IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF NEW MEXICO

UNITED STATES OF AMERICA and STATE OF NEW MEXICO ex rel. STATE ENGINEER, Plaintiffs, and ZUNI INDIAN TRIBE, NAVAJO NATION, Plaintiffs in Intervention, v. A & R PRODUCTIONS, et al., Defendants.	No. 01-cv-0072-MV/WPL ZUNI RIVER BASIN ADJUDICATION **Subfile No. ZRB-2-0038**

DECLARATION OF SCOTT TURNBULL

1. My name is Scott Turnbull. I am an Associate Engineer at Natural Resources Consulting Engineers, Inc. ("NRCE") headquartered in Fort Collins, Colorado. Since January of 2008, I have conducted technical analysis on behalf of the United States concerning matters associated with the hydrographic survey of the Zuni River Basin and the Zuni River Basin Adjudication. As an employee of NRCE, I perform field visits to document and verify water features within and throughout the Basin to support any technical analysis associated with the Zuni River Basin Adjudication. I also compute water quantities associated with these features based upon available information.

2. NRCE is the contractor retained by the United States Depart of Justice to

conduct the hydrographic survey of the Zuni River Basin and to support any technical analysis necessary for the litigation of individual subfile actions. NRCE is a civil, environmental, and water resources engineering consulting firm that specializes in water use studies, agricultural & irrigation engineering, surface water hydrology, groundwater, and providing expert support for water right disputes. NRCE's technical staff consists of engineers, hydrogeologists, geologists, and GIS/CAD experts. For almost three decades, NRCE has been providing water resources engineering and consulting services to clients throughout the United States and internationally.

3. I have a Bachelor's of Science degree in Civil Engineering from Colorado State University in Fort Collins, CO. Coursework for this degree includes topics of physical hydrology, environmental engineering, soil science, water resources, and hydraulic engineering. I am Professional Engineer licensed in the state of Colorado (No. 47227). This license was obtained by meeting the requirements set by the State through relevant education, professional experience under the supervision of a licensed engineer, and examination.

4. In addition to my own involvement with the hydrographic survey of the Zuni River Basin and the preparation of materials concerning individual subfile actions, the following staff are, or have been, directly involved with NRCE's work relating to the Zuni Basin adjudication:

- Dr. L. Niel Allen, P.E., PhD. Senior Engineer (1997-2012). PhD. Civil Engineering (U. of Idaho 1991); M.S. Agricultural & Irrigation

Engineering (Utah State U., 1980); B.S. Agricultural & Irrigation Engineering (Utah State U., 1979). Responsibilities: Project Supervisor, Field Work, Consultations, Water use Calculations, Report Preparation.

- Dr. Hadi Jaafar, PhD. Associate Engineer (2003-2007). PhD. Irrigation Engineering (Utah State U., 2003); M.S. Irrigation (U. of Beirut, 1999); B.S. Biology (Univ. of Beirut, 1995), B.S. Agricultural Engineering (U. of Beirut, 1997). Responsibilities: Field Work, Consultations, and Water use Calculations
- Chris Kizer. GIS Analyst (2007-2016). B.S. Natural Resources Management (Colo. State U., 2007). Responsibilities: Geospatial Analysis and Mapping
- Dr. Thomas W. Ley, P.E., PhD. Senior Engineer (2013-present). PhD. Irrigation Engineering (Utah State U., 1995); M.S. Agricultural Engineering (Colo. State U., 1978); B.S. Agricultural Engineering (Colo. State U., 1977). Responsibilities: Project Supervision
- Randy Macan. GIS/CAD Supervisor (1992-present). A.A.S. Drafting and Design Technology (Mississippi Gulf Coast Community College, 1987). Responsibilities: Computer Aided Design, Geospatial Analysis, and Mapping
- Kathleen Madigan. Assistant Engineer (2003-2006). Education: B.S. Bioresources and Agricultural Engineering (Colo. State U., 2003). Responsibilities: Field Work and Geospatial Data

