotevilla School Well 1	9	530092	3975521	L 1	018	AZ14T0290N0160E	M	District 6
W0934	Hotevilla PDC2/School Well 2	9	529947	3975403	L 1	018	AZ14T0290N0160E	M	District 6
W0935	Hotevilla Village Well	9	530172	3975558	NENW	018	AZ14T0290N0160E	M	District 6
W0936	Hotevilla 2004-1	9	529350	3974166	SWSE	013	AZ14T0290N0150E	M	District 6
W0937	Bacavi/Bacabi	9	530177	3974993	SENW	018	AZ14T0290N0160E	M	District 6
W0938	Hopi Civic Center/Vet Center	9	538946	3969246	L 4	006	AZ14T0280N0170E	M	District 6
W094	06M-64	9	536591	3982270	SESW	023	AZ14T0300N0160E	D/S	District 6
W095	06M-46	9	524042	3958102	SESE	004	AZ14T0270N0150E	D/S	District 6
W096		9	526126	3959257	SWNW	002	AZ14T0270N0150E	D/S	District 6
W097	06K-261	9	531269	3959418	L 7	005	AZ14T0270N0160E	D/S	District 6
W099	06K-310	9	527111	3964519	SESE	014	AZ14T0280N0150E	D/S	District 6
W1010	06PW5	10	545233	3958555	NESE	003	AZ14T0270N0170E	D/S	District 6
W1011	6H-15	10	550284	3962279	SWNW	029	AZ14T0280N0180E	D/S	District 6
W1012	06-1F7	10	553992	3962796	NENW	027	AZ14T0280N0180E	D/S	District 6
W1013	6-1H1	10	551946	3965554	SWNW	016	AZ14T0280N0180E	D/S	District 6
W1014	SUNLIGHT MISSION	10	546994	3962723	NWNW	025	AZ14T0280N0170E	D	District 6
W1015	06K-306	10	560100	3961970	NESW	029	AZ14T0280N0190E	D/S	District 6
W1016	06M-07	10	556625	3963765	NWSW	024	AZ14T0280N0180E	D/S	District 6
W1017	FLOWING WELL	10	558727	3964673	SESW	018	AZ14T0280N0190E	D/S	District 6
W1018	06K-301	10	556811	3966016	NWNW	013	AZ14T0280N0180E	D/S	District 6
W1019	06-1F3	10	566188	3965680	SWNW	013	AZ14T0280N0190E	D/S	District 6
W102	06-1HS	10	547211	3973754	SENE	023	AZ14T0290N0170E	D/S	District 6
W1020	06M-03	10	566527	3965639	SENW	013	AZ14T0280N0190E	D/S	District 6
W1021		10	562370	3967470	NWNE	009	AZ14T0280N0190E	D	District 6
W1022	6K-304	10	547851	3983524	NENW	024	AZ14T0300N0170E	D/S	District 6
W1023	6M-10A	10	556616	3965985	NWNW	013	AZ14T0280N0180E	D/S	District 6
W1025	6M-40	10	547196	3973781	SENE	023	AZ14T0290N0170E	D/S	District 6
W1026	6H-2-1	10	553833	3974871	NESE	016	AZ14T0290N0180E	D/S	District 6
W1027	6-1-H7/RUIN WELL, 355727110275601	10	548157	3979366	SESW	036	AZ14T0300N0170E	D/S	District 6
W1028	6K-303	10	550683	3962805	NENW	029	AZ14T0280N0180E	M	District 6
W1029	6M-10, 6-1F6/6M-10, 355013110221301	10	556811	3966046	NWNW	013	AZ14T0280N0180E	D/S	District 6
W1034	No name 4	10	559414	3967090	SENE	007	AZ14T0280N0190E	D/S	District 6
W1035	No name 5	10	552414	3964899	SESW	016	AZ14T0280N0180E	D/S	District 6
W1036	Polacca Day School Well	10	555322	3965328	NESW	014	AZ14T0280N0180E	M	District 6
W1037	Polacca #6	10	553351	3963405	NWSW	022	AZ14T0280N0180E	M	District 6
W1038	Keams Canyon #2	10	562478	3966393	SESE	009	AZ14T0280N0190E	M	District 6
W1039	Hopi High School #1	10	562434	3963711	NWSE	021	AZ14T0280N0190E	M	District 6
W104		10	552188	3980267	NENE	032	AZ14T0300N0180E	D/S	District 6
W1040	Hopi High School #3	10	563005	3964547	NWNW	022	AZ14T0280N0190E	M	District 6

US Label	Name	Plate	Easting	Northing	QQ	Sec	Lndkey	Use	Land Status
W1041	Lower Sipaulovi #1	10	545507	3961328	NWNW	035	AZ14T0280N0170E	M	District 6
W1042	Second Mesa Day School 1/ Toreva Well	10	545154	3961573	SESE	027	AZ14T0280N0170E	M	District 6
W1043	Sipaulovi-Mishongnovi Well #1	10	545751	3962716	NENW	026	AZ14T0280N0170E	M	District 6
W1044	Polacca #5	10	553251	3963312	SWSW	022	AZ14T0280N0180E	M	District 6
W1045	W1027, A-28-18 11AAD, Polacca #8	10	557089	3967234	SENW	012	AZ14T0280N0180E	M	District 6
W1046	Keams Canyon #3	10	562401	3966731	NWSE	009	AZ14T0280N0190E	M	District 6
W1047	Hopi High School #2	10	562682	3964145	SENE	021	AZ14T0280N0190E	M	District 6
W1048	Second Mesa Day School 2	10	545155	3961542	SESE	027	AZ14T0280N0170E	M	District 6
W1049	06 094 10.78 11.20	10	548848	3961868	NESW	030	AZ14T0280N0180E	D/S	District 6
W105	06M-66	10	563249	3970927	NENE	033	AZ14T0290N0190E	D/S	District 6
W106	06-1H6	10	556574	3977903	NWSE	002	AZ14T0290N0180E	D/S	District 6
W107	06K-311	10	565075	3978274	NESE	003	AZ14T0290N0190E	D/S	District 6
W108	6H-8	10	559951	3980178	SENE	031	AZ14T0300N0190E	D/S	District 6
W109	6K-305-94	10	549739	3956576	SESE	007	AZ14T0270N0180E	D/S	District 6
W1111	NO. 19	11	587542	3961429	NWNE	031	AZ14T0280N0220E	D/S	HPL
W1112	07H-26	11	584606	3963866	NWSE	023	AZ14T0280N0210E	D/S	HPL
W1113	07K-364	11	580788	3964292	NENW	021	AZ14T0280N0210E	D/S	HPL
W1114	07K-371	11	589434	3965454	NWSE	017	AZ14T0280N0220E	D/S	HPL
W1115	#18 (A8)	11	585048	3967537	NENE	011	AZ14T0280N0210E	D/S	HPL
W1116	#20	11	585247	3970342	NESW	035	AZ14T0290N0210E	D/S	HPL
W1117	07H-37	11	587203	3957214	NESW	007	AZ14T0270N0220E	D/S	HPL
W1118		11	573820	3962654	NENE	027	AZ14T0280N0200E	D/S	District 6
W112	06M-80	11	567974	3974627	SESE	013	AZ14T0290N0190E	D/S	District 6
W1120	4T-385	11	571651	3976476	NWSW	009	AZ14T0290N0200E	D/S	District 6
W1121	7P-387	11	578422	3978752	SENW	006	AZ14T0290N0210E	D/S	HPL
W1122	4M-79	11	574713	3979213	NENE	003	AZ14T0290N0200E	D/S	HPL
W1123	6K-85	11	573019	3962930	NENW	027	AZ14T0280N0200E	D/S	District 6
W1124	6M-1	11	571933	3963784	SENE	021	AZ14T0280N0200E	D/S	District 6
W1125	6P-400	11	572082	3963970	SENE	021	AZ14T0280N0200E	D/M	District 6
W1126	KEAMS PDC 1	11	570905	3963653	NWSW	021	AZ14T0280N0200E	D	District 6
W1127	KEAMS PDC 2	11	573219	3963025	SWSE	022	AZ14T0280N0200E	D/M	District 6
W115	61F9	11	568348	3956854	SWSE	007	AZ14T0270N0200E	D/S	District 6
W116	61F8	11	576261	3962526	SENW	025	AZ14T0280N0200E	D	District 6
W117	6-1F10	11	576097	3965879	NENW	013	AZ14T0280N0200E	D/S	District 6
W118	06M-02	11	569352	3966238	SWSW	008	AZ14T0280N0200E	D/S	District 6
W121	06M-45	12	521033	3956246	NWNW	017	AZ14T0270N0150E	D/S	District 6
W1210		12	514123	3946488	NWNE	016	AZ14T0260N0140E	D/S	HPL
W1211	5T-500	12	513039	3949399	SWNW	004	AZ14T0260N0140E	D/S	HPL
W1214	Sand Spring well 2	12	506089	3952578	SWNE	027	AZ14T0270N0130E	D	HPL
W123	RED ROCK SP/WELL	12	511303	3943029	SENE	030	AZ14T0260N0140E	D/S	HPL
W124	WIDE DAM #5-11	12	508811	3943099	SENW	025	AZ14T0260N0130E	D/S	HPL
W125	SALT	12	511635	3949834	L 4	005	AZ14T0260N0140E	D/S	HPL
W126	SWEET WTR WELL	12	511644	3949836	L 4	005	AZ14T0260N0140E	D/S	HPL
W127	06K-310(N)	12	515395	3949395	SENW	003	AZ14T0260N0140E	D/S	HPL
W128	06H-79	12	518183	3949985	L 4	001	AZ14T0260N0140E	D/S	District 6
W129	3A-154	12	501636	3954557	NENE	019	AZ14T0270N0130E	D/S	HPL

US Label	Name	Plate	Easting	Northing	QQ	Sec	Lndkey	Use	Land Status
W1310	06M-29	13	543248	3953738	NWSE	021	AZ14T0270N0170E	D/S	District 6
W1312	05K-330	13	528988	3935165	NENE	024	AZ14T0250N0150E	D/S	HPL
W1313	5K-300	13	526295	3935095	SWNW	023	AZ14T0250N0150E	D/S	HPL
W1314		13	522710	3935794	SWSW	016	AZ14T0250N0150E	D/S	HPL
W1315	06-2B5	13	532184	3938409	NENE	008	AZ14T0250N0160E	D/S	District 6
W1316	06M-25	13	536187	3942134	SESW	026	AZ14T0260N0160E	D/S	District 6
W1317	6K-307	13	522703	3955757	SWNW	016	AZ14T0270N0150E	D/S	District 6
W1318		13	539646	3955881	SWNE	018	AZ14T0270N0170E	D/S	District 6
W132		13	523581	3942882	L 6	028	AZ14T0260N0150E	D/S/IRR	HPL
W134	6K-307	13	522715	3956125	NWNW	016	AZ14T0270N0150E	D/S	District 6
W138	06M-26	13	543226	3948007	SWNE	009	AZ14T0260N0170E	D/S	District 6
W139	06K-304	13	535443	3951578	NENE	034	AZ14T0270N0160E	D/S	District 6
W141	06M-17A	14	556436	3951737	SESE	026	AZ14T0270N0180E	D/S	District 6
W1410	07K-315	14	552881	3932070	NENE	033	AZ14T0250N0180E	D/S	HPL
W1411	07K-302	14	550972	3935090	SWNE	020	AZ14T0250N0180E	D/S	HPL
W1412	CROWN POINT WELL	14	555944	3936341	NWSE	014	AZ14T0250N0180E	D/S	HPL
W1413	6-GS-113-1	14	553769	3949908	L 3	003	AZ14T0260N0180E	D/S	District 6
W1414	6-GS-113-2	14	549216	3947077	SESW	007	AZ14T0260N0180E	D/S	District 6
W1415	7T-503	14	553640	3941448	L 7	034	AZ14T0260N0180E	D/S	HPL
W1416	7T-502	14	555410	3940587	SESW	035	AZ14T0260N0180E	D/S	HPL
W1417	7T-501	14	557578	3940511	SWSE	036	AZ14T0260N0180E	D/S	HPL
W142	06-2BB1	14	554620	3956354	NENE	015	AZ14T0270N0180E	D/S	District 6
W143	07T-504	14	560310	3945889	NESW	017	AZ14T0260N0190E	D/S	HPL
W144		14	566594	3942853	NWSW	025	AZ14T0260N0190E	D/S	HPL
W145	06H-13	14	559341	3947135	SWSE	007	AZ14T0260N0190E	D/S	District 6
W146	06H-12	14	562677	3948987	NESE	004	AZ14T0260N0190E	D/S	District 6
W147	07H-5A2	14	566506	3947844	SWNW	012	AZ14T0260N0190E	D/S	HPL
W148	06-1T4	14	559984	3955192	SWSW	017	AZ14T0270N0190E	D/S	District 6
W149		14	551951	3930913	SWSW	033	AZ14T0250N0180E	D/S	HPL
W151	7K-355	15	569621	3943745	SESW	020	AZ14T0260N0200E	D/S	HPL
W1510	7K-363	15	575445	3945703	SESE	014	AZ14T0260N0200E	D/S	HPL
W1511	Spider Mound #1	15	581790	3950043	L 1	004	AZ14T0260N0210E	M	HPL
W1512	Spider Mound #2	15	584089	3950454	SESW	035	AZ14T0270N0210E	M	HPL
W152	07H-55	15	572833	3949453	SENW	003	AZ14T0260N0200E	D/S	HPL
W153		15	574286	3949538	SWNW	002	AZ14T0260N0200E	D/S	HPL
W155	NEW WELL	15	579952	3949117	NWSE	005	AZ14T0260N0210E	D/S	HPL
W156	07T-519	15	585437	3950508	SWSW	036	AZ14T0270N0210E	D/S	HPL
W157	GLORIA LABAN	15	587285	3955754	NESW	018	AZ14T0270N0220E	D/S	HPL
W158	7T-520	15	576349	3940528	SESW	036	AZ14T0260N0200E	D/S	HPL

Schedule of Points of Diversion from Springs for DCMI Uses

US Label	Name	Plate	Easting	Northing	QQ	Sec	Lndkey	Use	Land Status	Quantity
S012	Kai Si Kato	1	517767	4017773	SWSE	35	AZ14T0340N0140E	C/D/S	HPL	4
S0224	Red Willow	2	540580	4019378	SWSE	30	AZ14T0340N0170E	C/D/S	HPL	2
S029	Kydestea	2	529432	4020566	NENE	25	AZ14T0340N0150E	C/D/S	HPL	3
S036	4M-190A	3	554795	4029046	L 3	27	AZ14T0350N0180E	C/D/S	HPL	2
S041	3A-15	4	484408	3994456	NWSW	1	AZ14T0310N0110E	C/D/S	Moenkopi	2
S0416	Moenkopi School, Susungva	4	480126	3996029	L 2	33	AZ14T0320N0110E	C/D/S/PS/IRR	Moenkopi	8-45
S043	3A-25	4	477971	3980889	L 1	20	AZ14T0300N0110E	C/D/S	Moenkopi	0.2–0.5
S049	Tonali	4	478048	3984250	NENW	8	AZ14T0300N0110E	C/D/S	Moenkopi	0.8-3
S0513	Lower Badger	5	511997	3989101	NESE	31	AZ14T0310N0140E	C/D/S	HPL	<0.01-1.8
S0518	Willow	5	519362	3996663	SWSE	1	AZ14T0310N0140E	C/D/S	HPL	6
S052	Nee De Miso Bito	5	500861	4009736	SWSW	30	AZ14T0330N0130E	C/D/S/IRR	HPL	<0.2-5
S0522	Muddy Water	5	504212	3996819	SWSW	4	AZ14T0310N0130E	C/D/S	HPL	15
S055	Sand	5	506283	4002775	NENW	22	AZ14T0320N0130E	C/D/S	HPL	0.1-2
S0615	Sweet Water	6	536881	4009999	NESW	26	AZ14T0330N0160E	C/D/S	HPL	<0.01-10
S0623	Cottonwod, White Cave	6	531411	3988388	L 4	5	AZ14T0300N0160E	C/D/S	HPL	0.1-1
S0625	Tis-Ya-Toh	6	524875	3992209	SESE	21	AZ14T0310N0150E	C/D/S	HPL	0-1.5
S0630	4M-142	6	533513	3992078	SESW	21	AZ14T0310N0160E	C/D/S	HPL	0.8
S0632	4M-146	6	533352	4005194	NESW	9	AZ14T0320N0160E	C/D/S	HPL	1
S065	Cottonwood	6	525072	4001669	SWSW	22	AZ14T0320N0150E	C/D/S	HPL	0.5
S0714	4M-130	7	547670	3986229	NWSW	12	AZ14T0300N0170E	C/D/S	District 6	2
S073	Crooked Finger	7	561478	3987399	SESE	5	AZ14T0300N0190E	C/D/S	HPL	0.5
S075	Under Rock	7	562271	3988513	L 3	4	AZ14T0300N0190E	C/D/S	HPL	<0.1-0.5
S077	Rough Rock	7	561667	3989002	SESE	32	AZ14T0310N0190E	C/D/S	HPL	0.3-0.5
S079	4M-103	7	562493	3988280	SENW	4	AZ14T0300N0190E	C/D/S	HPL	0.5
S0810	Sweetwater	8	505151	3957383	SWNW	10	AZ14T0270N0130E	C/D/S	HPL	2
S086	Hock	8	508365	3967593	NWNW	12	AZ14T0280N0130E	C/D/S	HPL	1-2
S0911	Grooming, Naftakinva	9	542974	3962524	NWNE	28	AZ14T0280N0170E	C/D/S	District 6	<0.01-1
S0912	Brown Rock	9	542176	3962575	NWNW	28	AZ14T0280N0170E	C/D/S	District 6	0.1-0.8
S0917	Sueiva	9	542525	3963474	NESW	21	AZ14T0280N0170E	C/D/S/IRR	District 6	0.2-4
S0920	6H-24	9	544476	3965437	SWNE	15	AZ14T0280N0170E	C/D/S	District 6	0.5
S0924	Ruins	9	542851	3967999	SWSE	4	AZ14T0280N0170E	C/D/S	District 6	<0.01-0.5
S0929	Siwukva	9	528761	3973260	NESW	24	AZ14T0290N0150E	C/D/S	District 6	3
S093	Bacavi, Paaqavi	9	530656	3975401	NWNE	18	AZ14T0290N0160E	C/D/S/IRR	District 6	0-15
S0933	Unnamed	9	540352	3980905	SWSE	30	AZ14T0300N0170E	C/D/S	District 6	3
S0940	6M-59 or Siwukva	9	529374	3972839	SESE	24	AZ14T0290N0150E	C/S	District 6	2
S095	Hotevilla	9	529406	3976057	SESE	12	AZ14T0290N0150E	C/D/S/IRR	District 6	1.72
S1012	Donkey	10	559395	3977186	NENW	7	AZ14T0290N0190E	C/D/S	District 6	0.2-0.5

US Label	Name	Plate	Easting	Northing	QQ	Sec	Lndkey	Use	Land Status	Quantity
S1015	Cat	10	566663	3982178	NENE	26	AZ14T0300N0190E	C/D/S	District 6	2
S1016	Lemova	10	546611	3962413	SENE	26	AZ14T0280N0170E	C/D/S/IRR	District 6	2
S1019	Aqwda	10	545580	3964254	NWNW	23	AZ14T0280N0170E	C/D/S	District 6	1
S1025	Flower, Wuko'kwantukwi, Siipa	10	556265	3966828	NESE	11	AZ14T0280N0180E	C/D/S/IRR	District 6	<0.01-1
S1028	Buhu Va	10	563145	3960944	SWNW	34	AZ14T0280N0190E	C/D/S	District 6	1
S1029	06M-04	10	566180	3961213	NWNW	36	AZ14T0280N0190E	C/S	District 6	4
S103	Onion	10	546295	3983831	NENW	23	AZ14T0300N0170E	C/D/S	District 6	0.1-2
S1030	Sacatone, Weekebe	10	567248	3964931	SWSE	13	AZ14T0280N0190E	C/D/S	District 6	0.5
S1031	Weni Bah, Wingva, Wiinpa, Standing Water	10	560998	3970080	NESW	32	AZ14T0290N0190E	C/D/S/IRR	District 6	0.2-0.5
S1036	6H-6	10	556672	3970207	NWSE	35	AZ14T0290N0180E	C/D/S/IRR	District 6	0.5
S1038	6K-310S	10	545384	3982559	SWSE	22	AZ14T0300N0170E	C/D/S	District 6	2
S1039	6M-12	10	565285	3959503	L 3	2	AZ14T0270N0190E	C/D/S	District 6	2-4
S105	Sand Hill, Parveckpah	10	558853	3971975	L 2	30	AZ14T0290N0190E	C/D/S/IRR	District 6	0.5-0.8
S1058	Hoecevi	10	545470	3965098	NWSW	14	AZ14T0280N0170E	C/S	District 6	3
S106	Wepo South, Cottonwood, Cohoivaka	10	556938	3971976	SENE	26	AZ14T0290N0180E	C/D/S/IRR	District 6	2.7-25
S1064	6M-5	10	563575	3961719	SESW	27	AZ14T0280N0190E	C/D/S	District 6	2
S107	Wepo, Wipho, Cattail, Reed	10	557189	3972104	SWNW	25	AZ14T0290N0180E	C/D/S/IRR	District 6	1.5-30
S108	Unnamed	10	557732	3972631	NENW	25	AZ14T0290N0180E	C/D/S/IRR	District 6	<0.01-0.8
S1111	Baptist Church	11	572462	3963542	NWSW	22	AZ14T0280N0200E	C/D/S	District 6	<0.01-0.5
S1112	Chili	11	573223	3962729	NWNE	27	AZ14T0280N0200E	C/D/IRR	District 6	0.1-3
S1113	06K-01S	11	574080	3962638	NWNW	26	AZ14T0280N0200E	C/D/PS	District 6	1.5-10
S1115	06K-02S	11	575211	3963357	SESE	23	AZ14T0280N0200E	C/D/S	District 6	3-5
S1116	06K-03S	11	575313	3963415	NESE	23	AZ14T0280N0200E	C/D	District 6	0.7-10
S1117	06K-14S	11	575725	3963623	NWSW	24	AZ14T0280N0200E	C/D	District 6	0.6
S1118	06K-13S	11	575835	3963713	NWSW	24	AZ14T0280N0200E	C/D	District 6	0.5
S1119	06K-07S	11	576937	3964741	SESE	13	AZ14T0280N0200E	C/D/S	District 6	50
S1121	06K-308S	11	574890	3967321	SWNE	11	AZ14T0280N0200E	C/S	District 6	0.5
S1123	06A-21A	11	576456	3969117	L 7	1	AZ14T0280N0200E	C/D/S	District 6	0.28-2
S1135	D.Lalo	11	576934	3969565	L 1	1	AZ14T0280N0200E	C/D/S	District 6	0.8
S1137	6K-11S	11	575888	3964013	SENW	24	AZ14T0280N0200E	C/D	District 6	1.5
S1138	6K-12S	11	575808	3963932	SWNW	24	AZ14T0280N0200E	C/D	District 6	8.5
S115	07H-06	11	586835	3973698	SWNE	24	AZ14T0290N0210E	C/D/S	HPL	0.5-0.8
S118	Bluebird, Tsorva	11	568464	3960821	SWNE	31	AZ14T0280N0200E	C/D/S/IRR	District 6	2-25
S1210	5M-73	12	510470	3949651	L 3	6	AZ14T0260N0140E	C/D/S	HPL	1
S123	Sand (multiple)	12	506349	3952682	SENE	27	AZ14T0270N0130E	C/D/S/IRR	HPL	3
S127	Whiskey	12	505437	3955791	SENW	15	AZ14T0270N0130E	C/D/S/IRR	HPL	.12-4
S128	05M-04	12	505639	3955421	NESW	15	AZ14T0270N0130E	C/S/IRR	HPL	<0.01-2

US Label	Name	Plate	Easting	Northing	QQ	Sec	Lndkey	Use	Land Status	Quantity
S131	Shonto	13	523078	3948047	NENW	9	AZ14T0260N0150E	C/D/S	District 6	0.67-2
S1311	Rock Ledge, Phillips Farm	13	540287	3947409	NESE	7	AZ14T0260N0170E	C/D/S/IRR	District 6	2
S1312	Pautsvi, Burro2	13	527501	3950572	NWSW	36	AZ14T0270N0150E	C/S	District 6	0-0.5
S132	06M-33	13	525882	3947711	SWNW	11	AZ14T0260N0150E	C/D/S	District 6	0.2-0.5
S134	Burro, Honani, New Pa'utsv	13	527740	3950571	NWSW	36	AZ14T0270N0150E	C/S	District 6	0.2-1
S136	Coyote	13	539432	3945576	SESW	18	AZ14T0260N0170E	C/D/S/IRR	District 6	1-15
S138	Little Burro	13	538834	3948185	L 1	7	AZ14T0260N0170E	C/S	District 6	3
S141	Ponsi Adams	14	561353	3952830	SWNW	28	AZ14T0270N0190E	C/D/S	District 6	0.5
S1410	Ram	14	563666	3931985	SENW	34	AZ14T0250N0190E	C/D/S	HPL	0.1-0.5
S1411	Shontah	14	564087	3934176	SESE	22	AZ14T0250N0190E	C/D/S	HPL	0.5-1
S1413	Horse	14	561745	3936749	SENW	16	AZ14T0250N0190E	C/D/S	HPL	0.5-1
S1414	Belle Butte	14	559227	3935616	SWSE	18	AZ14T0250N0190E	C/D/S	HPL	0.2-1.2
S1416	Trickle, Yatcakpa	14	564920	3954397	SWNW	23	AZ14T0270N0190E	C/D/S/IRR	District 6	0.2-1.5
S142	Awat ovi	14	565259	3953511	SESW	23	AZ14T0270N0190E	C/D/S	District 6	0-2
S143	Talahogan	14	565423	3954783	NWNE	23	AZ14T0270N0190E	C/D/S/IRR	District 6	0.88-2
S145	Kalbito #1	14	551863	3931146	SWSW	33	AZ14T0250N0180E	C/D/S	HPL	1.5-5
S146	Comar	14	552922	3932018	NENE	33	AZ14T0250N0180E	C/D/S	HPL	8
S147	Seba Delkai	14	553941	3937898	NESW	10	AZ14T0250N0180E	C/D/S	HPL	1
S148	Lukai	14	559127	3931137	SWSE	31	AZ14T0250N0190E	C/D/S	HPL	0.2-1

Use Key:

C- Cultural

D - Domestic

S - Stock

IRR - Irrigation

PS - Public Supply

Schedule of Points of Diversion from Additional Springs for DCMI Uses

US Label	Name	Easting	Northing	QQ	Sec	Lndkey	Use	Land Status	Acres Irrigated
S104	Sheep, Kanelva	557184	3970362	SWNW	36	AZ14T0290N0180E	C/D/S/IRR	District 6	3.5925
S119	Nu'vatotshba, Snowbird	569991	3962591	NWNE	29	AZ14T0280N0200E	C/D/S/IRR	District 6	0.3442
S1017	Toreva, Twisted Curve	545284	3962452	SWNW	26	AZ14T0280N0170E	C/D/S/IRR	District 6	0.0775
S137	Unnamed	540993	3946827	SESW	8	AZ14T0260N0170E	C/D/S/IRR	District 6	2.2035
S1417	Hail, Lemova	565997	3955454	NESE	14	AZ14T0270N0190E	C/D/S/IRR	District 6	0.06338

Use Key:

C- Cultural

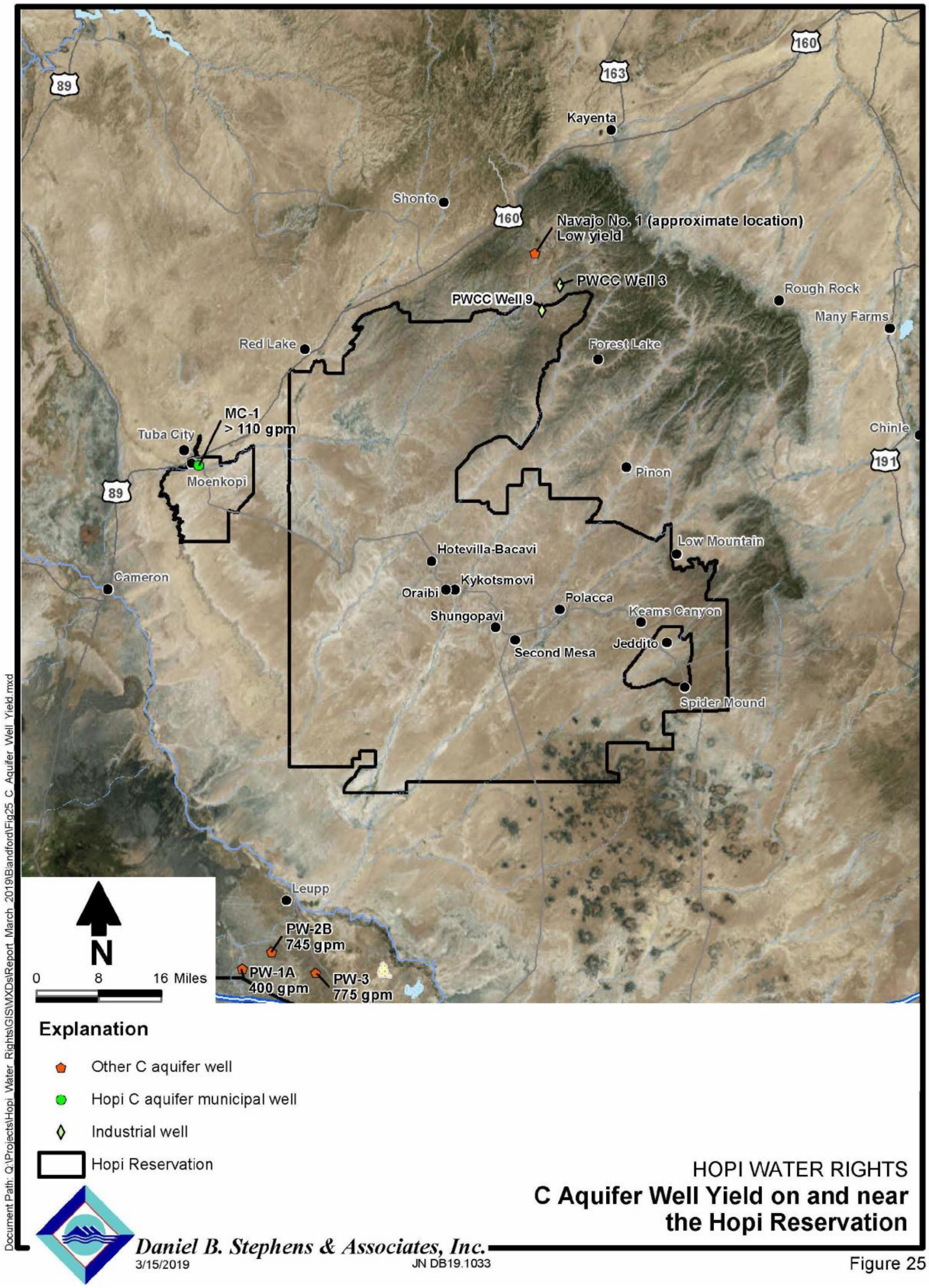
D - Domestic

S - Stock

IRR - Irrigation

PS - Public Supply

Map of well on Moenkopi Island used for DCMI uses



<u>Map of Existing and Planned Well Fields for DCMI use</u>

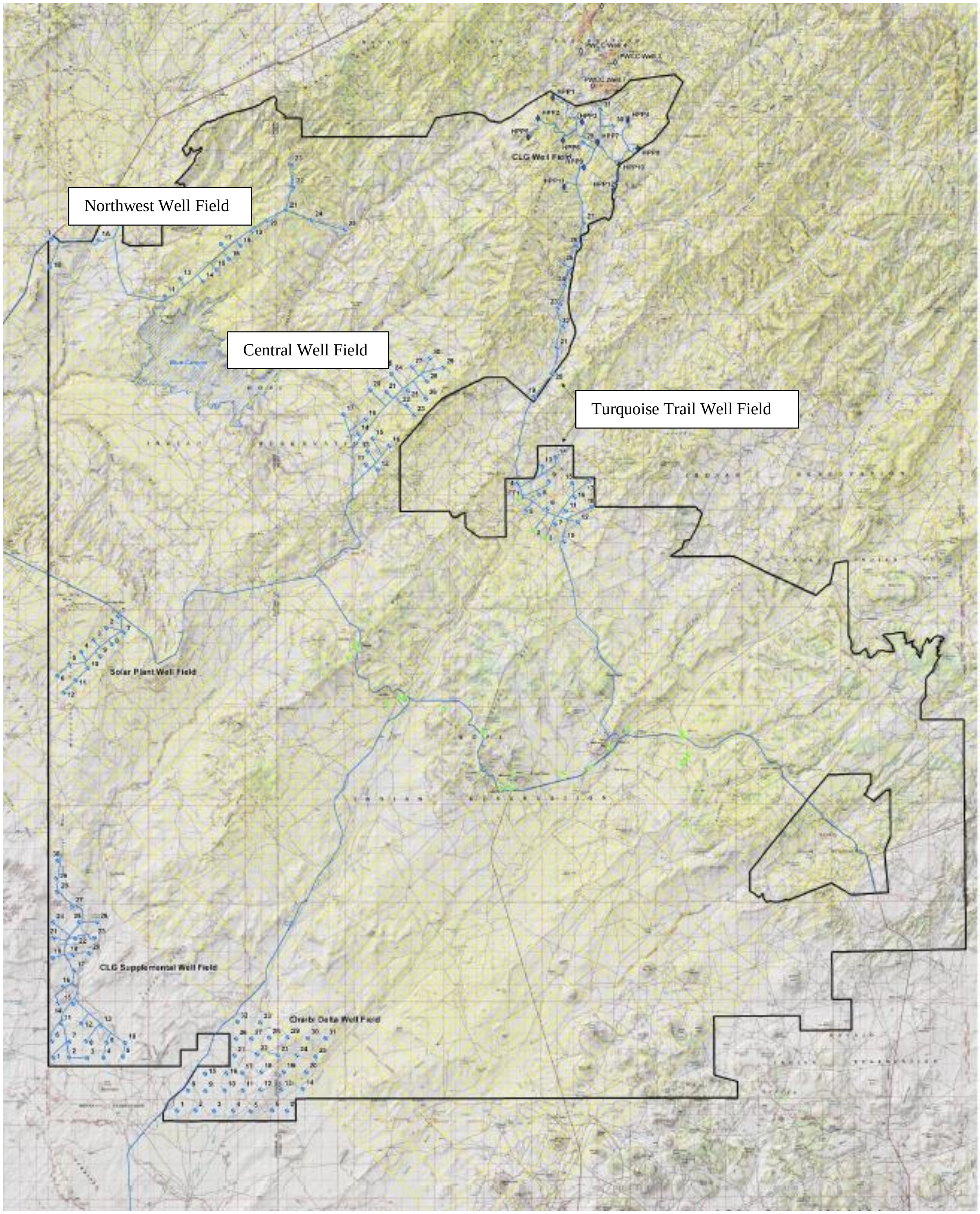


EXHIBIT C

Attributes of Water Rights for Agricultural Uses on the 1882 Reservation

from Wells, Impoundments, and Springs

Priority date	See paragraphs 20 through 23 of Recommended Decree
Type of use	Irrigation
Source of water	Wells, impoundments and springs on the 1882 Reservation
Points of diversion	Wells, impoundments, and springs on the Hopi Reservation identified on attached schedules. Maps of wells, springs, and impoundments listed on the schedules are attached as Appendix A to the Recommended Decree.
Places of use	Place of use is the same as the place of diversion as shown on attached schedules
Number of acres irrigated	188 acres: **Area** — **Acres Irrigated** Dinnebito 96 Jadito 2 Oraibi 17 Polacca 73
Diversion Amount	**Area** — **Acres Feet / Year** Dinnebito 189 Jadito 5 Oraibi 33 Polacca 158
Depletion Amount	**Area** — **Acres Feet / Year** Dinnebito 155 Jadito 4 Oraibi 27 Polacca 129
Period of use	Seasonal (April through October)
Owners	Hopi Tribe United States acting in its capacity as trustee for the Hopi Tribe

Schedule of wells used for Agricultural Use on the 1882 Reservation

US Label	Name	Plate	Easting	Northing	QQ	Sec	Lndkey	Use	Land Status
W0812	03K-311	8	516713	3982855	NESE	022	AZ14T0300N0140E	D/S/IRR	HPL
W132		13	523581	3942882	L 6	028	AZ14T0260N0150E	D/S/IRR	HPL

Schedule of Impoundments used for Agricultural Use on the 1882 Reservation

US Label	Plate	Easting	Northing	Area (acres)	Capacity (ac-ft)	QQ	Sec	Lndkey	Use	Land Status
I0981	9	529422	3976056	0.016	0.032	SESE	012	AZ14T0290N0150E	IRR/STOCK	District 6
I0982	9	530665	3975398	0.001	0.002	NWNE	018	AZ14T0290N0160E	IRR/STOCK	District 6
I10146	10	557178	3970370	0.017	0.034	SWNW	036	AZ14T0290N0180E	IRR/STOCK	District 6
I10147	10	557144	3972096	0.007	0.067	SWNW	025	AZ14T0290N0180E	IRR/STOCK	District 6
I10148	10	556945	3972009	0.006	0.064	SENE	026	AZ14T0290N0180E	IRR/STOCK	District 6
I1191	11	568414	3960735	0.012	0.025	SWNE	031	AZ14T0280N0200E	IRR/STOCK	District 6
I1192	11	569986	3962589	0.001	0.002	NWNE	029	AZ14T0280N0200E	IRR/STOCK	District 6
I14139	14	565417	3954815	0.026	0.053	NWNE	023	AZ14T0270N0190E	IRR/STOCK	District 6

Schedule of springs used for Agricultural Use on the 1882 Reservation

US Label	Name	Plate	Easting	Northing	QQ	Sec	Lndkey	Use	Land Status	Flow rate
S052	Nee De Miso Bito	5	500861	4009736	SWSW	30	AZ14T0330N0130E	C/D/S/IRR	HPL	<0.2-5
S0917	Sueiva	9	542525	3963474	NESW	21	AZ14T0280N0170E	C/D/S/IRR	District 6	0.2-4
S093	Bacavi, Paaqavi	9	530656	3975401	NWNE	18	AZ14T0290N0160E	C/D/S/IRR	District 6	0-15
S095	Hotevilla	9	529406	3976057	SESE	12	AZ14T0290N0150E	C/D/S/IRR	District 6	1.72
S1016	Lemova	10	546611	3962413	SENE	26	AZ14T0280N0170E	C/D/S/IRR	District 6	2
S1025	Flower, Wuko'kwantukwi, Siipa	10	556265	3966828	NESE	11	AZ14T0280N0180E	C/D/S/IRR	District 6	<0.01-1
S1031	Weni Bah, Wingva, Wiinpa, Standing Water	10	560998	3970080	NESW	32	AZ14T0290N0190E	C/D/S/IRR	District 6	0.2-0.5
S1036	6H-6	10	556672	3970207	NWSE	35	AZ14T0290N0180E	C/D/S/IRR	District 6	0.5
S105	Sand Hill, Parveckpah	10	558853	3971975	L 2	30	AZ14T0290N0190E	C/D/S/IRR	District 6	0.5-0.8
S106	Wepo South, Cottonwood, Cohoivaka	10	556938	3971976	SENE	26	AZ14T0290N0180E	C/D/S/IRR	District 6	2.7-25
S107	Wepo, Wipho, Cattail, Reed	10	557189	3972104	SWNW	25	AZ14T0290N0180E	C/D/S/IRR	District 6	1.5-30
S108	Unnamed	10	557732	3972631	NENW	25	AZ14T0290N0180E	C/D/S/IRR	District 6	<0.01-0.8
S1112	Chili	11	573223	3962729	NWNE	27	AZ14T0280N0200E	C/D/IRR	District 6	0.1-3
S118	Bluebird, Tsorva	11	568464	3960821	SWNE	31	AZ14T0280N0200E	C/D/S/IRR	District 6	2-25
S123	Sand (multiple)	12	506349	3952682	SENE	27	AZ14T0270N0130E	C/D/S/IRR	HPL	3
S127	Whiskey	12	505437	3955791	SENW	15	AZ14T0270N0130E	C/D/S/IRR	HPL	.12-4
S128	05M-04	12	505639	3955421	NESW	15	AZ14T0270N0130E	C/S/IRR	HPL	<0.01-2
S1311	Rock Ledge, Phillips Farm	13	540287	3947409	NESE	7	AZ14T0260N0170E	C/D/S/IRR	District 6	2
S136	Coyote	13	539432	3945576	SESW	18	AZ14T0260N0170E	C/D/S/IRR	District 6	1-15
S1416	Trickle, Yatcakpa	14	564920	3954397	SWNW	23	AZ14T0270N0190E	C/D/S/IRR	District 6	0.2-1.5
S143	Talahogan	14	565423	3954783	NWNE	23	AZ14T0270N0190E	C/D/S/IRR	District 6	0.88-2

Use Key:

C- Cultural

D - Domestic

S - Stock

IRR - Irrigation

PS - Public Supply

Schedule of additional springs used for Agricultural Uses on the 1882 Reservation

US Label	Name	Easting	Northing	QQ	Sec	Lndkey	Use	Land Status	Acres Irrigated
S104	Sheep, Kanelva	557184	3970362	SWNW	36	AZ14T0290N0180E	C/D/S/IRR	District 6	3.5925
S119	Nu'vatotshba, Snowbird	569991	3962591	NWNE	29	AZ14T0280N0200E	C/D/S/IRR	District 6	0.3442
S1017	Toreva, Twisted Curve	545284	3962452	SWNW	26	AZ14T0280N0170E	C/D/S/IRR	District 6	0.0775
S137	Unnamed	540993	3946827	SESW	8	AZ14T0260N0170E	C/D/S/IRR	District 6	2.2035
S1417	Hail, Lemova	565997	3955454	NESE	14	AZ14T0270N0190E	C/D/S/IRR	District 6	0.06338

Use Key:

C- Cultural

D - Domestic

S - Stock

IRR - Irrigation

PS - Public Supply

Attributes of Water Rights for Agricultural Uses on the 1882 Reservation

from Northern Washes and minor tributaries

Priority date	See paragraphs 20 through 23 of Recommended Decree
Type of use	Irrigation
Source of water	Northern Washes and minor tributaries on the Hopi Reservation
Period of use	Seasonal (April through October)
Owners	Hopi Tribe United States acting in its capacity as trustee for the Hopi Tribe

The length of each wash/ tributary within the boundaries of the Hopi Reservation shall constitute the points of diversion. The total amount that may be diverted from the Northern Washes and minor tributaries is 18,045 AFA. The total amount that may be diverted from the Northern Washes and minor tributaries is 12,992 AFA. The amount of water diverted and depleted from each wash/tributary is as follows:

Wash	Acres	Diversion (acre-feet/year)	Depletion (acre-feet/year)
Dinnebito	2,276	2,650	1,907
Jadito	1,302	2,259	1,627
Moenkopi	903	1,683	1,212
Oraibi	3,320	4,812	3,565
Polacca	4,759	6,615	4,763
Minor Tributaries	24	24	17

The place of use for the water diverted from each wash/tributary is the land located in, along or in close proximity to the source of water from which the water is diverted; provided, however, in no event shall any conveyance installed or method used to transport water from the wash/tributary that is the point of diversion to the place of use result in the aggregate, from that wash/tributary, losses in conveyance from that wash/tributary exceeding 10% (0.10). Conveyance efficiency from the point of diversion to place of use in the aggregate for each wash/tributary shall be no less than 90% (0.90).