- Kit Nielson, P.E. Senior Engineer (2003-2012). M.S. Civil Engineering/Groundwater/Modeling (Colo. State U., 1987); B.S. Environmental Engineering (U. of Florida, 1980). Field Work, Consultations, Water use Calculations
- Brent Read. GIS Analyst (2004-2007). Education: M.S. Forest Science (Colo. State U., 2004); B.S. Forest Fire Science (Colo. State U., 2002). Responsibilities: Geospatial Analysis and Mapping
- Dr. Assad Safadi, PhD. Senior Vice President (1991-present). PhD. Agricultural and Irrigation Engineering (Utah State U., 1991); M.S. Soils and Irrigation (U. of Jordan, 1987); B.S. Soils and Irrigation (U. of Jordan, 1985). Responsibilities: Project Supervision.

5. Throughout my work on the Zuni River Basin Adjudication, I have had access to and am familiar with the analysis and materials previously produced by the NRCE staff listed above.

6. While employed at NRCE, other than my work on the Zuni River Basin adjudication, I have performed work on the following projects relating to hydrographic surveys, water right claims, historic water use, and agricultural water use studies:

- Rio San Jose Basin, NM (2009 – present). For the Acoma Pueblo and Chestnut Law Offices, I provide technical support and analysis associated with the Rio San Jose adjudication. This includes work regarding historically irrigated lands, crop irrigation and diversion requirements, hydrographic survey of wells, springs, and stock ponds, livestock water use, DCMI (domestic, commercial, municipal, and industrial) water uses, and review of and rebuttal to expert reports. I have provided analysis regarding the modeling of natural and depleted surface flows in the Rio San Jose at the Acoma Pueblo.

- Peoples Creek and Little Bighorn Basins, MT (2014 - present). For the US Department of Justice, I evaluate many irrigation and livestock use claims located in the Peoples Creek and Little Bighorn River basins located near the Fort Belknap Indian Reservation and the Crow Indian Reservation. This includes determination of irrigated areas, priority dates, points and means of diversion, purpose of use, water use quantities such as flow rate and annual volume, evidence of abandonment/non-perfection of rights, and review of property ownership information. The US Dept. of Justice then relies upon these technical reviews when filing objections to water right claims and during hearings with water users.
- Hopi Indian Reservation, AZ (2010). For the US Department of Justice and Bureau of Indian Affairs, I reviewed and compared hydrographic surveys of wells, springs, and stock ponds prepared by NRCE, HKM Engineering, and the Arizona Department of Water Resources. I also assisted with the preparation of amended hydrographic survey claim for the Hopi Indian Reservation.

- Crow Indian Reservation, MT (2008 –2010). For White Shield International in support of the Crow Tribe's reserved water rights, I conducted field work to document historically and presently irrigated acreage at Pryor Creek. I also computed delivery requirements for pumped irrigation diversions at Pryor Creek, Bighorn, and Little Big Horn Rivers for practicably irrigated acreage (PIA) claim. This included engineering analysis to determine diversion and booster pump sizes, pipeline diameters, and selection of system components. I then produced estimates for capital costs and annual operation costs for the PIA claim.
- Walker River Reservation, NV (2013 – 2014). For the US Department of Justice and Bureau of Indian Affairs, I computed crop reference evapotranspiration using FAO Penman-Monteith soil water budget methodology. This included analysis by applying by applying growing season and crop curve data presented in publications by the Nevada Department of Water Resources.
- Santa Cruz/Truchas Adjudication, NM (2010-2011). For the US Department of Justice and Bureau of Indian Affairs, I evaluated crop water requirements using FAO Penman-Monteith methodology regarding the impact of various plant spacing on annual water use to evaluate historical water use. I also assisted in the rebuttal and discovery process concerning irrigation requirements and prepared exhibits supporting NRCE's analysis.

7. While employed at NRCE, I have prepared, or directly assisted with the preparation of, the following analyses relating to hydrographic surveys, water right claims, historic water use, and agricultural water use studies:

- Zuni Indian Reservation Identification of Lands and Estimation of Water Requirements for Past and Present Irrigated Lands Served by Permanent Irrigation Works. In the matter of United States v. A&R Production, et al. November 3, 2008.
- Zuni Indian Reservation Review of and Rebuttal to Expert Reports for Past and Present Irrigated Lands Served by Permanent Irrigation Works. In the matter of United States v. A&R Production, et al. November 1, 2011.
- Zuni River Basin Determination of Water Uses for Subfile ZRB-2-0014 and Rebuttal to Edward J. Bawolek, PE, PhD Expert Report. In the matter of United States v. A&R Production, et al. Prepared for the U.S. Department of Justice. June 30, 2014.
- Zuni River Basin Determination of Historic Water Uses for Subfile ZRB-2-0098 'Atarque Ranch'. In the matter of United States v. A&R Production, et al. Prepared for the U.S. Department of Justice. December 31, 2014.
- Zuni River Basin Rebuttal of Darrell Brown Report for Subfile ZRB-2-0098 'Atarque Ranch'. In the matter of United States v. A&R Production, et al. Prepared for the U.S. Department of Justice. March 19,

2015.

- Zuni River Basin Determination of Water Uses for Subfiles ZRB-4-0064 and ZRB-5-0009. In the matter of United States v. A&R Production, et al. Prepared for the U.S. Department of Justice. February 16, 2016.
- Zuni River Basin Determination of Water Uses for Subfile ZRB-4-0169. In the matter of United States v. A&R Production, et al. Prepared for the U.S. Department of Justice. June 1, 2016.
- Technical Memoranda relating to ongoing reviews of individual livestock and irrigation water right claims located in Montana, basin 40I (Peoples Creek), 40J (Milk River), and 43O (Little Bighorn). Prepared for the U.S. Department of Justice and Bureau of Indian Affairs. September 2014 – present day.
- Walker River Indian Reservation Identification of Historically Irrigated Area and Estimation of Irrigation Water Requirements. Prepared for the U.S. Department of Justice. March 2014.
- Rebuttal Report Concerning Expert Reports Submitted by the State of New Mexico Office of the State Engineer, Tri-State Generation and Transmission, Inc., and the Association of Community Ditches of the Rio San Jose. In the matter of the State of New Mexico, ex. rel. State Engineer v. Kerr McGee, et al. Water Right Adjudication of Past and Present Water Use on the Acoma Pueblo. November 23, 2010.
- Comprehensive Water Resources Management Plan. Draft report.

Prepared for Pueblo of Acoma. December 2012.

8. I have provided written reports and sworn oral testimony regarding historic water use within the Zuni River Basin as part of the Zuni River Basin adjudication. Specifically, and other than for subfile ZRB-2-0038, I have prepared individual reports concerning historic water use for domestic, livestock, and/or irrigation uses in subfile actions ZRB-2-0014, ZRB-2-0098, ZRB-4-0064, ZRB-5-0009, and ZRB-4-0169. I was deposed by opposing counsel regarding analysis of historic water use and hydrographic survey methodology in subfile action ZRB-2-0098.

9. As an Assistant Engineer at NRCE (2008-2012), I worked directly with and under L. Niel Allen, Ph.D., P.E while he was the principal expert on several water right cases. I assisted Dr. Allen with the preparation of his expert reports and rebuttal reports, where I performed calculations, analysis, research, and report preparation. The content of these reports included DCMI (domestic, commercial, municipal, and industrial) water use, irrigation and crop water requirements, livestock water use, historically irrigated acreage studies (HIA), undepleted natural flow studies, and water use projections. I worked with Dr. Allen on projects such as the Zuni River Basin (US v. A&R Productions), Rio San Jose (NM v. Kerr-McGee), and Ohkay Owingeh Pueblo (NM v. Abbott). I would also assist Dr. Allen with the preparation of exhibits, disclosure documents, discovery requests, review of expert reports by other parties, and prepare any additional materials necessary concerning Dr. Allen's testimony.