Attributes of Water Rights for Agricultural Uses on Moenkopi Island

Pasture Canyon

Priority date	See paragraphs 20 through 23 of Recommended Decree
Type of use	Irrigation
Source of water	Pasture Canyon and springs in Pasture Canyon located in the Hopi Reservation
Points of diversion	Pasture Canyon Reservoir Section 32 T13N R11E
Places of use	Land located in or near to Pasture Canyon
Number of acres irrigated	142.4 acres
Volume	259.3 AFA
Period of use	Seasonal (April through October)
Owners	Hopi Tribe United States acting in its capacity as trustee for the Hopi Tribe

Attributes of Water Rights for Agricultural Uses on Moenkopi Island

Priority date	See paragraphs 20 through 23 of Recommended Decree
Type of use	Irrigation
Source of water	Springs and impoundments in Moenkopi Island
Points of diversion	See attached schedule
Places of use	S2 Section 34 T32N R11E
Number of acres irrigated	15 acres
Volume	25.43 AFA
Period of use	Seasonal (April through October)
Owners	Hopi Tribe United States acting in its capacity as trustee for the Hopi Tribe

Schedule of impoundments used for Agricultural Use on Moenkopi Island

US Label	Plate	Easting	Northing	Area (acres)	Capacit y (ac-ft)	QQ	Sec	Lndkey	Use	Land Status
I048	4	480978	3997874	5.642	12.748	L 11	027	AZ14T0320N0110E	IRR/STOCK	Moenkopi
I0411	4	480761	3999554	36.399	212.000	L 2	021	AZ14T0320N0110E	IRR/STOCK	Moenkopi

Schedule of springs used for Agricultural Use on Moenkopi Island

US Label	Name	Plate	Easting	Northing	QQ	Sec	Lndkey	Use	Land Status	Quantity
S0416	Moenkopi School, Susungva	4	480126	3996029	L 2	33	AZ14T0320N0110E	C/D/S/PS/IRR	Moenkopi	8-45

Schedule of Place of Use for Agricultural Use on Moenkopi Island

978		32N 11E	34	SESW	Spring	11.243	Unnamed spring	S0425
979		32N 11E	34	SWSE	Spring	0.1475	Unnamed spring	S0427
980		32N 11E	34	SWSE	Spring	0.0304	Unnamed spring	S0427
980		32N 11E	34	SESE	Spring	2.0057	Unnamed spring	S0427
981		32N 11E	34	SWSE	Spring	0.0703	Unnamed spring	S0427

Source: U.S. exh. 582

EXHIBIT D

Attributes of Rights for Livestock and Wildlife Watering Uses

Priority date	See paragraphs 20 through 23 of Recommended Decree
Type of use	Livestock and wildlife watering
Source of water	Groundwater, washes, springs, and stockponds on the Hopi Reservation
Points of diversion	Wells, washes, springs and stockponds as shown on attached Schedule D-1. Maps of wells, springs, and impoundments are attached as Appendix A to the Recommended Decree.
Places of use	See attached Schedule D-2
Volume	824 AFA
Period of use	Year-round
Owners	Hopi Tribe United States acting in its capacity as trustee for the Hopi Tribe

Schedule D-1

Wells used for Livestock and Wildlife Watering

US Label	Name	Plate	Easting	Northing	QQ	Sec	Lndkey	Use	Land Status
W011		1	518500	4025870	SWSW	001	AZ14T0340N0140E	D/S	HPL
W012	1-A70	1	506765	4015570	NWNE	010	AZ14T0330N0130E	S	HPL
W014	SIDE ROCK WELL	1	501983	4011800	NWSE	019	AZ14T0330N0130E	D/S	HPL
W015	01 058-15.75X10.07	1	505984	4013862	SWNW	015	AZ14T0330N0130E	S	HPL
W021	04K-387	2	539248	4016419	NESE	001	AZ14T0330N0160E	D/S	HPL
W022	04-380	2	542209	4022085	NENE	020	AZ14T0340N0170E	D/S	HPL
W023	02T-503	2	534499	4025026	SENE	009	AZ14T0340N0160E	D/S	HPL
W024		2	522821	4019656	NWSE	029	AZ14T0340N0150E	D/S	HPL
W031	SAGE BRUSH WELL	3	554960	4028644	NWNE	034	AZ14T0350N0180E	D/S	HPL
W032	OWL WELL	3	549776	4015802	NENW	007	AZ14T0330N0180E	D/S	HPL
W033	ANGRY MAN WELL	3	549720	4016470	NESW	006	AZ14T0330N0180E	D/S	HPL
W034	04T-406	3	554271	4019432	SESW	027	AZ14T0340N0180E	D/S	HPL
W035	04T-405	3	552369	4025610	NWNW	009	AZ14T0340N0180E	D/S	HPL
W036		3	549600	4021308	NESW	019	AZ14T0340N0180E	S	HPL
W037	4K-380, 362152110204801	3	558550	4024570	NESE	012	AZ14T0340N0180E	D/S	HPL
W041		4	482733	3981130	NWNW	023	AZ14T0300N0110E	D/S	Moenkopi
W042		4	486893	3982941	SESE	007	AZ14T0300N0120E	D/S	Moenkopi
W043		4	481270	3988189	NWSW	027	AZ14T0310N0110E	D/S	Moenkopi
W044		4	492482	3990175	SWNW	023	AZ14T0310N0120E	D/S	Moenkopi
W045		4	479928	3996972	NENW	033	AZ14T0320N0110E	D/S	Moenkopi
W046	Moenkopi Well #1	4	480515	3997464	L 8	028	AZ14T0320N0110E	D/S	Moenkopi
W047	CRATER WELL	4	478990	3993318	SENE	008	AZ14T0310N0110E	D/S	Moenkopi
W048	No name 1	4	483638	3995026	SWNE	002	AZ14T0310N0110E	S	Moenkopi
W0510		5	520906	3988841	SWSE	031	AZ14T0310N0150E	S	HPL
W0511	JUA2-8-844B	5	521500	3991245	SENE	030	AZ14T0310N0150E	D/S	HPL
W0512	03K-344	5	517695	3992500	NWSE	023	AZ14T0310N0140E	D/S	HPL
W0513	03M-156	5	511941	3994000	NESE	018	AZ14T0310N0140E	D/S	HPL
W0514		5	514848	3997227	NESE	004	AZ14T0310N0140E	D/S	HPL
W0515	New well 1	5	508242	4011338	SWSE	023	AZ14T0330N0130E	S	HPL
W052	NEW WELL	5	508250	4011309	SWSE	023	AZ14T0330N0130E	D/S	HPL
W054	JUA2-7-345	5	509682	4001053	NWNE	025	AZ14T0320N0130E	D/S	HPL
W055	BLUE CYN WELL	5	511081	4001023	SENW	030	AZ14T0320N0140E	D/S	HPL
W056	2/7/01	5	504989	3998432	SWSE	033	AZ14T0320N0130E	S	HPL
W057	03K-345	5	508461	3997138	NESE	002	AZ14T0310N0130E	D/S	HPL
W058	03K-330	5	503739	3992606	SENE	020	AZ14T0310N0130E	D/S	HPL
W059	TOH HA HA CLAH	5	521967	3984530	NWSW	017	AZ14T0300N0150E	D/S	HPL
W061	04K-391	6	526202	3999977	SESE	027	AZ14T0320N0150E	D/S	HPL
W0610	04M-138	6	527304	3996923	SWSE	002	AZ14T0310N0150E	D/S	HPL
W0611		6	536656	3986243	SENW	011	AZ14T0300N0160E	D/S	HPL
W062	4T-515	6	527711	4001600	SESE	023	AZ14T0320N0150E	D/S	HPL
W063	2/11/01	6	535750	3999518	NENE	034	AZ14T0320N0160E	D/S	HPL
W064	04K-384	6	535637	4002691	NWNE	022	AZ14T0320N0160E	D/S	HPL

US Label	Name	Plate	Easting	Northing	QQ	Sec	Lndkey	Use	Land Status
W065	BENALLY WELL	6	543514	4006394	SWSE	004	AZ14T0320N0170E	D/S	HPL
W066	JUA2-5-1	6	541999	4009683	SWSE	029	AZ14T0330N0170E	D/S	HPL
W067	H-3-NO-3	6	533674	3987094	SESW	004	AZ14T0300N0160E	D/S	HPL
W068		6	525858	3989624	SWNE	034	AZ14T0310N0150E	D/S	HPL
W069	HK-383	6	528643	3994901	NENW	013	AZ14T0310N0150E	D/S	HPL
W071	4T-395	7	551579	4006530	SWSE	005	AZ14T0320N0180E	D/S	HPL
W073	04M-89A	7	550485	3992751	SENE	019	AZ14T0310N0180E	D/S	HPL
W074	04M-87	7	557380	3986447	SWNW	012	AZ14T0300N0180E	D/S	HPL
W075	ROUGH NECK WELL	7	561297	3988229	SWNE	005	AZ14T0300N0190E	D/S	HPL
W076	4M-89	7	550052	3992728	SWNE	019	AZ14T0310N0180E	D/S	HPL
W077	TURQUOISE TRAIL	7	546174	3989773	SWNW	035	AZ14T0310N0170E	D/S	HPL
W078	06-1H4	7	548457	3984144	SWSE	013	AZ14T0300N0170E	D/S	District 6
W081	03M-176A	8	502324	3979356	NESE	031	AZ14T0300N0130E	D/S	HPL
W0810	06H-55	8	518105	3978076	NWSE	002	AZ14T0290N0140E	D/S	District 6
W0811		8	511736	3978534	L 1	006	AZ14T0290N0140E	S	HPL
W0812	03K-311	8	516713	3982855	NESE	022	AZ14T0300N0140E	D/S/IRR	HPL
W0813	SWEET WATER WELL	8	505788	3957640	NWNE	010	AZ14T0270N0130E	D/S	HPL
W0814	O3A-153	8	501318	3960965	NWNE	031	AZ14T0280N0130E	D/S	HPL
W0815	MOENKOPI MONUMEN	8	503224	3965001	NESE	017	AZ14T0280N0130E	D/S	HPL
W0816	3K-320	8	505958	3965865	NWNE	015	AZ14T0280N0130E	D/S	HPL
W0817	3M-175	8	502370	3969438	SESE	031	AZ14T0290N0130E	D/S	HPL
W0818	06M-44	8	516502	3961781	NWSW	026	AZ14T0280N0140E	D/S	District 6
W0819	6-11A	8	517554	3967497	NENE	011	AZ14T0280N0140E	D/S	District 6
W082	DRY WELL	8	509360	3978514	L 3	001	AZ14T0290N0130E	D/S	HPL
W0821	6-3BP3	8	513030	3957157	NWSW	009	AZ14T0270N0140E	S	District 6
W0822	06K-321	8	515058	3956970	NESW	010	AZ14T0270N0140E	D/S	District 6
W0823	06-3BP1	8	511708	3961321	SWSW	029	AZ14T0280N0140E	S	District 6
W0824	06M-50	8	518568	3965562	SENW	013	AZ14T0280N0140E	D/S	District 6
W0825	06K-322	8	521096	3967335	NWNW	008	AZ14T0280N0150E	D/S	District 6
W0826	06M-174	8	515662	3969734	NWSW	034	AZ14T0290N0140E	D/S	District 6
W0827	3M-176	8	502242	3979419	NESE	031	AZ14T0300N0130E	D/S	HPL
W083	03K-332	8	507780	3976681	SENW	011	AZ14T0290N0130E	D/S	HPL
W0830	Orange Tank	8	512913	3970042	NWSE	032	AZ14T0290N0140E	S	HPL
W0831	Howell Mesa Tanl/Dam	8	507908	3964288	NENE	023	AZ14T0280N0130E	S	HPL
W084	BEETSO WELL	8	506536	3973195	NWSE	022	AZ14T0290N0130E	D/S	HPL
W085	03T-500	8	505448	3979575	NESE	033	AZ14T0300N0130E	S	HPL
W086	N HOCK SPRING WE	8	507476	3971144	SWSW	026	AZ14T0290N0130E	S	HPL
W087		8	521644	3978195	SENE	006	AZ14T0290N0150E	D/S	District 6
W088	H-3WD2	8	512072	3971479	NESE	030	AZ14T0290N0140E	S	HPL
W089	06M-183A	8	514045	3975826	SWSW	009	AZ14T0290N0140E	D/S	District 6
W091	06M70	9	525397	3976036	SESW	010	AZ14T0290N0150E	D/S	District 6
W0910	06M-52A	9	532874	3965080	NESW	016	AZ14T0280N0160E	D/S	District 6
W0911	06-3-503	9	529384	3967576	L 5	007	AZ14T0280N0160E	S	District 6
W0912	FLUTE WELL	9	532033	3969870	NESW	032	AZ14T0290N0160E	D/S	District 6
W0913	06M-302B	9	534545	3969228	L 7	003	AZ14T0280N0160E	D/S	District 6
W0914	06M-302A, Kykotsmovi PM2/Hopi Tribal Well	9	533289	3969682	SWSW	033	AZ14T0290N0160E	S	District 6

US Label	Name	Plate	Easting	Northing	QQ	Sec	Lndkey	Use	Land Status
W0915	6K-305-95	9	538129	3957817	NWNE	012	AZ14T0270N0160E	D/S	District 6
W0916	6K-309A	9	529810	3975111	L 2	018	AZ14T0290N0160E	D/S	District 6
W092		9	530506	3976823	SENW	007	AZ14T0290N0160E	D/S	District 6
W0922	6M-61	9	540263	3977758	SWSE	006	AZ14T0290N0170E	D/S	District 6
W0923	6-NO1	9	537353	3976964	SWNE	011	AZ14T0290N0160E	D/S	District 6
W0927	6M-35, 354647110390201	9	531520	3959573	L 6	005	AZ14T0270N0160E	S	District 6
W093	06M-60	9	537435	3973768	NENE	023	AZ14T0290N0160E	D/S	District 6
W094	06M-64	9	536591	3982270	SESW	023	AZ14T0300N0160E	D/S	District 6
W095	06M-46	9	524042	3958102	SESE	004	AZ14T0270N0150E	D/S	District 6
W096		9	526126	3959257	SWNW	002	AZ14T0270N0150E	D/S	District 6
W097	06K-261	9	531269	3959418	L 7	005	AZ14T0270N0160E	D/S	District 6
W098		9	522980	3961087	NWNW	033	AZ14T0280N0150E	S	District 6
W099	06K-310	9	527111	3964519	SESE	014	AZ14T0280N0150E	D/S	District 6
W1010	06PW5	10	545233	3958555	NESE	003	AZ14T0270N0170E	D/S	District 6
W1011	6H-15	10	550284	3962279	SWNW	029	AZ14T0280N0180E	D/S	District 6
W1012	06-1F7	10	553992	3962796	NENW	027	AZ14T0280N0180E	D/S	District 6
W1013	6-1H1	10	551946	3965554	SWNW	016	AZ14T0280N0180E	D/S	District 6
W1015	06K-306	10	560100	3961970	NESW	029	AZ14T0280N0190E	D/S	District 6
W1016	06M-07	10	556625	3963765	NWSW	024	AZ14T0280N0180E	D/S	District 6
W1017	FLOWING WELL	10	558727	3964673	SESW	018	AZ14T0280N0190E	D/S	District 6
W1018	06K-301	10	556811	3966016	NWNW	013	AZ14T0280N0180E	D/S	District 6
W1019	06-1F3	10	566188	3965680	SWNW	013	AZ14T0280N0190E	D/S	District 6
W102	06-1HS	10	547211	3973754	SENE	023	AZ14T0290N0170E	D/S	District 6
W1020	06M-03	10	566527	3965639	SENW	013	AZ14T0280N0190E	D/S	District 6
W1022	6K-304	10	547851	3983524	NENW	024	AZ14T0300N0170E	D/S	District 6
W1023	6M-10A	10	556616	3965985	NWNW	013	AZ14T0280N0180E	D/S	District 6
W1025	6M-40	10	547196	3973781	SENE	023	AZ14T0290N0170E	D/S	District 6
W1026	6H-2-1	10	553833	3974871	NESE	016	AZ14T0290N0180E	D/S	District 6
W1027	6-1-H7/RUIN WELL, 355727110275601	10	548157	3979366	SESW	036	AZ14T0300N0170E	D/S	District 6
W1029	6M-10, 6-1F6/6M-10, 355013110221301	10	556811	3966046	NWNW	013	AZ14T0280N0180E	D/S	District 6
W1033	No name 3	10	554219	3968445	NWSE	003	AZ14T0280N0180E	S	District 6
W1034	No name 4	10	559414	3967090	SENE	007	AZ14T0280N0190E	D/S	District 6
W1035	No name 5	10	552414	3964899	SESW	016	AZ14T0280N0180E	D/S	District 6
W104		10	552188	3980267	NENE	032	AZ14T0300N0180E	D/S	District 6
W1049	06 094 10.78 11.20	10	548848	3961868	NESW	030	AZ14T0280N0180E	D/S	District 6
W105	06M-66	10	563249	3970927	NENE	033	AZ14T0290N0190E	D/S	District 6
W1050	3557481	10	547004	3980056	SWNE	035	AZ14T0300N0170E	S	District 6
W106	06-1H6	10	556574	3977903	NWSE	002	AZ14T0290N0180E	D/S	District 6
W107	06K-311	10	565075	3978274	NESE	003	AZ14T0290N0190E	D/S	District 6
W108	6H-8	10	559951	3980178	SENE	031	AZ14T0300N0190E	D/S	District 6
W109	6K-305-94	10	549739	3956576	SESE	007	AZ14T0270N0180E	D/S	District 6
W1111	NO. 19	11	587542	3961429	NWNE	031	AZ14T0280N0220E	D/S	HPL
W1112	07H-26	11	584606	3963866	NWSE	023	AZ14T0280N0210E	D/S	HPL
W1113	07K-364	11	580788	3964292	NENW	021	AZ14T0280N0210E	D/S	HPL
W1114	07K-371	11	589434	3965454	NWSE	017	AZ14T0280N0220E	D/S	HPL
W1115	#18 (A8)	11	585048	3967537	NENE	011	AZ14T0280N0210E	D/S	HPL

US Label	Name	Plate	Easting	Northing	QQ	Sec	Lndkey	Use	Land Status
W1116	#20	11	585247	3970342	NESW	035	AZ14T0290N0210E	D/S	HPL
W1117	07H-37	11	587203	3957214	NESW	007	AZ14T0270N0220E	D/S	HPL
W1118		11	573820	3962654	NENE	027	AZ14T0280N0200E	D/S	District 6
W112	06M-80	11	567974	3974627	SESE	013	AZ14T0290N0190E	D/S	District 6
W1120	4T-385	11	571651	3976476	NWSW	009	AZ14T0290N0200E	D/S	District 6
W1121	7P-387	11	578422	3978752	SENW	006	AZ14T0290N0210E	D/S	HPL
W1122	4M-79	11	574713	3979213	NENE	003	AZ14T0290N0200E	D/S	HPL
W1123	6K-85	11	573019	3962930	NENW	027	AZ14T0280N0200E	D/S	District 6
W1124	6M-1	11	571933	3963784	SENE	021	AZ14T0280N0200E	D/S	District 6
W1128	New well 3	11	567781	3957969	L 1	007	AZ14T0270N0200E	S	District 6
W113		11	578467	3981100	SESW	030	AZ14T0300N0210E	S	HPL
W115	61F9	11	568348	3956854	SWSE	007	AZ14T0270N0200E	D/S	District 6
W117	6-1F10	11	576097	3965879	NENW	013	AZ14T0280N0200E	D/S	District 6
W118	06M-02	11	569352	3966238	SWSW	008	AZ14T0280N0200E	D/S	District 6
W119	06K-320	11	571311	3969252	L 6	004	AZ14T0280N0200E	S	District 6
W121	06M-45	12	521033	3956246	NWNW	017	AZ14T0270N0150E	D/S	District 6
W1210		12	514123	3946488	NWNE	016	AZ14T0260N0140E	D/S	HPL
W1211	5T-500	12	513039	3949399	SWNW	004	AZ14T0260N0140E	D/S	HPL
W1212	No name 6	12	516328	3943102	SWNW	026	AZ14T0260N0140E	S	HPL
W1213	3542181	12	515391	3951212	NENW	034	AZ14T0270N0140E	S	District 6
W1215	New well 2	12	506235	3949356	SENE	003	AZ14T0260N0130E	S	HPL
W122	SAND VALLEY WELL	12	501018	3945898	NWSE	018	AZ14T0260N0130E	S	HPL
W123	RED ROCK SP/WELL	12	511303	3943029	SENE	030	AZ14T0260N0140E	D/S	HPL
W124	WIDE DAM #5-11	12	508811	3943099	SENW	025	AZ14T0260N0130E	D/S	HPL
W125	SALT	12	511635	3949834	L 4	005	AZ14T0260N0140E	D/S	HPL
W126	SWEET WTR WELL	12	511644	3949836	L 4	005	AZ14T0260N0140E	D/S	HPL
W127	06K-310(N)	12	515395	3949395	SENW	003	AZ14T0260N0140E	D/S	HPL
W128	06H-79	12	518183	3949985	L 4	001	AZ14T0260N0140E	D/S	District 6
W129	3A-154	12	501636	3954557	NENE	019	AZ14T0270N0130E	D/S	HPL
W1310	06M-29	13	543248	3953738	NWSE	021	AZ14T0270N0170E	D/S	District 6
W1312	05K-330	13	528988	3935165	NENE	024	AZ14T0250N0150E	D/S	HPL
W1313	5K-300	13	526295	3935095	SWNW	023	AZ14T0250N0150E	D/S	HPL
W1314		13	522710	3935794	SWSW	016	AZ14T0250N0150E	D/S	HPL
W1315	06-2B5	13	532184	3938409	NENE	008	AZ14T0250N0160E	D/S	District 6
W1316	06M-25	13	536187	3942134	SESW	026	AZ14T0260N0160E	D/S	District 6
W1317	6K-307	13	522703	3955757	SWNW	016	AZ14T0270N0150E	D/S	District 6
W1318		13	539646	3955881	SWNE	018	AZ14T0270N0170E	D/S	District 6
W132		13	523581	3942882	L 6	028	AZ14T0260N0150E	D/S/IRR	HPL
W133	06-2B6	13	531442	3953257	SESW	020	AZ14T0270N0160E	S	District 6
W134	6K-307	13	522715	3956125	NWNW	016	AZ14T0270N0150E	D/S	District 6
W135	06M-27	13	538725	3948144	NENE	012	AZ14T0260N0160E	S	District 6
W138	06M-26	13	543226	3948007	SWNE	009	AZ14T0260N0170E	D/S	District 6
W139	06K-304	13	535443	3951578	NENE	034	AZ14T0270N0160E	D/S	District 6
W141	06M-17A	14	556436	3951737	SESE	026	AZ14T0270N0180E	D/S	District 6
W1410	07K-315	14	552881	3932070	NENE	033	AZ14T0250N0180E	D/S	HPL
W1411	07K-302	14	550972	3935090	SWNE	020	AZ14T0250N0180E	D/S	HPL
W1412	CROWN POINT WELL	14	555944	3936341	NWSE	014	AZ14T0250N0180E	D/S	HPL
W1413	6-GS-113-1	14	553769	3949908	L 3	003	AZ14T0260N0180E	D/S	District 6

US Label	Name	Plate	Easting	Northing	QQ	Sec	Lndkey	Use	Land Status
W1414	6-GS-113-2	14	549216	3947077	SESW	007	AZ14T0260N0180E	D/S	District 6
W1415	7T-503	14	553640	3941448	L 7	034	AZ14T0260N0180E	D/S	HPL
W1416	7T-502	14	555410	3940587	SESW	035	AZ14T0260N0180E	D/S	HPL
W1417	7T-501	14	557578	3940511	SWSE	036	AZ14T0260N0180E	D/S	HPL
W1418	New well 4	14	551861	3931259	NWSW	033	AZ14T0250N0180E	S	HPL
W142	06-2BB1	14	554620	3956354	NENE	015	AZ14T0270N0180E	D/S	District 6
W143	07T-504	14	560310	3945889	NESW	017	AZ14T0260N0190E	D/S	HPL
W144		14	566594	3942853	NWSW	025	AZ14T0260N0190E	D/S	HPL
W145	06H-13	14	559341	3947135	SWSE	007	AZ14T0260N0190E	D/S	District 6
W146	06H-12	14	562677	3948987	NESE	004	AZ14T0260N0190E	D/S	District 6
W147	07H-5A2	14	566506	3947844	SWNW	012	AZ14T0260N0190E	D/S	HPL
W148	06-1T4	14	559984	3955192	SWSW	017	AZ14T0270N0190E	D/S	District 6
W149		14	551951	3930913	SWSW	033	AZ14T0250N0180E	D/S	HPL
W151	7K-355	15	569621	3943745	SESW	020	AZ14T0260N0200E	D/S	HPL
W1510	7K-363	15	575445	3945703	SESE	014	AZ14T0260N0200E	D/S	HPL
W152	07H-55	15	572833	3949453	SENW	003	AZ14T0260N0200E	D/S	HPL
W153		15	574286	3949538	SWNW	002	AZ14T0260N0200E	D/S	HPL
W154	07H-5A7A1	15	588148	3948553	NENE	007	AZ14T0260N0220E	S	HPL
W155	NEW WELL	15	579952	3949117	NWSE	005	AZ14T0260N0210E	D/S	HPL
W156	07T-519	15	585437	3950508	SWSW	036	AZ14T0270N0210E	D/S	HPL
W157	GLORIA LABAN	15	587285	3955754	NESW	018	AZ14T0270N0220E	D/S	HPL
W158	7T-520	15	576349	3940528	SESW	036	AZ14T0260N0200E	D/S	HPL

Schedule D-1

Springs used for Livestock and Wildlife Watering

US Label	Name	Plate	Easting	Northing	QQ	Sec	Lndkey	Use	Land Status	Quantity
S012	Kai Si Kato	1	517767	4017773	SWSE	35	AZ14T0340N0140E	C/D/S	HPL	4
S0224	Red Willow	2	540580	4019378	SWSE	30	AZ14T0340N0170E	C/D/S	HPL	2
S029	Kydestea	2	529432	4020566	NENE	25	AZ14T0340N0150E	C/D/S	HPL	3
S036	4M-190A	3	554795	4029046	L 3	27	AZ14T0350N0180E	C/D/S	HPL	2
S041	3A-15	4	484408	3994456	NWSW	1	AZ14T0310N0110E	C/D/S	Moenkopi	2
S0416	Moenkopi School, Susungva	4	480126	3996029	L 2	33	AZ14T0320N0110E	C/D/S/PS/IRR	Moenkopi	8-45
S043	3A-25	4	477971	3980889	L 1	20	AZ14T0300N0110E	C/D/S	Moenkopi	0.2–0.5
S049	Tonali	4	478048	3984250	NENW	8	AZ14T0300N0110E	C/D/S	Moenkopi	0.8-3
S0513	Lower Badger	5	511997	3989101	NESE	31	AZ14T0310N0140E	C/D/S	HPL	<0.01-1.8
S0518	Willow	5	519362	3996663	SWSE	1	AZ14T0310N0140E	C/D/S	HPL	6
S052	Nee De Miso Bito	5	500861	4009736	SWSW	30	AZ14T0330N0130E	C/D/S/IRR	HPL	<0.2-5
S0522	Muddy Water	5	504212	3996819	SWSW	4	AZ14T0310N0130E	C/D/S	HPL	15
S055	Sand	5	506283	4002775	NENW	22	AZ14T0320N0130E	C/D/S	HPL	0.1-2
S0615	Sweet Water	6	536881	4009999	NESW	26	AZ14T0330N0160E	C/D/S	HPL	<0.01-10
S0623	Cottonwood, White Cave	6	531411	3988388	L 4	5	AZ14T0300N0160E	C/D/S	HPL	0.1-1
S0625	Tis-Ya-Toh	6	524875	3992209	SESE	21	AZ14T0310N0150E	C/D/S	HPL	0-1.5
S0630	4M-142	6	533513	3992078	SESW	21	AZ14T0310N0160E	C/D/S	HPL	0.8
S0632	4M-146	6	533352	4005194	NESW	9	AZ14T0320N0160E	C/D/S	HPL	1
S065	Cottonwood	6	525072	4001669	SWSW	22	AZ14T0320N0150E	C/D/S	HPL	0.5
S0714	4M-130	7	547670	3986229	NWSW	12	AZ14T0300N0170E	C/D/S	District 6	2
S073	Crooked Finger	7	561478	3987399	SESE	5	AZ14T0300N0190E	C/D/S	HPL	0.5
S075	Under Rock	7	562271	3988513	L 3	4	AZ14T0300N0190E	C/D/S	HPL	<0.1-0.5
S077	Rough Rock	7	561667	3989002	SESE	32	AZ14T0310N0190E	C/D/S	HPL	0.3-0.5
S079	4M-103	7	562493	3988280	SENW	4	AZ14T0300N0190E	C/D/S	HPL	0.5
S0810	Sweetwater	8	505151	3957383	SWNW	10	AZ14T0270N0130E	C/D/S	HPL	2
S086	Hock	8	508365	3967593	NWNW	12	AZ14T0280N0130E	C/D/S	HPL	1-2
S0911	Grooming, Naftakinva	9	542974	3962524	NWNE	28	AZ14T0280N0170E	C/D/S	District 6	<0.01-1
S0912	Brown Rock	9	542176	3962575	NWNW	28	AZ14T0280N0170E	C/D/S	District 6	0.1-0.8
S0917	Sueiva	9	542525	3963474	NESW	21	AZ14T0280N0170E	C/D/S/IRR	District 6	0.2-4
S0920	6H-24	9	544476	3965437	SWNE	15	AZ14T0280N0170E	C/D/S	District 6	0.5
S0924	Ruins	9	542851	3967999	SWSE	4	AZ14T0280N0170E	C/D/S	District 6	<0.01-0.5
S0929	Siwukva	9	528761	3973260	NESW	24	AZ14T0290N0150E	C/D/S	District 6	3
S093	Bacavi, Paaqavi	9	530656	3975401	NWNE	18	AZ14T0290N0160E	C/D/S/IRR	District 6	0-15
S0933	Unnamed	9	540352	3980905	SWSE	30	AZ14T0300N0170E	C/D/S	District 6	3

US Label	Name	Plate	Easting	Northing	QQ	Sec	Lndkey	Use	Land Status	Quantity
S0940	6M-59 or Siwukva	9	529374	3972839	SESE	24	AZ14T0290N0150E	C/S	District 6	2
S095	Hotevilla	9	529406	3976057	SESE	12	AZ14T0290N0150E	C/D/S/IRR	District 6	1.72
S1012	Donkey	10	559395	3977186	NENW	7	AZ14T0290N0190E	C/D/S	District 6	0.2-0.5
S1015	Cat	10	566663	3982178	NENE	26	AZ14T0300N0190E	C/D/S	District 6	2
S1016	Lemova	10	546611	3962413	SENE	26	AZ14T0280N0170E	C/D/S/IRR	District 6	2
S1019	Aqwda	10	545580	3964254	NWNW	23	AZ14T0280N0170E	C/D/S	District 6	1
S1025	Flower, Wuko'kwantukwi, Siipa	10	556265	3966828	NESE	11	AZ14T0280N0180E	C/D/S/IRR	District 6	<0.01-1
S1028	Buhu Va	10	563145	3960944	SWNW	34	AZ14T0280N0190E	C/D/S	District 6	1
S1029	06M-04	10	566180	3961213	NWNW	36	AZ14T0280N0190E	C/S	District 6	4
S103	Onion	10	546295	3983831	NENW	23	AZ14T0300N0170E	C/D/S	District 6	0.1-2
S1030	Sacatone, Weekebe	10	567248	3964931	SWSE	13	AZ14T0280N0190E	C/D/S	District 6	0.5
S1031	Weni Bah, Wingva, Wiinpa, Standing Water	10	560998	3970080	NESW	32	AZ14T0290N0190E	C/D/S/IRR	District 6	0.2-0.5
S1036	6H-6	10	556672	3970207	NWSE	35	AZ14T0290N0180E	C/D/S/IRR	District 6	0.5
S1038	6K-310S	10	545384	3982559	SWSE	22	AZ14T0300N0170E	C/D/S	District 6	2
S1039	6M-12	10	565285	3959503	L 3	2	AZ14T0270N0190E	C/D/S	District 6	2-4
S105	Sand Hill, Parveckpah	10	558853	3971975	L 2	30	AZ14T0290N0190E	C/D/S/IRR	District 6	0.5-0.8
S1058	Hoecevi	10	545470	3965098	NWSW	14	AZ14T0280N0170E	C/S	District 6	3
S106	Wepo South, Cottonwood, Cohoivaka	10	556938	3971976	SENE	26	AZ14T0290N0180E	C/D/S/IRR	District 6	2.7-25
S1064	6M-5	10	563575	3961719	SESW	27	AZ14T0280N0190E	C/D/S	District 6	2
S107	Wepo, Wipho, Cattail, Reed	10	557189	3972104	SWNW	25	AZ14T0290N0180E	C/D/S/IRR	District 6	1.5-30
S108	Unnamed	10	557732	3972631	NENW	25	AZ14T0290N0180E	C/D/S/IRR	District 6	<0.01-0.8
S1111	Baptist Church	11	572462	3963542	NWSW	22	AZ14T0280N0200E	C/D/S	District 6	<0.01-0.5
S1115	06K-02S	11	575211	3963357	SESE	23	AZ14T0280N0200E	C/D/S	District 6	3-5
S1119	06K-07S	11	576937	3964741	SESE	13	AZ14T0280N0200E	C/D/S	District 6	50
S1121	06K-308S	11	574890	3967321	SWNE	11	AZ14T0280N0200E	C/S	District 6	0.5
S1123	06A-21A	11	576456	3969117	L 7	1	AZ14T0280N0200E	C/D/S	District 6	0.28-2
S1135	D.Lalo	11	576934	3969565	L 1	1	AZ14T0280N0200E	C/D/S	District 6	0.8
S115	07H-06	11	586835	3973698	SWNE	24	AZ14T0290N0210E	C/D/S	HPL	0.5-0.8
S118	Bluebird, Tsorva	11	568464	3960821	SWNE	31	AZ14T0280N0200E	C/D/S/IRR	District 6	2-25
S1210	5M-73	12	510470	3949651	L 3	6	AZ14T0260N0140E	C/D/S	HPL	1
S123	Sand (multiple)	12	506349	3952682	SENE	27	AZ14T0270N0130E	C/D/S/IRR	HPL	3
S127	Whiskey	12	505437	3955791	SENW	15	AZ14T0270N0130E	C/D/S/IRR	HPL	.12-4
S128	05M-04	12	505639	3955421	NESW	15	AZ14T0270N0130E	C/S/IRR	HPL	<0.01-2
S131	Shonto	13	523078	3948047	NENW	9	AZ14T0260N0150E	C/D/S	District 6	0.67-2
S1311	Rock Ledge, Phillips Farm	13	540287	3947409	NESE	7	AZ14T0260N0170E	C/D/S/IRR	District 6	2
S1312	Pautsvi, Burro2	13	527501	3950572	NWSW	36	AZ14T0270N0150E	C/S	District 6	0-0.5

US Label	Name	Plate	Easting	Northing	QQ	Sec	Lndkey	Use	Land Status	Quantity
S132	06M-33	13	525882	3947711	SWNW	11	AZ14T0260N0150E	C/D/S	District 6	0.2-0.5
S134	Burro, Honani, New Pa'utsv	13	527740	3950571	NWSW	36	AZ14T0270N0150E	C/S	District 6	0.2-1
S136	Coyote	13	539432	3945576	SESW	18	AZ14T0260N0170E	C/D/S/IRR	District 6	1-15
S138	Little Burro	13	538834	3948185	L 1	7	AZ14T0260N0170E	C/S	District 6	3
S141	Ponsi Adams	14	561353	3952830	SWNW	28	AZ14T0270N0190E	C/D/S	District 6	0.5
S1410	Ram	14	563666	3931985	SENW	34	AZ14T0250N0190E	C/D/S	HPL	0.1-0.5
S1411	Shontah	14	564087	3934176	SESE	22	AZ14T0250N0190E	C/D/S	HPL	0.5-1
S1413	Horse	14	561745	3936749	SENW	16	AZ14T0250N0190E	C/D/S	HPL	0.5-1
S1414	Belle Butte	14	559227	3935616	SWSE	18	AZ14T0250N0190E	C/D/S	HPL	0.2-1.2
S1416	Trickle, Yatcakpa	14	564920	3954397	SWNW	23	AZ14T0270N0190E	C/D/S/IRR	District 6	0.2-1.5
S142	Awat ovi	14	565259	3953511	SESW	23	AZ14T0270N0190E	C/D/S	District 6	0-2
S143	Talahogan	14	565423	3954783	NWNE	23	AZ14T0270N0190E	C/D/S/IRR	District 6	0.88-2
S145	Kalbito #1	14	551863	3931146	SWSW	33	AZ14T0250N0180E	C/D/S	HPL	1.5-5
S146	Comar	14	552922	3932018	NENE	33	AZ14T0250N0180E	C/D/S	HPL	8
S147	Seba Delkai	14	553941	3937898	NESW	10	AZ14T0250N0180E	C/D/S	HPL	1
S148	Lukai	14	559127	3931137	SWSE	31	AZ14T0250N0190E	C/D/S	HPL	0.2-1

Additional Springs used for Livestock and Wildlife Watering

US Label	Name	Easting	Northing	QQ	Sec	Lndkey	Use	Land Status	Acres Irrigated
S104	Sheep, Kanelva	557184	3970362	SWNW	36	AZ14T0290N0180E	C/D/S/IRR	District 6	3.5925
S119	Nu'vatotshba, Snowbird	569991	3962591	NWNE	29	AZ14T0280N0200E	C/D/S/IRR	District 6	0.3442
S1017	Toreva, Twisted Curve	545284	3962452	SWNW	26	AZ14T0280N0170E	C/D/S/IRR	District 6	0.0775
S137	Unnamed	540993	3946827	SESW	8	AZ14T0260N0170E	C/D/S/IRR	District 6	2.2035
S1417	Hail, Lemova	565997	3955454	NESE	14	AZ14T0270N0190E	C/D/S/IRR	District 6	0.06338

Use Key:

C- Cultural

D - Domestic

S - Stock

IRR - Irrigaiton
PS - Public
Supply

Schedule D-2

Places of Use

Range Unit	Total Acres	Exclusion Areas Total	Exclusion Types			Grazed Acres[b]	Sections
			Farming	Rip.	Misc.[a]		
Tovar	37,660	0	0	0	0	37,659	58.84
Burro Springs	57,030	0	0	0	0	57,050	89.14
Polacca Wash	48,985	26,735	26,735	0	0	22,244	34.75
Talahogan	47,599	644	0	0	644	46,959	73.37
Hardrock	63,353	11,603	11,603	0	0	51,749	80.85
Toreva	25,767	12,868	12,868	0	0	12,901	20.15
Shonto	37,090	658	658	0	0	36,443	56.94
Bluepoint	22,210	233	135	0	98	21,977	34.34
E. Dinnebito	40,503	20,004	18,278	517	1,209	20,500	32.03
W. Dinnebito	17,107	4,701	4,701	0	0	12,403	19.38
North Oraibi	52,868	37,849	37,849	0	0	15,017	23.46
Upper Polacca	58,861	588	0	0	588	58,280	91.06
Five Houses	72,833	38,502	37,997	68	437	34,287	53.57
South Oraibi	32,520	32,520	19,726	0	12,794	0	0
Shongopovi	35,481	35,481	35,481	0	0	0	0
Total	**649,867**	**222,387**	**206,032**	**585**	**15,770**	**427,469**	**667.92**

Range Unit	Total Acres	Exclusion Areas Total	Exclusion Types			Grazed Acres[b]
			Farming	Rip.	Misc.[a]	
Moenkopi	60,518	0	0	0	0	60,518

Location	Range Unit	Total Acres	Sections
HPL	251	32,174	50.27
	252	53,288	83.26
	253	50,504	78.91
	254	25,091	39.20
	255	80,620	125.97
	256	36,669	57.30
	257	49,588	77.48
	258	9,988	15.61
	259	31,799	49.69
	260	23,553	36.80
	261	24,628	38.48
	262	28,029	43.80
	263	53,831	84.11
	351	27,456	42.90
	451	12,147	18.98
	551	54,240	84.75
	552	34,802	54.38
	553	35,439	55.37
	554	30,069	46.98
	555	36,508	57.04
	556	9,325	14.57
	557	7,736	12.09
	558	11,872	18.55
	559	27,423	42.85
	560	--	0.00
	561	--	0.00
	562	22,605	35.32
	563	21,808	34.08
	564	3,026	4.73
	565	14,302	22.35
	566	6,466	10.10
	567	13,161	20.56
	568		
	569	15,274	23.87
	570		
	571	6,831	10.67
	572	9,896	15.46
	573	7,715	12.05
	Total	**907,863**	**1418.54**

EXHIBIT E

Attributes of Rights for Stockpond Uses

Priority date	See paragraphs 20 through 23 of Recommended Decree
Beneficial use	Livestock and wildlife watering
Source of water	Groundwater from the alluvial, T or D Aquifers on the Hopi Reservation and washes on the Hopi Reservation
Points of diversion	Stockponds on the Hopi Reservation, as described on the attached schedule. Maps of stockponds are attached as Appendix A to the Recommended Decree.
Places of use	Stockponds on the Hopi Reservation, as described on the attached schedule. Maps of wells, springs, and impoundments are attached as Appendix A to the Recommended Decree.
Volume	3,572 acre-feet of combined total storage capacity, with continuous fill
Period of use	Year-round
Owners	Hopi Tribe United States acting in its capacity as trustee for the Hopi Tribe

Schedule of Places of Use for Stockpond Uses

US Label	Plate	Easting	Northing	Area (acres)	Capacity (ac-ft)	QQ	Sec	Lndkey	Use	Land Status
I0411	4	480761	3999554	36.399	212.000	L 2	021	AZ14T0320N0110E	IRR/STOCK	Moenkopi
I011	1	514529	4013605	1.623	3.081	SWNE	016	AZ14T0330N0140E	STOCK	HPL
I0110	1	521546	4020647	1.039	1.853	NENE	030	AZ14T0340N0150E	STOCK	HPL
I0111	1	517543	4024519	1.057	1.890	NESW	011	AZ14T0340N0140E	STOCK	HPL
I0112	1	512691	4018951	0.449	0.712	NENW	032	AZ14T0340N0140E	STOCK	HPL
I0113	1	518982	4019335	0.669	1.122	SESW	025	AZ14T0340N0140E	STOCK	HPL
I0114	1	521942	4020003	1.107	1.992	SWNW	029	AZ14T0340N0150E	STOCK	HPL
I0115	1	522106	4018268	0.903	1.580	NWSW	032	AZ14T0340N0150E	STOCK	HPL
I0116	1	521596	4023304	1.336	2.468	SENE	018	AZ14T0340N0150E	STOCK	HPL
I0117	1	519990	4017748	0.831	1.437	SESE	036	AZ14T0340N0140E	STOCK	HPL
I0118	1	511620	4015500	0.713	1.207	SWNE	007	AZ14T0330N0140E	STOCK	HPL
I0119	1	520661	4019326	1.051	1.878	SESW	030	AZ14T0340N0150E	STOCK	HPL
I012	1	504775	4015241	0.554	0.905	SENW	009	AZ14T0330N0130E	STOCK	HPL
I0120	1	520533	4018906	1.151	2.083	NENW	031	AZ14T0340N0150E	STOCK	HPL
I0121	1	517115	4017899	0.679	1.141	NWSW	035	AZ14T0340N0140E	STOCK	HPL
I0122	1	521695	4012797	0.983	1.740	SESE	018	AZ14T0330N0150E	STOCK	HPL
I0123	1	514343	4013013	1.084	1.945	SESW	016	AZ14T0330N0140E	STOCK	HPL
I0124	1	516156	4021236	0.395	0.616	NWSE	022	AZ14T0340N0140E	STOCK	HPL
I0125	1	521766	4015194	1.077	1.931	SWNW	008	AZ14T0330N0150E	STOCK	HPL
I0126	1	519721	4013692	0.752	1.282	SWNE	013	AZ14T0330N0140E	STOCK	HPL
I0127	1	502780	4012053	0.354	0.543	SWNW	020	AZ14T0330N0130E	STOCK	HPL
I0128	1	503159	4012660	0.329	0.500	NENW	020	AZ14T0330N0130E	STOCK	HPL
I0129	1	503239	4012892	0.334	0.508	SESW	017	AZ14T0330N0130E	STOCK	HPL
I013	1	519308	4027264	0.584	0.961	SWSE	036	AZ14T0350N0140E	STOCK	HPL
I0130	1	505105	4012664	1.123	2.025	NWNE	021	AZ14T0330N0130E	STOCK	HPL
I0131	1	504954	4012549	1.045	1.866	NWNE	021	AZ14T0330N0130E	STOCK	HPL
I0132	1	504135	4012034	1.604	3.040	SWNW	021	AZ14T0330N0130E	STOCK	HPL
I0133	1	508207	4012029	0.292	0.436	SWNE	023	AZ14T0330N0130E	STOCK	HPL
I0134	1	522326	4017614	0.434	0.686	SESW	032	AZ14T0340N0150E	STOCK	HPL
I0135	1	503786	4013969	0.327	0.496	NENE	017	AZ14T0330N0130E	STOCK	HPL
I0136	1	502706	4012450	0.160	0.140	NWNW	020	AZ14T0330N0130E	STOCK	HPL
I0137	1	502909	4012800	0.103	0.070	SESW	017	AZ14T0330N0130E	STOCK	HPL
I0138	1	503135	4013220	0.053	0.030	NESW	017	AZ14T0330N0130E	STOCK	HPL
I0139	1	502845	4012630	0.079	0.050	NW	020	AZ14T0330N0130E	STOCK	HPL
I014	1	520950	4027500	0.777	1.331	NWSE	031	AZ14T0350N0150E	STOCK	HPL
I0140	1	502591	4012220	0.040	0.020	SWNW	020	AZ14T0330N0130E	STOCK	HPL
I0141	1	502796	4012660	0.064	0.040	NWNW	020	AZ14T0330N0130E	STOCK	HPL
I015	1	517380	4013540	1.793	3.452	SENW	014	AZ14T0330N0140E	STOCK	HPL
I016	1	508255	4013416	1.230	2.246	NWSE	014	AZ14T0330N0130E	STOCK	HPL
I017	1	505317	4016768	0.695	1.172	SENE	004	AZ14T0330N0130E	STOCK	HPL
I018	1	520459	4025634	0.779	1.335	SWSW	006	AZ14T0340N0150E	STOCK	HPL
I019	1	503773	4013907	0.322	0.488	NENE	017	AZ14T0330N0130E	STOCK	HPL
I0210	2	538714	4017863	0.525	0.851	SWSE	036	AZ14T0340N0160E	STOCK	HPL
I0211	2	524378	4013403	0.758	1.294	NWSE	016	AZ14T0330N0150E	STOCK	HPL
I0212	2	524060	4019393	0.848	1.470	SESW	028	AZ14T0340N0150E	STOCK	HPL
I0213	2	524038	4019304	0.635	1.057	SESW	028	AZ14T0340N0150E	STOCK	HPL

US Label	Plate	Easting	Northing	Area (acres)	Capacity (ac-ft)	QQ	Sec	Lndkey	Use	Land Status
I0214	2	525663	4016707	0.545	0.888	NESW	003	AZ14T0330N0150E	STOCK	HPL
I0215	2	523106	4015645	1.028	1.831	NENE	008	AZ14T0330N0150E	STOCK	HPL
I0216	2	534516	4025077	0.034	0.038	SENE	009	AZ14T0340N0160E	STOCK	HPL
I0217	2	524512	4017811	2.642	5.369	SWSE	033	AZ14T0340N0150E	STOCK	HPL
I0218	2	539150	4016441	0.096	0.123	NESE	001	AZ14T0330N0160E	STOCK	HPL
I0219	2	525563	4024896	0.413	0.648	SENW	010	AZ14T0340N0150E	STOCK	HPL
I022	2	524892	4013603	0.677	1.137	SENE	016	AZ14T0330N0150E	STOCK	HPL
I023	2	522807	4016795	1.458	2.727	SWNE	005	AZ14T0330N0150E	STOCK	HPL
I024	2	543630	4022654	1.010	1.795	SWSE	016	AZ14T0340N0170E	STOCK	HPL
I025	2	523242	4018245	0.522	0.846	NESE	032	AZ14T0340N0150E	STOCK	HPL
I026	2	523437	4018138	0.459	0.730	NWSW	033	AZ14T0340N0150E	STOCK	HPL
I027	2	525805	4024323	0.721	1.222	NWSE	010	AZ14T0340N0150E	STOCK	HPL
I028	2	522573	4017787	0.496	0.798	SWSE	032	AZ14T0340N0150E	STOCK	HPL
I029	2	525660	4024897	0.120	0.158	SENW	010	AZ14T0340N0150E	STOCK	HPL
I031	3	554785	4017852	0.493	0.792	SWSE	034	AZ14T0340N0180E	STOCK	HPL
I0311	3	552383	4027872	1.275	5.610	NWSW	033	AZ14T0350N0180E	STOCK	HPL
I0312	3	556319	4029849	1.033	2.479	L 3	026	AZ14T0350N0180E	STOCK	HPL
I0314	3	552417	4028211	0.783	1.879	SWNW	033	AZ14T0350N0180E	STOCK	HPL
I0315	3	555162	4023546	0.562	0.920	SENE	015	AZ14T0340N0180E	STOCK	HPL
I0316	3	560522	4031242	0.941	1.655	NWSW	020	AZ14T0350N0190E	STOCK	HPL
I0317	3	552237	4022308	0.442	0.700	NWNW	021	AZ14T0340N0180E	STOCK	HPL
I0318	3	554300	4019484	0.060	0.072	SESW	027	AZ14T0340N0180E	STOCK	HPL
I0319	3	549796	4015822	0.140	0.189	NENW	007	AZ14T0330N0180E	STOCK	HPL
I032	3	551594	4012610	0.683	1.149	NWNE	020	AZ14T0330N0180E	STOCK	HPL
I0320	3	554329	4024986	3.830	8.198	SENW	010	AZ14T0340N0180E	STOCK	HPL
I0321	3	560909	4030830	2.670	5.434	SESW	020	AZ14T0350N0190E	STOCK	HPL
I0322	3	560791	4028362	0.141	0.190	SENW	032	AZ14T0350N0190E	STOCK	HPL
I0323	3	552212	4027752	0.336	1.075	NWSW	033	AZ14T0350N0180E	STOCK	HPL
I0324	3	560242	4027043	0.758	1.294	NWNW	005	AZ14T0340N0190E	STOCK	HPL
I0325	3	553250	4026706	0.766	1.309	SWNE	004	AZ14T0340N0180E	STOCK	HPL
I0326	3	552787	4028890	0.709	1.702	NENW	033	AZ14T0350N0180E	STOCK	HPL
I0327	3	553576	4028751	0.277	1.994	NENE	033	AZ14T0350N0180E	STOCK	HPL
I0328	3	553691	4028616	1.099	7.913	NENE	033	AZ14T0350N0180E	STOCK	HPL
I0329	3	553960	4028580	1.110	1.332	NWNW	034	AZ14T0350N0180E	STOCK	HPL
I033	3	551543	4012985	0.441	0.698	SWSE	017	AZ14T0330N0180E	STOCK	HPL
I0330	3	554222	4028573	1.016	4.470	NENW	034	AZ14T0350N0180E	STOCK	HPL
I0331	3	554491	4028653	0.677	1.137	NENW	034	AZ14T0350N0180E	STOCK	HPL
I0332	3	554687	4028734	0.782	1.341	NWNE	034	AZ14T0350N0180E	STOCK	HPL
I0333	3	556059	4029700	0.249	0.363	NESW	026	AZ14T0350N0180E	STOCK	HPL
I034	3	550063	4021049	0.968	1.710	SWSE	019	AZ14T0340N0180E	STOCK	HPL
I035	3	552078	4020798	2.027	3.970	NENE	029	AZ14T0340N0180E	STOCK	HPL
I036	3	552085	4021037	0.455	0.723	SESE	020	AZ14T0340N0180E	STOCK	HPL
I037	3	552426	4028082	0.360	2.160	NWSW	033	AZ14T0350N0180E	STOCK	HPL
I038	3	556053	4029744	0.205	0.492	NESW	026	AZ14T0350N0180E	STOCK	HPL
I039	3	555755	4029470	0.625	2.000	L 4	026	AZ14T0350N0180E	STOCK	HPL
I041	4	476589	3989205	0.159	0.218	SESW	019	AZ14T0310N0110E	STOCK	Moenkopi
I0410	4	486042	3987971	0.133	0.178	NWSW	030	AZ14T0310N0120E	STOCK	Moenkopi
I0413	4	475822	3994851	1.526	2.872	L 9	001	AZ14T0310N0100E	STOCK	Moenkopi
I0414	4	485902	3987431	0.532	0.864	NWNW	031	AZ14T0310N0120E	STOCK	Moenkopi
I0415	4	480704	3996850	11.038	50.810	NENE	033	AZ14T0320N0110E	STOCK	Moenkopi

US Label	Plate	Easting	Northing	Area (acres)	Capacity (ac-ft)	QQ	Sec	Lndkey	Use	Land Status
I042	4	491469	3991800	0.146	0.198	SWNE	015	AZ14T0310N0120E	STOCK	Moenkopi
I043	4	484966	3987063	0.886	1.546	NWNE	036	AZ14T0310N0110E	STOCK	Moenkopi
I044	4	479323	3996907	0.690	1.162	NWNW	033	AZ14T0320N0110E	STOCK	Moenkopi
I045	4	480211	3996603	0.700	1.182	SWNE	033	AZ14T0320N0110E	STOCK	Moenkopi
I046	4	481205	3997383	1.875	3.632	SWSW	027	AZ14T0320N0110E	STOCK	Moenkopi
I047	4	480862	3996668	0.423	0.666	SENE	033	AZ14T0320N0110E	STOCK	Moenkopi
I048	4	480978	3997874	5.642	12.748	L 11	027	AZ14T0320N0110E	IRR/STOCK	Moenkopi
I049	4	481086	3998223	0.925	1.623	L 3	027	AZ14T0320N0110E	STOCK	Moenkopi
I051	5	508891	4010261	0.073	0.090	NWSW	025	AZ14T0330N0130E	STOCK	HPL
I0510	5	508301	4011654	0.678	1.139	NWSE	023	AZ14T0330N0130E	STOCK	HPL
I05100	5	500970	4009190	0.278	0.300	NWNW	031	AZ14T0330N0130E	STOCK	HPL
I05101	5	500829	3991940	0.860	1.440	NESW	013	AZ14T0310N0122E	STOCK	HPL
I0511	5	502785	4011222	1.287	2.365	SWSW	020	AZ14T0330N0130E	STOCK	HPL
I0512	5	508021	4011602	1.439	2.686	NESW	023	AZ14T0330N0130E	STOCK	HPL
I0513	5	506823	4008161	1.387	2.576	SWSE	034	AZ14T0330N0130E	STOCK	HPL
I0514	5	500630	3991979	1.278	2.347	NENE	013	AZ14T0310N0122E	STOCK	HPL
I0515	5	504617	3988866	8.548	20.468	SESW	033	AZ14T0310N0130E	STOCK	HPL
I0516	5	505409	3989705	2.126	4.191	SENE	033	AZ14T0310N0130E	STOCK	HPL
I0517	5	516245	3986218	1.747	2.096	SWNE	010	AZ14T0300N0140E	STOCK	HPL
I0518	5	507573	4003345	1.436	2.680	SWSW	014	AZ14T0320N0130E	STOCK	HPL
I0519	5	515085	3997476	0.348	0.533	SENE	004	AZ14T0310N0140E	STOCK	HPL
I052	5	508463	4011554	1.298	2.389	NWSE	023	AZ14T0330N0130E	STOCK	HPL
I0520	5	519083	3988780	0.269	0.430	SESW	036	AZ14T0310N0140E	STOCK	HPL
I0521	5	516333	3985357	1.373	2.197	SWSE	010	AZ14T0300N0140E	STOCK	HPL
I0522	5	515851	3985898	1.577	2.523	NESW	010	AZ14T0300N0140E	STOCK	HPL
I0523	5	519930	3987925	0.847	2.372	SENE	001	AZ14T0300N0140E	STOCK	HPL
I0524	5	520139	3987980	0.974	1.948	L 5	006	AZ14T0300N0150E	STOCK	HPL
I0525	5	516410	3985623	2.527	5.054	SWSE	010	AZ14T0300N0140E	STOCK	HPL
I0526	5	512419	3985605	0.849	1.472	SWSW	008	AZ14T0300N0140E	STOCK	HPL
I0527	5	521096	3988050	2.176	11.315	SWNE	006	AZ14T0300N0150E	STOCK	HPL
I0528	5	502517	3988667	0.334	0.668	SWSW	032	AZ14T0310N0130E	STOCK	HPL
I0529	5	511684	3995810	0.717	1.214	SENE	007	AZ14T0310N0140E	STOCK	HPL
I053	5	501780	4010828	0.329	0.500	NWNE	030	AZ14T0330N0130E	STOCK	HPL
I0530	5	513143	3994729	1.239	2.265	NWNE	017	AZ14T0310N0140E	STOCK	HPL
I0531	5	517194	3993859	0.819	1.413	NWSW	014	AZ14T0310N0140E	STOCK	HPL
I0532	5	513973	3992279	0.688	1.159	NWSW	021	AZ14T0310N0140E	STOCK	HPL
I0533	5	518971	3988451	0.395	0.474	L 3	001	AZ14T0300N0140E	STOCK	HPL
I0534	5	518914	3987759	2.050	2.460	NESW	001	AZ14T0300N0140E	STOCK	HPL
I0535	5	518553	3987348	1.265	1.518	SWSW	001	AZ14T0300N0140E	STOCK	HPL
I0536	5	517837	3986667	0.511	0.715	NWNE	011	AZ14T0300N0140E	STOCK	HPL
I0537	5	516232	3987069	2.544	6.106	SWSE	003	AZ14T0300N0140E	STOCK	HPL
I0538	5	520556	3987427	0.550	0.660	NESW	006	AZ14T0300N0150E	STOCK	HPL
I0539	5	518422	4006511	0.926	1.625	SESE	002	AZ14T0320N0140E	STOCK	HPL
I054	5	502045	4011410	0.356	0.547	SESE	019	AZ14T0330N0130E	STOCK	HPL
I0540	5	519488	4006878	0.686	1.155	NWSE	001	AZ14T0320N0140E	STOCK	HPL
I0541	5	521340	4007733	0.890	1.554	NENE	006	AZ14T0320N0150E	STOCK	HPL
I0542	5	518695	4008576	2.413	4.842	NWSW	036	AZ14T0330N0140E	STOCK	HPL
I0543	5	511474	4004733	0.292	0.436	SWSE	007	AZ14T0320N0140E	STOCK	HPL
I0544	5	518519	4006542	0.581	0.956	SWSW	001	AZ14T0320N0140E	STOCK	HPL
I0545	5	517807	4005986	2.051	4.023	NWNE	011	AZ14T0320N0140E	STOCK	HPL

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I0546	5	509012	4007250	0.488	0.783	SWNW	001	AZ14T0320N0130E	STOCK	HPL
I0547	5	506182	4005000	1.150	2.081	SESW	010	AZ14T0320N0130E	STOCK	HPL
I0548	5	506833	4006228	1.066	1.908	NENE	010	AZ14T0320N0130E	STOCK	HPL
I0549	5	507666	4008061	1.782	3.428	SWSW	035	AZ14T0330N0130E	STOCK	HPL
I055	5	502171	4003181	0.197	0.279	SESE	018	AZ14T0320N0130E	STOCK	HPL
I0550	5	508694	4006409	0.308	0.464	SESE	002	AZ14T0320N0130E	STOCK	HPL
I0551	5	508825	4006693	1.034	1.843	NESE	002	AZ14T0320N0130E	STOCK	HPL
I0552	5	509163	4001989	1.385	2.572	NWSW	024	AZ14T0320N0130E	STOCK	HPL
I0553	5	508500	4003456	0.814	1.403	NESE	014	AZ14T0320N0130E	STOCK	HPL
I0554	5	511321	4004428	0.576	0.946	NWNE	018	AZ14T0320N0140E	STOCK	HPL
I0555	5	516671	4010959	1.085	1.947	NENE	027	AZ14T0330N0140E	STOCK	HPL
I0556	5	509452	4002168	0.882	1.538	NESW	024	AZ14T0320N0130E	STOCK	HPL
I0557	5	509684	4001735	0.517	0.837	SWSE	024	AZ14T0320N0130E	STOCK	HPL
I0558	5	510474	4001930	2.354	4.707	NWSW	019	AZ14T0320N0140E	STOCK	HPL
I0559	5	520709	4011014	0.815	1.405	NENW	030	AZ14T0330N0150E	STOCK	HPL
I056	5	501922	4010440	0.756	1.290	SWNE	030	AZ14T0330N0130E	STOCK	HPL
I0560	5	500062	3984080	1.052	1.052	NWNE	012	AZ14T0300N0122E	STOCK	HPL
I0561	5	501379	4010128	0.986	1.746	NESW	030	AZ14T0330N0130E	STOCK	HPL
I0562	5	501289	4009972	0.247	0.360	NESW	030	AZ14T0330N0130E	STOCK	HPL
I0563	5	501196	4009780	0.736	1.251	SWSW	030	AZ14T0330N0130E	STOCK	HPL
I0564	5	502403	4003006	1.382	2.565	SESE	018	AZ14T0320N0130E	STOCK	HPL
I0565	5	512757	4001915	5.934	13.502	NESW	020	AZ14T0320N0140E	STOCK	HPL
I0566	5	504582	3988136	3.220	6.727	SENW	004	AZ14T0300N0130E	STOCK	HPL
I0567	5	500525	3987952	0.416	0.653	NESE	025	AZ14T0310N0122E	STOCK	HPL
I0568	5	512603	4006025	0.822	1.419	NENW	008	AZ14T0320N0140E	STOCK	HPL
I0569	5	505208	3989533	0.456	0.725	SWNE	033	AZ14T0310N0130E	STOCK	HPL
I057	5	514111	4010481	0.383	0.594	SENW	028	AZ14T0330N0140E	STOCK	HPL
I0570	5	500883	3988656	0.736	1.251	L 4	031	AZ14T0310N0130E	STOCK	HPL
I0571	5	500618	3988403	0.437	0.691	SENE	025	AZ14T0310N0122E	STOCK	HPL
I0572	5	501096	3990642	0.476	0.761	L 3	030	AZ14T0310N0130E	STOCK	HPL
I0573	5	501256	3990653	0.714	1.209	NESW	030	AZ14T0310N0130E	STOCK	HPL
I0574	5	501262	3990881	0.717	1.214	NESW	030	AZ14T0310N0130E	STOCK	HPL
I0575	5	500840	3987016	0.759	1.296	L 7	006	AZ14T0300N0130E	STOCK	HPL
I0576	5	500875	3990216	0.673	1.130	L 4	030	AZ14T0310N0130E	STOCK	HPL
I0577	5	500923	3991255	0.367	0.566	L 2	030	AZ14T0310N0130E	STOCK	HPL
I0578	5	501051	3991229	0.304	0.457	L 2	030	AZ14T0310N0130E	STOCK	HPL
I0579	5	499944	3987830	0.220	0.316	SESW	025	AZ14T0310N0122E	STOCK	HPL
I058	5	512946	4010687	3.030	6.277	NWNE	029	AZ14T0330N0140E	STOCK	HPL
I0580	5	512576	4005424	1.518	2.855	NESW	008	AZ14T0320N0140E	STOCK	HPL
I0581	5	511644	4005170	0.953	1.680	NESE	007	AZ14T0320N0140E	STOCK	HPL
I0582	5	511919	3989073	1.734	3.323	NESE	031	AZ14T0310N0140E	STOCK	HPL
I0583	5	513440	4006677	1.360	2.519	NESE	005	AZ14T0320N0140E	STOCK	HPL
I0584	5	520702	3990203	0.172	0.239	SESW	030	AZ14T0310N0150E	STOCK	HPL
I0585	5	504620	3988278	0.943	1.660	L 3	004	AZ14T0300N0130E	STOCK	HPL
I0586	5	504585	3988251	0.520	0.842	L 3	004	AZ14T0300N0130E	STOCK	HPL
I0587	5	501569	4010238	1.882	3.648	NESW	030	AZ14T0330N0130E	STOCK	HPL
I0588	5	508681	3988857	0.109	0.142	SESE	035	AZ14T0310N0130E	STOCK	HPL
I0589	5	503271	4011010	3.289	6.892	NWNE	029	AZ14T0330N0130E	STOCK	HPL
I059	5	501035	4008639	24.887	69.186	NWSW	031	AZ14T0330N0130E	STOCK	HPL
I0590	5	506796	4007312	0.109	0.142	SWNE	003	AZ14T0320N0130E	STOCK	HPL

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I0591	5	514871	3997267	0.205	0.291	NESE	004	AZ14T0310N0140E	STOCK	HPL
I0592	5	508410	3997190	0.071	0.087	NWSE	002	AZ14T0310N0130E	STOCK	HPL
I0593	5	508430	3997153	0.021	0.022	NWSE	002	AZ14T0310N0130E	STOCK	HPL
I0594	5	511902	3993993	0.144	0.195	NESE	018	AZ14T0310N0140E	STOCK	HPL
I0595	5	503713	3992573	0.063	0.063	SENE	020	AZ14T0310N0130E	STOCK	HPL
I0596	5	517727	3992492	0.161	0.221	NWSE	023	AZ14T0310N0140E	STOCK	HPL
I0597	5	514460	3985655	1.907	3.703	SESW	009	AZ14T0300N0140E	STOCK	HPL
I0598	5	514640	3985757	1.376	2.552	NWSE	009	AZ14T0300N0140E	STOCK	HPL
I0599	5	515225	3985962	0.405	0.634	NESE	009	AZ14T0300N0140E	STOCK	HPL
I061	6	536780	3988548	1.398	2.599	L 3	002	AZ14T0300N0160E	STOCK	HPL
I0610	6	539451	4003958	1.488	2.791	SWNW	018	AZ14T0320N0170E	STOCK	HPL
I0611	6	535690	4001819	1.576	2.980	SESE	022	AZ14T0320N0160E	STOCK	HPL
I0612	6	525355	4004332	0.297	0.445	NENW	015	AZ14T0320N0150E	STOCK	HPL
I0613	6	530427	4010631	1.054	1.884	SENW	030	AZ14T0330N0160E	STOCK	HPL
I0614	6	525791	3989837	2.726	5.564	NWNE	034	AZ14T0310N0150E	STOCK	HPL
I0615	6	530151	3994302	3.098	6.437	SENW	018	AZ14T0310N0160E	STOCK	HPL
I0616	6	524462	3991341	0.966	1.706	SWNE	028	AZ14T0310N0150E	STOCK	HPL
I0617	6	532920	4001385	1.786	3.436	NWNW	028	AZ14T0320N0160E	STOCK	HPL
I0618	6	522897	4011133	0.741	1.261	SWSE	020	AZ14T0330N0150E	STOCK	HPL
I0619	6	527038	4004467	1.068	1.912	NENW	014	AZ14T0320N0150E	STOCK	HPL
I062	6	530699	3985876	2.772	5.671	NWSE	007	AZ14T0300N0160E	STOCK	HPL
I0620	6	536370	3999892	1.149	2.079	SWSW	026	AZ14T0320N0160E	STOCK	HPL
I0621	6	543981	3985650	1.481	1.481	SESE	009	AZ14T0300N0170E	STOCK	HPL
I0622	6	543646	3985889	0.285	0.342	NWSE	009	AZ14T0300N0170E	STOCK	HPL
I0623	6	539243	3984966	6.586	21.075	SENE	013	AZ14T0300N0160E	STOCK	HPL
I0624	6	544527	3984553	0.672	0.806	NWSW	015	AZ14T0300N0170E	STOCK	HPL
I0625	6	544382	3985638	5.737	12.993	SWSW	010	AZ14T0300N0170E	STOCK	HPL
I0626	6	539600	3984549	0.350	0.536	L 3	018	AZ14T0300N0170E	STOCK	HPL
I0627	6	534160	3989483	0.682	1.147	SENE	033	AZ14T0310N0160E	STOCK	HPL
I0628	6	537119	3986787	0.100	0.129	NWNE	011	AZ14T0300N0160E	STOCK	HPL
I0629	6	527689	4001593	0.099	0.127	SESE	023	AZ14T0320N0150E	STOCK	HPL
I063	6	529341	3989642	0.421	0.662	SENE	036	AZ14T0310N0150E	STOCK	HPL
I0632	6	530382	4000150	0.101	0.130	SESW	030	AZ14T0320N0160E	STOCK	HPL
I0633	6	526186	3999961	0.095	0.121	SESE	027	AZ14T0320N0150E	STOCK	HPL
I0634	6	528639	3994890	0.113	0.148	NENW	013	AZ14T0310N0150E	STOCK	HPL
I0635	6	528973	3991023	0.185	0.259	SWNE	025	AZ14T0310N0150E	STOCK	HPL
I0636	6	525858	3989574	0.030	0.033	SWNE	034	AZ14T0310N0150E	STOCK	HPL
I0637	6	543920	3986020	0.040	0.020	NESE	009	AZ14T0300N0170E	STOCK	HPL
I0638	6	534282	3985660	2.389	5.990	SESE	009	AZ14T0300N0160E	STOCK	HPL
I064	6	541835	4001938	0.305	0.458	NWSE	020	AZ14T0320N0170E	STOCK	HPL
I065	6	522565	3985784	0.936	1.645	NWSE	008	AZ14T0300N0150E	STOCK	HPL
I066	6	538023	4002470	1.142	2.064	SWNW	024	AZ14T0320N0160E	STOCK	HPL
I067	6	536809	4005698	0.814	1.403	SENW	011	AZ14T0320N0160E	STOCK	HPL
I068	6	535809	3998865	0.618	1.025	NESE	034	AZ14T0320N0160E	STOCK	HPL
I069	6	541560	4007979	0.599	0.989	SESW	032	AZ14T0330N0170E	STOCK	HPL
I071	7	548672	4001597	0.452	0.452	SESE	024	AZ14T0320N0170E	STOCK	HPL
I0710	7	548893	4004904	0.384	0.596	SESE	012	AZ14T0320N0170E	STOCK	HPL
I0711	7	548811	4004918	0.640	1.067	SESE	012	AZ14T0320N0170E	STOCK	HPL
I0712	7	548370	4004355	0.531	0.862	SWNE	013	AZ14T0320N0170E	STOCK	HPL
I0713	7	554072	3988022	0.831	1.994	SWNW	003	AZ14T0300N0180E	STOCK	HPL

US Label	Plate	Easting	Northing	Area (acres)	Capacity (ac-ft)	QQ	Sec	Lndkey	Use	Land Status
I0714	7	551005	3990221	1.382	2.565	NENW	032	AZ14T0310N0180E	STOCK	HPL
I0715	7	552555	3988842	0.629	1.258	SWSW	033	AZ14T0310N0180E	STOCK	HPL
I0716	7	551053	3989825	0.251	0.367	SENW	032	AZ14T0310N0180E	STOCK	HPL
I0717	7	549445	3989388	1.737	3.329	NESW	031	AZ14T0310N0180E	STOCK	HPL
I0718	7	547009	3988121	0.893	1.560	SENE	002	AZ14T0300N0170E	STOCK	District 6
I0719	7	551784	3986456	1.860	9.672	SWNE	008	AZ14T0300N0180E	STOCK	HPL
I072	7	545772	4001172	0.317	0.479	NWNW	026	AZ14T0320N0170E	STOCK	HPL
I0720	7	547441	3984428	1.808	2.170	NWSW	013	AZ14T0300N0170E	STOCK	District 6
I0721	7	546172	3987964	0.622	0.995	SWNW	002	AZ14T0300N0170E	STOCK	HPL
I0722	7	547658	3985907	1.208	2.201	NWSW	012	AZ14T0300N0170E	STOCK	District 6
I0723	7	549921	3985932	2.318	4.625	NWSE	007	AZ14T0300N0180E	STOCK	District 6
I0724	7	550222	3990472	0.409	0.640	SESE	030	AZ14T0310N0180E	STOCK	HPL
I0725	7	547567	3989792	0.800	1.376	SWNW	036	AZ14T0310N0170E	STOCK	HPL
I0726	7	556172	3984821	1.373	2.546	SENW	014	AZ14T0300N0180E	STOCK	HPL
I0727	7	548454	3985780	1.571	2.969	SWSE	012	AZ14T0300N0170E	STOCK	District 6
I0728	7	547002	3987929	0.831	1.437	SENE	002	AZ14T0300N0170E	STOCK	District 6
I0729	7	546964	3987658	1.170	2.122	NWSE	002	AZ14T0300N0170E	STOCK	District 6
I073	7	548409	4002158	0.531	0.862	NWSE	024	AZ14T0320N0170E	STOCK	HPL
I0732	7	547049	3987174	0.191	0.269	SESE	002	AZ14T0300N0170E	STOCK	District 6
I0733	7	547007	3987107	0.066	0.080	SESE	002	AZ14T0300N0170E	STOCK	District 6
I0734	7	547084	3986975	0.740	1.259	NENE	011	AZ14T0300N0170E	STOCK	District 6
I0735	7	547463	3987019	0.219	0.314	NWNW	012	AZ14T0300N0170E	STOCK	District 6
I0736	7	548910	3985452	0.636	1.059	NENE	013	AZ14T0300N0170E	STOCK	District 6
I0737	7	549712	3984665	0.782	1.341	NESW	018	AZ14T0300N0180E	STOCK	District 6
I0738	7	546859	4000434	0.718	1.216	NWSE	026	AZ14T0320N0170E	STOCK	HPL
I0739	7	546621	3986488	2.697	5.497	SWNE	011	AZ14T0300N0170E	STOCK	District 6
I074	7	546863	4000582	0.597	0.955	NWSE	026	AZ14T0320N0170E	STOCK	HPL
I0740	7	547127	3986843	1.664	1.664	NENE	011	AZ14T0300N0170E	STOCK	District 6
I0741	7	548103	3985456	1.061	1.898	NENW	013	AZ14T0300N0170E	STOCK	District 6
I0742	7	550428	3984647	0.403	0.630	NESE	018	AZ14T0300N0180E	STOCK	District 6
I0743	7	550786	4008820	0.719	1.218	SWNW	032	AZ14T0330N0180E	STOCK	HPL
I0744	7	547264	3989044	1.909	3.707	SESE	035	AZ14T0310N0170E	STOCK	HPL
I0745	7	551630	4006484	0.132	0.177	SWSE	005	AZ14T0320N0180E	STOCK	HPL
I0746	7	550488	3992816	0.270	0.399	SENE	019	AZ14T0310N0180E	STOCK	HPL
I0747	7	545276	3989316	0.575	0.944	NWSE	034	AZ14T0310N0170E	STOCK	HPL
I0748	7	548705	3987546	0.104	0.135	NESE	001	AZ14T0300N0170E	STOCK	HPL
I0749	7	557354	3986500	0.087	0.209	SWNW	012	AZ14T0300N0180E	STOCK	HPL
I075	7	547459	4000395	5.853	14.047	NWSW	025	AZ14T0320N0170E	STOCK	HPL
I0750	7	548744	4009770	0.056	0.030	SESE	025	AZ14T0330N0170E	STOCK	HPL
I0751	7	545547	3989480	0.458	0.600	SENE	034	AZ14T0310N0170E	STOCK	HPL
I0752	7	546513	3986990	1.368	2.750	NENW	011	AZ14T0300N0170E	STOCK	District 6
I0753	7	551435	3989650	0.639	0.950	SWNE	032	AZ14T0310N0180E	STOCK	HPL
I0754	7	556215	3984770	0.678	1.030	SENW	014	AZ14T0300N0180E	STOCK	HPL
I0755	7	547721	3985910	0.972	1.710	NWSW	012	AZ14T0300N0170E	STOCK	District 6
I077	7	546831	4001493	0.476	0.476	NWNE	026	AZ14T0320N0170E	STOCK	HPL
I078	7	549349	4003410	4.068	8.781	SESW	018	AZ14T0320N0180E	STOCK	HPL
I079	7	550546	4003842	0.744	1.267	NWSW	017	AZ14T0320N0180E	STOCK	HPL
I081	8	520132	3982850	0.974	3.506	L 3	019	AZ14T0300N0150E	STOCK	HPL
I0810	8	520765	3983268	0.852	1.363	SENW	019	AZ14T0300N0150E	STOCK	HPL
I08100	8	520315	3980497	0.243	0.354	L 1	031	AZ14T0300N0150E	STOCK	District 6

US Label	Plate	Easting	Northing	Area (acres)	Capacity (ac-ft)	QQ	Sec	Lndkey	Use	Land Status
I08101	8	518117	3978131	0.199	0.398	SENE	002	AZ14T0290N0140E	STOCK	District 6
I08102	8	518135	3978082	0.081	0.081	NESE	002	AZ14T0290N0140E	STOCK	District 6
I08103	8	510507	3968485	4.102	8.865	NESW	006	AZ14T0280N0140E	STOCK	HPL
I08104	8	521071	3967344	0.130	0.173	NWNW	008	AZ14T0280N0150E	STOCK	District 6
I08105	8	505953	3965828	0.056	0.066	NWNE	015	AZ14T0280N0130E	STOCK	HPL
I08106	8	511665	3961342	0.286	0.426	SWSW	029	AZ14T0280N0140E	STOCK	District 6
I08107	8	514922	3957739	0.113	0.148	NWNW	010	AZ14T0270N0140E	STOCK	District 6
I08108	8	511695	3957148	0.983	1.740	NWSW	008	AZ14T0270N0140E	STOCK	District 6
I08109	8	515058	3957009	0.277	0.411	NESW	010	AZ14T0270N0140E	STOCK	District 6
I0811	8	520694	3983499	1.190	4.998	NENW	019	AZ14T0300N0150E	STOCK	HPL
I08111	8	502306	3979432	0.041	0.047	NESE	031	AZ14T0300N0130E	STOCK	HPL
I08112	8	501543	3976204	0.349	0.535	NESW	007	AZ14T0290N0130E	STOCK	HPL
I08113	8	512078	3971044	0.246	0.359	SESE	030	AZ14T0290N0140E	STOCK	HPL
I08114	8	517148	3977091	0.355	0.546	NWNW	011	AZ14T0290N0140E	STOCK	District 6
I08115	8	516750	3982893	0.096	0.123	NESE	022	AZ14T0300N0140E	STOCK	HPL
I08116	8	507687	3976723	0.117	0.153	SENW	011	AZ14T0290N0130E	STOCK	HPL
I08117	8	507703	3976695	0.118	0.155	SENW	011	AZ14T0290N0130E	STOCK	HPL
I08118	8	516808	3970100	0.812	1.330	SENE	034	AZ14T0290N0140E	STOCK	District 6
I08119	8	515638	3969720	0.172	0.150	NWSW	034	AZ14T0290N0140E	STOCK	District 6
I0812	8	520113	3983494	1.843	2.949	L 1	019	AZ14T0300N0150E	STOCK	HPL
I08120	8	515709	3969770	0.056	0.030	NWSW	034	AZ14T0290N0140E	STOCK	District 6
I08121	8	506219	3978390	0.405	0.500	SENW	003	AZ14T0290N0130E	STOCK	HPL
I08122	8	514429	3970480	0.788	1.270	NENW	033	AZ14T0290N0140E	STOCK	District 6
I08123	8	514950	3960550	0.958	1.670	SWNW	034	AZ14T0280N0140E	STOCK	District 6
I08124	8	511721	3963260	0.950	1.650	SWSW	020	AZ14T0280N0140E	STOCK	District 6
I08125	8	511845	3968400	0.535	0.740	NESW	005	AZ14T0280N0140E	STOCK	HPL
I08126	8	511563	3963350	0.300	0.330	NWSW	020	AZ14T0280N0140E	STOCK	District 6
I0813	8	521527	3983805	0.611	2.933	SESE	018	AZ14T0300N0150E	STOCK	HPL
I0814	8	514631	3960497	1.457	2.725	SWNW	034	AZ14T0280N0140E	STOCK	District 6
I0815	8	515948	3980807	0.704	0.704	SESW	027	AZ14T0300N0140E	STOCK	District 6
I0816	8	517116	3973834	3.516	7.436	NWNW	023	AZ14T0290N0140E	STOCK	District 6
I0817	8	518994	3971235	0.318	0.481	SESW	025	AZ14T0290N0140E	STOCK	District 6
I0818	8	517698	3981584	0.901	1.576	SENW	026	AZ14T0300N0140E	STOCK	HPL
I0819	8	518293	3972123	1.077	1.931	NENE	026	AZ14T0290N0140E	STOCK	District 6
I082	8	519661	3971923	0.652	1.090	SWNE	025	AZ14T0290N0140E	STOCK	District 6
I0820	8	517712	3971145	0.767	1.311	SESW	026	AZ14T0290N0140E	STOCK	District 6
I0821	8	507320	3976107	0.586	0.586	NWSW	011	AZ14T0290N0130E	STOCK	HPL
I0822	8	507197	3974681	7.376	14.752	NESE	015	AZ14T0290N0130E	STOCK	HPL
I0823	8	514430	3970413	1.108	1.994	SENW	033	AZ14T0290N0140E	STOCK	District 6
I0824	8	515406	3971508	0.987	1.748	NWSW	027	AZ14T0290N0140E	STOCK	District 6
I0826	8	513194	3960588	3.190	6.656	SWNW	033	AZ14T0280N0140E	STOCK	District 6
I0827	8	513084	3959520	1.272	2.334	L 4	004	AZ14T0270N0140E	STOCK	District 6
I0828	8	515417	3957160	0.953	1.680	NWSE	010	AZ14T0270N0140E	STOCK	District 6
I0829	8	510903	3965991	2.295	4.573	NWNE	018	AZ14T0280N0140E	STOCK	HPL
I083	8	517451	3977637	0.943	0.943	SESW	002	AZ14T0290N0140E	STOCK	District 6
I0830	8	509285	3964137	1.500	2.817	NWNE	024	AZ14T0280N0130E	STOCK	HPL
I0831	8	507657	3961606	1.552	2.928	SWSE	026	AZ14T0280N0130E	STOCK	HPL
I0832	8	507598	3959180	0.440	0.696	SWNE	002	AZ14T0270N0130E	STOCK	District 6
I0833	8	520594	3969055	0.736	1.251	L 1	006	AZ14T0280N0150E	STOCK	District 6
I0834	8	517325	3969372	1.283	2.357	SESW	035	AZ14T0290N0140E	STOCK	District 6

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I0835	8	521717	3965737	0.877	1.528	NENW	017	AZ14T0280N0150E	STOCK	District 6
I0836	8	512141	3968286	1.137	2.054	NESW	005	AZ14T0280N0140E	STOCK	HPL
I0837	8	512672	3964410	0.738	1.255	NENE	020	AZ14T0280N0140E	STOCK	District 6
I0838	8	512997	3959362	0.171	0.237	L 4	004	AZ14T0270N0140E	STOCK	District 6
I0839	8	511494	3963318	0.911	1.595	NWSW	020	AZ14T0280N0140E	STOCK	District 6
I084	8	519835	3980194	0.713	0.998	NENE	036	AZ14T0300N0140E	STOCK	District 6
I0840	8	517107	3960006	0.811	1.397	SWSE	035	AZ14T0280N0140E	STOCK	District 6
I0841	8	515596	3960833	0.847	1.468	SWNE	034	AZ14T0280N0140E	STOCK	District 6
I0842	8	514882	3960564	0.410	0.642	SWNW	034	AZ14T0280N0140E	STOCK	District 6
I0843	8	512003	3963428	0.863	1.500	NESW	020	AZ14T0280N0140E	STOCK	District 6
I0844	8	501495	3975632	0.632	1.052	NENW	018	AZ14T0290N0130E	STOCK	HPL
I0847	8	512060	3979522	2.027	4.865	NESE	031	AZ14T0300N0140E	STOCK	HPL
I0849	8	511439	3980453	1.425	2.657	NWNE	031	AZ14T0300N0140E	STOCK	HPL
I085	8	518862	3976622	0.991	1.756	SWNW	012	AZ14T0290N0140E	STOCK	District 6
I0850	8	512664	3978590	0.318	0.636	L 3	005	AZ14T0290N0140E	STOCK	HPL
I0851	8	511955	3979662	0.184	0.368	NESE	031	AZ14T0300N0140E	STOCK	HPL
I0852	8	512085	3981476	2.000	3.909	SWNW	029	AZ14T0300N0140E	STOCK	HPL
I0853	8	509935	3976865	3.461	7.304	SWNE	012	AZ14T0290N0130E	STOCK	HPL
I0854	8	507385	3981221	2.088	4.176	NWSW	026	AZ14T0300N0130E	STOCK	HPL
I0855	8	505989	3982783	0.640	0.768	NWSW	022	AZ14T0300N0130E	STOCK	HPL
I0856	8	505030	3983140	5.842	21.031	SWNE	021	AZ14T0300N0130E	STOCK	HPL
I0858	8	501180	3983109	0.934	0.934	L 2	019	AZ14T0300N0130E	STOCK	HPL
I0859	8	511220	3983290	1.401	2.606	SENW	019	AZ14T0300N0140E	STOCK	HPL
I086	8	518641	3981116	4.170	9.032	NWSW	025	AZ14T0300N0140E	STOCK	HPL
I0860	8	506599	3981016	2.288	5.491	NWSE	027	AZ14T0300N0130E	STOCK	HPL
I0861	8	505491	3982506	4.170	4.170	SESE	021	AZ14T0300N0130E	STOCK	HPL
I0862	8	515279	3975494	0.288	0.429	NENE	016	AZ14T0290N0140E	STOCK	District 6
I0863	8	521129	3958198	0.386	0.600	SWSW	005	AZ14T0270N0150E	STOCK	District 6
I0864	8	521061	3960764	0.821	1.417	SWNW	032	AZ14T0280N0150E	STOCK	District 6
I0865	8	520177	3956743	0.520	0.842	SESW	007	AZ14T0270N0150E	STOCK	District 6
I0866	8	516098	3978867	1.628	8.683	L 3	003	AZ14T0290N0140E	STOCK	District 6
I0867	8	515874	3978665	0.518	0.838	L 3	003	AZ14T0290N0140E	STOCK	District 6
I0868	8	512527	3978196	0.555	0.888	SENW	005	AZ14T0290N0140E	STOCK	HPL
I0869	8	512458	3977703	0.309	0.371	NWSW	005	AZ14T0290N0140E	STOCK	HPL
I087	8	518913	3971437	0.593	0.978	NWSW	025	AZ14T0290N0140E	STOCK	District 6
I0870	8	512750	3977689	0.577	0.577	NESW	005	AZ14T0290N0140E	STOCK	HPL
I0871	8	515395	3981798	0.125	0.166	NWNW	027	AZ14T0300N0140E	STOCK	HPL
I0872	8	519518	3981296	0.066	0.080	NWSE	025	AZ14T0300N0140E	STOCK	HPL
I0873	8	517677	3977572	0.693	1.168	SESW	002	AZ14T0290N0140E	STOCK	District 6
I0874	8	518630	3976785	1.145	2.070	SWNW	012	AZ14T0290N0140E	STOCK	District 6
I0875	8	518369	3972060	1.020	1.815	SENE	026	AZ14T0290N0140E	STOCK	District 6
I0876	8	507268	3979820	0.592	0.592	SWNW	035	AZ14T0300N0130E	STOCK	HPL
I0877	8	507219	3979637	0.558	0.670	NESE	034	AZ14T0300N0130E	STOCK	HPL
I0878	8	507116	3979544	0.482	0.578	NESE	034	AZ14T0300N0130E	STOCK	HPL
I0879	8	521546	3956683	0.533	0.866	SESW	008	AZ14T0270N0150E	STOCK	District 6
I088	8	517936	3982281	0.533	0.640	SWSE	023	AZ14T0300N0140E	STOCK	HPL
I0880	8	521561	3956581	0.723	1.226	SESW	008	AZ14T0270N0150E	STOCK	District 6
I0881	8	506230	3982360	0.359	0.359	SESW	022	AZ14T0300N0130E	STOCK	HPL
I0882	8	506367	3981226	0.863	0.863	NESW	027	AZ14T0300N0130E	STOCK	HPL
I0883	8	504105	3983510	0.719	0.863	NWNW	021	AZ14T0300N0130E	STOCK	HPL