WATER CLAIMS ASSERTED BY DEFENDANTS

10. I have reviewed all the material available concerning Subfile ZRB-2-0038, Craig L. Fredrickson and Regina R. Fredrickson ("Defendants"). The real property associated with this subfile is located in Section 19, Township 5 North, Range 18 West, New Mexico Principal Meridian (see Attachment A – Hydrographic Survey Map for Subfile ZRB-2-0038). The material in my review included notes, photographs, and geospatial data collected by NRCE engineers during visits to the Defendants' property. My review also included:

- Defendants' *Status Report*, dated July 8, 2008 ("2008 Status Report"),
- Defendants' *Subfile Answer*, filed December 21, 2015 ("2015 Answer"),
- Defendants' *Response to Plaintiffs' First Joint Discovery Requests* ("First Response"),
- Defendants' *Response to Plaintiffs' Second Joint Discovery Requests* ("Second Response"),
- Defendants' *Supplemental Response to Plaintiffs' Discovery Requests* ("Supplemental Response"),
- Defendants' *Supplemental Response to Interrogatory No. 7* ("Supplemental Response to Int. No. 7"),
- *Expert Witness Report of Craig L. Fredrickson*, dated April 2, 2016, with subsequent revisions dated April 29, 2016 and June 27, 2016 and all accompanying appendices,
- Defendants' *Motion for Summary Judgment*, filed August 12, 2016

("MSJ"),

- *Deposition of Tom Cox*, dated May 18, 2016 ("Cox Dep."), and
- *Deposition of Craig Fredrickson*, dated July 6, 2016 ("Fredrickson Dep.").

11. The well is identified by NRCE hydrographic survey ID number 10A-5-W06 (Office of the State Engineer file number G2469) as shown on the Hydrographic Survey Map for Subfile ZRB-2-0038. The Defendants have asserted several different quantities of historic use, both livestock and domestic, associated with their subfile as listed in Table 1.

Table 1. Historic Use for Well 10A-5-W06 Asserted by Defendants

Source	Asserted Quantity Diverted for Historic Use
Status Report July 8, 2008	13.081 AFY*
Expert Report of Craig L. Fredrickson April 12, 2016	4.633 AFY**
Revised Expert Report of Craig L. Fredrickson April 29, 2016	4.334 AFY**
Final Expert Report of Craig L. Fredrickson June 27, 2016	4.479 AFY**

* Includes 3.0 AFY for domestic use
** Includes 0.7 AFY for domestic use

In the Defendants' *Motion for Summary Judgment*, filed August 12, 2016, the Defendants have apparently settled on an asserted quantity for well 10A-5-W06 of 4.479 AFY.

REGARDING THE HYDROGRAPHIC SURVEY REPORT

12. The Hydrographic Survey Report was prepared by NRCE to identify water users and water features within the boundaries of the Zuni River Basin. This

includes the identification of wells, springs, impoundments, reservoirs, and irrigated land. Since it is not feasible for NRCE to find and collect all relevant information for each and every water user throughout the Zuni Basin, it is the responsibility of each water user to demonstrate the basis of their claimed water use. This was accomplished by consultations involving each water user, the Department of Justice, and NRCE engineers. When possible, water rights offered in the Plaintiffs' consent orders are based upon evidence of actual historic use to the extent that it can be demonstrated by the water user. When the water user failed to demonstrate actual historic use, or the actual historic use could not be determined based upon the information available to the Plaintiffs, the broad assumptions described in the hydrographic survey report were then applied to develop default water rights.

13. Although the Defendants take issue with the selected animal use rate presented in publications authored by the New Mexico Office of the State Engineer (OSE), and applied in the hydrographic survey report, the values compare favorably with other publications and studies on beef cattle water consumption. The OSE report in question is "New Mexico Water Use by Categories in 1995"[1] which presents a value of 10 gallons per day for beef cattle. This report is released every five years and the most recent report, "New Mexico Water Use

[1] Wilson, B. C., and Lucero, A. A. (1997). *Water Use by Categories in New Mexico Counties and River Basins, and Irrigated Acreage in 1995*. New Mexico Office of the State Engineer Technical Report 49. Santa Fe, NM.

by Categories in 2010", [2] continues to apply a value of 10 gallons per day associated with beef cattle water intake in New Mexico.

14. Furthermore, a report titled "Water Intake Rates of Cattle"[3] states the daily water intake of a 1,000-lb beef steer is 10.2 gallons per day at a mean ambient temperature of 70°F.[4] The Winchester and Morris report is the basis for cattle water intake values published in "Nutrient Requirements for Beef Cattle: Seventh Revised Edition"[5] by the National Research Council. Actual water intake and air temperatures were measured in "Water Intake by Feedlot Steers"[6] which found that "cattle fed during the summer (maximum daily temperatures of about 90°F) required about 10 gallons of water per day." Similarly, an article from the University of Georgia titled "Water Requirements and Quality Issues for Cattle"[7] present water requirement guidelines for a dry cow of 1 gallon per 100 pounds of body weight at a daily high of 90°F. Thus, for a 1,000-lb cow, the water requirement is 10 gallons per day under these guidelines. The Defendants have not presented any publications or studies which suggest the 10

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[2] Longworth, et al. (2013). Water Use by Categories in New Mexico Counties and River Basins, and Irrigated Acreage in 2010. New Mexico office of the State Engineer Technical Report 54. Santa Fe, NM.

[3] Winchester. C. F., and Morris, M. J. (1956). Water Intake Rates of Cattle. Journal of Animal Science, 15(3), 722-740.

[4] The average annual high, mean, and minimum temperatures at the Fence Lake weather station are 65.8°F, 48.6°F, and 31.7°F, respectively. (http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?nm3180)

[5] National Research Council. (2000). Nutrient Requirements of Beef Cattle. Seventh Revised Ed. The National Academies Press. Washington, DC.

[6] Hicks, et al. (1988). Water Intake of Feedlot Steers. Oklahoma Animal Science Report, p 208-212.

[7] Dyer, T. G. (2012). Water Requirements and Quality Issues for Cattle. University of Georgia Cooperative Extension Special Bulletin 56.

gallons per day applied by the Hydrographic Survey is not a reasonable estimate of average water intake of non-lactating mature beef cattle.

15. The hydrographic survey applied an estimated carrying capacity of 15 animal units ("AU") per 640 acre section of land. This value, while not based on any particular analysis or calculation by NRCE, considers the forage requirements of livestock and corresponds to typical rangeland carrying capacities reported in New Mexico. Furthermore, this approach has only been applied when defendants have failed to provide evidence of the actual number of livestock having used a particular watering source.

16. Information regarding typical rangeland grazing capacities is available for New Mexico. In the article "Estimation of stocking rate on New Mexico rangeland"[8], actual stocking rates of 59.1 ha/AU (4.4 AU/sec) at the Chihuahuan Desert range in southcentral New Mexico to 24.3 ha/AU (10.7 AU/sec) at a shortgrass prairie range similar to ranges in central and east New Mexico are presented. An article from New Mexico State University titled "Perspectives on Rangeland Management"[9] presents a grazing capacity analysis for arid rangelands resulting in 13 AU/sec for rangeland good condition. New Mexico State University also developed carrying capacities throughout the entire state of New Mexico in

[8] Holechek, J. L., and Pieper, R. D. (1992). Estimation of stocking rates on New Mexico Rangelands. Journal of Soil and Water Conservation 47(1). 116-119.

[9] Hurd, B. H., Torell, L. A., and McDaniel, K. C. (2007). Perspectives on Rangeland Management: Stocking rates, Seasonal Forecasts, and the Value of Weather Information to New Mexico Ranchers. Agricultural Experiment Station Research Report 759. New Mexico State University. Las Cruces, NM.

"Grazing Capacities and Selected Factors Affecting Public Land Use."[10] This report includes a map of New Mexico with grazing capacity contours. For the land in the Zuni River Basin, and including the Defendants' property, the contours indicate a grazing capacity of 70 acres per AU (9.14 AU/sec). Relying on this report, "Range Livestock Costs and Returns for New Mexico"[11] states typical rangeland carrying capacities of the northwestern and southwestern counties of New Mexico at 5 to 14 AU/sec. With the above considerations, and in lieu of any rangeland study specific to the entire basin conducted for the purpose of this adjudication, the 15 AU/sec applied by the Hydrographic Survey is a reasonable estimate of the rangeland carrying capacity in the Zuni River Basin.