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I0884	8	503819	3982836	0.520	0.520	NESE	020	AZ14T0300N0130E	STOCK	HPL
I0885	8	503627	3982665	1.364	1.364	NWSE	020	AZ14T0300N0130E	STOCK	HPL
I0886	8	503519	3982389	0.946	1.135	SWSE	020	AZ14T0300N0130E	STOCK	HPL
I0889	8	515345	3957335	1.233	2.253	SENW	010	AZ14T0270N0140E	STOCK	District 6
I089	8	515582	3973488	1.251	2.290	SWNW	022	AZ14T0290N0140E	STOCK	District 6
I0890	8	515709	3981252	0.286	0.286	NESW	027	AZ14T0300N0140E	STOCK	HPL
I0891	8	518075	3976908	0.861	1.496	NWNE	011	AZ14T0290N0140E	STOCK	District 6
I0892	8	521174	3983516	0.622	1.033	NWNE	019	AZ14T0300N0150E	STOCK	HPL
I0893	8	515839	3980756	0.560	0.560	SESW	027	AZ14T0300N0140E	STOCK	District 6
I0895	8	518156	3978216	0.571	0.571	SENE	002	AZ14T0290N0140E	STOCK	District 6
I0896	8	522502	3970719	0.944	1.662	NENW	032	AZ14T0290N0150E	STOCK	District 6
I0897	8	513925	3966173	0.153	0.209	SWSE	009	AZ14T0280N0140E	STOCK	District 6
I0898	8	507928	3964308	0.049	0.057	NENE	023	AZ14T0280N0130E	STOCK	HPL
I0899	8	502383	3969383	0.052	0.061	SESE	031	AZ14T0290N0130E	STOCK	HPL
I091	9	522804	3971206	0.671	1.126	SWSE	029	AZ14T0290N0150E	STOCK	District 6
I0910	9	535781	3958727	2.414	4.844	NWSW	002	AZ14T0270N0160E	STOCK	District 6
I0911	9	523178	3960647	0.717	1.214	SENW	033	AZ14T0280N0150E	STOCK	District 6
I0912	9	526124	3960833	5.042	11.215	SWNW	035	AZ14T0280N0150E	STOCK	District 6
I0913	9	522948	3961355	0.562	0.920	SWSW	028	AZ14T0280N0150E	STOCK	District 6
I0914	9	530117	3965919	5.031	11.187	NWNE	018	AZ14T0280N0160E	STOCK	District 6
I0915	9	532953	3963231	5.375	12.063	SESW	021	AZ14T0280N0160E	STOCK	District 6
I0916	9	533512	3965999	1.055	1.886	NENE	016	AZ14T0280N0160E	STOCK	District 6
I0917	9	531359	3957556	4.064	8.771	SENW	008	AZ14T0270N0160E	STOCK	District 6
I0918	9	530928	3958490	2.431	4.883	NWSW	005	AZ14T0270N0160E	STOCK	District 6
I0919	9	535153	3956768	0.364	0.561	SESE	010	AZ14T0270N0160E	STOCK	District 6
I092	9	524364	3981415	0.851	1.476	SWNE	028	AZ14T0300N0150E	STOCK	District 6
I0920	9	529451	3957831	0.600	0.991	NENW	007	AZ14T0270N0160E	STOCK	District 6
I0921	9	543762	3978716	0.173	0.240	L 2	004	AZ14T0290N0170E	STOCK	District 6
I0922	9	524095	3959052	0.852	1.478	SENE	004	AZ14T0270N0150E	STOCK	District 6
I0923	9	537953	3975346	1.581	2.991	SWNW	013	AZ14T0290N0160E	STOCK	District 6
I0924	9	543392	3978887	0.195	0.275	L 3	004	AZ14T0290N0170E	STOCK	District 6
I0925	9	542782	3982622	8.363	33.452	NWSW	021	AZ14T0300N0170E	STOCK	District 6
I0926	9	542654	3983017	1.868	5.978	NWSW	021	AZ14T0300N0170E	STOCK	District 6
I0927	9	544132	3972447	1.045	2.508	NENE	028	AZ14T0290N0170E	STOCK	District 6
I0928	9	544132	3972609	1.257	3.520	SESE	021	AZ14T0290N0170E	STOCK	District 6
I0929	9	540491	3983421	1.451	1.741	NWNE	019	AZ14T0300N0170E	STOCK	District 6
I093	9	524449	3983095	1.207	2.199	SWNE	021	AZ14T0300N0150E	STOCK	HPL
I0930	9	540932	3982666	1.777	3.554	NESE	019	AZ14T0300N0170E	STOCK	District 6
I0931	9	523182	3964292	2.042	4.003	NENW	021	AZ14T0280N0150E	STOCK	District 6
I0932	9	529444	3956851	1.500	2.817	L 8	007	AZ14T0270N0160E	STOCK	District 6
I0933	9	541515	3982181	3.235	7.764	NENW	029	AZ14T0300N0170E	STOCK	District 6
I0934	9	538685	3957475	0.849	1.472	SENE	012	AZ14T0270N0160E	STOCK	District 6
I0935	9	538412	3957472	0.589	0.971	SENE	012	AZ14T0270N0160E	STOCK	District 6
I0937	9	538079	3973933	1.039	1.853	NWNW	024	AZ14T0290N0160E	STOCK	District 6
I0938	9	526251	3961017	1.820	3.511	NENW	035	AZ14T0280N0150E	STOCK	District 6
I0939	9	537258	3974413	2.396	4.803	SWSE	014	AZ14T0290N0160E	STOCK	District 6
I094	9	537361	3982985	0.448	0.711	NWSE	023	AZ14T0300N0160E	STOCK	District 6
I0940	9	533615	3970453	0.929	1.631	SENW	033	AZ14T0290N0160E	STOCK	District 6
I0941	9	533550	3970649	1.730	3.314	NENW	033	AZ14T0290N0160E	STOCK	District 6
I0945	9	527514	3982837	0.752	1.282	NWSE	023	AZ14T0300N0150E	STOCK	District 6

US Label	Plate	Easting	Northing	Area (acres)	Capacity (ac-ft)	QQ	Sec	Lndkey	Use	Land Status
I0946	9	532480	3969050	2.559	5.177	L 8	004	AZ14T0280N0160E	STOCK	District 6
I0947	9	529664	3962665	1.079	1.935	NENW	030	AZ14T0280N0160E	STOCK	District 6
I0948	9	529975	3962638	3.118	6.485	NWNE	030	AZ14T0280N0160E	STOCK	District 6
I0949	9	529849	3962722	2.316	4.621	NWNE	030	AZ14T0280N0160E	STOCK	District 6
I095	9	538364	3975075	2.381	4.769	SENW	013	AZ14T0290N0160E	STOCK	District 6
I0950	9	530276	3959871	0.353	0.542	SESE	031	AZ14T0280N0160E	STOCK	District 6
I0951	9	529478	3957905	0.716	1.212	NENW	007	AZ14T0270N0160E	STOCK	District 6
I0952	9	529495	3958098	0.389	0.605	SESW	006	AZ14T0270N0160E	STOCK	District 6
I0953	9	529573	3958062	0.397	0.619	NENW	007	AZ14T0270N0160E	STOCK	District 6
I0954	9	529711	3958214	0.709	1.199	SESW	006	AZ14T0270N0160E	STOCK	District 6
I0955	9	529308	3956945	0.477	0.763	L 7	007	AZ14T0270N0160E	STOCK	District 6
I0956	9	524385	3959980	2.569	5.200	SWSW	034	AZ14T0280N0150E	STOCK	District 6
I096	9	537901	3974495	13.531	34.546	SWSW	013	AZ14T0290N0160E	STOCK	District 6
I0960	9	536000	3964288	1.826	3.524	NENW	023	AZ14T0280N0160E	STOCK	District 6
I0963	9	543750	3971302	0.333	0.533	SWSE	028	AZ14T0290N0170E	STOCK	District 6
I0964	9	526591	3965033	4.664	10.262	NESW	014	AZ14T0280N0150E	STOCK	District 6
I0965	9	530108	3956494	0.395	0.616	SWSE	007	AZ14T0270N0160E	STOCK	District 6
I0966	9	533329	3960303	0.515	0.833	NWSE	033	AZ14T0280N0160E	STOCK	District 6
I0967	9	534527	3968330	1.983	3.872	NESW	003	AZ14T0280N0160E	STOCK	District 6
I0969	9	542678	3982774	0.717	1.214	NWSW	021	AZ14T0300N0170E	STOCK	District 6
I097	9	540908	3977904	0.861	1.496	NESE	006	AZ14T0290N0170E	STOCK	District 6
I0971	9	541097	3969533	5.180	11.565	SWSW	032	AZ14T0290N0170E	STOCK	District 6
I0972	9	527097	3964586	0.411	0.644	SESE	014	AZ14T0280N0150E	STOCK	District 6
I0973	9	542576	3983849	7.412	35.578	SESE	017	AZ14T0300N0170E	STOCK	District 6
I0974	9	542627	3983289	2.256	9.024	SWNW	021	AZ14T0300N0170E	STOCK	District 6
I0975	9	525325	3963630	0.101	0.130	NWSE	022	AZ14T0280N0150E	STOCK	District 6
I0977	9	539125	3958283	0.392	0.610	L 14	006	AZ14T0270N0170E	STOCK	District 6
I0978	9	536626	3982309	0.250	0.365	SESW	023	AZ14T0300N0160E	STOCK	District 6
I0979	9	542900	3978560	0.077	0.095	SWNW	004	AZ14T0290N0170E	STOCK	District 6
I098	9	541710	3977473	0.975	1.724	SESW	005	AZ14T0290N0170E	STOCK	District 6
I0980	9	527600	3958203	0.163	0.224	SWSW	001	AZ14T0270N0150E	STOCK	District 6
I0981	9	529422	3976056	0.016	0.032	SESE	012	AZ14T0290N0150E	IRR/STOCK	District 6
I0982	9	530665	3975398	0.001	0.002	NWNE	018	AZ14T0290N0160E	IRR/STOCK	District 6
I0983	9	525893	3981910	0.136	0.110	NWNE	027	AZ14T0300N0150E	STOCK	District 6
I099	9	533548	3959775	0.357	0.549	SESE	033	AZ14T0280N0160E	STOCK	District 6
I101	10	561971	3957603	1.195	2.174	SENW	009	AZ14T0270N0190E	STOCK	District 6
I1010	10	561523	3968306	5.293	11.853	NWSW	004	AZ14T0280N0190E	STOCK	District 6
I10100	10	558790	3961922	3.129	6.511	NESW	030	AZ14T0280N0190E	STOCK	District 6
I10101	10	559465	3961771	2.699	5.501	SESE	030	AZ14T0280N0190E	STOCK	District 6
I10102	10	559816	3961486	1.497	2.810	SWSW	029	AZ14T0280N0190E	STOCK	District 6
I10103	10	560082	3961471	1.378	2.557	SESW	029	AZ14T0280N0190E	STOCK	District 6
I10104	10	560305	3961424	0.524	0.849	SESW	029	AZ14T0280N0190E	STOCK	District 6
I10105	10	560323	3961290	0.492	0.791	NENW	032	AZ14T0280N0190E	STOCK	District 6
I10106	10	559864	3961808	0.851	1.476	NWSW	029	AZ14T0280N0190E	STOCK	District 6
I10107	10	560292	3960746	2.142	4.227	SENW	032	AZ14T0280N0190E	STOCK	District 6
I10108	10	560565	3960004	0.638	1.063	SWSE	032	AZ14T0280N0190E	STOCK	District 6
I10109	10	560605	3959875	0.743	1.265	SWSE	032	AZ14T0280N0190E	STOCK	District 6
I1011	10	563589	3969555	0.445	1.068	SWSW	034	AZ14T0290N0190E	STOCK	District 6
I10110	10	561816	3960517	0.913	1.599	NESW	033	AZ14T0280N0190E	STOCK	District 6
I10111	10	558118	3982373	4.373	9.535	SWSE	024	AZ14T0300N0180E	STOCK	District 6

US Label	Plate	Easting	Northing	Area (acres)	Capacity (ac-ft)	QQ	Sec	Lndkey	Use	Land Status
I10112	10	566840	3984028	3.531	7.473	SWSW	013	AZ14T0300N0190E	STOCK	HPL
I10113	10	558139	3981773	1.163	2.108	SWNE	025	AZ14T0300N0180E	STOCK	District 6
I10114	10	566874	3973656	0.991	0.991	SWNW	024	AZ14T0290N0190E	STOCK	District 6
I10115	10	565465	3972797	0.607	0.728	SWSW	023	AZ14T0290N0190E	STOCK	District 6
I10116	10	563410	3970800	2.224	4.412	NENE	033	AZ14T0290N0190E	STOCK	District 6
I10117	10	557952	3975927	1.942	3.780	SWSE	012	AZ14T0290N0180E	STOCK	District 6
I10118	10	556737	3972155	0.337	0.514	SENE	026	AZ14T0290N0180E	STOCK	District 6
I10119	10	556577	3972164	0.497	0.800	SWNE	026	AZ14T0290N0180E	STOCK	District 6
I1012	10	563948	3969640	1.675	2.010	SWSW	034	AZ14T0290N0190E	STOCK	District 6
I10120	10	545210	3962345	0.716	1.212	SENE	027	AZ14T0280N0170E	STOCK	District 6
I10121	10	551021	3957635	1.900	3.687	SWNE	008	AZ14T0270N0180E	STOCK	District 6
I10122	10	551295	3957912	1.850	3.577	NENE	008	AZ14T0270N0180E	STOCK	District 6
I10123	10	551484	3958081	0.589	0.971	NENE	008	AZ14T0270N0180E	STOCK	District 6
I10124	10	551542	3958390	0.800	1.376	SESE	005	AZ14T0270N0180E	STOCK	District 6
I10125	10	551700	3958486	0.539	0.877	SWSW	004	AZ14T0270N0180E	STOCK	District 6
I10126	10	551937	3958420	0.542	0.883	SWSW	004	AZ14T0270N0180E	STOCK	District 6
I10127	10	558205	3967305	0.335	0.510	L 6	007	AZ14T0280N0190E	STOCK	District 6
I10128	10	561727	3976997	0.110	0.143	SENE	008	AZ14T0290N0190E	STOCK	District 6
I10129	10	563268	3970999	0.426	0.671	NENE	033	AZ14T0290N0190E	STOCK	District 6
I10130	10	566958	3965176	1.377	2.555	NWSE	013	AZ14T0280N0190E	STOCK	District 6
I10131	10	554536	3962880	3.008	6.225	NENE	027	AZ14T0280N0180E	STOCK	District 6
I10132	10	547297	3959619	0.194	0.274	L 7	001	AZ14T0270N0170E	STOCK	District 6
I10133	10	549721	3956584	0.116	0.152	SESE	007	AZ14T0270N0180E	STOCK	District 6
I10135	10	546920	3980030	0.216	0.309	SWNE	035	AZ14T0300N0170E	STOCK	District 6
I10136	10	548146	3979348	0.020	0.020	SESW	036	AZ14T0300N0170E	STOCK	District 6
I10137	10	559964	3980152	0.311	0.311	SENE	031	AZ14T0300N0190E	STOCK	District 6
I10138	10	564977	3978298	0.150	0.204	NESE	003	AZ14T0290N0190E	STOCK	District 6
I10139	10	556577	3977912	0.050	0.050	NWSE	002	AZ14T0290N0180E	STOCK	District 6
I1014	10	567374	3964396	0.729	1.238	NENE	024	AZ14T0280N0190E	STOCK	District 6
I10140	10	547151	3973769	0.169	0.169	SENE	023	AZ14T0290N0170E	STOCK	District 6
I10141	10	547222	3973751	0.143	0.172	SENE	023	AZ14T0290N0170E	STOCK	District 6
I10142	10	554176	3966789	2.476	4.986	NWSE	010	AZ14T0280N0180E	STOCK	District 6
I10143	10	560118	3961999	0.119	0.157	NESW	029	AZ14T0280N0190E	STOCK	District 6
I10144	10	546204	3959747	1.767	3.394	SWSE	035	AZ14T0280N0170E	STOCK	District 6
I10145	10	546661	3960103	1.475	2.763	SESE	035	AZ14T0280N0170E	STOCK	District 6
I10146	10	557178	3970370	0.017	0.034	SWNW	036	AZ14T0290N0180E	IRR/STOCK	District 6
I10147	10	557144	3972096	0.007	0.067	SWNW	025	AZ14T0290N0180E	IRR/STOCK	District 6
I10148	10	556945	3972009	0.006	0.064	SENE	026	AZ14T0290N0180E	IRR/STOCK	District 6
I10149	10	551412	3976680	0.252	0.260	SENW	008	AZ14T0290N0180E	STOCK	District 6
I1015	10	567625	3967282	0.454	0.721	SENE	012	AZ14T0280N0190E	STOCK	District 6
I10150	10	558974	3962400	0.345	0.400	SWNE	030	AZ14T0280N0190E	STOCK	District 6
I10151	10	558586	3962470	0.246	0.250	SENW	030	AZ14T0280N0190E	STOCK	District 6
I10152	10	551833	3962730	0.480	0.640	NWNW	028	AZ14T0280N0180E	STOCK	District 6
I10154	10	549787	3956640	0.678	1.030	SESE	007	AZ14T0270N0180E	STOCK	District 6
I10155	10	550000	3960160	0.788	1.270	NESE	031	AZ14T0280N0180E	STOCK	District 6
I10156	10	549920	3960390	0.860	1.440	NESE	031	AZ14T0280N0180E	STOCK	District 6
I10157	10	549486	3960870	1.228	2.360	SWNE	031	AZ14T0280N0180E	STOCK	District 6
I10158	10	546438	3958130	0.082	0.050	SWSE	002	AZ14T0270N0170E	STOCK	District 6
I10159	10	549825	3956560	0.147	0.120	SESE	007	AZ14T0270N0180E	STOCK	District 6
I1016	10	567248	3969452	0.619	1.027	L 2	001	AZ14T0280N0190E	STOCK	District 6

US Label	Plate	Easting	Northing	Area (acres)	Capacity (ac-ft)	QQ	Sec	Lndkey	Use	Land Status
I10160	10	551683	3962960	2.362	5.900	SWSW	021	AZ14T0280N0180E	STOCK	District 6
I1017	10	567061	3969373	0.186	0.261	L 2	001	AZ14T0280N0190E	STOCK	District 6
I1018	10	566922	3962472	0.428	0.675	SWNE	025	AZ14T0280N0190E	STOCK	District 6
I1019	10	557695	3967017	3.846	8.237	SENE	012	AZ14T0280N0180E	STOCK	District 6
I102	10	550981	3983930	1.064	1.904	SWSW	017	AZ14T0300N0180E	STOCK	District 6
I1020	10	563975	3979179	0.883	1.540	SESW	034	AZ14T0300N0190E	STOCK	District 6
I1021	10	566429	3980248	1.896	3.679	SENE	035	AZ14T0300N0190E	STOCK	District 6
I1022	10	561456	3976505	1.743	3.342	NWSE	008	AZ14T0290N0190E	STOCK	District 6
I1023	10	565204	3975330	2.530	5.111	SWNW	014	AZ14T0290N0190E	STOCK	District 6
I1024	10	566173	3973457	0.363	0.559	NWSE	023	AZ14T0290N0190E	STOCK	District 6
I1025	10	563516	3970830	0.493	0.789	NENE	033	AZ14T0290N0190E	STOCK	District 6
I1026	10	551567	3958763	1.342	2.481	NESE	005	AZ14T0270N0180E	STOCK	District 6
I1027	10	562423	3970211	0.996	1.766	NESW	033	AZ14T0290N0190E	STOCK	District 6
I1028	10	563532	3963803	1.792	3.450	NESW	022	AZ14T0280N0190E	STOCK	District 6
I1029	10	558594	3960065	0.778	1.333	SESW	031	AZ14T0280N0190E	STOCK	District 6
I103	10	548508	3982905	3.383	4.060	NWSE	024	AZ14T0300N0170E	STOCK	District 6
I1030	10	560372	3959605	1.722	3.296	L 3	005	AZ14T0270N0190E	STOCK	District 6
I1031	10	560729	3961955	1.780	3.423	NWSE	029	AZ14T0280N0190E	STOCK	District 6
I1032	10	560524	3960065	0.624	1.037	SWSE	032	AZ14T0280N0190E	STOCK	District 6
I1033	10	559414	3967098	0.614	1.018	SENE	007	AZ14T0280N0190E	STOCK	District 6
I1034	10	558285	3963506	1.179	2.358	L 7	019	AZ14T0280N0190E	STOCK	District 6
I1035	10	553561	3960388	1.573	2.973	NWSW	034	AZ14T0280N0180E	STOCK	District 6
I1036	10	553555	3957882	4.276	9.294	NWNW	010	AZ14T0270N0180E	STOCK	District 6
I1037	10	551324	3980726	0.272	0.402	SESW	029	AZ14T0300N0180E	STOCK	District 6
I1038	10	553675	3974804	3.318	6.961	NESE	016	AZ14T0290N0180E	STOCK	District 6
I1039	10	555247	3979075	1.498	2.812	SESE	034	AZ14T0300N0180E	STOCK	District 6
I104	10	545888	3981769	1.234	2.255	SWNW	026	AZ14T0300N0170E	STOCK	District 6
I1040	10	546388	3973535	2.876	4.602	SENW	023	AZ14T0290N0170E	STOCK	District 6
I1041	10	553887	3975301	15.145	39.281	SENE	016	AZ14T0290N0180E	STOCK	District 6
I1042	10	552063	3979933	2.036	3.990	SENE	032	AZ14T0300N0180E	STOCK	District 6
I1043	10	550896	3978043	2.625	5.330	NWSW	005	AZ14T0290N0180E	STOCK	District 6
I1044	10	552629	3977744	1.263	2.315	SWSW	004	AZ14T0290N0180E	STOCK	District 6
I1045	10	549482	3974776	2.686	5.471	NESW	018	AZ14T0290N0180E	STOCK	District 6
I1046	10	563610	3983039	1.117	2.013	NWSW	022	AZ14T0300N0190E	STOCK	District 6
I1047	10	548361	3974013	0.827	1.429	NWNE	024	AZ14T0290N0170E	STOCK	District 6
I1048	10	548847	3971607	0.753	1.284	NESE	025	AZ14T0290N0170E	STOCK	District 6
I1049	10	546104	3970500	1.251	2.290	SWNW	035	AZ14T0290N0170E	STOCK	District 6
I105	10	548520	3981333	1.741	3.338	NWSE	025	AZ14T0300N0170E	STOCK	District 6
I1050	10	551314	3976579	2.553	5.163	NESW	008	AZ14T0290N0180E	STOCK	District 6
I1051	10	566036	3982311	0.245	0.357	NWNE	026	AZ14T0300N0190E	STOCK	District 6
I1052	10	552981	3962761	1.997	3.903	NENE	028	AZ14T0280N0180E	STOCK	District 6
I1053	10	553611	3964057	0.388	0.603	SWNW	022	AZ14T0280N0180E	STOCK	District 6
I1054	10	553016	3967256	1.438	2.684	SENE	009	AZ14T0280N0180E	STOCK	District 6
I1055	10	559026	3977462	1.078	1.933	L 1	007	AZ14T0290N0190E	STOCK	District 6
I1056	10	557709	3976286	1.249	1.998	NESW	012	AZ14T0290N0180E	STOCK	District 6
I1057	10	545435	3973173	0.710	1.704	NWSE	022	AZ14T0290N0170E	STOCK	District 6
I1058	10	565499	3982606	1.354	2.506	SESW	023	AZ14T0300N0190E	STOCK	District 6
I1059	10	563808	3982680	0.841	1.457	SWSW	022	AZ14T0300N0190E	STOCK	District 6
I106	10	547464	3978311	0.367	0.566	SWNW	001	AZ14T0290N0170E	STOCK	District 6
I1060	10	558232	3982029	7.517	12.027	NWNE	025	AZ14T0300N0180E	STOCK	District 6

US Label	Plate	Easting	Northing	Area (acres)	Capacity (ac-ft)	QQ	Sec	Lndkey	Use	Land Status
I1061	10	558793	3975918	1.990	3.887	L 4	007	AZ14T0290N0190E	STOCK	District 6
I1062	10	557848	3974986	0.699	1.180	NESW	013	AZ14T0290N0180E	STOCK	District 6
I1063	10	557080	3972984	0.470	0.750	SESE	023	AZ14T0290N0180E	STOCK	District 6
I1064	10	563496	3956641	0.811	1.397	SESW	010	AZ14T0270N0190E	STOCK	District 6
I1065	10	547993	3983533	1.394	2.591	NENW	024	AZ14T0300N0170E	STOCK	District 6
I1066	10	557277	3983125	0.629	1.046	SWNW	024	AZ14T0300N0180E	STOCK	District 6
I1067	10	557483	3982884	0.725	1.230	NESW	024	AZ14T0300N0180E	STOCK	District 6
I1068	10	552924	3980713	0.583	0.959	SESW	028	AZ14T0300N0180E	STOCK	District 6
I1069	10	548705	3971529	0.810	1.395	NESE	025	AZ14T0290N0170E	STOCK	District 6
I1070	10	547696	3965478	1.029	1.833	SWNE	013	AZ14T0280N0170E	STOCK	District 6
I1071	10	547920	3965598	1.037	1.849	SWNE	013	AZ14T0280N0170E	STOCK	District 6
I1072	10	548010	3963258	0.968	1.710	SWSE	024	AZ14T0280N0170E	STOCK	District 6
I1075	10	546970	3958464	0.371	0.573	SWSW	001	AZ14T0270N0170E	STOCK	District 6
I1076	10	545256	3959419	1.221	2.228	L 8	002	AZ14T0270N0170E	STOCK	District 6
I1077	10	550500	3966584	0.275	0.407	SESW	008	AZ14T0280N0180E	STOCK	District 6
I1078	10	550642	3966587	1.402	2.608	SESW	008	AZ14T0280N0180E	STOCK	District 6
I1079	10	550761	3966490	0.513	0.829	SESW	008	AZ14T0280N0180E	STOCK	District 6
I108	10	545307	3976118	1.601	3.034	SWSE	010	AZ14T0290N0170E	STOCK	District 6
I1080	10	552165	3963346	0.760	1.298	SESW	021	AZ14T0280N0180E	STOCK	District 6
I1081	10	552501	3963744	1.575	2.978	NWSE	021	AZ14T0280N0180E	STOCK	District 6
I1082	10	555059	3963714	0.369	0.570	NWSW	023	AZ14T0280N0180E	STOCK	District 6
I1084	10	557079	3967226	0.586	0.965	SENW	012	AZ14T0280N0180E	STOCK	District 6
I1085	10	558139	3967854	0.591	0.974	L 14	006	AZ14T0280N0190E	STOCK	District 6
I1086	10	557234	3968128	0.425	0.669	SWSE	001	AZ14T0280N0180E	STOCK	District 6
I1087	10	562792	3969499	0.424	0.667	SWSE	033	AZ14T0290N0190E	STOCK	District 6
I1088	10	557334	3963936	0.762	1.302	SWNE	024	AZ14T0280N0180E	STOCK	District 6
I1089	10	558264	3963424	1.960	3.820	L 7	019	AZ14T0280N0190E	STOCK	District 6
I109	10	545129	3975805	0.502	0.809	SWSE	010	AZ14T0290N0170E	STOCK	District 6
I1090	10	558146	3962669	0.936	1.645	L 5	030	AZ14T0280N0190E	STOCK	District 6
I1091	10	559158	3963731	1.157	2.095	NWSE	019	AZ14T0280N0190E	STOCK	District 6
I1092	10	559853	3964882	0.530	0.861	SWSW	017	AZ14T0280N0190E	STOCK	District 6
I1093	10	561342	3964317	2.601	5.274	NWNW	021	AZ14T0280N0190E	STOCK	District 6
I1096	10	563440	3963510	0.580	0.954	NESW	022	AZ14T0280N0190E	STOCK	District 6
I1097	10	564858	3964037	1.224	2.234	SWNW	023	AZ14T0280N0190E	STOCK	District 6
I1098	10	560347	3963597	1.107	1.328	NESW	020	AZ14T0280N0190E	STOCK	District 6
I1099	10	560019	3963958	0.713	1.207	SWNW	020	AZ14T0280N0190E	STOCK	District 6
I111	11	589789	3961841	0.263	0.387	SESE	029	AZ14T0280N0220E	STOCK	HPL
I1110	11	587125	3968132	14.588	37.639	SESW	006	AZ14T0280N0220E	STOCK	HPL
I1111	11	577795	3972084	0.113	0.148	SENE	025	AZ14T0290N0200E	STOCK	District 6
I1112	11	577342	3965139	10.392	25.572	NWSW	018	AZ14T0280N0210E	STOCK	District 6
I1113	11	574822	3963155	1.217	2.219	SWSE	023	AZ14T0280N0200E	STOCK	District 6
I1114	11	574312	3963331	0.566	0.927	SESW	023	AZ14T0280N0200E	STOCK	District 6
I1115	11	573328	3963785	0.806	1.388	SWNE	022	AZ14T0280N0200E	STOCK	District 6
I1116	11	572220	3964144	0.315	0.476	SENE	021	AZ14T0280N0200E	STOCK	District 6
I1117	11	573216	3962543	0.440	0.696	SWNE	027	AZ14T0280N0200E	STOCK	District 6
I1118	11	575975	3964397	1.501	2.819	NENW	024	AZ14T0280N0200E	STOCK	District 6
I1119	11	577056	3965117	1.162	2.105	NESE	013	AZ14T0280N0200E	STOCK	District 6
I112	11	588117	3960170	2.584	5.235	SESE	031	AZ14T0280N0220E	STOCK	HPL
I1120	11	571305	3967552	0.651	1.088	NENW	009	AZ14T0280N0200E	STOCK	District 6
I1121	11	577173	3965006	2.030	3.976	SWSW	018	AZ14T0280N0210E	STOCK	District 6

US Label	Plate	Easting	Northing	Area (acres)	Capacity (ac-ft)	QQ	Sec	Lndkey	Use	Land Status
I1122	11	577509	3968424	2.243	4.455	NESW	006	AZ14T0280N0210E	STOCK	District 6
I1123	11	576959	3970431	0.389	0.605	SENW	036	AZ14T0290N0200E	STOCK	District 6
I1124	11	569598	3960160	0.949	1.672	NESW	032	AZ14T0280N0200E	STOCK	District 6
I1125	11	575629	3967004	1.533	2.887	NWSW	012	AZ14T0280N0200E	STOCK	District 6
I1126	11	577045	3967409	0.244	0.355	SWNW	007	AZ14T0280N0210E	STOCK	District 6
I1127	11	574010	3970035	0.498	0.802	NESW	034	AZ14T0290N0200E	STOCK	District 6
I1128	11	568014	3963944	0.830	1.435	SENW	019	AZ14T0280N0200E	STOCK	District 6
I1129	11	572925	3976671	1.595	3.021	NESE	009	AZ14T0290N0200E	STOCK	District 6
I113	11	588326	3965339	3.653	7.767	NWSW	017	AZ14T0280N0220E	STOCK	HPL
I1130	11	574104	3962798	2.940	6.065	NWNW	026	AZ14T0280N0200E	STOCK	District 6
I1131	11	569214	3969787	0.928	1.629	SWSE	031	AZ14T0290N0200E	STOCK	District 6
I1132	11	568137	3964890	0.674	1.132	SESW	018	AZ14T0280N0200E	STOCK	District 6
I1133	11	571122	3959479	0.537	0.874	L 3	004	AZ14T0270N0200E	STOCK	District 6
I1134	11	570691	3960370	0.452	0.718	NWSW	033	AZ14T0280N0200E	STOCK	District 6
I1135	11	569423	3962609	2.054	4.030	NWNW	029	AZ14T0280N0200E	STOCK	District 6
I1136	11	569930	3962883	0.634	1.056	NWNE	029	AZ14T0280N0200E	STOCK	District 6
I1137	11	570056	3962698	0.663	1.111	NWNE	029	AZ14T0280N0200E	STOCK	District 6
I1138	11	579064	3969483	1.608	3.049	NENW	005	AZ14T0280N0210E	STOCK	District 6
I1139	11	573392	3962424	0.405	0.633	SWNE	027	AZ14T0280N0200E	STOCK	District 6
I114	11	584951	3957179	1.905	3.698	NESE	011	AZ14T0270N0210E	STOCK	HPL
I1140	11	584026	3969282	1.266	2.322	NENW	002	AZ14T0280N0210E	STOCK	HPL
I1141	11	582083	3967404	0.638	1.063	SWNW	010	AZ14T0280N0210E	STOCK	HPL
I1142	11	575301	3973549	0.525	0.851	NESW	023	AZ14T0290N0200E	STOCK	District 6
I1143	11	569528	3979791	0.727	1.234	NESE	031	AZ14T0300N0200E	STOCK	District 6
I1144	11	569083	3973621	1.013	1.621	SENW	019	AZ14T0290N0200E	STOCK	District 6
I1145	11	571457	3973330	1.983	3.872	NESE	020	AZ14T0290N0200E	STOCK	District 6
I1146	11	577026	3971884	0.149	0.203	NESW	025	AZ14T0290N0200E	STOCK	District 6
I1147	11	577450	3971938	0.130	0.173	NWSE	025	AZ14T0290N0200E	STOCK	District 6
I1148	11	577929	3983021	2.111	4.158	NWSW	019	AZ14T0300N0210E	STOCK	HPL
I1149	11	578793	3972330	0.386	0.600	SENW	030	AZ14T0290N0210E	STOCK	District 6
I115	11	588360	3964485	0.716	1.212	NWNW	020	AZ14T0280N0220E	STOCK	HPL
I1150	11	578911	3972292	0.217	0.311	SWNE	030	AZ14T0290N0210E	STOCK	District 6
I1151	11	580748	3970512	1.153	2.087	SWNE	032	AZ14T0290N0210E	STOCK	District 6
I1152	11	575034	3974257	0.266	0.392	NWNW	023	AZ14T0290N0200E	STOCK	District 6
I1153	11	574720	3971603	1.602	3.036	NESE	027	AZ14T0290N0200E	STOCK	District 6
I1154	11	570994	3976637	0.716	3.150	NWSE	008	AZ14T0290N0200E	STOCK	District 6
I1155	11	574835	3973639	0.151	0.206	SWNW	023	AZ14T0290N0200E	STOCK	District 6
I1156	11	583048	3970757	0.485	0.778	SWNW	034	AZ14T0290N0210E	STOCK	District 6
I1157	11	571359	3975937	1.658	3.316	NENE	017	AZ14T0290N0200E	STOCK	District 6
I1158	11	583962	3974107	4.132	8.939	NWNE	022	AZ14T0290N0210E	STOCK	HPL
I1159	11	581886	3974179	2.112	4.160	NENW	021	AZ14T0290N0210E	STOCK	HPL
I116	11	589617	3967616	2.419	4.856	NENE	008	AZ14T0280N0220E	STOCK	HPL
I1160	11	580762	3972112	1.265	2.319	SWNE	029	AZ14T0290N0210E	STOCK	District 6
I1161	11	583350	3971225	9.721	23.699	NENW	034	AZ14T0290N0210E	STOCK	District 6
I1162	11	567718	3983727	0.467	0.745	NWNE	024	AZ14T0300N0190E	STOCK	HPL
I1163	11	567918	3983230	1.321	2.437	SENE	024	AZ14T0300N0190E	STOCK	HPL
I1164	11	576032	3965336	0.220	0.316	NESW	013	AZ14T0280N0200E	STOCK	District 6
I1165	11	569585	3968674	0.118	0.155	L 11	005	AZ14T0280N0200E	STOCK	District 6
I1166	11	569422	3968349	0.171	0.237	NESW	005	AZ14T0280N0200E	STOCK	District 6
I1167	11	570774	3968326	0.475	0.760	NWSW	004	AZ14T0280N0200E	STOCK	District 6

US Label	Plate	Easting	Northing	Area (acres)	Capacity (ac-ft)	QQ	Sec	Lndkey	Use	Land Status
I1168	11	569468	3966324	0.225	0.324	SESW	008	AZ14T0280N0200E	STOCK	District 6
I1169	11	569249	3974200	0.813	1.330	NWNE	019	AZ14T0290N0200E	STOCK	District 6
I117	11	586598	3963127	4.492	9.831	SESE	024	AZ14T0280N0210E	STOCK	HPL
I1170	11	567775	3957940	0.087	0.060	L 1	007	AZ14T0270N0200E	STOCK	District 6
I1171	11	575166	3974230	0.276	0.290	NWNW	023	AZ14T0290N0200E	STOCK	District 6
I1172	11	569752	3962871	0.208	0.296	NENW	029	AZ14T0280N0200E	STOCK	District 6
I1173	11	568383	3956898	0.194	0.274	SWSE	007	AZ14T0270N0200E	STOCK	District 6
I1174	11	578205	3982441	1.126	2.031	NWNW	030	AZ14T0300N0210E	STOCK	HPL
I1175	11	568410	3974514	0.940	1.653	SWSW	018	AZ14T0290N0200E	STOCK	District 6
I1176	11	571358	3976268	1.032	1.839	SESE	008	AZ14T0290N0200E	STOCK	District 6
I1177	11	571387	3976159	0.732	1.243	SESE	008	AZ14T0290N0200E	STOCK	District 6
I1178	11	575407	3973379	0.778	1.333	NESW	023	AZ14T0290N0200E	STOCK	District 6
I1179	11	578830	3978356	0.666	1.116	NWSE	006	AZ14T0290N0210E	STOCK	HPL
I118	11	586380	3963214	4.403	9.610	SESE	024	AZ14T0280N0210E	STOCK	HPL
I1180	11	587140	3957241	0.198	0.280	NESW	007	AZ14T0270N0220E	STOCK	HPL
I1181	11	589547	3967622	0.443	0.702	NENE	008	AZ14T0280N0220E	STOCK	HPL
I1182	11	589650	3967494	0.567	0.929	SENE	008	AZ14T0280N0220E	STOCK	HPL
I1183	11	589400	3965395	0.091	0.116	NWSE	017	AZ14T0280N0220E	STOCK	HPL
I1184	11	576347	3962499	0.272	0.402	L 3	025	AZ14T0280N0200E	STOCK	District 6
I1185	11	574679	3979316	0.170	0.235	SESE	034	AZ14T0300N0200E	STOCK	HPL
I1186	11	575438	3975101	0.090	0.114	NESW	014	AZ14T0290N0200E	STOCK	District 6
I1187	11	567934	3974642	0.243	0.389	SWSE	013	AZ14T0290N0190E	STOCK	District 6
I1188	11	571227	3969276	0.165	0.228	L 6	004	AZ14T0280N0200E	STOCK	District 6
I1189	11	570019	3968341	0.253	0.370	NWSE	005	AZ14T0280N0200E	STOCK	District 6
I119	11	585103	3961864	5.061	11.263	SWSW	025	AZ14T0280N0210E	STOCK	HPL
I1190	11	575432	3963723	0.300	0.450	NESE	023	AZ14T0280N0200E	STOCK	District 6
I1191	11	568414	3960735	0.012	0.025	SWNE	031	AZ14T0280N0200E	IRR/STOCK	District 6
I1192	11	569986	3962589	0.001	0.002	NWNE	029	AZ14T0280N0200E	IRR/STOCK	District 6
I121	12	513825	3954317	1.938	3.772	SWNE	021	AZ14T0270N0140E	STOCK	District 6
I1210	12	500373	3946334	1.471	2.755	L 2	018	AZ14T0260N0130E	STOCK	HPL
I1211	12	511526	3943066	5.134	11.448	SWNW	029	AZ14T0260N0140E	STOCK	HPL
I1212	12	513929	3954465	2.298	4.580	NWNE	021	AZ14T0270N0140E	STOCK	District 6
I1213	12	513151	3931280	4.721	10.405	NWSW	033	AZ14T0250N0140E	STOCK	HPL
I1214	12	500633	3934219	0.968	1.710	SESW	019	AZ14T0250N0130E	STOCK	HPL
I1215	12	502627	3939543	1.127	2.033	SWNE	005	AZ14T0250N0130E	STOCK	HPL
I1216	12	505459	3938034	1.505	2.827	SENW	010	AZ14T0250N0130E	STOCK	HPL
I1217	12	507028	3938284	1.652	3.144	SENW	011	AZ14T0250N0130E	STOCK	HPL
I1218	12	510869	3941165	1.249	2.286	SWNE	031	AZ14T0260N0140E	STOCK	HPL
I1219	12	513432	3935867	0.359	0.552	SESW	016	AZ14T0250N0140E	STOCK	HPL
I122	12	510782	3954295	0.854	1.482	SWNE	019	AZ14T0270N0140E	STOCK	HPL
I1220	12	505638	3934160	1.258	2.305	SESW	022	AZ14T0250N0130E	STOCK	HPL
I1222	12	522414	3951489	4.235	9.193	NENE	032	AZ14T0270N0150E	STOCK	District 6
I1223	12	519542	3945565	1.354	2.506	L 4	018	AZ14T0260N0150E	STOCK	HPL
I1224	12	519744	3945619	0.529	0.859	L 3	018	AZ14T0260N0150E	STOCK	HPL
I1225	12	519282	3952369	1.470	2.752	NESE	025	AZ14T0270N0140E	STOCK	District 6
I1226	12	519688	3950479	2.717	5.543	L 3	031	AZ14T0270N0150E	STOCK	District 6
I1227	12	520018	3949970	1.987	3.880	L 3	006	AZ14T0260N0150E	STOCK	District 6
I1228	12	519326	3952421	0.420	0.660	NESE	025	AZ14T0270N0140E	STOCK	District 6
I1229	12	519955	3954038	0.929	1.631	SENW	019	AZ14T0270N0150E	STOCK	District 6
I123	12	504923	3954732	1.851	3.579	NENE	021	AZ14T0270N0130E	STOCK	HPL

US Label	Plate	Easting	Northing	Area (acres)	Capacity (ac-ft)	QQ	Sec	Lndkey	Use	Land Status
I1230	12	517486	3953988	1.068	1.912	NESE	023	AZ14T0270N0140E	STOCK	District 6
I1231	12	521197	3955707	0.241	0.351	SWNW	017	AZ14T0270N0150E	STOCK	District 6
I1232	12	516884	3945602	0.870	1.514	NESW	014	AZ14T0260N0140E	STOCK	HPL
I1233	12	518759	3954961	2.118	4.173	SWSE	013	AZ14T0270N0140E	STOCK	District 6
I1234	12	516114	3940749	79.261	259.051	SESE	034	AZ14T0260N0140E	STOCK	HPL
I1235	12	510758	3936953	1.185	2.153	NWNE	018	AZ14T0250N0140E	STOCK	HPL
I1236	12	517667	3928955	0.539	0.877	NWNE	012	AZ14T0240N0140E	STOCK	HPL
I1237	12	520668	3937272	1.533	2.887	SESE	007	AZ14T0250N0150E	STOCK	HPL
I1238	12	516599	3941009	1.422	2.650	NWSW	035	AZ14T0260N0140E	STOCK	HPL
I1239	12	521258	3935363	1.570	2.970	NWNW	020	AZ14T0250N0150E	STOCK	HPL
I124	12	504336	3952617	1.991	3.889	SWNE	028	AZ14T0270N0130E	STOCK	HPL
I1240	12	518523	3938428	0.310	0.467	NENW	012	AZ14T0250N0140E	STOCK	HPL
I1241	12	520803	3939753	0.232	0.336	SENE	006	AZ14T0250N0150E	STOCK	HPL
I1242	12	511763	3938371	1.361	2.521	NWNW	008	AZ14T0250N0140E	STOCK	HPL
I1243	12	521370	3943412	0.766	1.309	NWNW	029	AZ14T0260N0150E	STOCK	HPL
I1244	12	520749	3937192	0.936	1.645	SESE	007	AZ14T0250N0150E	STOCK	HPL
I1245	12	513284	3955376	1.698	3.244	NWSW	016	AZ14T0270N0140E	STOCK	District 6
I1246	12	511417	3934216	2.060	4.043	SWSW	020	AZ14T0250N0140E	STOCK	HPL
I1247	12	516222	3929607	0.923	1.619	NWSE	002	AZ14T0240N0140E	STOCK	HPL
I1248	12	516466	3929647	1.432	2.672	NESE	002	AZ14T0240N0140E	STOCK	HPL
I1249	12	506873	3938585	0.961	1.696	NWNW	011	AZ14T0250N0130E	STOCK	HPL
I125	12	500868	3948702	1.146	2.072	SESW	006	AZ14T0260N0130E	STOCK	HPL
I1250	12	508920	3937141	2.056	4.034	SESW	012	AZ14T0250N0130E	STOCK	HPL
I1251	12	509525	3937728	0.384	0.596	NESE	012	AZ14T0250N0130E	STOCK	HPL
I1253	12	522110	3954600	0.460	0.732	NWNE	020	AZ14T0270N0150E	STOCK	District 6
I1254	12	522454	3954370	0.105	0.136	SENE	020	AZ14T0270N0150E	STOCK	District 6
I1255	12	522095	3945851	1.387	2.576	NWSE	017	AZ14T0260N0150E	STOCK	District 6
I1256	12	521373	3944179	3.269	6.844	NWSW	020	AZ14T0260N0150E	STOCK	HPL
I1257	12	518173	3950028	0.093	0.118	SWSW	036	AZ14T0270N0140E	STOCK	District 6
I1258	12	520819	3937250	0.762	1.210	SESE	007	AZ14T0250N0150E	STOCK	HPL
I1259	12	518700	3939870	0.136	0.110	SWNE	001	AZ14T0250N0140E	STOCK	HPL
I126	12	503987	3950410	3.668	7.804	NESW	033	AZ14T0270N0130E	STOCK	HPL
I1260	12	502677	3939580	0.339	0.390	SWNE	005	AZ14T0250N0130E	STOCK	HPL
I1261	12	505779	3934260	12.760	62.220	SESW	022	AZ14T0250N0130E	STOCK	HPL
I1262	12	513464	3935810	0.058	0.030	SESW	016	AZ14T0250N0140E	STOCK	HPL
I1263	12	500540	3934110	0.377	0.450	L 4	019	AZ14T0250N0130E	STOCK	HPL
I127	12	506735	3947781	6.370	14.639	SWNW	011	AZ14T0260N0130E	STOCK	HPL
I128	12	507124	3947150	1.470	2.752	SESW	011	AZ14T0260N0130E	STOCK	HPL
I129	12	506155	3946624	4.922	10.911	NWNE	015	AZ14T0260N0130E	STOCK	HPL
I131	13	542303	3935969	0.633	1.054	NWSW	016	AZ14T0250N0170E	STOCK	District 6
I1310	13	526996	3949764	0.384	0.596	L 2	002	AZ14T0260N0150E	STOCK	District 6
I1311	13	529626	3953652	2.425	4.869	NESW	019	AZ14T0270N0160E	STOCK	District 6
I1312	13	524644	3954747	4.741	10.455	NENW	022	AZ14T0270N0150E	STOCK	District 6
I1313	13	525024	3941795	1.290	2.360	L 2	034	AZ14T0260N0150E	STOCK	District 6
I1314	13	524576	3950160	0.824	1.423	SWSW	034	AZ14T0270N0150E	STOCK	District 6
I1315	13	524568	3948317	1.508	2.834	NWNW	010	AZ14T0260N0150E	STOCK	District 6
I1316	13	533228	3943492	1.430	2.667	NWNE	028	AZ14T0260N0160E	STOCK	District 6
I1317	13	523863	3943072	8.340	19.901	L 5	028	AZ14T0260N0150E	STOCK	District 6
I1318	13	524316	3944968	0.437	0.691	NWNW	022	AZ14T0260N0150E	STOCK	District 6
I1319	13	524515	3946721	1.266	2.322	NWNW	015	AZ14T0260N0150E	STOCK	District 6

US Label	Plate	Easting	Northing	Area (acres)	Capacity (ac-ft)	QQ	Sec	Lndkey	Use	Land Status
I132	13	544171	3935324	6.160	14.090	NENW	022	AZ14T0250N0170E	STOCK	District 6
I1320	13	524870	3941917	2.534	5.120	L 2	034	AZ14T0260N0150E	STOCK	District 6
I1321	13	522781	3935814	1.350	2.498	SWSW	016	AZ14T0250N0150E	STOCK	HPL
I1322	13	523955	3931064	1.330	2.456	SESE	033	AZ14T0250N0150E	STOCK	HPL
I1323	13	531401	3932285	0.690	1.162	NENW	032	AZ14T0250N0160E	STOCK	HPL
I1324	13	532365	3934468	1.437	2.682	NWSW	021	AZ14T0250N0160E	STOCK	District 6
I1325	13	531495	3937084	1.192	2.167	NENW	017	AZ14T0250N0160E	STOCK	District 6
I1326	13	529882	3940570	0.715	1.211	SESW	031	AZ14T0260N0160E	STOCK	District 6
I1327	13	527783	3934961	0.854	1.482	SWNW	024	AZ14T0250N0150E	STOCK	HPL
I1328	13	525492	3936878	2.062	4.048	NWNE	015	AZ14T0250N0150E	STOCK	HPL
I1329	13	536996	3935917	0.342	0.522	SESE	014	AZ14T0250N0160E	STOCK	District 6
I133	13	544961	3935445	0.489	0.785	NENE	022	AZ14T0250N0170E	STOCK	District 6
I1330	13	541124	3938116	0.755	1.288	SENW	008	AZ14T0250N0170E	STOCK	District 6
I1331	13	541258	3937525	1.430	2.667	SWSE	008	AZ14T0250N0170E	STOCK	District 6
I1332	13	534195	3941567	3.213	6.710	SWNW	034	AZ14T0260N0160E	STOCK	District 6
I1333	13	540335	3941997	2.794	5.723	SESE	030	AZ14T0260N0170E	STOCK	District 6
I1334	13	541100	3938937	3.431	7.232	SESW	005	AZ14T0250N0170E	STOCK	District 6
I1335	13	525735	3936959	0.945	1.664	NENE	015	AZ14T0250N0150E	STOCK	HPL
I1336	13	536664	3944863	0.952	1.678	NWNE	023	AZ14T0260N0160E	STOCK	District 6
I1337	13	544840	3942594	1.232	2.251	NWSE	027	AZ14T0260N0170E	STOCK	District 6
I1338	13	536817	3944882	3.187	6.649	NENE	023	AZ14T0260N0160E	STOCK	District 6
I1339	13	537059	3946243	2.467	4.966	SENE	014	AZ14T0260N0160E	STOCK	District 6
I134	13	544326	3935493	1.297	2.386	NENW	022	AZ14T0250N0170E	STOCK	District 6
I1340	13	544621	3949397	0.625	1.038	SWNE	003	AZ14T0260N0170E	STOCK	District 6
I1341	13	541363	3945691	1.121	2.021	NWSE	017	AZ14T0260N0170E	STOCK	District 6
I1342	13	540790	3954582	0.270	0.399	NWNW	020	AZ14T0270N0170E	STOCK	District 6
I1343	13	535903	3945647	1.457	2.725	NWSW	014	AZ14T0260N0160E	STOCK	District 6
I1344	13	540003	3950438	1.824	3.520	SWSE	031	AZ14T0270N0170E	STOCK	District 6
I1345	13	543280	3947931	1.919	3.729	SWNE	009	AZ14T0260N0170E	STOCK	District 6
I1346	13	524385	3944985	0.847	1.468	NWNW	022	AZ14T0260N0150E	STOCK	District 6
I1347	13	524673	3955737	2.615	5.307	SENW	015	AZ14T0270N0150E	STOCK	District 6
I1348	13	523542	3953616	2.734	5.583	SWSE	021	AZ14T0270N0150E	STOCK	District 6
I1349	13	523819	3953805	0.411	0.644	NWSE	021	AZ14T0270N0150E	STOCK	District 6
I135	13	541989	3936364	2.234	4.435	NESE	017	AZ14T0250N0170E	STOCK	District 6
I1350	13	528033	3953153	0.240	0.349	NENW	025	AZ14T0270N0150E	STOCK	District 6
I1351	13	527628	3950753	0.364	0.561	NWSW	036	AZ14T0270N0150E	STOCK	District 6
I1352	13	524498	3950118	1.768	3.397	SWSW	034	AZ14T0270N0150E	STOCK	District 6
I1353	13	524754	3949278	0.448	0.711	SENW	003	AZ14T0260N0150E	STOCK	District 6
I1354	13	527226	3950949	4.885	10.817	SENE	035	AZ14T0270N0150E	STOCK	District 6
I1355	13	528026	3952946	1.812	3.493	NENW	025	AZ14T0270N0150E	STOCK	District 6
I1356	13	533741	3949152	1.239	2.265	NESE	004	AZ14T0260N0160E	STOCK	District 6
I1357	13	530750	3948441	0.980	1.734	SWSW	005	AZ14T0260N0160E	STOCK	District 6
I1358	13	532048	3946658	1.412	2.629	NENE	017	AZ14T0260N0160E	STOCK	District 6
I1359	13	531957	3942400	5.535	12.473	NESE	029	AZ14T0260N0160E	STOCK	District 6
I136	13	542559	3936457	0.814	1.403	SENW	016	AZ14T0250N0170E	STOCK	District 6
I1360	13	536014	3950564	0.446	0.707	NESW	035	AZ14T0270N0160E	STOCK	District 6
I1361	13	536059	3950617	0.368	0.568	NESW	035	AZ14T0270N0160E	STOCK	District 6
I1362	13	539175	3951066	0.883	1.540	L 6	031	AZ14T0270N0170E	STOCK	District 6
I1363	13	539298	3950953	1.383	2.568	SENW	031	AZ14T0270N0170E	STOCK	District 6
I1364	13	536846	3944795	1.169	2.120	SENE	023	AZ14T0260N0160E	STOCK	District 6

US Label	Plate	Easting	Northing	Area (acres)	Capacity (ac-ft)	QQ	Sec	Lndkey	Use	Land Status
I1365	13	538050	3944561	0.404	0.632	SWNE	024	AZ14T0260N0160E	STOCK	District 6
I1366	13	544837	3949586	0.445	0.705	SWNE	003	AZ14T0260N0170E	STOCK	District 6
I1367	13	543812	3948370	1.539	2.900	NWNW	010	AZ14T0260N0170E	STOCK	District 6
I1368	13	541065	3946929	0.244	0.355	SESW	008	AZ14T0260N0170E	STOCK	District 6
I1369	13	540761	3944109	0.135	0.181	NWSW	020	AZ14T0260N0170E	STOCK	District 6
I137	13	526188	3949897	0.423	0.666	L 4	002	AZ14T0260N0150E	STOCK	District 6
I1370	13	540657	3944194	0.287	0.428	NWSW	020	AZ14T0260N0170E	STOCK	District 6
I1371	13	536207	3942317	1.095	1.968	SESW	026	AZ14T0260N0160E	STOCK	District 6
I1372	13	541803	3936440	2.126	4.192	SENE	017	AZ14T0250N0170E	STOCK	District 6
I1373	13	542039	3936489	0.088	0.111	SWNW	016	AZ14T0250N0170E	STOCK	District 6
I1374	13	537444	3929425	70.520	226.751	SWSE	001	AZ14T0240N0160E	STOCK	District 6
I1375	13	533934	3939840	1.688	3.222	SENE	004	AZ14T0250N0160E	STOCK	District 6
I1376	13	543179	3953651	0.493	0.792	SWSE	021	AZ14T0270N0170E	STOCK	District 6
I1377	13	535501	3951558	0.396	0.617	NENE	034	AZ14T0270N0160E	STOCK	District 6
I1378	13	529854	3940909	0.448	0.711	NESW	031	AZ14T0260N0160E	STOCK	District 6
I1379	13	532187	3938449	0.276	0.409	NENE	008	AZ14T0250N0160E	STOCK	District 6
I138	13	530116	3948607	2.353	4.705	SWSE	006	AZ14T0260N0160E	STOCK	District 6
I1380	13	541289	3931672	0.755	1.288	SWNE	032	AZ14T0250N0170E	STOCK	District 6
I1381	13	522728	3955757	0.216	0.309	SWNW	016	AZ14T0270N0150E	STOCK	District 6
I1382	13	531448	3953323	0.243	0.354	SESW	020	AZ14T0270N0160E	STOCK	District 6
I1383	13	523129	3947915	0.264	0.389	SENW	009	AZ14T0260N0150E	STOCK	District 6
I1384	13	522848	3943202	1.100	1.978	L 3	028	AZ14T0260N0150E	STOCK	HPL
I1385	13	539616	3955907	0.230	0.332	SENW	018	AZ14T0270N0170E	STOCK	District 6
I1386	13	543187	3948048	0.264	0.389	NWNE	009	AZ14T0260N0170E	STOCK	District 6
I1387	13	543207	3948009	0.163	0.224	SWNE	009	AZ14T0260N0170E	STOCK	District 6
I1388	13	524281	3944885	0.057	0.067	NWNW	022	AZ14T0260N0150E	STOCK	District 6
I1389	13	524288	3944909	0.091	0.116	NWNW	022	AZ14T0260N0150E	STOCK	District 6
I139	13	528338	3953912	2.745	5.608	NWSE	024	AZ14T0270N0150E	STOCK	District 6
I1390	13	534159	3941720	8.793	36.980	NWNW	034	AZ14T0260N0160E	STOCK	District 6
I1391	13	538958	3931680	0.079	0.050	L 2	031	AZ14T0250N0170E	STOCK	District 6
I10153	14	550780	3955800	0.324	0.370	SENW	017	AZ14T0270N0180E	STOCK	District 6
I141	14	560677	3955617	0.692	1.384	NWSE	017	AZ14T0270N0190E	STOCK	District 6
I1410	14	562048	3953832	1.058	1.892	NESW	021	AZ14T0270N0190E	STOCK	District 6
I14100	14	564587	3947795	1.666	3.174	SENE	010	AZ14T0260N0190E	STOCK	HPL
I14101	14	564554	3947927	0.791	1.358	SENE	010	AZ14T0260N0190E	STOCK	HPL
I14102	14	558325	3946096	2.021	3.956	L 2	018	AZ14T0260N0190E	STOCK	District 6
I14103	14	558380	3945943	2.918	6.013	L 3	018	AZ14T0260N0190E	STOCK	District 6
I14104	14	558737	3946559	5.466	12.296	NENW	018	AZ14T0260N0190E	STOCK	District 6
I14105	14	558712	3946784	0.704	1.189	NENW	018	AZ14T0260N0190E	STOCK	District 6
I14106	14	559183	3946360	3.728	7.949	SWNE	018	AZ14T0260N0190E	STOCK	District 6
I14107	14	565650	3944575	1.022	1.819	SWNE	023	AZ14T0260N0190E	STOCK	HPL
I14108	14	557983	3940624	0.996	1.766	SESE	036	AZ14T0260N0180E	STOCK	HPL
I14109	14	557779	3940650	0.806	1.388	SWSE	036	AZ14T0260N0180E	STOCK	HPL
I1411	14	564747	3950062	0.783	1.343	L 4	002	AZ14T0260N0190E	STOCK	District 6
I14110	14	558135	3940457	1.648	3.135	L 4	006	AZ14T0250N0190E	STOCK	HPL
I14111	14	562388	3941401	1.641	3.120	SWNE	033	AZ14T0260N0190E	STOCK	HPL
I14112	14	566468	3940842	1.813	3.496	SWSW	036	AZ14T0260N0190E	STOCK	HPL
I14113	14	547328	3944054	1.142	2.064	NWSW	024	AZ14T0260N0170E	STOCK	District 6
I14114	14	557578	3956167	2.988	6.178	NWNE	013	AZ14T0270N0180E	STOCK	District 6
I14115	14	557514	3955915	0.837	1.449	SWNE	013	AZ14T0270N0180E	STOCK	District 6

US Label	Plate	Easting	Northing	Area (acres)	Capacity (ac-ft)	QQ	Sec	Lndkey	Use	Land Status
I14116	14	556616	3953643	0.332	0.505	SWSW	024	AZ14T0270N0180E	STOCK	District 6
I14117	14	556677	3953517	0.456	0.725	SWSW	024	AZ14T0270N0180E	STOCK	District 6
I14118	14	556721	3953771	0.342	0.522	NWSW	024	AZ14T0270N0180E	STOCK	District 6
I14119	14	556731	3950598	0.403	0.630	NWSW	036	AZ14T0270N0180E	STOCK	District 6
I1412	14	559808	3949751	1.435	2.678	L 4	005	AZ14T0260N0190E	STOCK	District 6
I14120	14	557129	3950556	0.560	0.916	NESW	036	AZ14T0270N0180E	STOCK	District 6
I14121	14	556425	3940620	3.538	7.489	SESE	035	AZ14T0260N0180E	STOCK	HPL
I14122	14	559456	3940965	1.926	3.745	NESE	031	AZ14T0260N0190E	STOCK	HPL
I14123	14	558969	3945782	16.231	42.507	NESW	018	AZ14T0260N0190E	STOCK	District 6
I14124	14	559953	3955214	0.542	0.542	SWSW	017	AZ14T0270N0190E	STOCK	District 6
I14125	14	560278	3948282	0.437	0.691	NENW	008	AZ14T0260N0190E	STOCK	District 6
I14126	14	560350	3948250	1.004	1.782	NENW	008	AZ14T0260N0190E	STOCK	District 6
I14127	14	565004	3946923	0.129	0.172	NWNW	014	AZ14T0260N0190E	STOCK	HPL
I14128	14	548711	3955405	2.036	3.990	L 7	018	AZ14T0270N0180E	STOCK	District 6
I14129	14	556377	3951737	0.190	0.267	SESE	026	AZ14T0270N0180E	STOCK	District 6
I1413	14	558799	3950937	1.587	3.003	SENW	031	AZ14T0270N0190E	STOCK	District 6
I14130	14	563540	3950487	0.819	1.413	SESW	034	AZ14T0270N0190E	STOCK	District 6
I14131	14	562652	3949044	0.113	0.148	NESE	004	AZ14T0260N0190E	STOCK	District 6
I14132	14	566433	3947761	0.090	0.114	NWSW	012	AZ14T0260N0190E	STOCK	HPL
I14133	14	559365	3947152	0.110	0.143	SWSE	007	AZ14T0260N0190E	STOCK	District 6
I14134	14	555556	3943079	0.123	0.163	SENW	026	AZ14T0260N0180E	STOCK	District 6
I14135	14	557167	3940192	0.762	1.302	L 3	001	AZ14T0250N0180E	STOCK	HPL
I14136	14	552594	3940177	0.471	0.752	L 7	004	AZ14T0250N0180E	STOCK	District 6
I14137	14	554584	3956282	0.230	0.332	NENE	015	AZ14T0270N0180E	STOCK	District 6
I14138	14	559684	3954149	0.352	0.539	NESE	019	AZ14T0270N0190E	STOCK	District 6
I14139	14	565417	3954815	0.026	0.053	NWNE	023	AZ14T0270N0190E	IRR/STOCK	District 6
I1414	14	557362	3949636	0.491	0.789	SWNE	001	AZ14T0260N0180E	STOCK	District 6
I14140	14	551843	3931310	0.245	0.250	NWSW	033	AZ14T0250N0180E	STOCK	HPL
I14141	14	553153	3941280	0.609	0.890	SENE	033	AZ14T0260N0180E	STOCK	District 6
I14142	14	562309	3949760	0.331	0.380	L 2	004	AZ14T0260N0190E	STOCK	District 6
I14143	14	553440	3939630	0.404	0.500	SWNW	003	AZ14T0250N0180E	STOCK	HPL
I14144	14	550878	3955700	0.127	0.100	NWSE	017	AZ14T0270N0180E	STOCK	District 6
I1415	14	558886	3953715	1.367	2.534	SESW	019	AZ14T0270N0190E	STOCK	District 6
I1416	14	556658	3944580	0.940	1.128	SWNW	024	AZ14T0260N0180E	STOCK	District 6
I1417	14	553489	3942824	0.576	0.946	NWSW	027	AZ14T0260N0180E	STOCK	District 6
I1418	14	555690	3949183	0.134	0.180	NESW	002	AZ14T0260N0180E	STOCK	District 6
I1419	14	565212	3941044	1.023	1.821	NESW	035	AZ14T0260N0190E	STOCK	HPL
I142	14	558529	3940355	0.363	0.559	L 3	006	AZ14T0250N0190E	STOCK	HPL
I1420	14	554095	3934841	0.560	0.916	SWNE	022	AZ14T0250N0180E	STOCK	HPL
I1421	14	547063	3932655	2.474	4.982	SWSW	025	AZ14T0250N0170E	STOCK	HPL
I1422	14	546389	3938149	0.196	0.277	SWNE	011	AZ14T0250N0170E	STOCK	District 6
I1423	14	546567	3938506	1.215	2.215	NENE	011	AZ14T0250N0170E	STOCK	District 6
I1424	14	548188	3938536	0.746	1.271	NENE	012	AZ14T0250N0170E	STOCK	District 6
I1425	14	554084	3934631	2.096	4.124	NWSE	022	AZ14T0250N0180E	STOCK	HPL
I1427	14	555757	3939106	0.407	0.637	SWSE	002	AZ14T0250N0180E	STOCK	HPL
I1428	14	553376	3939619	0.457	0.727	SWNW	003	AZ14T0250N0180E	STOCK	HPL
I1429	14	553490	3941621	1.416	2.638	L 6	034	AZ14T0260N0180E	STOCK	District 6
I143	14	559890	3941288	0.499	0.803	SWNW	032	AZ14T0260N0190E	STOCK	HPL
I1430	14	553576	3941706	1.251	2.290	L 5	034	AZ14T0260N0180E	STOCK	District 6
I1431	14	552676	3942295	0.462	0.736	SWSE	028	AZ14T0260N0180E	STOCK	District 6

US Label	Plate	Easting	Northing	Area (acres)	Capacity (ac-ft)	QQ	Sec	Lndkey	Use	Land Status
I1432	14	556935	3933508	1.080	1.937	SENW	025	AZ14T0250N0180E	STOCK	HPL
I1433	14	564422	3935812	2.098	4.128	SESE	015	AZ14T0250N0190E	STOCK	HPL
I1434	14	566413	3940851	0.720	1.221	SWSW	036	AZ14T0260N0190E	STOCK	HPL
I1435	14	565115	3942580	0.704	1.189	NESW	026	AZ14T0260N0190E	STOCK	HPL
I1436	14	563595	3945268	1.084	1.945	NENW	022	AZ14T0260N0190E	STOCK	HPL
I1437	14	550769	3946670	0.459	0.730	NENW	017	AZ14T0260N0180E	STOCK	District 6
I1438	14	554440	3950998	0.434	0.685	SWNE	034	AZ14T0270N0180E	STOCK	District 6
I1439	14	552286	3948857	2.284	4.548	SESW	004	AZ14T0260N0180E	STOCK	District 6
I144	14	559754	3954004	0.944	1.133	NWSW	020	AZ14T0270N0190E	STOCK	District 6
I1440	14	565556	3942951	1.582	2.993	SWNE	026	AZ14T0260N0190E	STOCK	HPL
I1441	14	555744	3948237	0.420	0.660	NENW	011	AZ14T0260N0180E	STOCK	District 6
I1442	14	556829	3956026	0.272	0.402	SWNW	013	AZ14T0270N0180E	STOCK	District 6
I1443	14	554954	3956192	1.447	2.703	NWNW	014	AZ14T0270N0180E	STOCK	District 6
I1444	14	553175	3953246	1.767	3.395	NENE	028	AZ14T0270N0180E	STOCK	District 6
I1445	14	556640	3955817	0.763	1.304	SWNW	013	AZ14T0270N0180E	STOCK	District 6
I1446	14	548505	3948223	1.477	2.767	NENE	012	AZ14T0260N0170E	STOCK	District 6
I1447	14	545967	3950786	2.192	4.340	NESW	035	AZ14T0270N0170E	STOCK	District 6
I1448	14	550075	3951905	1.178	2.139	SESE	030	AZ14T0270N0180E	STOCK	District 6
I1449	14	551223	3952935	0.542	0.883	NWNE	029	AZ14T0270N0180E	STOCK	District 6
I145	14	561506	3941100	3.356	7.052	NWSW	033	AZ14T0260N0190E	STOCK	HPL
I1450	14	553886	3941753	0.405	0.633	L 4	034	AZ14T0260N0180E	STOCK	District 6
I1451	14	553417	3941465	0.186	0.261	L 6	034	AZ14T0260N0180E	STOCK	District 6
I1452	14	546247	3938425	1.800	3.467	NWNE	011	AZ14T0250N0170E	STOCK	District 6
I1453	14	546069	3938080	1.214	2.213	SWNE	011	AZ14T0250N0170E	STOCK	District 6
I1454	14	549416	3938962	0.742	1.263	SWSE	006	AZ14T0250N0180E	STOCK	District 6
I1455	14	555331	3940294	0.878	1.530	L 3	002	AZ14T0250N0180E	STOCK	HPL
I1456	14	548274	3955318	0.691	1.164	NESE	013	AZ14T0270N0170E	STOCK	District 6
I1457	14	547691	3954910	0.436	0.689	NWNE	024	AZ14T0270N0170E	STOCK	District 6
I1458	14	547437	3954106	0.912	1.597	SENW	024	AZ14T0270N0170E	STOCK	District 6
I1459	14	547142	3953631	2.901	5.973	SWSW	024	AZ14T0270N0170E	STOCK	District 6
I146	14	563148	3941466	0.413	0.648	SWNW	034	AZ14T0260N0190E	STOCK	HPL
I1460	14	547430	3952893	1.103	1.984	SENW	025	AZ14T0270N0170E	STOCK	District 6
I1461	14	547607	3952943	1.776	3.414	NENW	025	AZ14T0270N0170E	STOCK	District 6
I1462	14	547603	3952844	0.945	1.664	SENW	025	AZ14T0270N0170E	STOCK	District 6
I1463	14	549063	3956173	1.082	1.941	NENW	018	AZ14T0270N0180E	STOCK	District 6
I1464	14	551835	3955269	1.176	2.134	SWSW	016	AZ14T0270N0180E	STOCK	District 6
I1465	14	552930	3955875	2.385	4.778	SENE	016	AZ14T0270N0180E	STOCK	District 6
I1466	14	555729	3951518	2.039	3.996	NWNE	035	AZ14T0270N0180E	STOCK	District 6
I1467	14	555219	3951313	1.007	1.788	NWNW	035	AZ14T0270N0180E	STOCK	District 6
I1468	14	555249	3951159	0.782	1.341	SWNW	035	AZ14T0270N0180E	STOCK	District 6
I1469	14	554901	3947097	0.292	0.436	SESE	010	AZ14T0260N0180E	STOCK	District 6
I147	14	561941	3940377	1.777	3.417	L 3	004	AZ14T0250N0190E	STOCK	HPL
I1470	14	552024	3946832	2.308	4.603	NWNW	016	AZ14T0260N0180E	STOCK	District 6
I1471	14	552213	3946943	2.176	4.304	SESW	009	AZ14T0260N0180E	STOCK	District 6
I1472	14	552291	3946870	2.756	5.634	SESW	009	AZ14T0260N0180E	STOCK	District 6
I1473	14	554984	3945321	2.506	5.055	SWSW	014	AZ14T0260N0180E	STOCK	District 6
I1474	14	555157	3945448	1.274	2.338	SWSW	014	AZ14T0260N0180E	STOCK	District 6
I1475	14	555259	3945293	1.805	3.478	SWSW	014	AZ14T0260N0180E	STOCK	District 6
I1476	14	555132	3945199	0.811	1.397	NWNW	023	AZ14T0260N0180E	STOCK	District 6
I1477	14	554994	3945188	0.495	0.796	NWNW	023	AZ14T0260N0180E	STOCK	District 6

US Label	Plate	Easting	Northing	Area (acres)	Capacity (ac-ft)	QQ	Sec	Lndkey	Use	Land Status
I1478	14	554984	3944817	1.543	2.909	SWNW	023	AZ14T0260N0180E	STOCK	District 6
I1479	14	555068	3944755	0.997	1.768	SWNW	023	AZ14T0260N0180E	STOCK	District 6
I148	14	563257	3933712	1.093	1.964	NWNW	027	AZ14T0250N0190E	STOCK	HPL
I1480	14	555325	3944596	1.395	2.593	SWNW	023	AZ14T0260N0180E	STOCK	District 6
I1481	14	555451	3944573	1.914	3.718	SENW	023	AZ14T0260N0180E	STOCK	District 6
I1482	14	555645	3944849	0.334	0.508	SENW	023	AZ14T0260N0180E	STOCK	District 6
I1483	14	555798	3944797	0.870	1.514	SWNE	023	AZ14T0260N0180E	STOCK	District 6
I1484	14	552707	3943144	0.406	0.635	SWNE	028	AZ14T0260N0180E	STOCK	District 6
I1485	14	552868	3943106	0.530	0.861	SWNE	028	AZ14T0260N0180E	STOCK	District 6
I1486	14	552996	3943052	1.524	2.868	SENE	028	AZ14T0260N0180E	STOCK	District 6
I1487	14	561115	3955995	0.483	0.774	SENE	017	AZ14T0270N0190E	STOCK	District 6
I1488	14	561352	3955755	0.233	0.337	NWSW	016	AZ14T0270N0190E	STOCK	District 6
I1489	14	560969	3955193	0.904	1.582	SESE	017	AZ14T0270N0190E	STOCK	District 6
I149	14	561683	3954600	0.885	2.124	NWNW	021	AZ14T0270N0190E	STOCK	District 6
I1490	14	560456	3955401	0.300	0.450	NESW	017	AZ14T0270N0190E	STOCK	District 6
I1491	14	559258	3954852	0.239	0.347	NWNE	019	AZ14T0270N0190E	STOCK	District 6
I1492	14	559201	3954662	0.753	1.284	NWNE	019	AZ14T0270N0190E	STOCK	District 6
I1493	14	559404	3954080	0.989	1.752	NESE	019	AZ14T0270N0190E	STOCK	District 6
I1494	14	559236	3953876	0.464	0.740	NWSE	019	AZ14T0270N0190E	STOCK	District 6
I1495	14	561037	3953935	1.684	1.684	NESE	020	AZ14T0270N0190E	STOCK	District 6
I1496	14	560363	3954290	0.945	1.664	SENW	020	AZ14T0270N0190E	STOCK	District 6
I1497	14	559549	3948687	0.318	0.481	SESE	006	AZ14T0260N0190E	STOCK	District 6
I1498	14	559617	3948663	0.276	0.409	SESE	006	AZ14T0260N0190E	STOCK	District 6
I1499	14	559342	3954111	0.366	0.564	NESE	019	AZ14T0270N0190E	STOCK	District 6
I151	15	589391	3949602	0.293	0.438	SWNE	005	AZ14T0260N0220E	STOCK	HPL
I1510	15	574294	3944424	0.457	0.727	NWSW	023	AZ14T0260N0200E	STOCK	HPL
I1511	15	571059	3948379	0.260	0.382	NWNW	009	AZ14T0260N0200E	STOCK	HPL
I1512	15	568119	3946440	0.593	0.978	L 2	018	AZ14T0260N0200E	STOCK	HPL
I1513	15	568186	3946315	0.336	0.512	L 2	018	AZ14T0260N0200E	STOCK	HPL
I1514	15	570921	3942887	0.364	0.561	SWNW	028	AZ14T0260N0200E	STOCK	HPL
I1515	15	582714	3955674	0.670	1.124	L 7	015	AZ14T0270N0210E	STOCK	HPL
I1516	15	572664	3946547	1.440	2.689	NWNW	015	AZ14T0260N0200E	STOCK	HPL
I1517	15	583742	3950380	1.762	3.384	SWSW	035	AZ14T0270N0210E	STOCK	HPL
I1518	15	584714	3952877	1.090	1.957	SWNE	026	AZ14T0270N0210E	STOCK	HPL
I1519	15	573189	3939417	0.493	0.792	NESW	003	AZ14T0250N0200E	STOCK	HPL
I152	15	589590	3945741	0.866	1.506	SWSE	017	AZ14T0260N0220E	STOCK	HPL
I1520	15	578108	3939359	0.440	0.696	NWSE	006	AZ14T0250N0210E	STOCK	HPL
I1521	15	577032	3942281	0.728	1.236	SESE	025	AZ14T0260N0200E	STOCK	HPL
I1522	15	578709	3939217	45.871	138.894	SESE	006	AZ14T0250N0210E	STOCK	HPL
I1523	15	588487	3946178	0.368	0.568	NWSW	017	AZ14T0260N0220E	STOCK	HPL
I1524	15	590061	3951370	1.165	2.112	SWNW	033	AZ14T0270N0220E	STOCK	HPL
I1525	15	590157	3951494	0.800	1.376	NWNW	033	AZ14T0270N0220E	STOCK	HPL
I1526	15	572112	3945102	1.286	2.363	NENE	021	AZ14T0260N0200E	STOCK	HPL
I1527	15	587288	3955737	0.049	0.057	NESW	018	AZ14T0270N0220E	STOCK	HPL
I1528	15	575433	3945690	0.157	0.215	SESE	014	AZ14T0260N0200E	STOCK	HPL
I1529	15	569587	3943709	0.152	0.207	SWSW	020	AZ14T0260N0200E	STOCK	HPL
I153	15	589340	3954796	2.437	4.897	NWNE	020	AZ14T0270N0220E	STOCK	HPL
I1530	15	571670	3945190	0.243	0.354	NWNE	021	AZ14T0260N0200E	STOCK	HPL
I154	15	589626	3951006	1.754	3.366	NESE	032	AZ14T0270N0220E	STOCK	HPL
I155	15	587796	3945897	1.096	1.970	NWSE	018	AZ14T0260N0220E	STOCK	HPL

US Label	Plate	Easting	Northing	Area (acres)	Capacity (ac-ft)	QQ	Sec	Lndkey	Use	Land Status
I156	15	581908	3947038	2.399	4.810	SESE	009	AZ14T0260N0210E	STOCK	HPL
I157	15	589391	3950606	0.599	0.989	SWSE	032	AZ14T0270N0220E	STOCK	HPL
I158	15	588574	3952494	0.647	1.080	NWSW	029	AZ14T0270N0220E	STOCK	HPL
I159	15	569233	3942571	0.658	1.101	NWSW	029	AZ14T0260N0200E	STOCK	HPL

<u>EXHIBIT F</u>

Attributes of Rights for Keams Lake Recreation Use

Priority date	See paragraphs 20 through 23 of Recommended Decree
Type of use	Recreation
Source of water	Washes in Land Management District 6
Point of diversion	Washes in Land Management District 6, as shown on the attached map.
Place of use	NW ¼ NW¼ Section 26 Township 28N Range 20E Keams Lake in Land Management District 6, as shown on the attached map.
Volume	8.3 acre-feet storage capacity, with continuous fill from washes, 17.7 AFA evaporative loss
Period of use	Year-round
Owners	Hopi Tribe United States acting in its capacity as trustee for the Hopi Tribe

Map Showing Place of Use for Keams Lake Recreation Uses

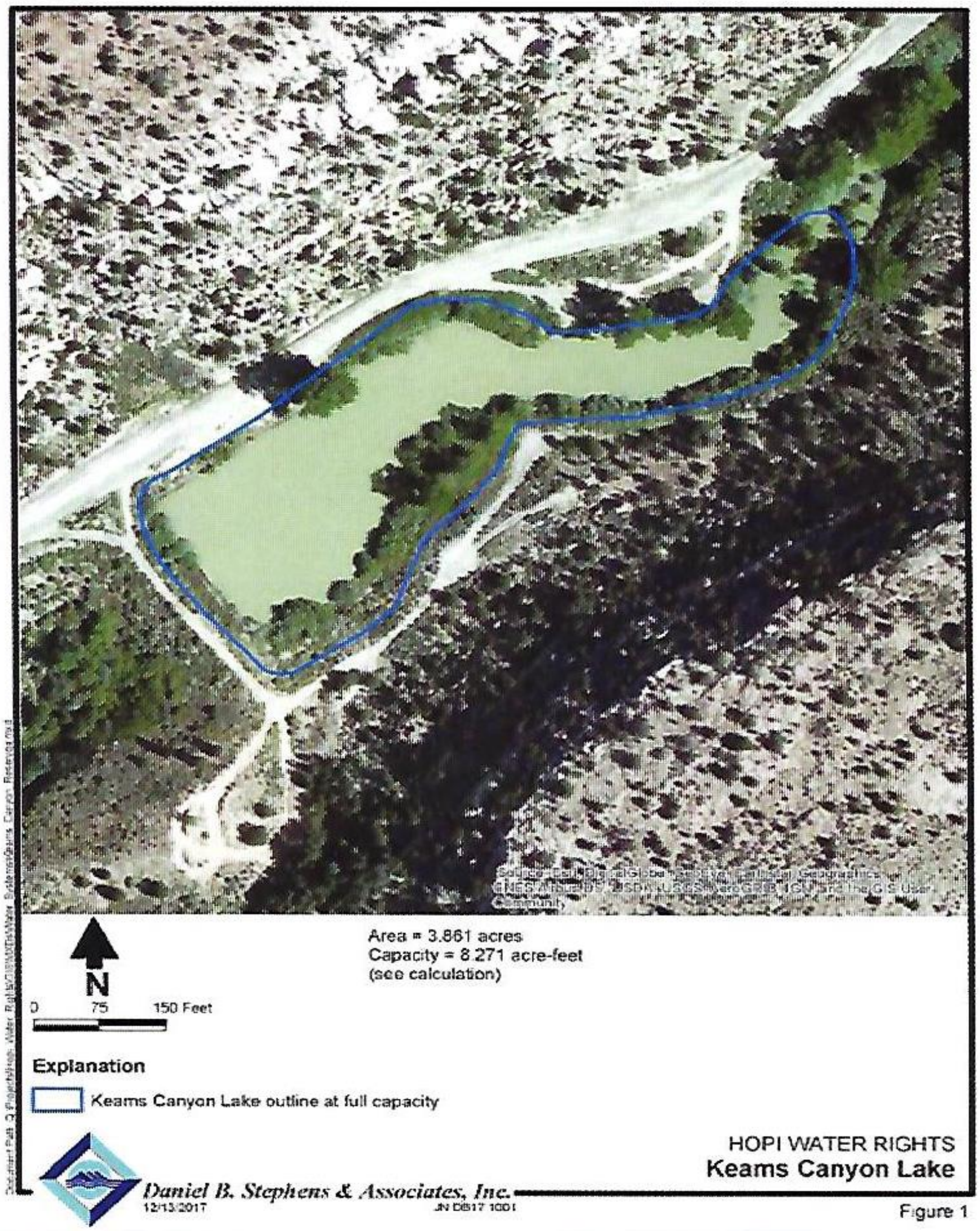


Figure 59: *Keams Canyon Lake*
Source: Hopi Exh. 3948 at 4

EXHIBIT G

Attributes of Rights for Riparian and Wetland Habitat

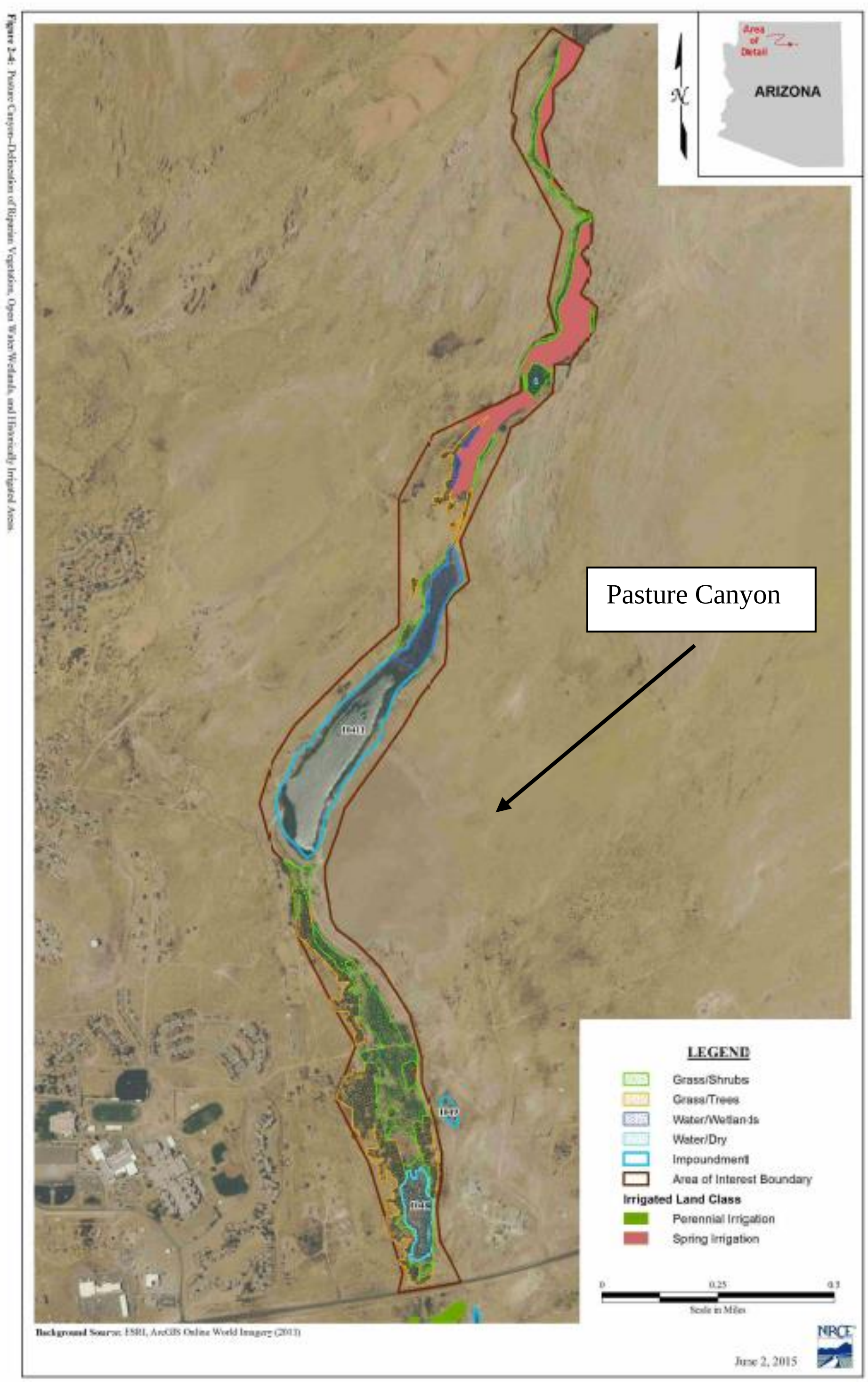
Attributes of Rights for Pasture Canyon

Priority date	June 14, 1934
Type of use	Hopi Reservation of wetlands and riparian areas (non-consumptive) in Pasture Canyon
Source of water	Pasture Canyon Reservoir, spring flow on the Moenkopi Island, subflow between Pasture Canyon Reservoir and the Pasture Canyon wetland area and Moenkopi Wash located on the 1934 Reservation
Points of diversion	See attached Schedule and map
Places of use	See attached Schedule and map
Volume	286.8 AFA
Period of use	Year-round
Owners	Hopi Tribe United States acting in its capacity as trustee for the Hopi Tribe