17. Although the basis of cattle water use in the hydrographic survey is 10 gallons per animal per day as previously discussed, the ultimate value applied when computing an offer for each water user is 20 gallons per animal per day. This includes a 50% efficiency factor to account for unavoidable losses associated with delivering drinking water to livestock (such as evaporation or operational spillage) as well as any variations between cattle management practices in the Zuni Basin and the assumptions of the hydrographic survey. The Defendants' assertion that the 50% efficiency factor value was simply selected is correct in

[10] Stuckey, H. R., and Henderson, D. C. 1969. Grazing Capacities and Selected Factors Affecting Public Land Use. New Mexico State University Agricultural Experiment Station Research Report 158. Las Cruces, NM.

[11] Hawkes, J. M., and Libbin, J. D. 2007. Range livestock costs and returns for New Mexico, 2002. Range Improvement Task Force, Report 75. New Mexico State University Cooperative Extension Service.

the sense that it is not based upon any particular calculation or measurement relating to any specific subfile in this adjudication. However, this approach has been frequently accepted by cattle ranchers throughout the basin by virtue of the agreements reached through consultations in numerous subfile actions.

LIVESTOCK WATER USE

18. The Defendants claim a livestock water right associated with historic use of 3.779 AFY (2.504 AFY animal consumption and 1.275 AFY operational losses). In general, this amount is based upon opinions stated by Mr. Fredrickson in his report where he computes a theoretical water use associated with the cattle operation by Mr. Cox. Mr. Fredrickson relies upon published literature, general assumptions, and portions of Mr. Cox's testimony to complete his analysis. His analysis is not based upon any measured water use by cattle, or observed cattle behavior, at any point during the Defendants' ownership of the property or during Mr. Cox's cattle ranching operation (Fredrickson Dep., pp. 83-85). Furthermore, some of the assumptions applied by Mr. Fredrickson in his analysis are incorrect, unsupported, or contradicted by Mr. Cox's testimony.

19. In his testimony, Mr. Cox described that his cattle herd, of about 150-200 head, would water at six permanent water sources during the summer, including the Defendants' well (Cox Dep., pp. 30-32). However, Mr. Fredrickson constructs his analysis "assuming that 100% of the herd waters exclusively at this well during the summer season" (MSJ, p. 21). The Defendants go on to state that "in

years of favorable forage production, cattle have no incentive to forage and water anywhere else in the summer season except at well 10A-5-W06" (MSJ, p. 21). This conclusion is based upon Mr. Fredrickson's computed carrying capacity of 51,874 animal unit days ("AUD") using soils data from the Natural Resources Conservation Service (NRCS) for soils within a 2-mile radius of the well. This value of 51,874 AUD is greater than his computed herd forage requirement of 49,860 AUD leading to Mr. Fredrickson's conclusion that forage quantity within the vicinity of the well is adequate. There are numerous issues with this approach that undermine the reasonableness and reliability of Mr. Fredrickson's conclusion. First, this carrying capacity is computed using "favorable year forage growth" as defined by NRCS without any further discussion by the Defendants as to when this favorable year occurred during the operation of cattle at the ranch or whether that best represents historical conditions on the ranch. Second, this carrying capacity is computed with an assumed forage utilization rate of 45% (MSJ, Exhibit G, p. 28). A forage utilization rate is the amount of the total forage to be consumed by the animals and must be selected based upon range type and climate to ensure that the rangeland is not overgrazed. In "An Approach for Setting the Stocking Rate"[12], the cited publication by Mr. Fredrickson, forage utilization rates ranging from 25 to 60% are presented based upon rangeland studies through the United

[12] Holechek, J. L. 1988. An approach for setting the stocking rate. Rangelands 10(1).

States. However, utilization rates based on studies conducted in New Mexico, Arizona, and Utah, which would be similar conditions to the Zuni River Basin, report rates of 30 to 40%, with the lower end of this range representative of active grazing during the growing season, as described in the Holechek publication. "Grazing Capacity and Stocking Rates"[13] recommends a rate of 25% for western rangelands, which is significantly lower than the 45% assumed by Mr. Fredrickson. Thus, Mr. Fredrickson's 45% utilization rate likely significantly overestimates carrying capacity using this method.