Schedule of Points of Diversion and Places of Use for Riparian and Wetland Habitat

ID	x	y	Qtr-Qtr	Section	Meridian-Twp-Rge	County	Area (acres)	Cover Type	Ave. Annual Total Water Requirement (ac-ft)	Ave. Annual Total Water Depletion (ac-ft)
0	481581.285	4000958.415	NESW	15	AZ14T0320N0110E	Coconino	0.18	Grass/Shrubs	0.71	0.71
1	480996.648	3999959.012	SWNW	22	AZ14T0320N0110E	Coconino	2.41	Grass/Shrubs	9.44	9.44
2	480812.5312	3998492.786	SWNW	27	AZ14T0320N0110E	Coconino	16.45	Grass/Shrubs	64.55	64.55
7	481454.6031	4001302.526	NESW, SENW, NENW	15	AZ14T0320N0110E	Coconino	5.88	Grass/Shrubs	23.07	23.07
9	481205.1725	4000474.606	SWSW	15	AZ14T0320N0110E	Coconino	0.38	Grass/Shrubs	1.51	1.51
12	480556.6573	3998926.909	SESE	21	AZ14T0320N0110E	Coconino	0.37	Grass/Shrubs	1.45	1.45
16	480969.0052	3997866.654	NWSW	27	AZ14T0320N0110E	Coconino	2.50	Grass/Shrubs	9.80	9.80
20	480559.7517	3999010.345	SESE	21	AZ14T0320N0110E	Coconino	1.48	Grass/Shrubs	5.81	5.81
					SUBTOTAL		**29.6**		**116.34**	**116.34**
6	481124.6907	4000464.579	SWSW	15	AZ14T0320N0110E	Coconino	2.05	Grass/Trees	7.68	7.68
10	481125.7649	4000274.62	NWNW	22	AZ14T0320N0110E	Coconino	0.72	Grass/Trees	2.70	2.70
11	480966.1547	4000038.586	NWNW	22	AZ14T0320N0110E	Coconino	0.34	Grass/Trees	1.26	1.26
13a	480667.5056	3998723.692	SESE	21	AZ14T0320N0110E	Coconino	5.62	Grass/Trees	21.06	21.06
13b	480667.5056	3998723.692	NENE	28	AZ14T0320N0110E					
14	480860.248	3998004.994	SENE, NESE	28	AZ14T0320N0110E	Coconino	13.23	Grass/Trees	49.60	49.60
15	481003.8513	3998060.961	SWNW	27	AZ14T0320N0110E	Coconino	2.96	Grass/Trees	11.09	11.09
17	480886.3027	3998216.706	SENE	28	AZ14T0320N0110E	Coconino	0.23	Grass/Trees	0.85	0.85
18	480949.8431	3998349.064	NWNW	27	AZ14T0320N0110E	Coconino	0.95	Grass/Trees	3.55	3.55
19	480743.5338	3998730.224	SESE	21	AZ14T0320N0110E	Coconino	0.17	Grass/Trees	0.63	0.63
					SUBTOTAL		**26.2**		**98.41**	**98.41**
3	481386.6171	4000751.617	NESW	15	AZ14T0320N0110E	Coconino	0.04	Water/Small, Shallow	0.16	0.16
22	480974.2955	3997865.986	NWSW	27	AZ14T0320N0110E	Coconino	5.64	Water/Small, Shallow	22.14	22.14
					SUBTOTAL		**5.7**		**22.31**	**22.31**
4	481157.5494	4000557.299	SWSW	15	AZ14T0320N0110E	Coconino	0.17	Water/Wetlands	1.10	1.10
5	481110.6283	4000437.341	SWSW	15	AZ14T0320N0110E	Coconino	0.26	Water/Wetlands	1.65	1.65
8	481387.3726	4000752.65	NESW	15	AZ14T0320N0110E	Coconino	0.004	Water/Wetlands	0.02	0.02
21	481004.5944	3999963.893	SWNW, NWNW	22	AZ14T0320N0110E	Coconino	7.40	Water/Wetlands	47.00	47.00
					SUBTOTAL		**7.8**		**49.78**	**49.78**
					TOTAL		**69.4**		**286.8**	**286.8**

Map Showing Places of Use for Pasture Canyon



Attributes of Rights for White Ruin Canyon

Priority date	See paragraphs 20 through 23 of Recommended Decree
Beneficial use	Preservation of wetlands and riparian areas (non-consumptive) in White Ruin Canyon
Source of water	Seeps and springs
Points of diversion	White Ruin Canyon on the Hopi Reservation GPS coordinates: 36° 12’ 2.9844” N; 110° 44’ 10.5108” W (see attached map)
Place(s) of use	White Ruin Canyon on the Hopi Reservation GPS coordinates: 36° 12’ 2.9844” N; 110° 44’ 10.5108” W (see attached map)
Volume	12.39 AFA
Period of use	Year-round
Owners	Hopi Tribe United States acting in its capacity as trustee for the Hopi Tribe

Map Showing the Location of White Ruin Canyon

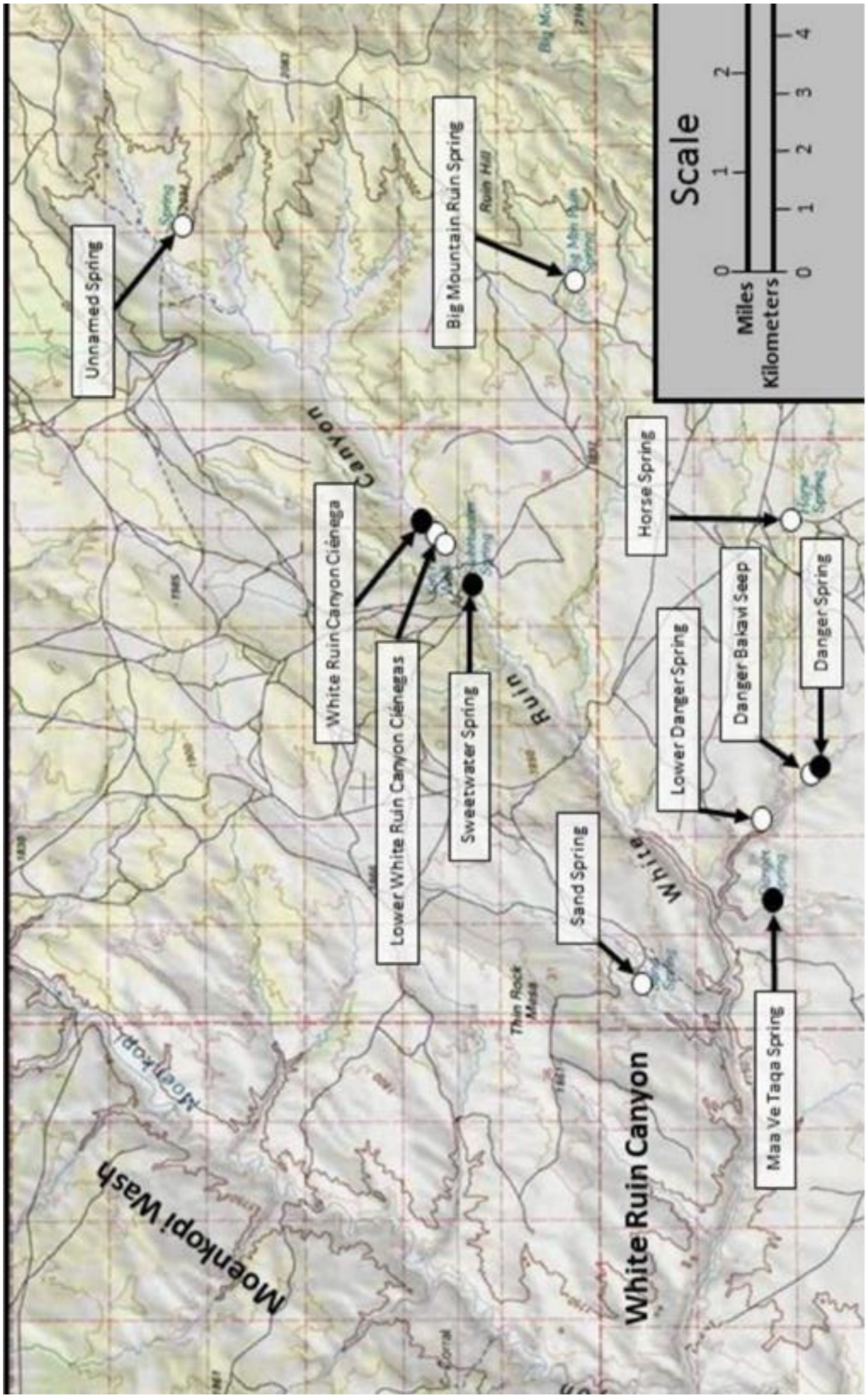
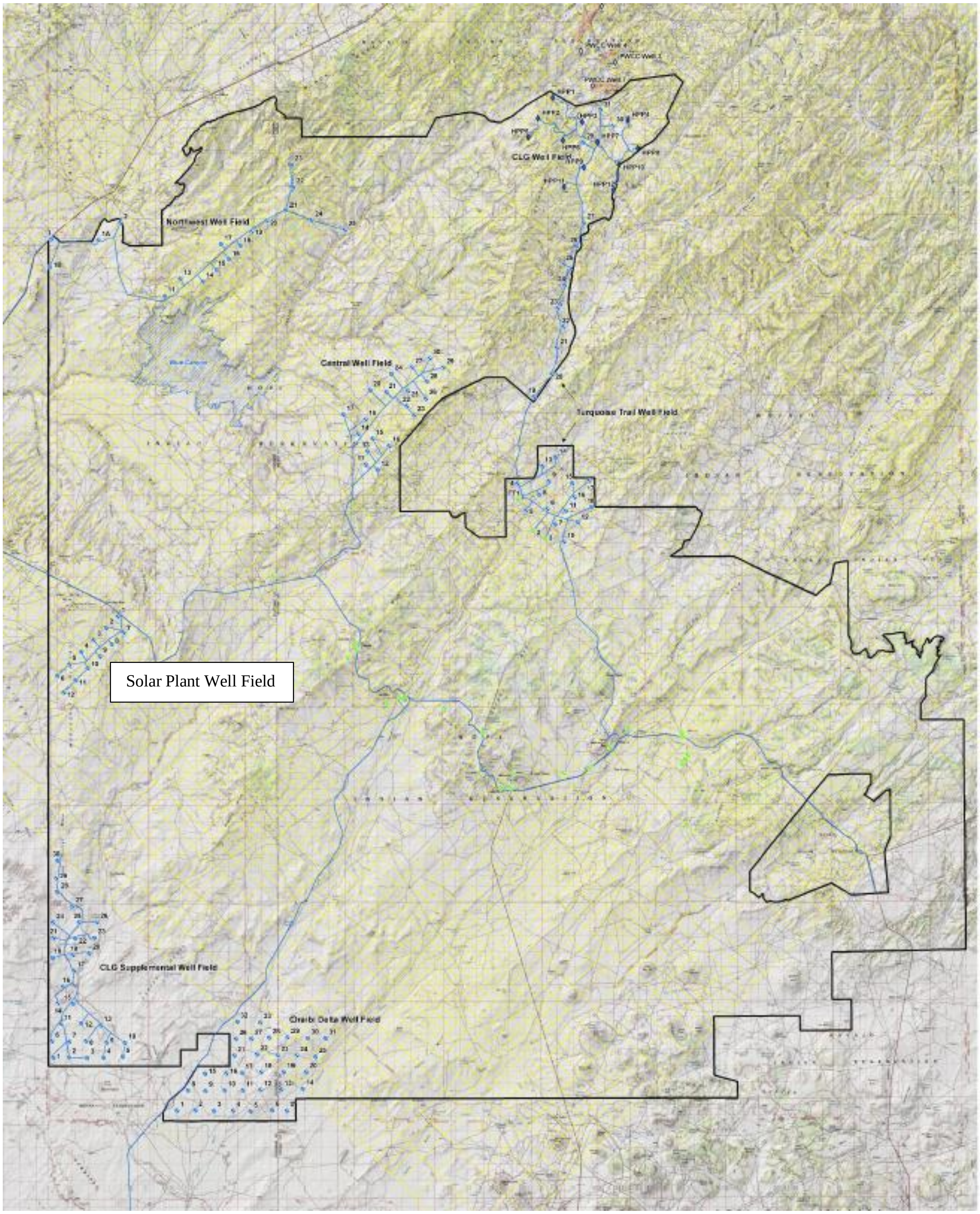


EXHIBIT H

Attributes of Rights for Mining and Heavy Industrial Use

Priority date	See paragraphs 20 through 23 of Recommended Decree
Beneficial use	Mining and heavy industrial use
Source of water	Groundwater on the Hopi Reservation
Points of diversion	Wells to be drilled on the Hopi Reservation on the Solar Plant well field, as shown on the attached map and PWCC Well #9
Place of use	Wells to be drilled on the Hopi Reservation at the Solar Plant well field, as shown on the attached map, and PWCC Well #9, as shown on the attached map
Volume	2,300 AFA No more than 1,800 AFA may be withdrawn from the Solar Plant well field 500 AFA up to the maximum 2,300 AFA may be withdrawn from the N Aquifer from the PWCC Well #9 or another well or wells in the general vicinity of PWCC Well #9 located on the Hopi Reservation
Period of use	Year-round
Owners	Hopi Tribe United States acting in its capacity as trustee for the Hopi Tribe

Map of Existing and proposed Hopi Supply Wells



Map of location of PWCC Well # 9

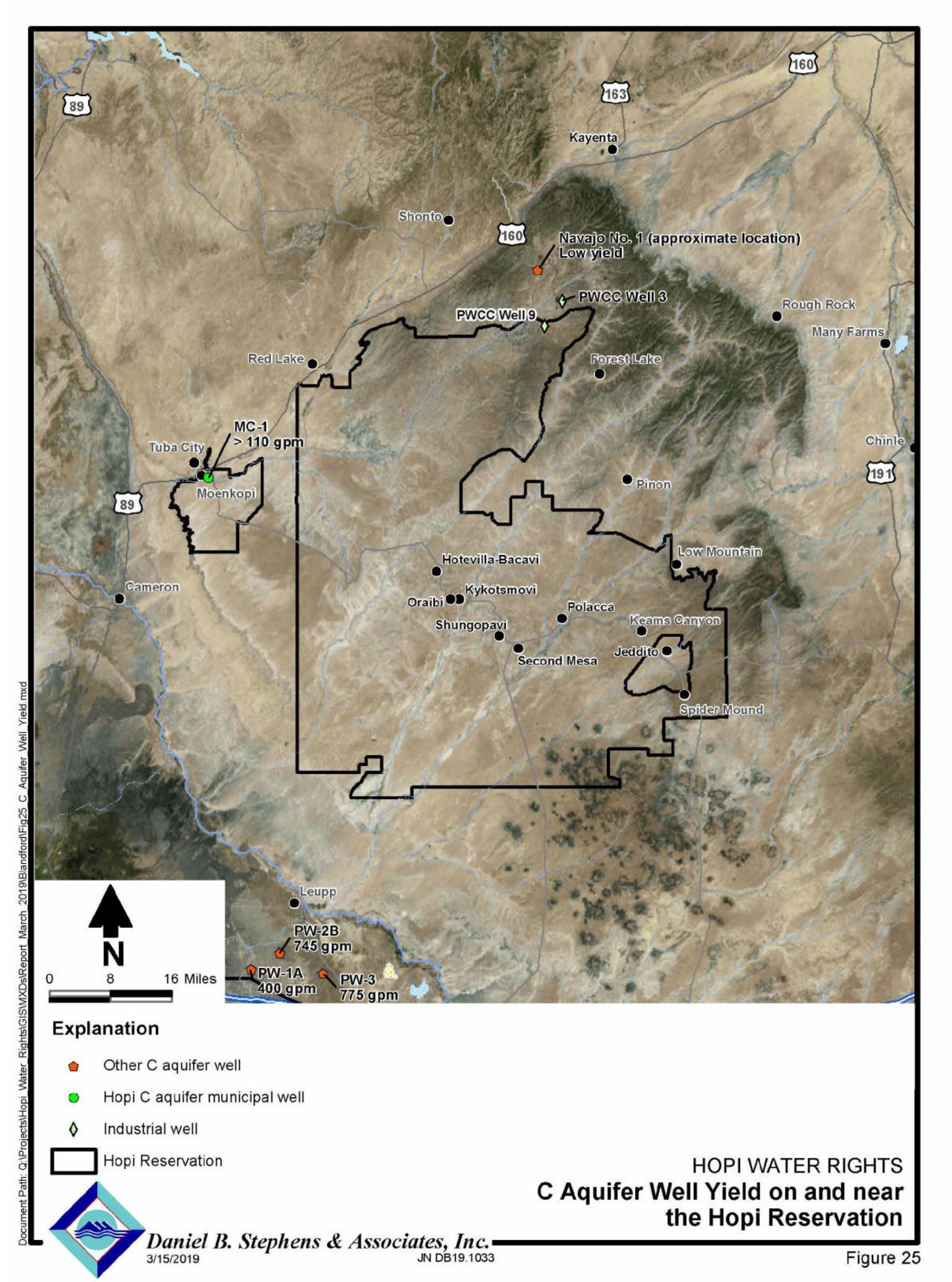


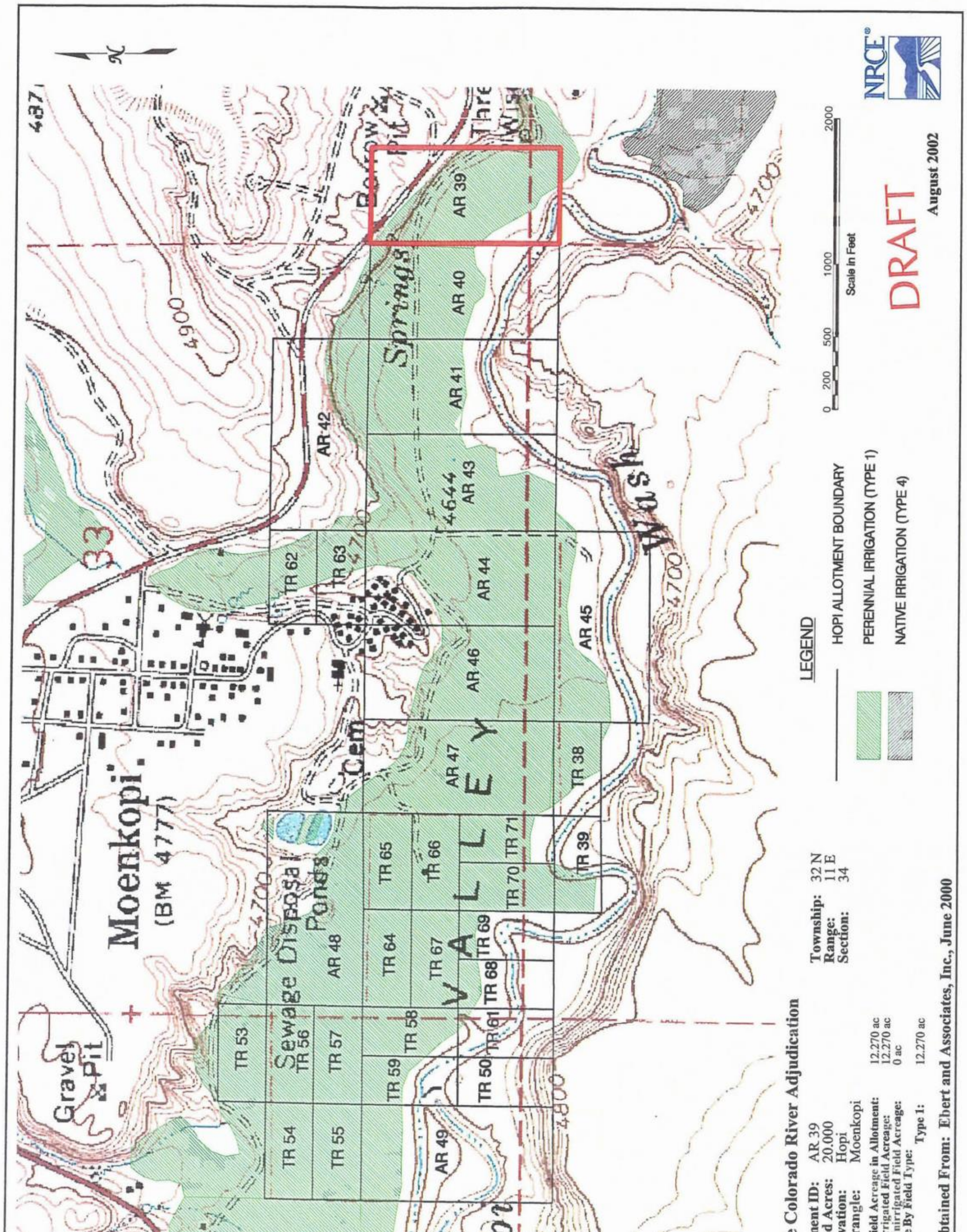
EXHIBIT I

Attributes and maps of Rights for Hopi Allotments

Attributes of Rights for Hopi Allotment Number 39

Priority date	June 14, 1934
Beneficial use	Irrigated Agriculture and Domestic uses
Source of water	Pasture Canyon Reservoir, springs, and Moenkopi Wash
Point(s) of diversion	NWNW Sec 3 T31N R11E and SWSW Sec 34 T32N R 11E on the Hopi Reservation as shown on the attached map.
Place(s) of use	NWNW Sec 3 T31N R11E and SWSW Sec 34 T32N R 11E on the Hopi Reservation as shown on the attached map.
Volume	17.06 AFA
Period of use	Year-round
Owners	Hopi Tribe United States acting in its capacity as trustee for the Allottees of Allotment No. 39

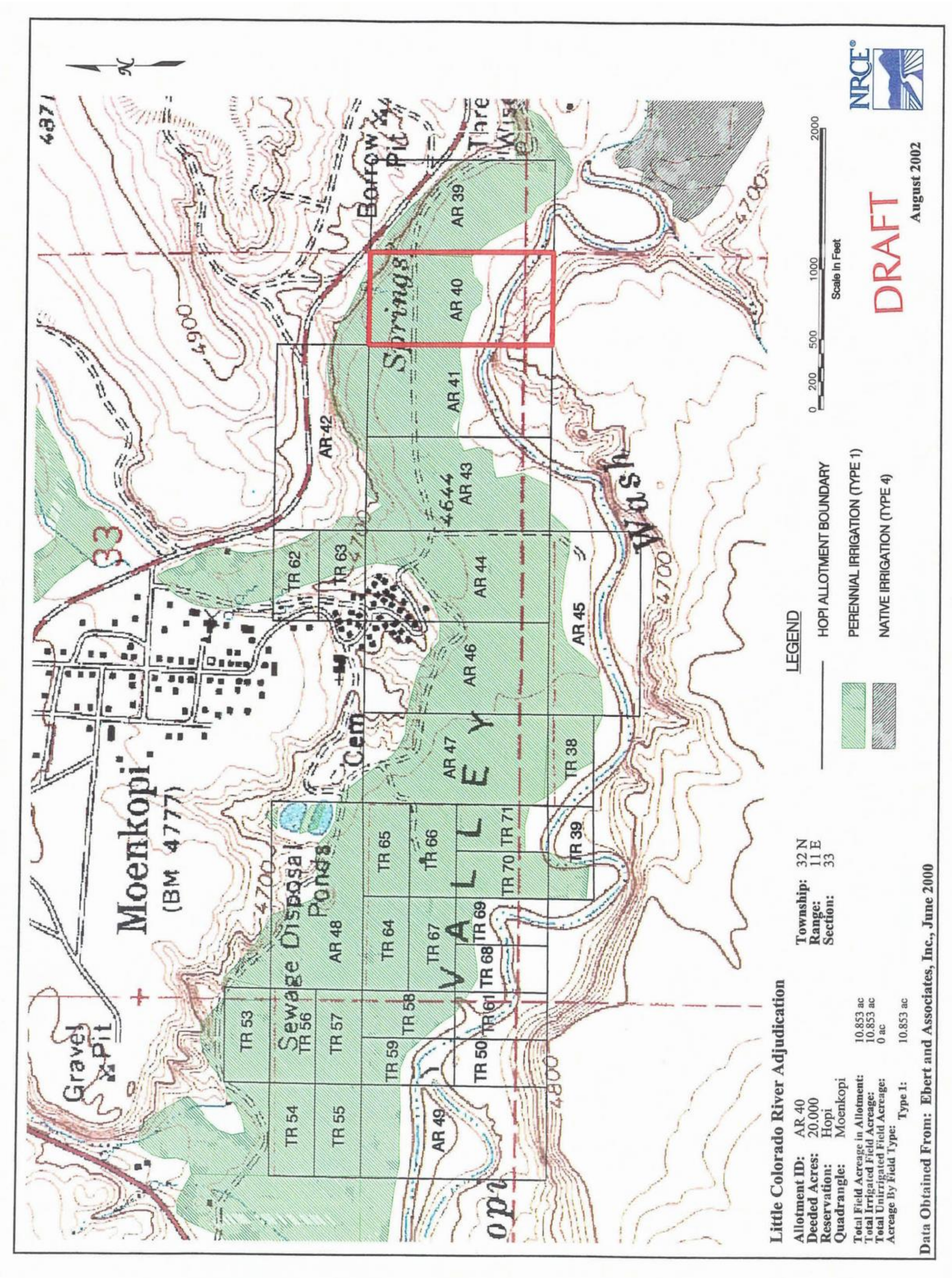
Map Showing Places of Use for Hopi Allotment 39



Attributes of Rights for Hopi Allotment Number 40

Priority date	June 14, 1934
Beneficial use	Irrigated Agriculture and Domestic uses
Source of water	Pasture Canyon Reservoir, springs, and Moenkopi Wash
Point(s) of diversion	SWSW Sec 34 T32N R11E and SESE Sec 33 T32N R 11E on the Hopi Reservation (see attached map)
Place(s) of use	SWSW Sec 34 T32N R11E and SESE Sec 33 T32N R 11E on the Hopi Reservation (see attached map)
Volume	15.67 AFA
Period of use	Year-round
Owners	Hopi Tribe United States acting in its capacity as trustee for the Allottees of Allotment No. 40

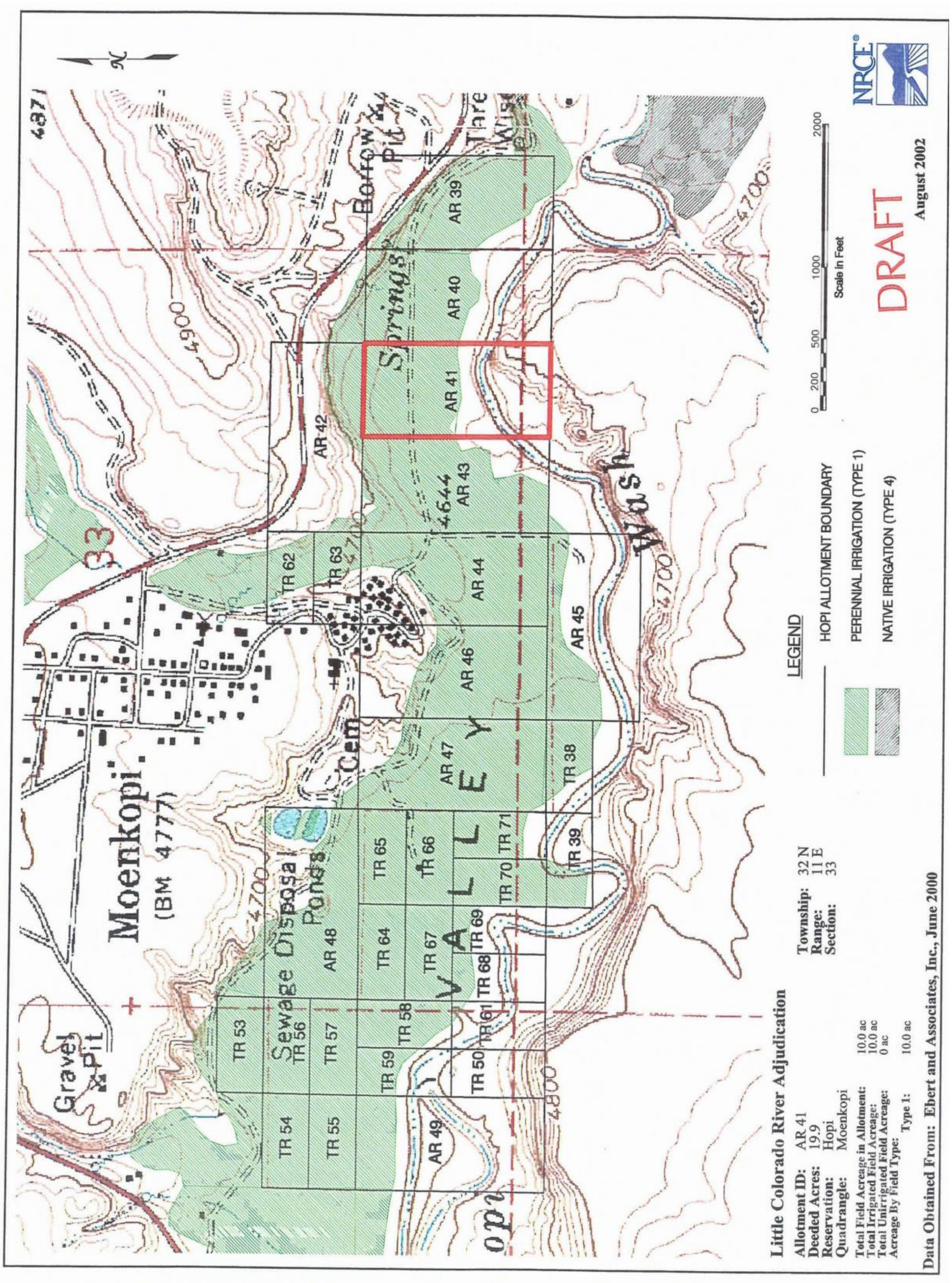
Map Showing Points of Diversion and Places of Use for Hopi Allotment 40



Attributes of Rights for Hopi Allotment Number 41

Priority date	June 14, 1934
Beneficial use	Irrigated Agriculture and Domestic uses
Source of water	Pasture Canyon Reservoir, springs, and Moenkopi Wash
Point(s) of diversion	SESE Sec 33 T32 N R 11E on the Hopi Reservation (see attached map)
Place(s) of use	SESE Sec 33 T32 N R 11E on the Hopi Reservation (see attached map)
Volume	10.02 AFA
Period of use	Year-round
Owners	Hopi Tribe United States acting in its capacity as trustee for the Allottees of Allotment No. 41

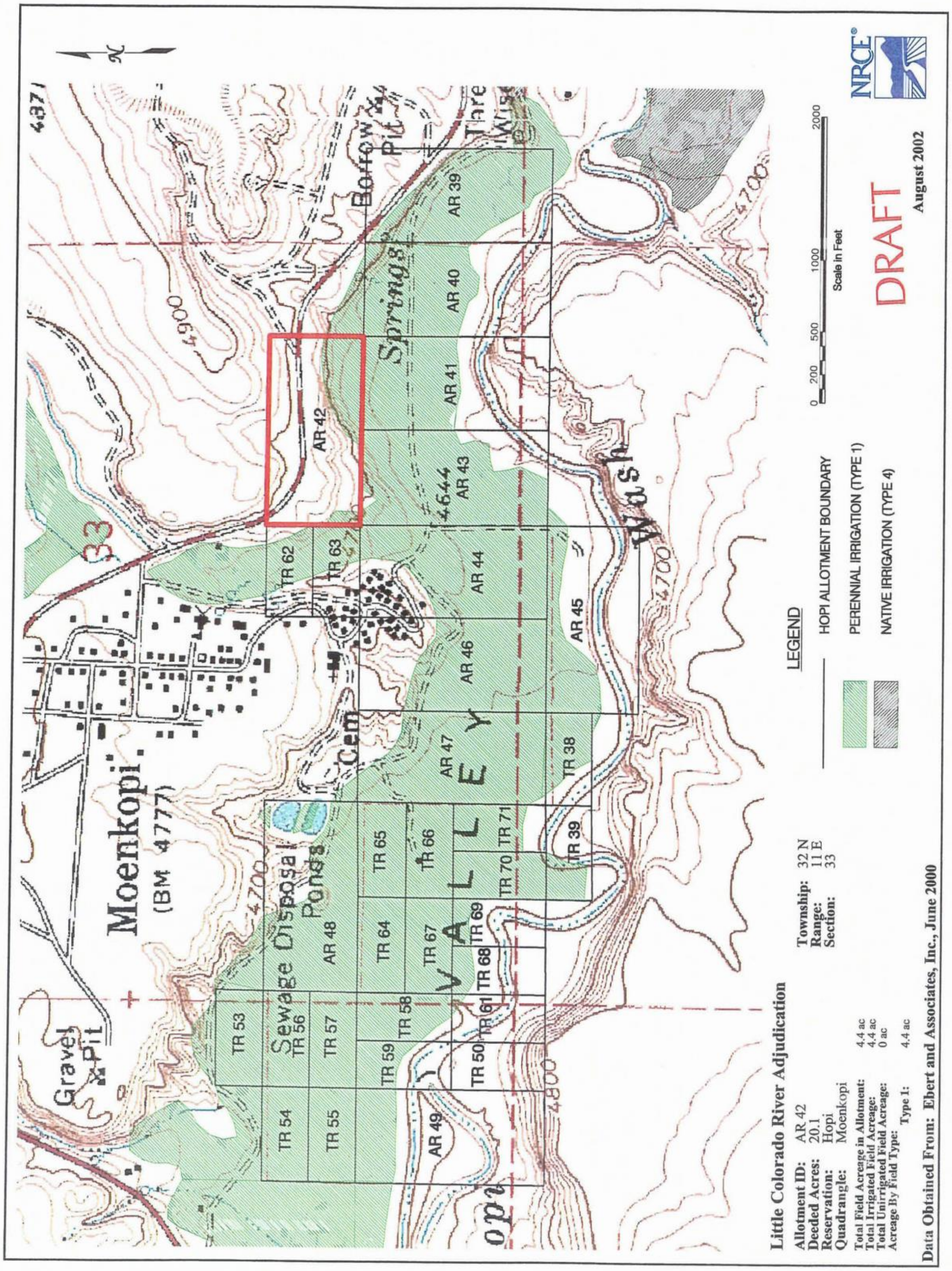
Map Showing Points of Diversion and Places of Use for Hopi Allotment 41



Attributes of Rights for Hopi Allotment Number 42

Priority date	June 14, 1934
Beneficial use	Irrigated Agriculture and Domestic uses
Source of water	Reservoir Canyon/Pasture Canyon Springs
Point(s) of diversion	SWSE Sec 33 T32N R11E and SESE Sec 33 T32N R11E on the Hopi Reservation (see attached map)
Place(s) of use	SWSE Sec 33 T32N R11E and SESE Sec 33 T32N R11E on the Hopi Reservation (see attached map)
Volume	6 AFA
Period of use	Year-round
Owners	Hopi Tribe United States acting in its capacity as trustee for the Allottees of Allotment No. 42

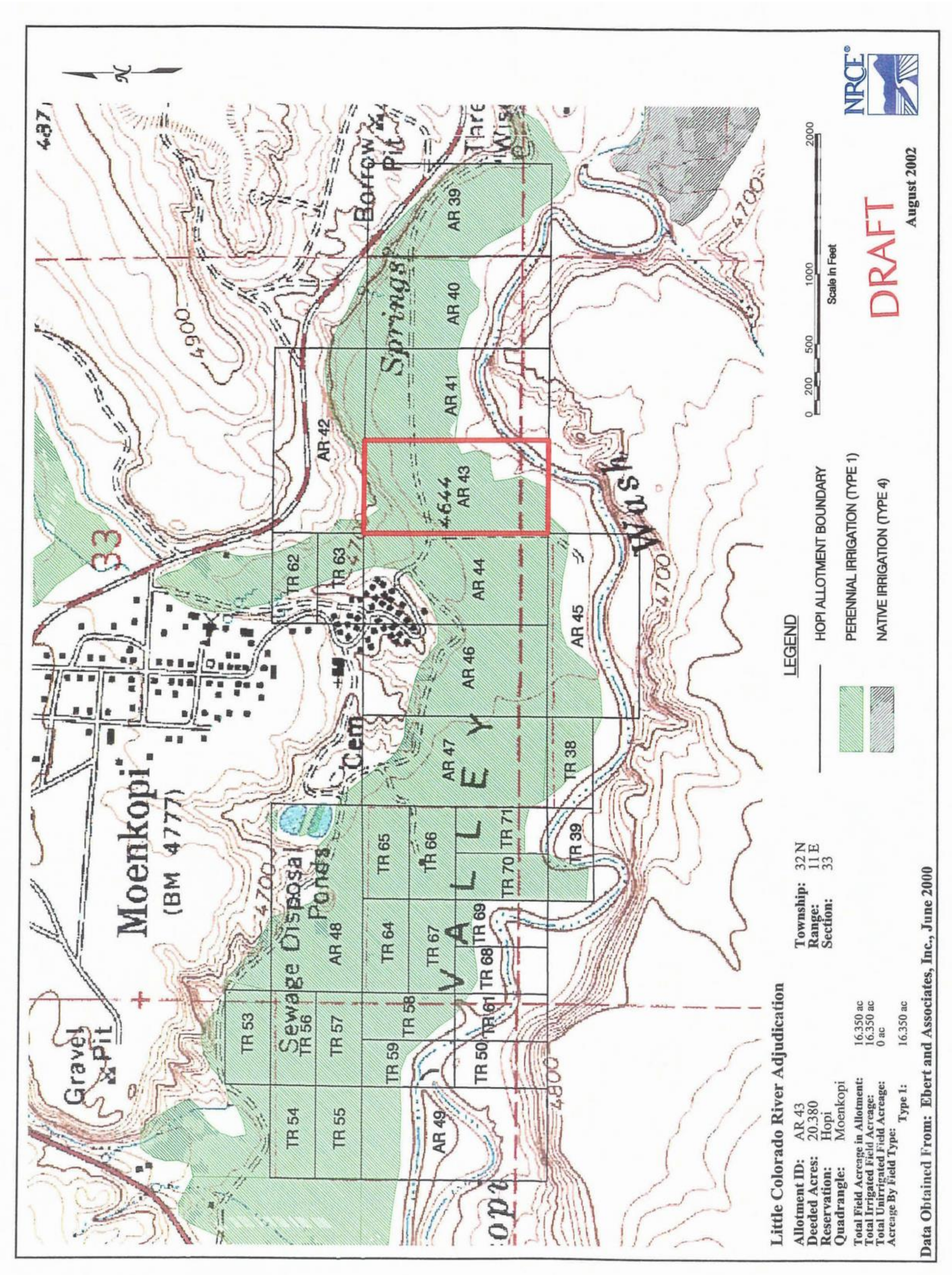
Map Showing Points of Diversion and Places of Use for Hopi Allotment 42



Attributes of Rights for Hopi Allotment Number 43

Priority date	June 14, 1934
Beneficial use	Irrigated Agriculture and Domestic uses
Source of water	Pasture Canyon Reservoir, springs, and Moenkopi Wash
Point(s) of diversion	NWNE Sec 4 T31N R11E; SWSE Sec 33 T32N R 11E; SESE Sec 33 T32N R 11E ; SWSE Sec 33 T32N R11E on the Hopi Reservation (see attached map)
Place(s) of use	NWNE Sec 4 T31N R11E; SWSE Sec 33 T32N R 11E; SESE Sec 33 T32N R 11E ; SWSE Sec 33 T32N R11E on the Hopi Reservation (see attached map)
Volume	22.55 AFA
Period of use	Year-round
Owners	Hopi Tribe United States acting in its capacity as trustee for the Allottees of Allotment No. 43

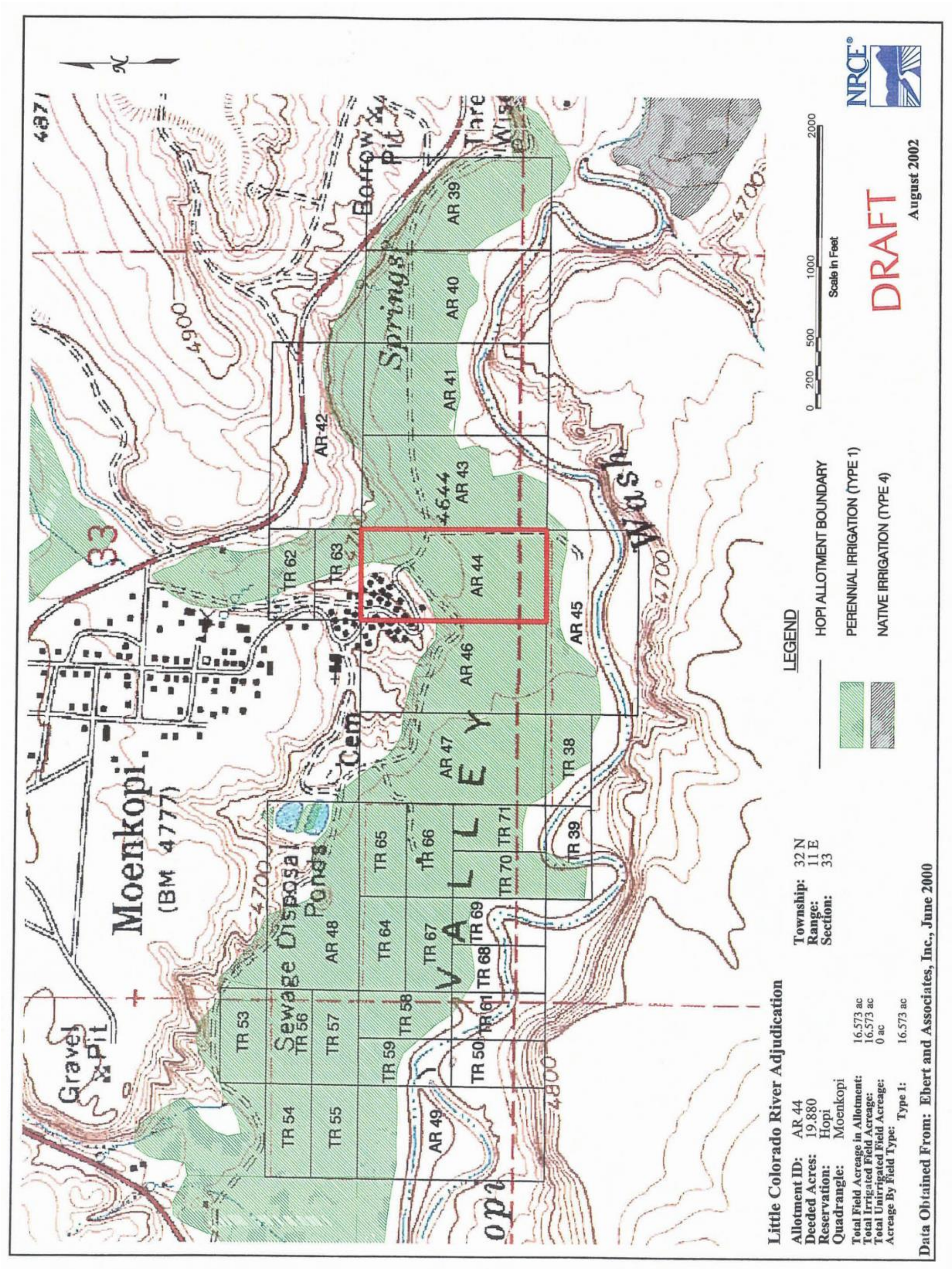
Map Showing Points of Diversion and Places of Use for Hopi Allotment 43



Attributes of Rights for Hopi Allotment Number 44

Priority date	June 14, 1934
Beneficial use	Irrigated Agriculture and Domestic uses
Source of water	Pasture Canyon Reservoir, springs, and Moenkopi Wash
Point(s) of diversion	NWNE Sec 4 T31N R11E and SWSE Sec 33 T32N R11E on the Hopi Reservation (see attached map)
Place(s) of use	NWNE Sec 4 T31N R11E and SWSE Sec 33 T32N R11E on the Hopi Reservation (see attached map)
Volume	21.64 AFA
Period of use	Year-round
Owners	Hopi Tribe United States acting in its capacity as trustee for the Allottees of Allotment No. 44

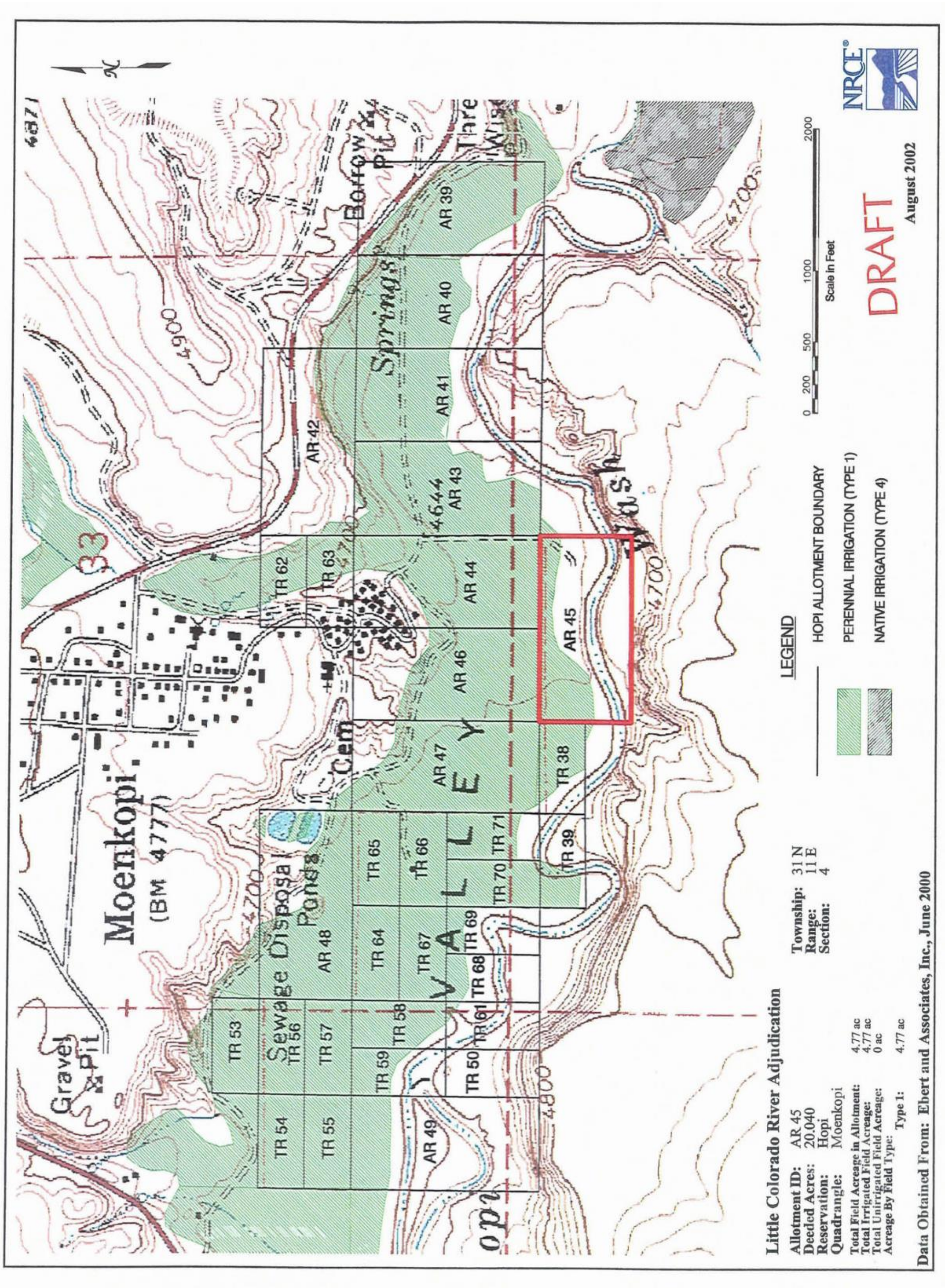
Map Showing Points of Diversion and Places of Use for Hopi Allotment 44



Attributes of Rights for Hopi Allotment Number 45

Priority date	June 14, 1934
Beneficial use	Irrigated Agriculture and Domestic uses
Source of water	Pasture Canyon Reservoir, springs, and Moenkopi Wash
Point(s) of diversion	NWNE Sec 4 T31N R11E and NENW Sec 4 T31N R11E on the Hopi Reservation (see attached map)
Place(s) of use	NWNE Sec 4 T31N R11E and NENW Sec 4 T31N R11E on the Hopi Reservation (see attached map)
Volume	19.26 AFA
Period of use	Year-round
Owners	Hopi Tribe United States acting in its capacity as trustee for the Allottees of Allotment No. 45

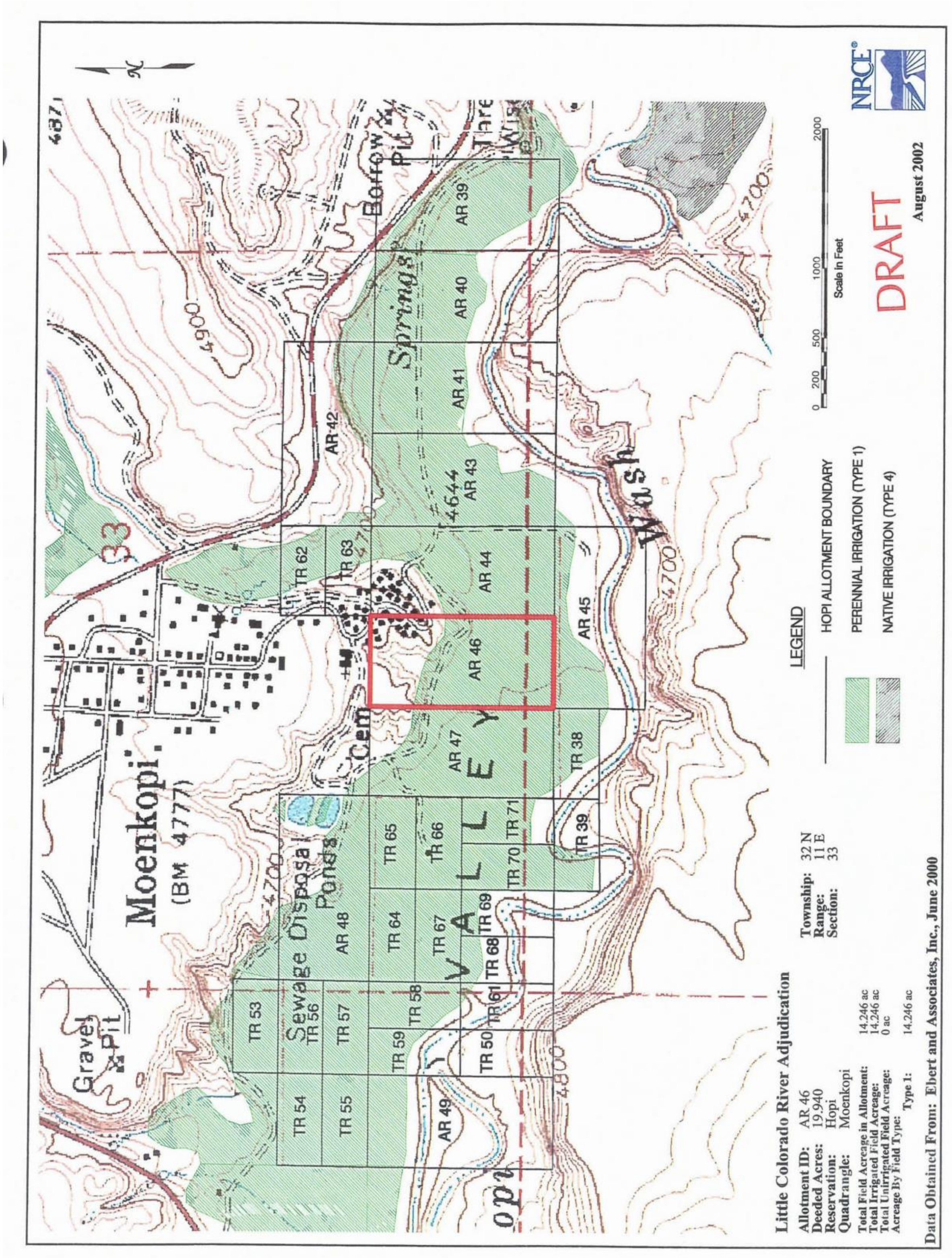
Map Showing Points of Diversion and Places of Use for Hopi Allotment 45



Attributes of Rights for Hopi Allotment Number 46

Priority date	June 14, 1934
Beneficial use	Irrigated Agriculture and Domestic uses
Source of water	Pasture Canyon Reservoir, springs, and Moenkopi Wash
Point(s) of diversion	NENW Sec 4 T31N R11E; NWNE Sec 4 T31N R11E; SWSE Sec 33 T32N R11E; SESW Sec 33 T32N R11E on the Hopi Reservation (see attached map)
Place(s) of use	NENW Sec 4 T31N R11E; NWNE Sec 4 T31N R11E; SWSE Sec 33 T32N R11E; SESW Sec 33 T32N R11E on the Hopi Reservation (see attached map)
Volume	18.66 AFA
Period of use	Year-round
Owners	Hopi Tribe United States acting in its capacity as trustee for the Allottees of Allotment No. 46

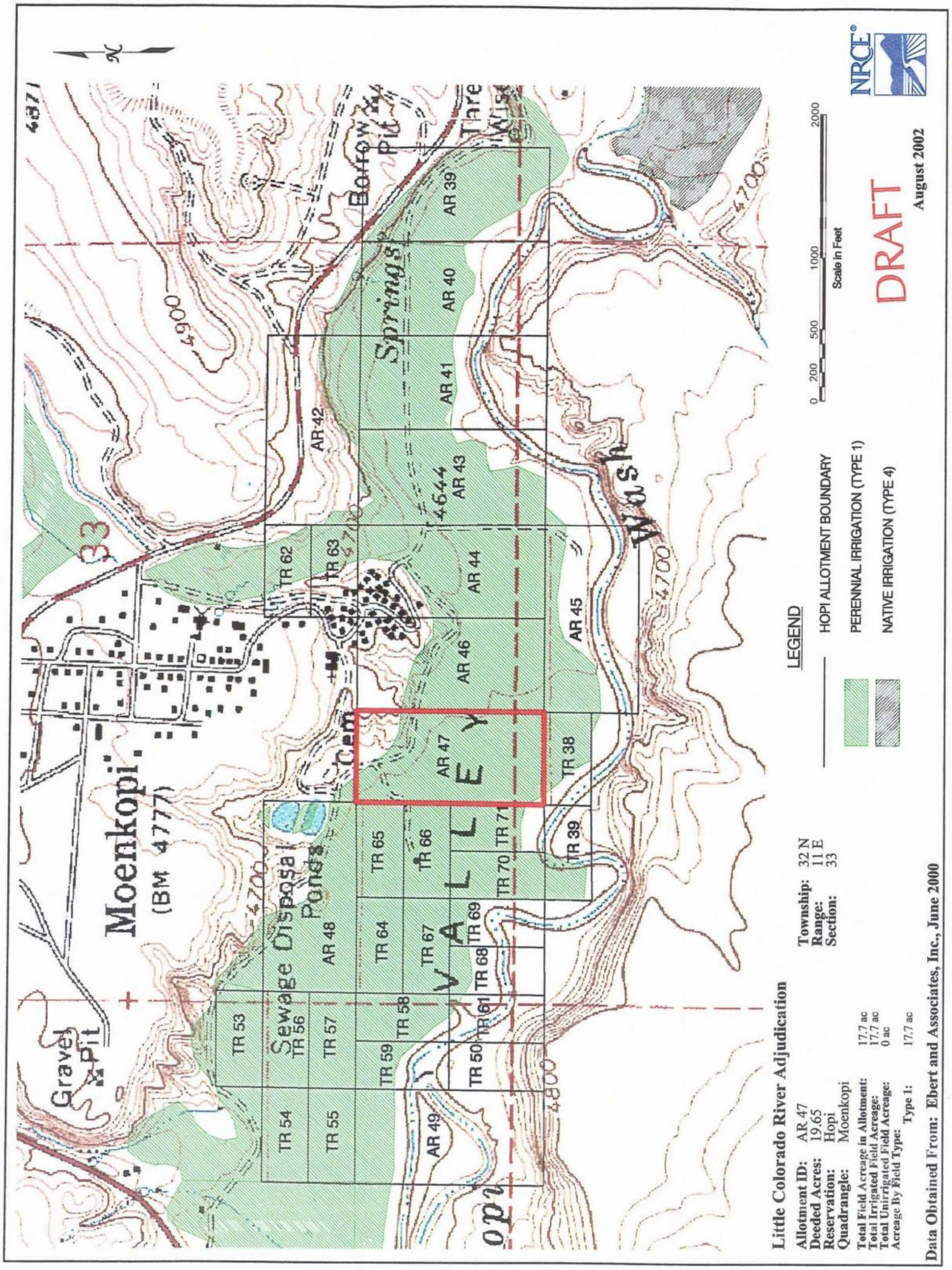
Map Showing Points of Diversion and Places of Use for Hopi Allotment 46



Attributes of Rights for Hopi Allotment Number 47

Priority date	June 14, 1934
Beneficial use	Irrigated Agriculture and Domestic uses
Source of water	Pasture Canyon Reservoir, springs, and Moenkopi Wash
Point(s) of diversion	NENW Sec 4 T31N R11E and SESW Sec 33 T32N R11E on the Hopi Reservation (see attached map)
Place(s) of use	NENW Sec 4 T31N R11E and SESW Sec 33 T32N R11E on the Hopi Reservation (see attached map)
Volume	25.24 AFA
Period of use	Year-round
Owners	Hopi Tribe United States acting in its capacity as trustee for the Allottees of Allotment No. 47

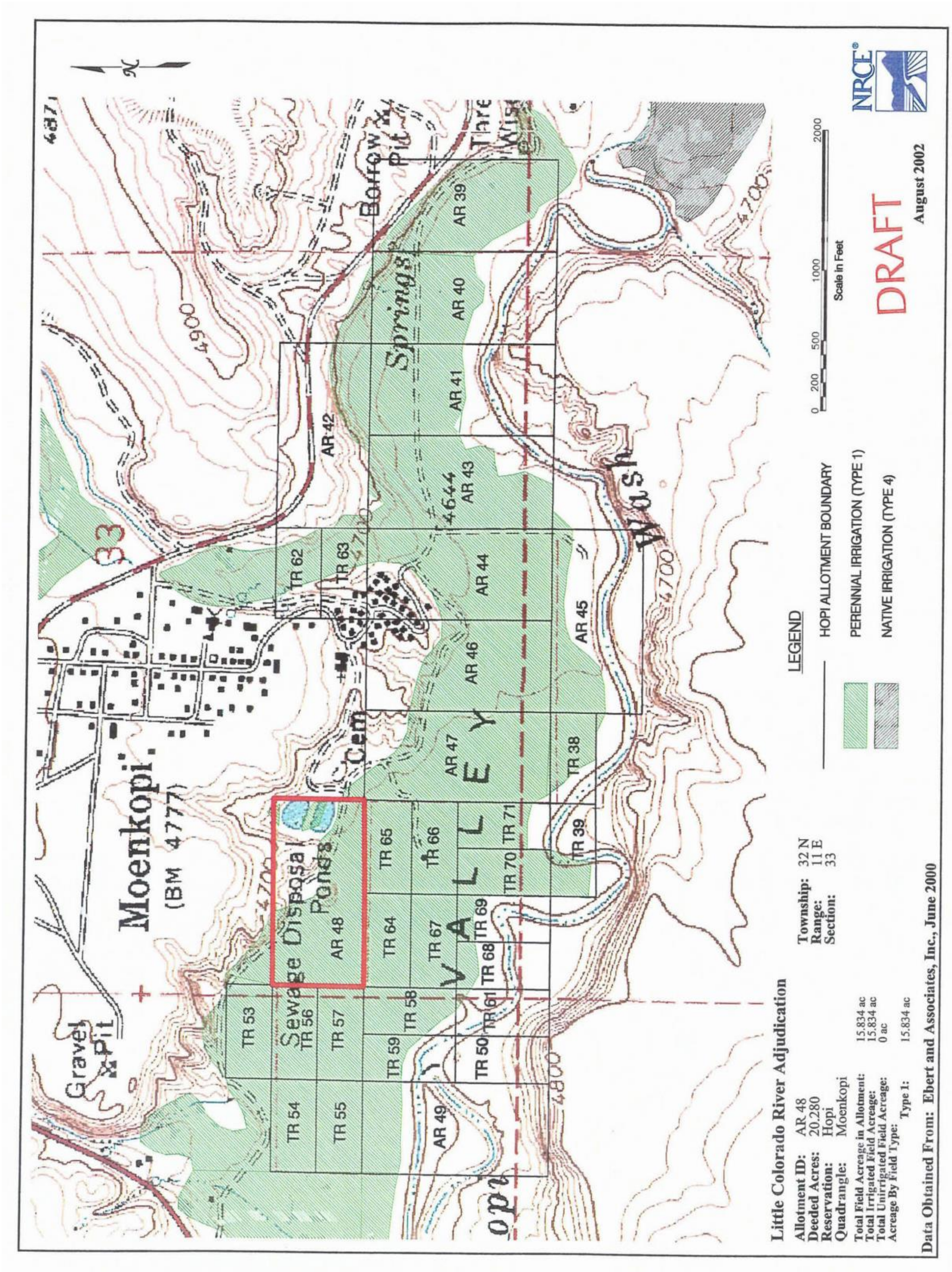
Map Showing Points of Diversion and Places of Use for Hopi Allotment 47



Attributes of Rights for Hopi Allotment Number 48

Priority date	June 14, 1934
Beneficial use	Irrigated Agriculture and Domestic uses
Source of water	Pasture Canyon Reservoir, springs, and Moenkopi Wash
Point(s) of diversion	NWSW Sec 33 T32N R11E; SWSW Sec 33 T32N R11E; SESW Sec 33 T32N R11E; NESW Sec 33 T32N R11E on the Hopi Reservation (see attached map)
Place(s) of use	NWSW Sec 33 T32N R11E; SWSW Sec 33 T32N R11E; SESW Sec 33 T32N R11E; NESW Sec 33 T32N R11E on the Hopi Reservation (see attached map)
Volume	19.83 AFA
Period of use	Year-round
Owners	Hopi Tribe United States acting in its capacity as trustee for the Allottees of Allotment No. 48

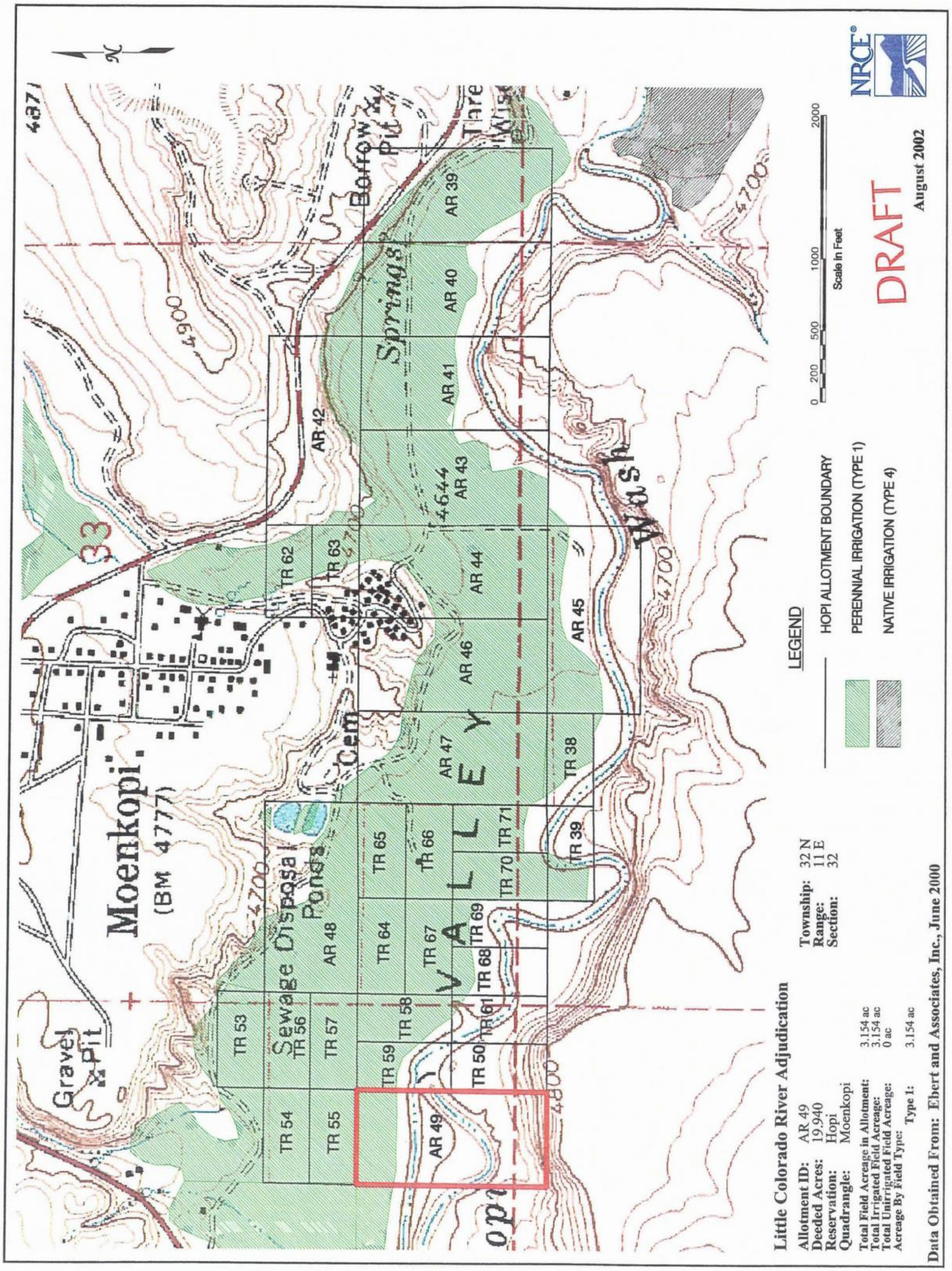
Map Showing Points of Diversion and Places of Use for Hopi Allotment 48



Attributes of Rights for Hopi Allotment Number 49

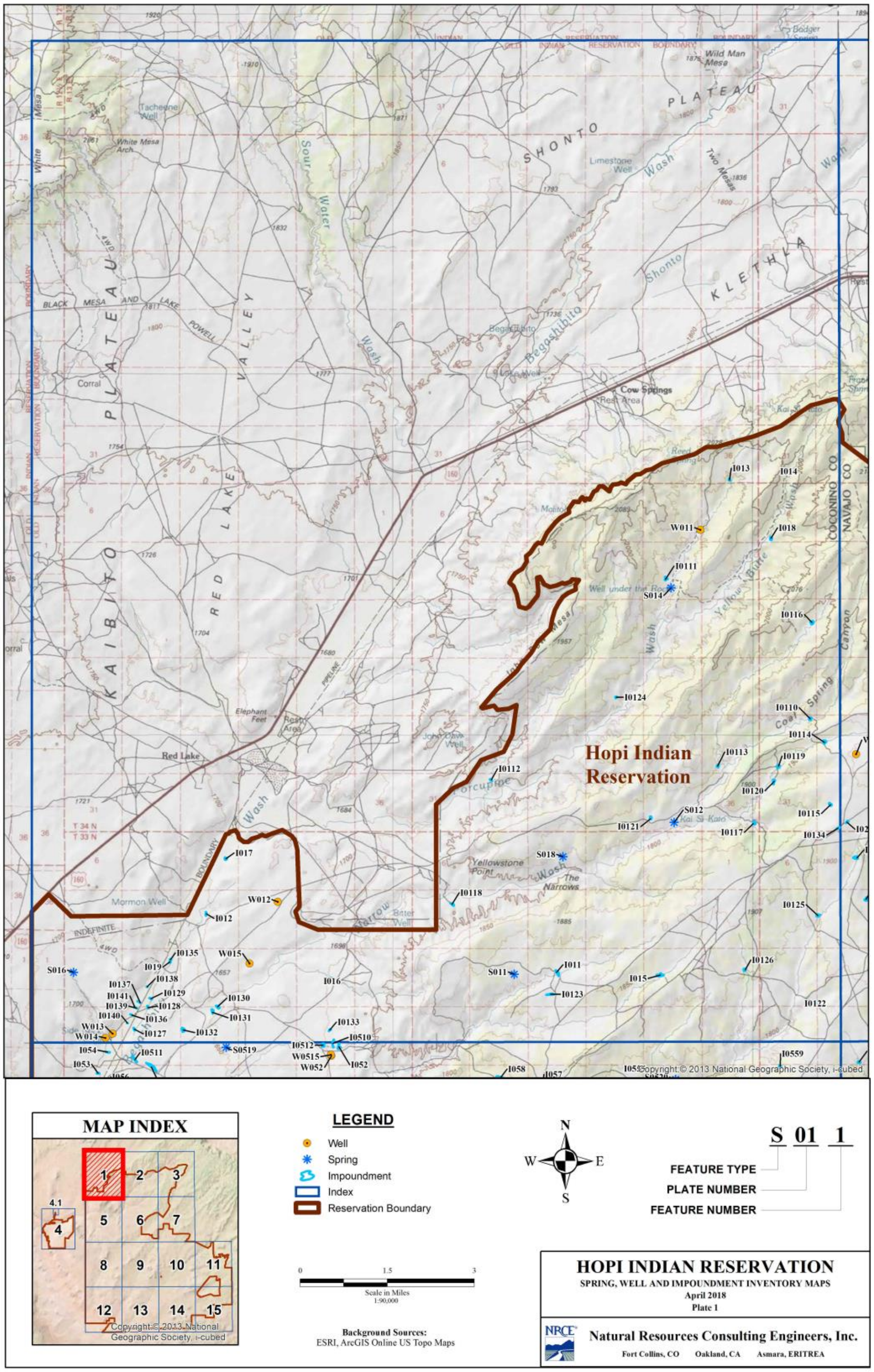
Priority date	June 14, 1934
Beneficial use	Irrigated Agriculture and Domestic uses
Source of water	Pasture Canyon Reservoir, springs, and Moenkopi Wash
Point(s) of diversion	SESE Sec 32 T32N R11E on the Hopi Reservation (see attached map)
Place(s) of use	SESE Sec 32 T32N R11E on the Hopi Reservation (see attached map)
Volume	6.23 AFA
Period of use	Year-round
Owners	Hopi Tribe United States acting in its capacity as trustee for the Allottees of Allotment No. 49

Map Showing Points of Diversion and Places of Use for Hopi Allotment 49



APPENDIX A TO PROPOSED DECREE

Maps of Wells, Springs, and Stockponds on the Hopi Reservation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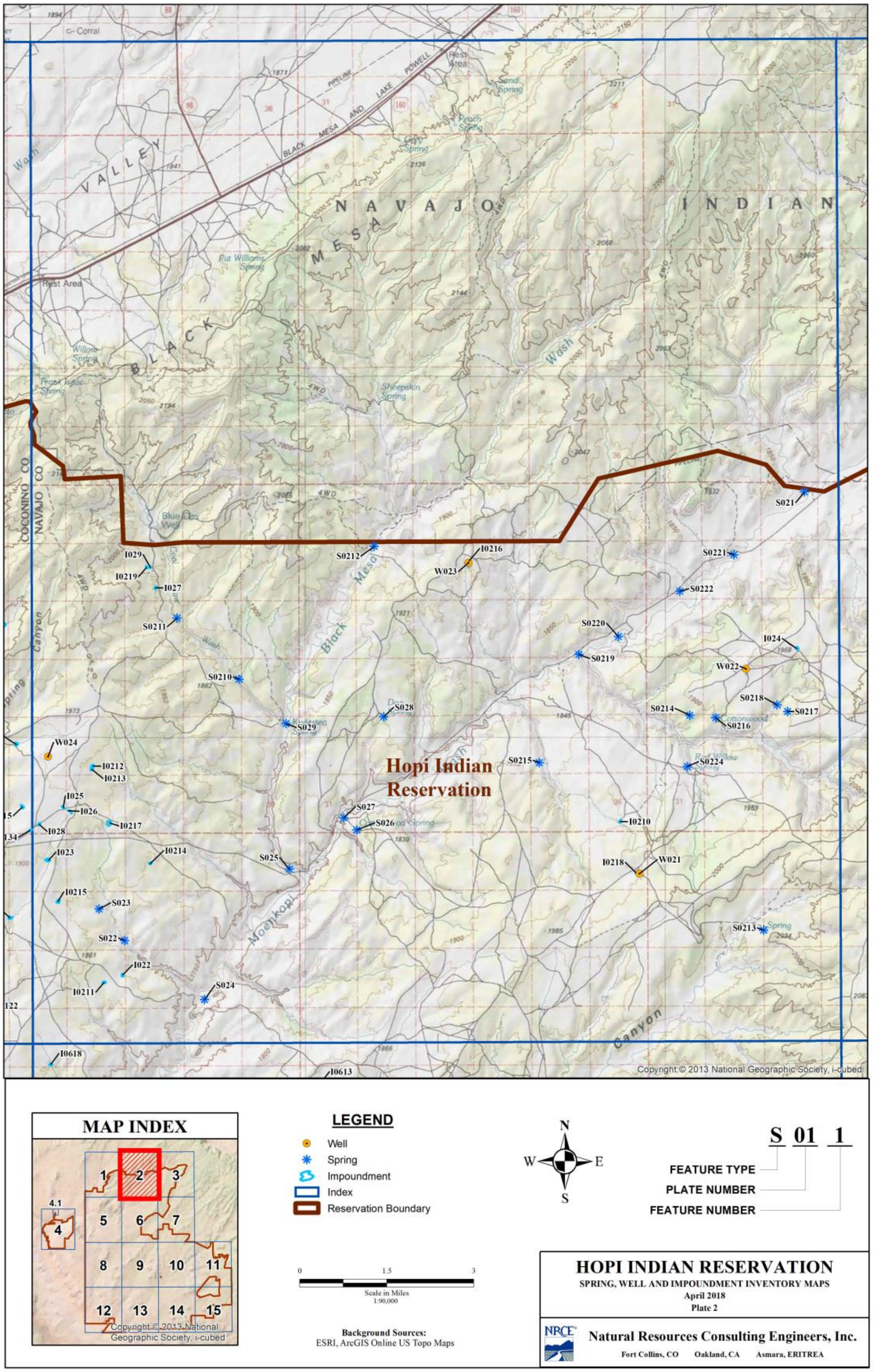
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VALLEY
COCONINO CO
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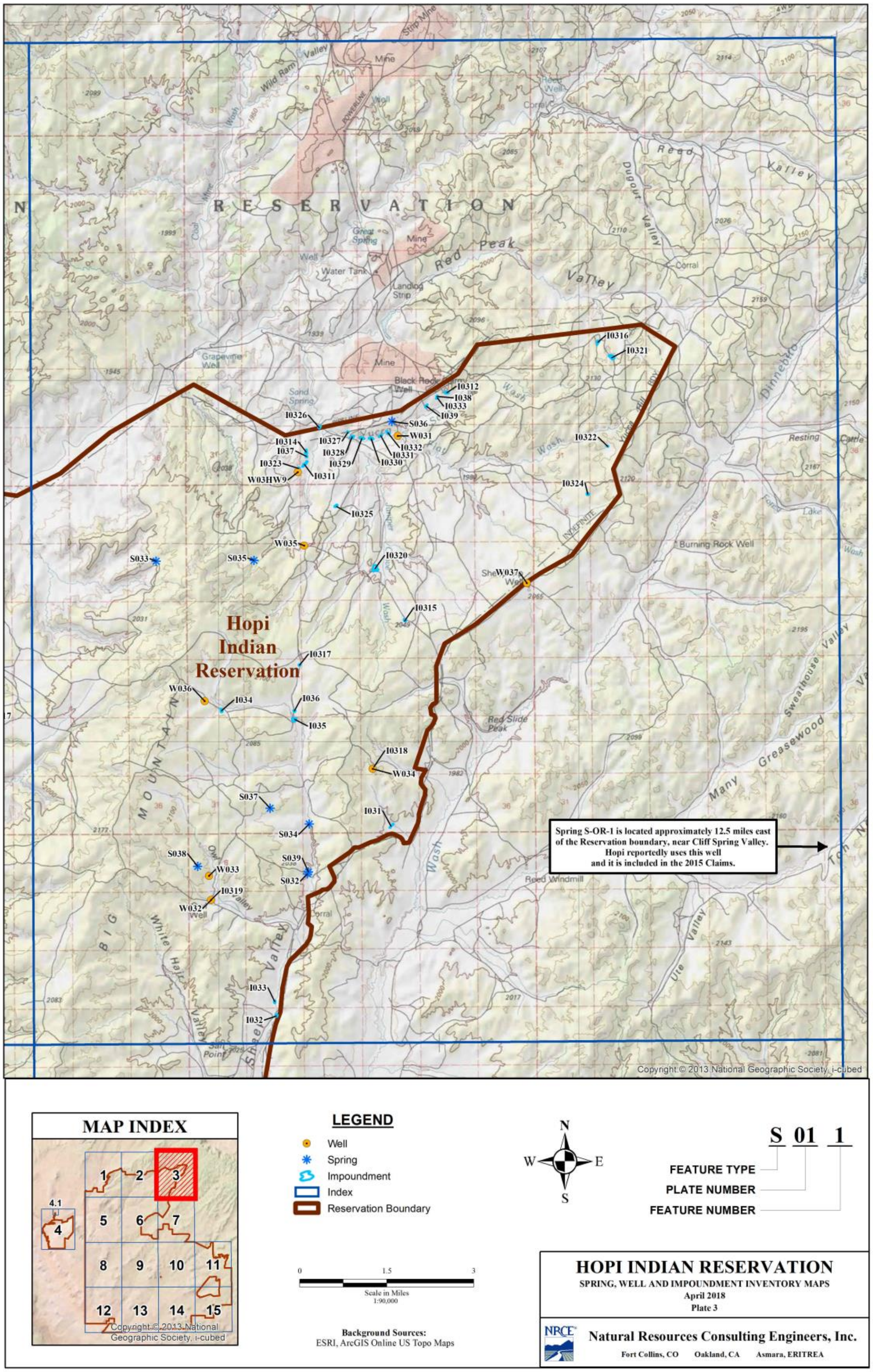
R E S E R V A T I O N
Hopi
Indian
Reservation
Red Peak Valley
Dinnebito
Many Greasewood
Sweathouse Valley
Red Slide Peak
Burning Rock Well
Black Rock Well
Grapevine Well
Water Tank
Landing Strip
Mine
Reed Windmill
Resting
Cattle
Spring S-OR-1 is located approximately 12.5 miles east of the Reservation boundary, near Cliff Spring Valley. Hopi reportedly uses this well and it is included in the 2015 Claims.
I0316
I0321
I0312
I038
I0333
I039
S036
W031
I0332
I0331
I0330
I0329
I0328
I0327
I0326
I0314
I037
I0323
I0311
W03HW9
I0322
I0324
I0325
W035
S035
S033
I0320
W037
I0315
I0317
W036
I034
I036
I035
I0318
W034
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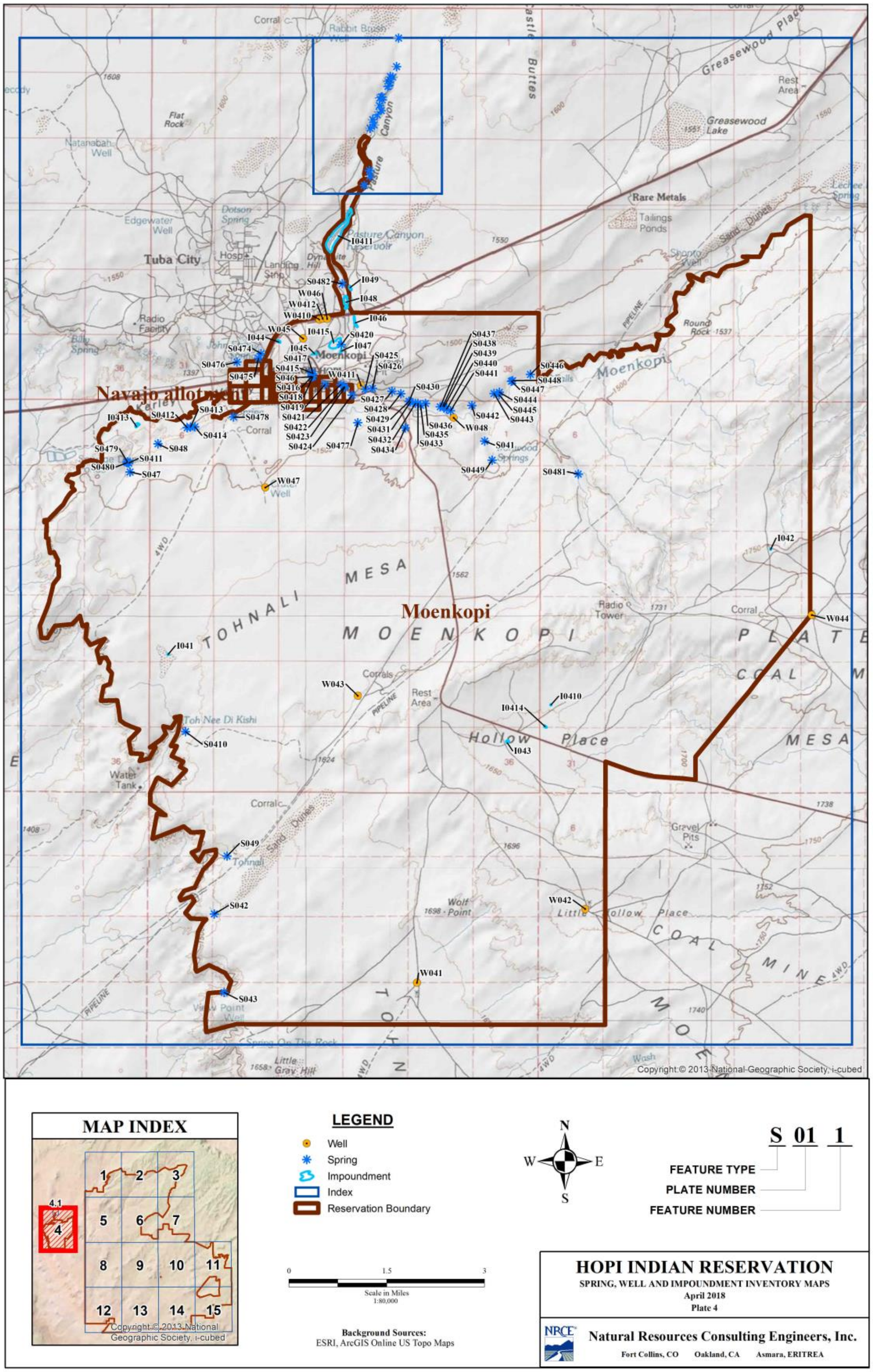
Navajo allotment
Moenkopi
Tuba City
Moenkopi
TOHNALI
MESA
MOENKOPI
PLATE
COAL
MESA
Hollow Place
Little Hollow Place
COAL MINE
Rare Metals
Tailings Ponds
Greasewood Lake
Greasewood Place
Pasture Canyon Reservoir
Rabbit Brush Well
Dotson Spring
Edgewater Well
Natanabah Well
Flat Rock
Radio Facility
Radio Tower
Rest Area
Corrals
Corral
Water Tank
Toh Nee Di Kishi
Wolf Point
Gravel Pits
View Point Well
Spring On The Rock
Little Gray Hill
Round Rock
Shonto Well
PIPELINE
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I0411
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S0422
S0423
S0424
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S0440
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S0443
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S0449
S0481
S0413
S0412
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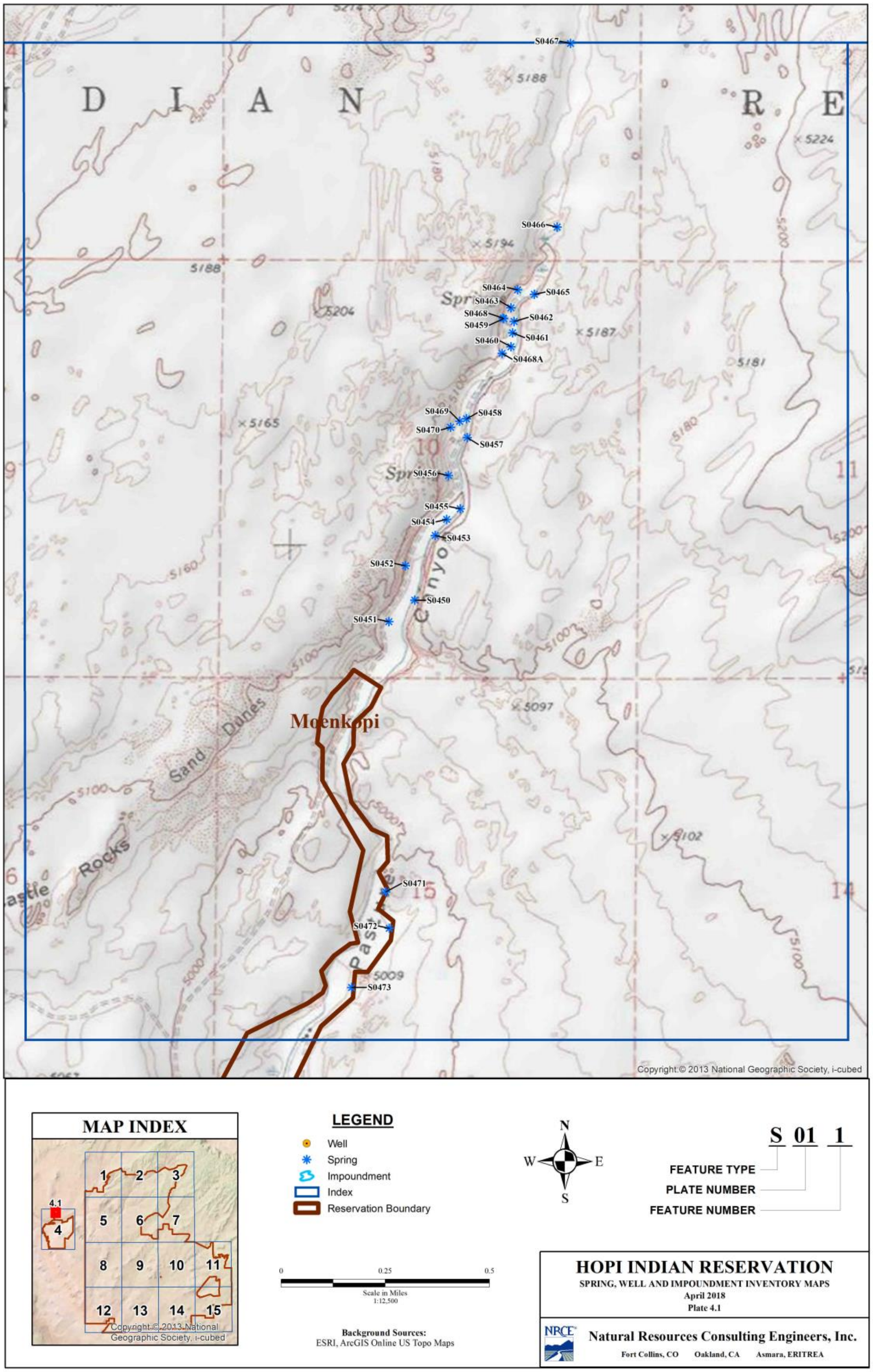
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S0460
S0468A
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S0458
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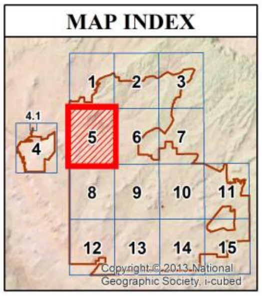

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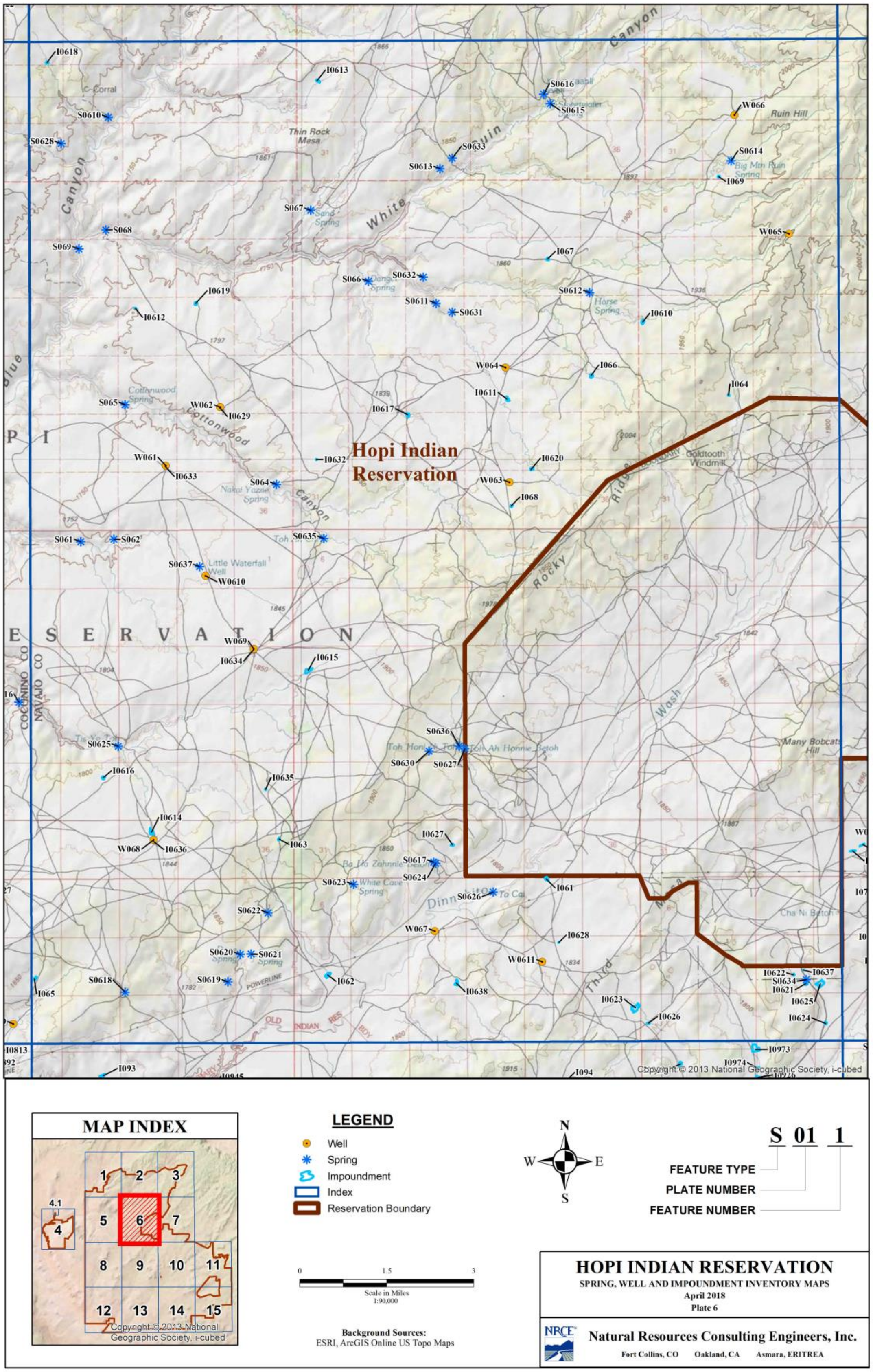
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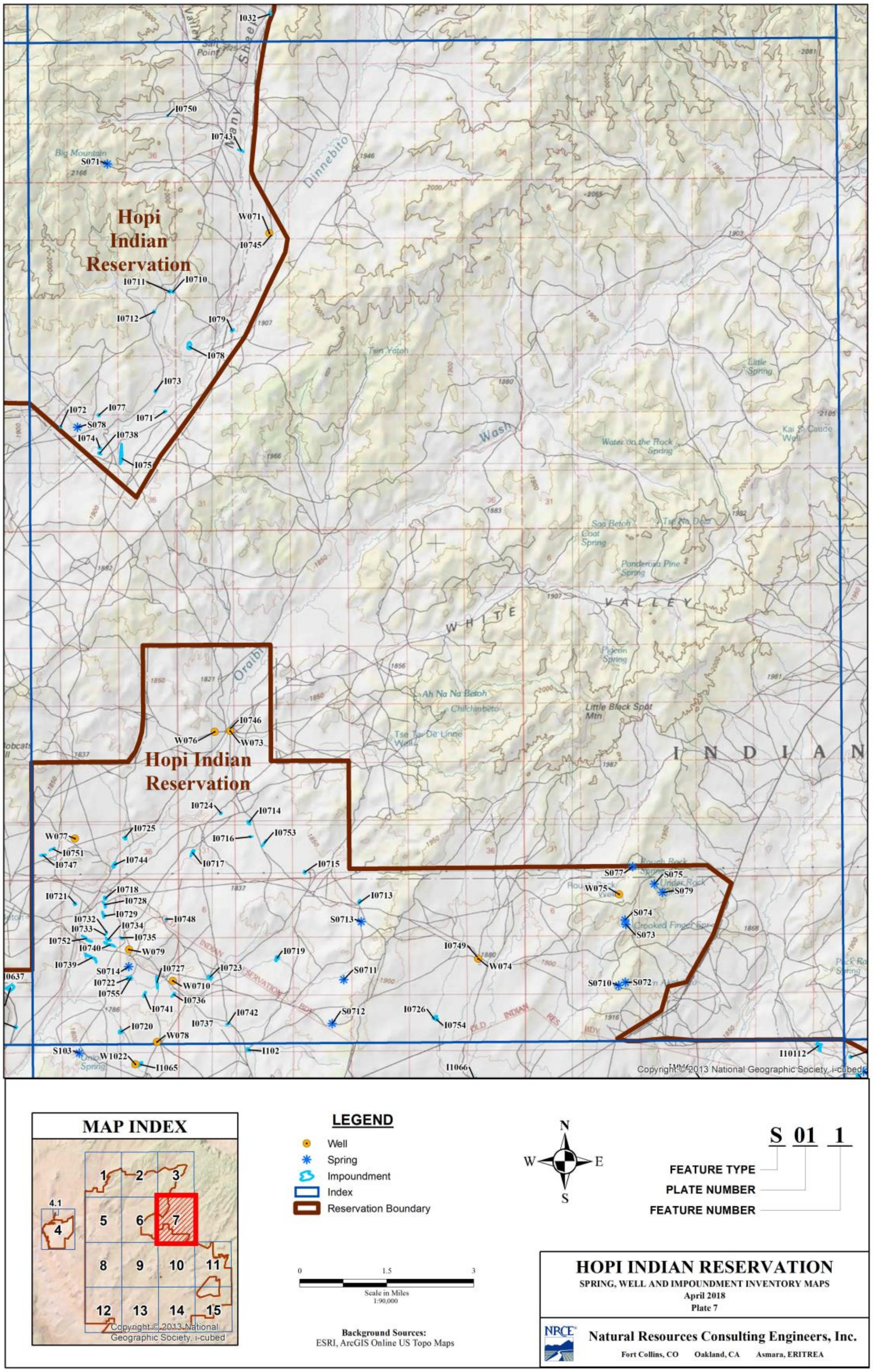
S0610
Thin Rock Mesa
S0628
S0633
S0613
S0614
Big Mtn Ruin Spring
I069
S067
Sand Spring
S068
S069
W065
I067
S066
S0632
S0612
Horse Spring
I0619
S0611
S0631
I0612
I0610
W064
I066
I064
Cottonwood Spring
S065
W062
I0629
I0617
I0611
Goldtooth Windmill
W061
I0632
I0620
I0633
S064
Nakai Yazzie Spring
W063
I068
S061
S062
S0635
Rocky Ridge
S0637
Little Waterfall Well
W0610
W069
I0634
I0615
COCONINO CO
NAVAJO CO
S0625
S0636
S0630
S0627
Toh Ah Honne Betoh
Many Bobcats Hill
I0616
I0635
I0614
W068
I0636
I063
I0627
S0617
S0624
S0623
White Cave Spring
S0626
I061
S0622
W067
I0628
S0620
S0621
W0611
S0618
I065
S0619
I062
I0638
I0622
I0637
S0634
I0621
I0625
I0623
I0626
I0624
I0973
I0813
I093
I0974
I094
Cha Ni Betoh
Wash
Third Mesa
Canyon
White
Cottonwood
Canyon
Ruin Hill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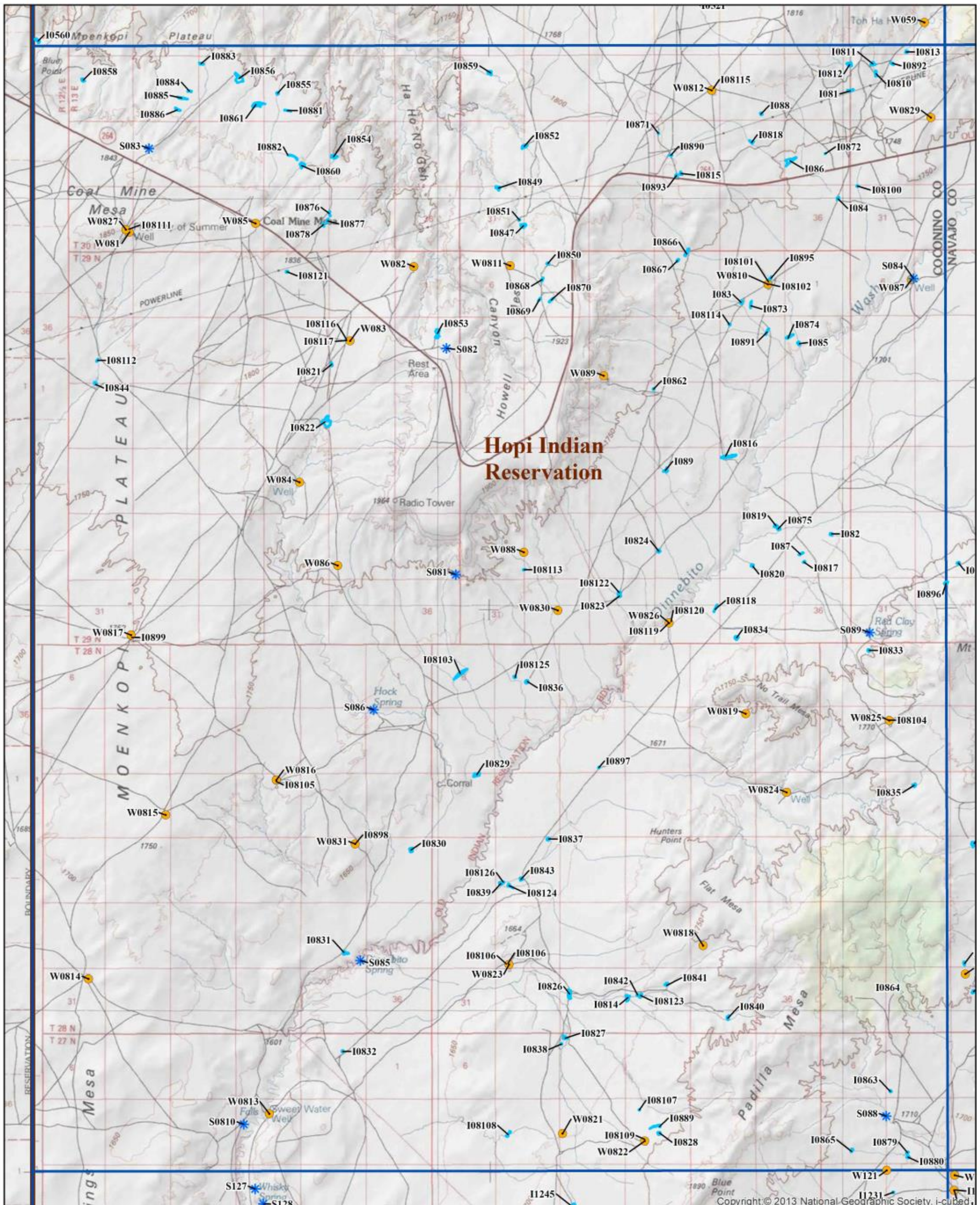

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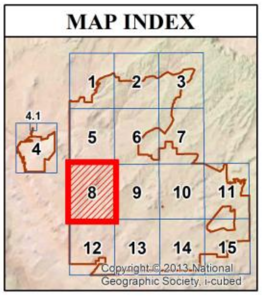

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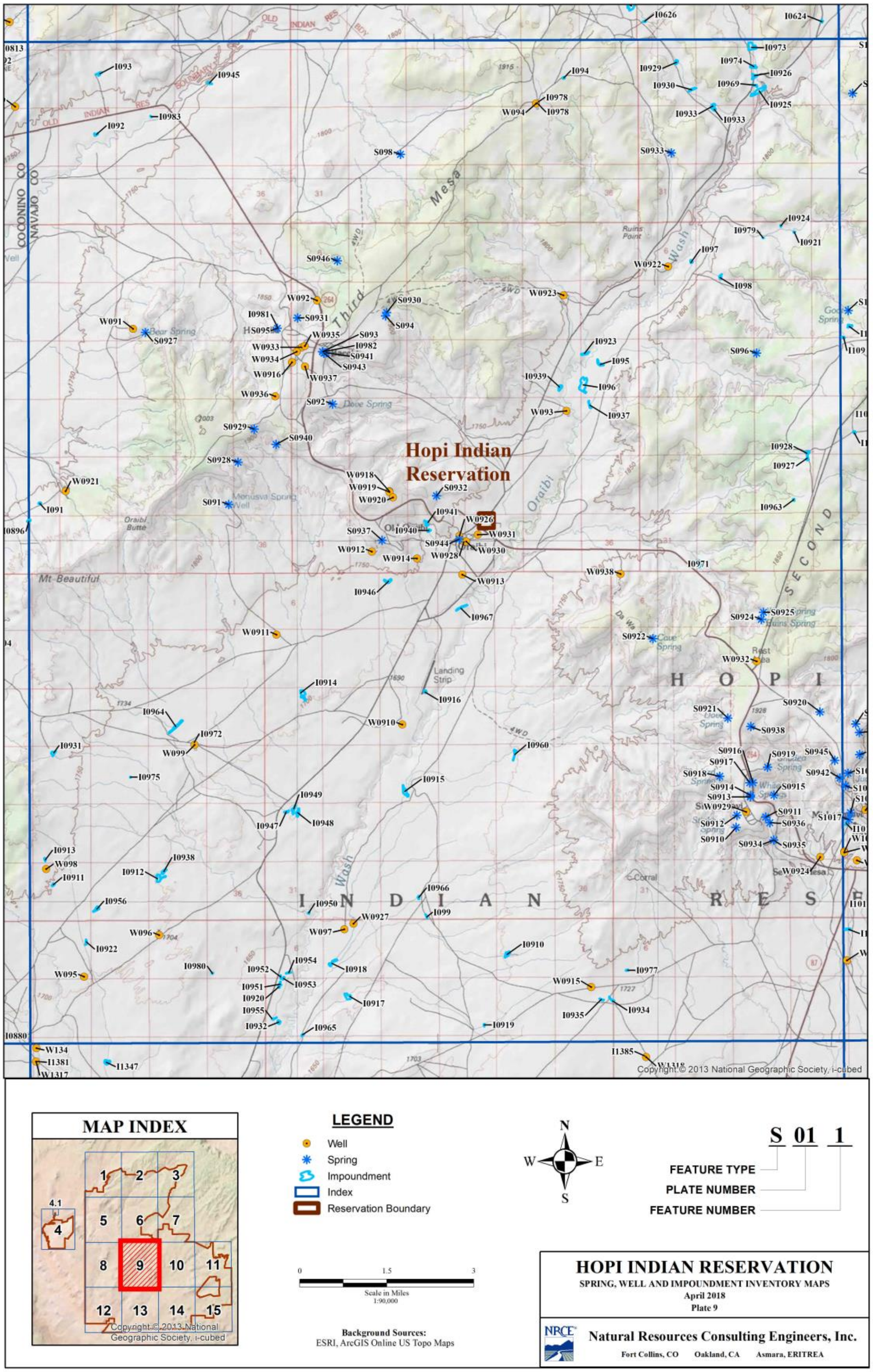
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HOPI INDIAN RESERVATION
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Oraibi Wash
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Dove Spring
Monusva Spring
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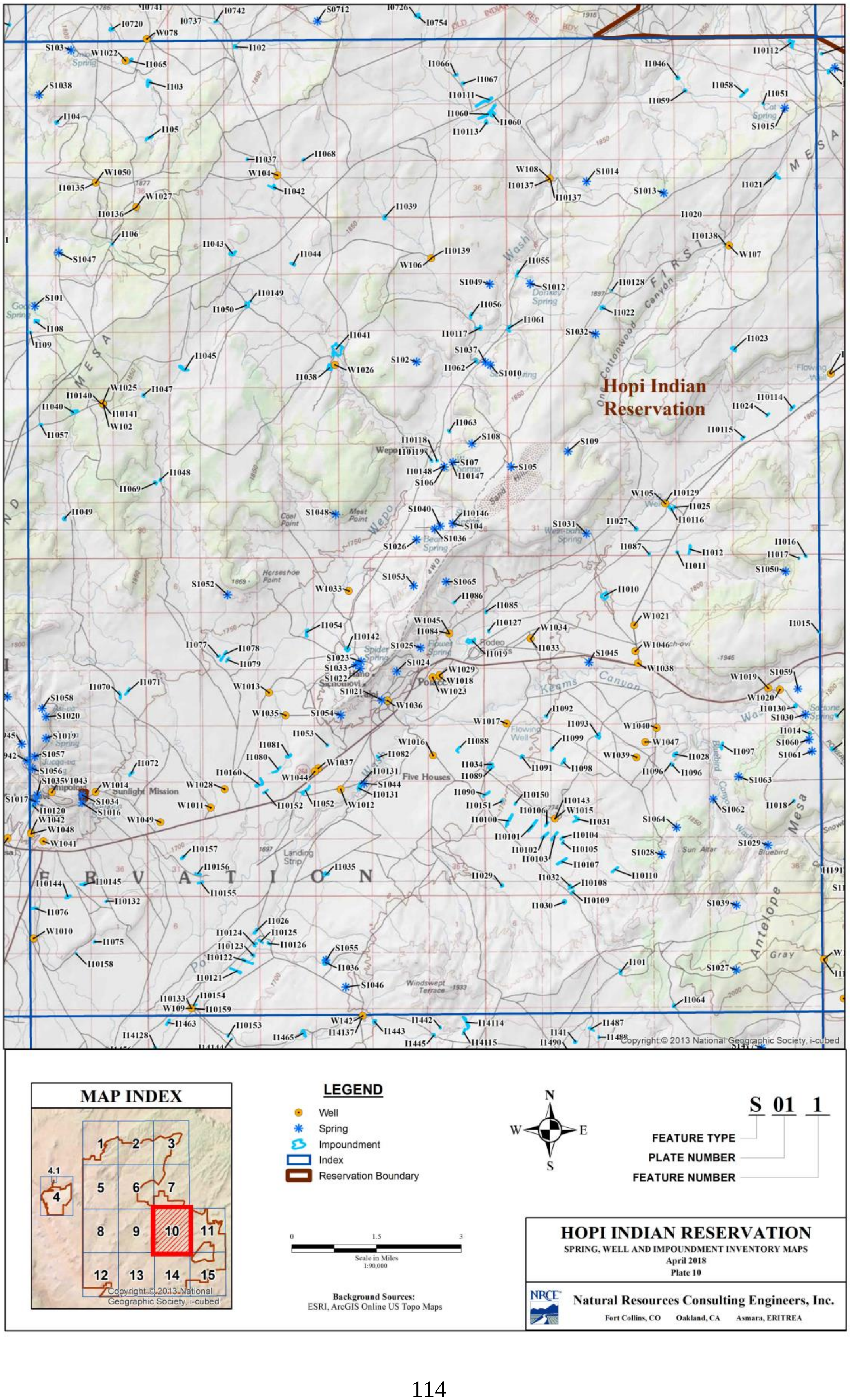
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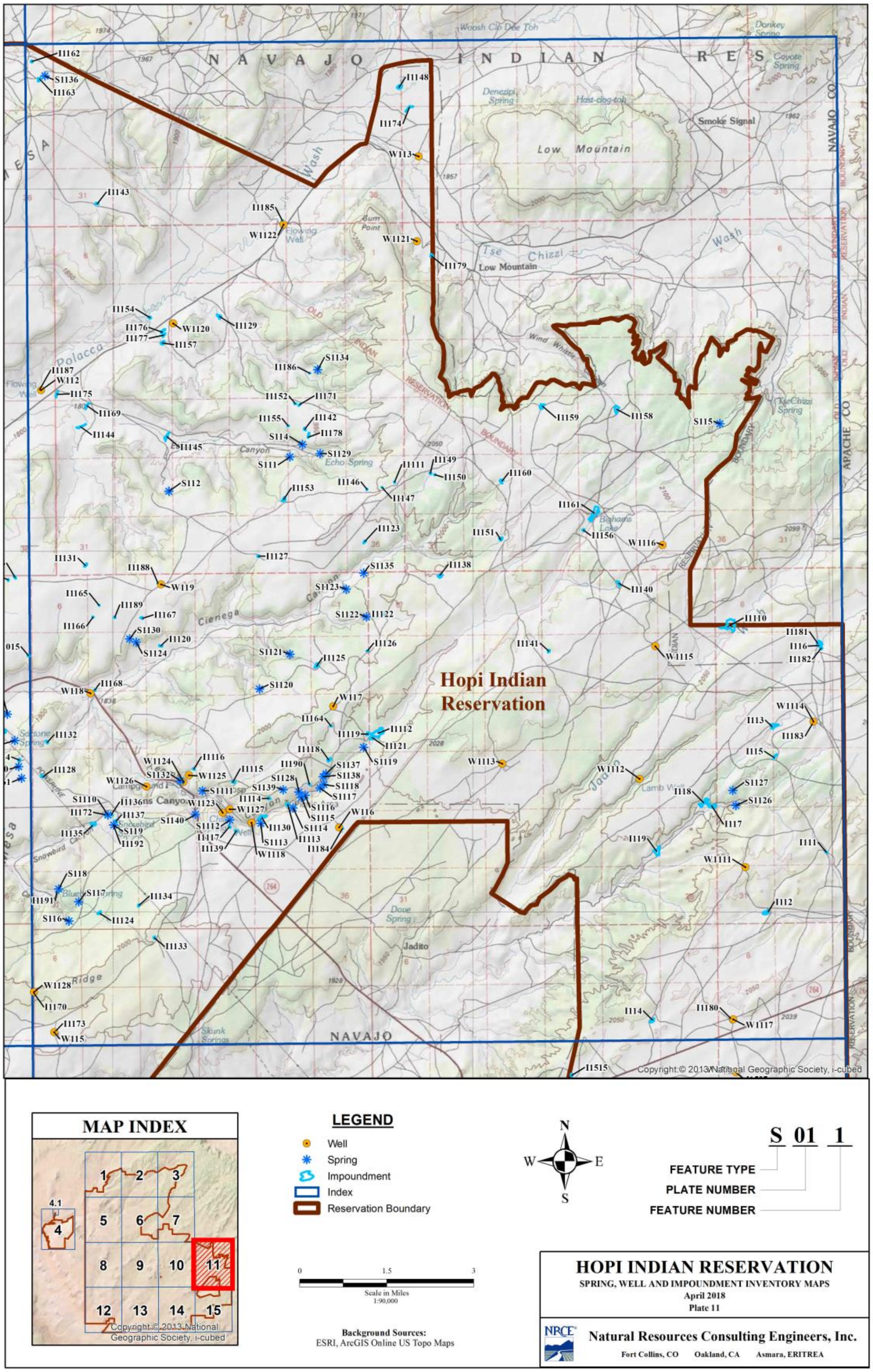
NAVAJO INDIAN RES
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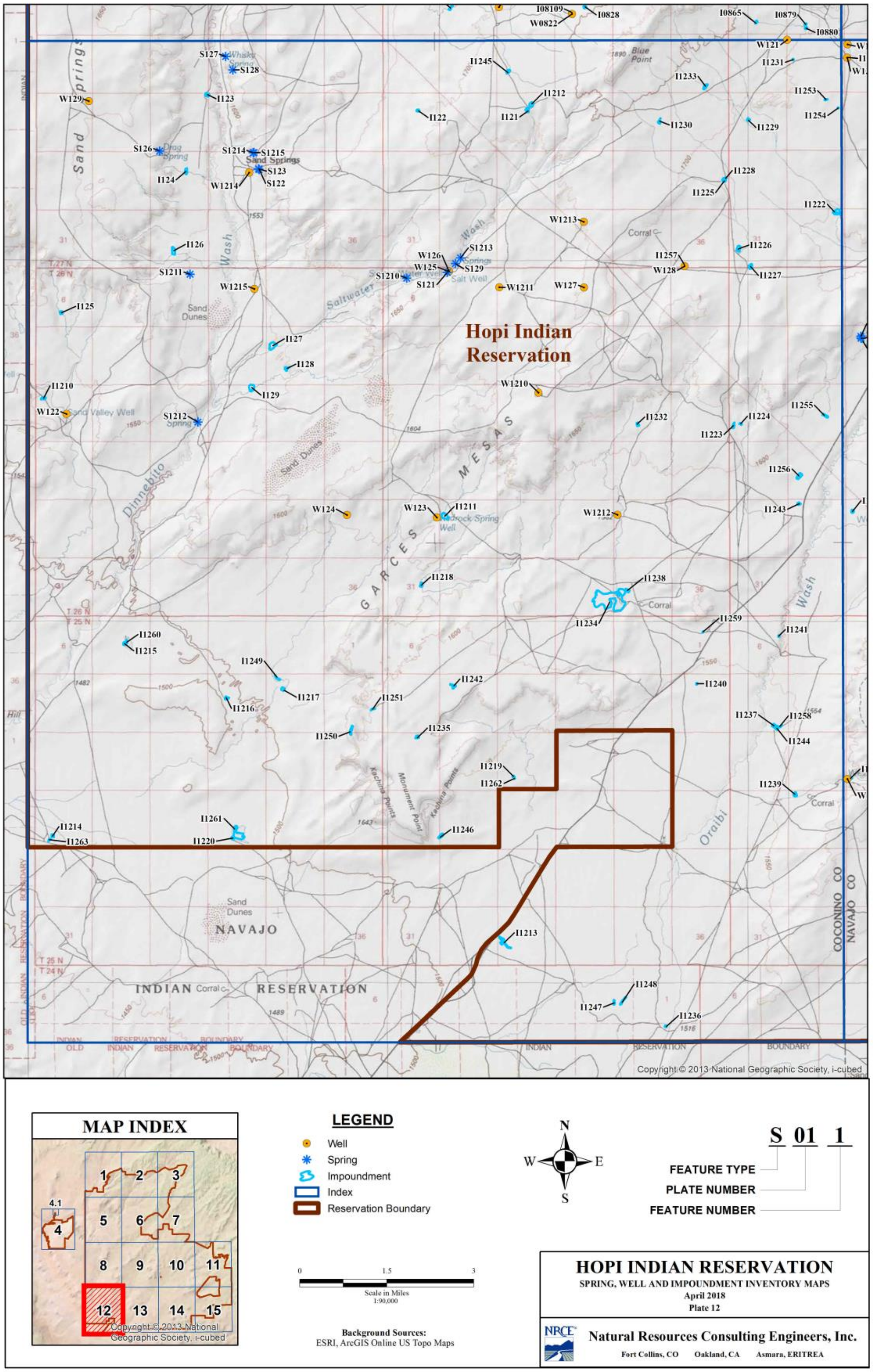
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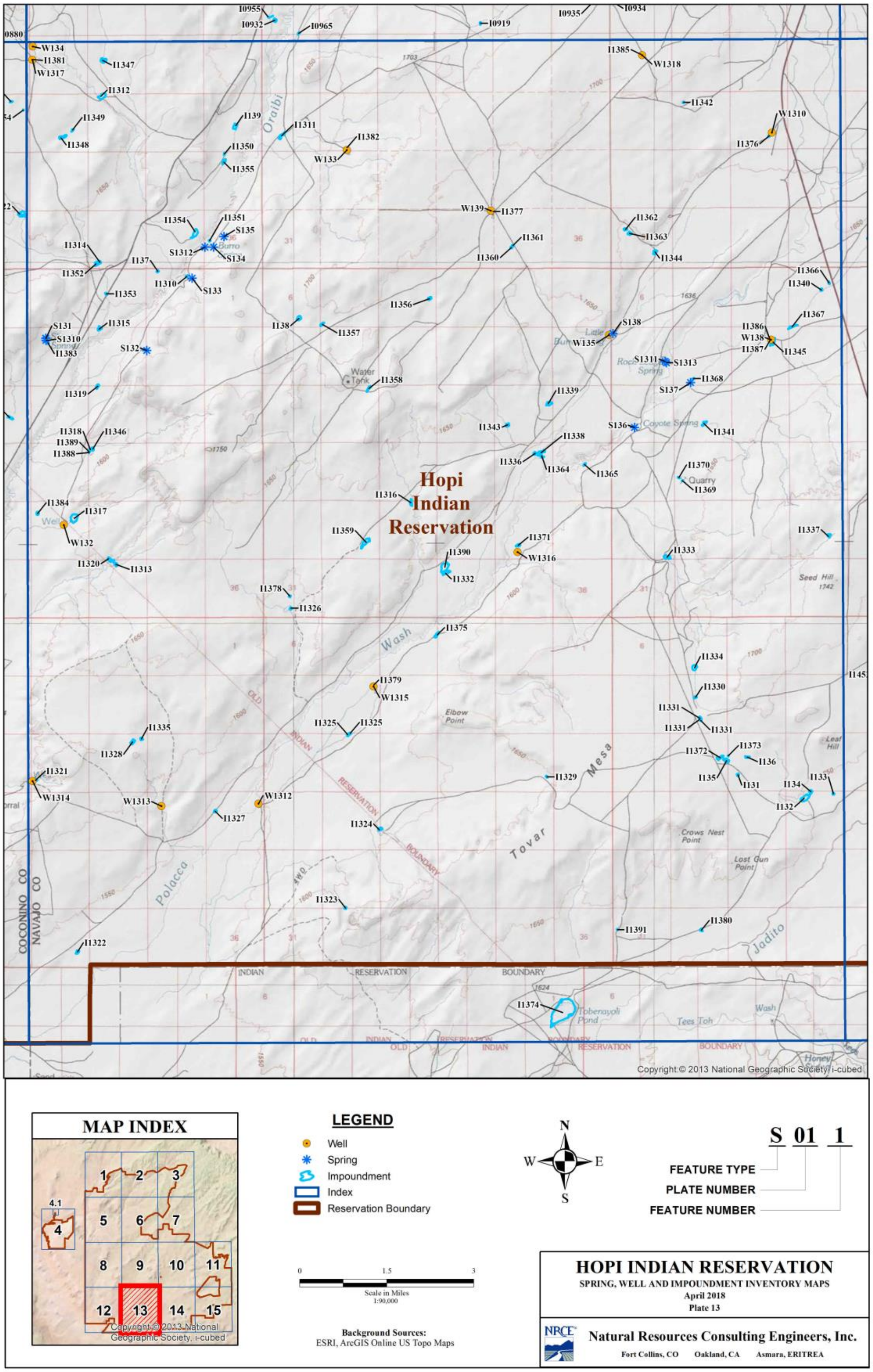
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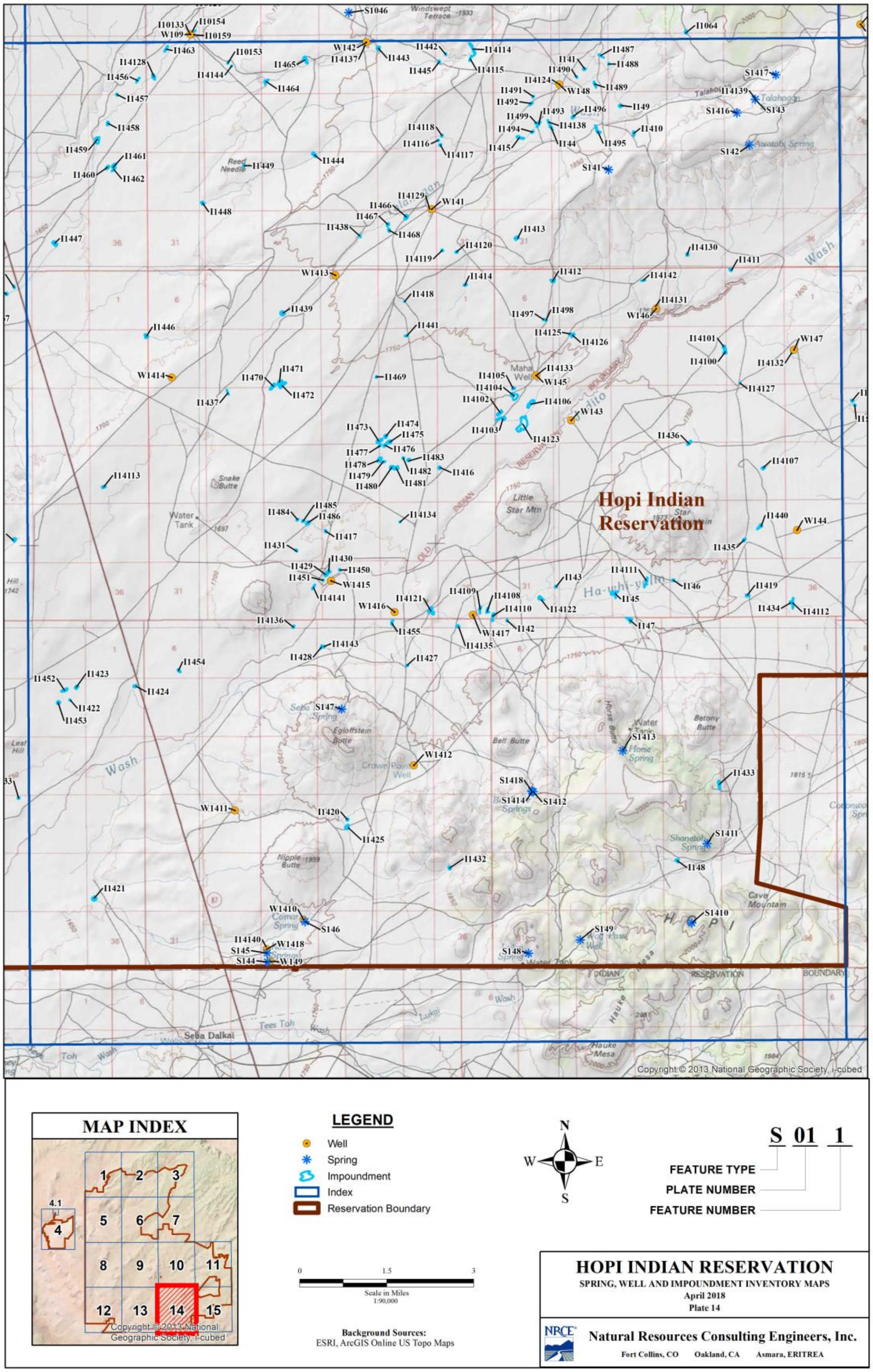
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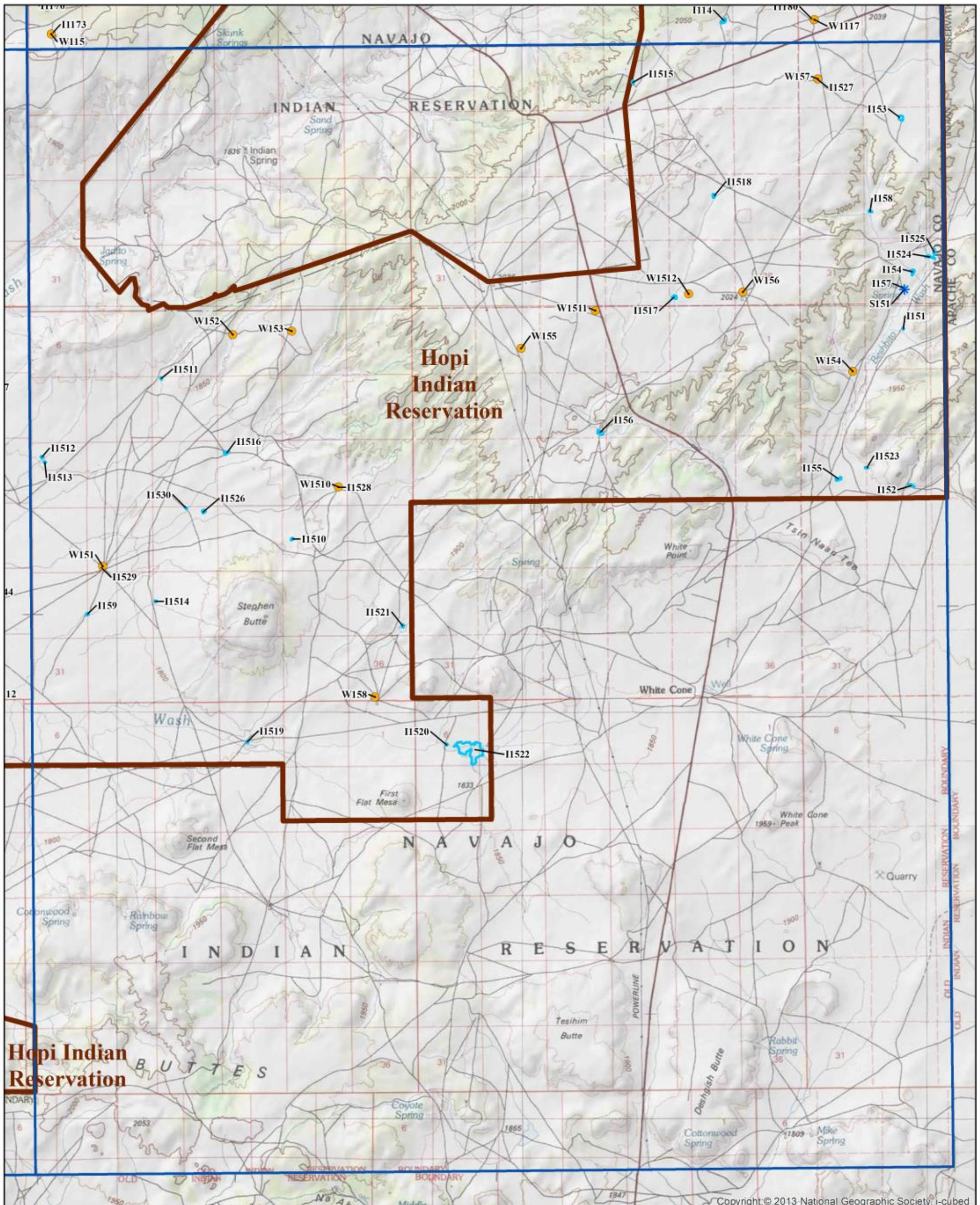

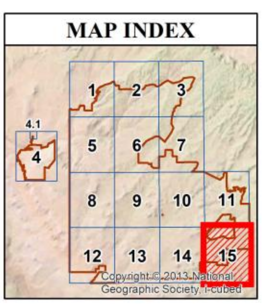

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