20. Clearly, the Defendants' argument that the available forage in the vicinity of the well was sufficient for the entire herd is not true when appropriate assumptions regarding forage utilization rate of the cattle are applied. Furthermore, Mr. Fredrickson stated that although portions of this 2-mile radius of the well were fenced off to cattle in the summer he still included the area in forage analysis (Fredrickson Dep., p. 100). Thus, since it would be reasonable to conclude that the estimated carrying capacity would be much less than the 51,874 AUD asserted by Mr. Fredrickson, even in favorable years, the cattle would have likely needed to seek out sufficient forage, and water, from the other locations. Notably, this matches what Mr. Cox described in his testimony and undermines what Mr. Fredrickson states in his report.

21. Mr. Cox stated that his 150-200 cattle would utilize several different permanent

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[13] Galt, D., Molinar, F., Mavarro, J., Joseph, J., and Holechek, J. 2000. Grazing Capacity and Stocking Rate. Rangelands.

watering sources during the summer: Rincon Hondo well (aka well 10A-5-W06), Perry Canyon well, High Lonesome Well, and Zuni Spring (Cox Dep., pp. 37-38). The Defendants assert, however, that "100% of the herd waters exclusively at this well during the summer season" (MSJ, p. 21). The Defendants' basic assumptions regarding the operation of the ranch by Mr. Cox are contradictory to Mr. Cox's testimony. When the cattle were at the other watering sources mentioned by Mr. Cox, they could not also consume water from the Defendants' well.

22. Even if the Defendants could provide evidence that 150-200 cattle ever watered exclusively at well 10A-5-W06, the water intake requirements computed by Mr. Fredrickson of 815,802 gallons per year, or 2.504 AFY (MSJ, p. 24), likely overestimate cattle water intake of the assumed herd. Mr. Fredrickson applies the peak lactation rates of "cows nursing calves, 3-4 months after parturition" from Winchester and Morris (1956) to the entire nursing period (MSJ, Exhibit G, p. 44). While cows do require additional water during milk production, milk production declines after this peak period which would also correspond to a decrease in water intake. Furthermore, Mr. Fredrickson added in water requirements of the calves without regard for any water the calves receive from milk (Fredrickson Dep., p. 119). From Mr. Fredrickson's cited reference, "Young calves, summer heat, and water consumption"[14], the author states "it is

[14] Jenkins, K. H. (2014). Young Calves, Summer Heat, and Water Consumption. University of Nebraska-Lincoln.

fair to say the amount of milk [nursing beef calves] get will impact their need for free choice water."

23. The Defendants assert that the "time-weighted moisture content is 12%" for blue grama grass on their property and also assert that the Winchester and Morris study included feed with a moisture content of 10% (MSJ, p. 23). The Defendants' claim is based entirely on literature review and they do not present any measurement of vegetation moisture specific to their property. The Defendants also do not describe if their asserted moisture content of "12%" corresponds to the "favorable year forage conditions" used previously in Mr. Fredrickson's carrying capacity analysis.

24. Furthermore, the water intake values in Winchester and Morris are presented in terms of total water intake of the animals (water drank plus water in feed). The Defendants appear to have confused the example calculation provided by the authors which demonstrates how one would go about adjusting the water intake values to account for moisture in feed. In their example, the authors chose to use 10% moisture content to demonstrate this moisture adjustment when estimating free drinking water intake of cattle.

25. When selecting the daily temperature applied in his analysis, Mr. Fredrickson elects to use an "ambient daytime temperature", which is neither the daily mean nor daily maximum temperature but rather the mid-point temperature between the daily mean and daily maximum (MSJ, Exhibit G, pp. 42-43). This approach was invented by Mr. Fredrickson and it is not presented in any of the literature

cited by the Defendants. Mr. Fredrickson settled on this approach because "cattle drink almost exclusively in the daytime and seldom at night" (Supplemental Response to Int. No. 7). The Defendants have supplied photographic evidence of a stray neighbor's cow in the vicinity of the well during daytime hours (MSJ, pp. 22-23). However, the authors of the study in which Mr. Fredrickson takes water intake rates (Winchester and Morris) use mean temperatures when comparing their results to other studies of cattle water intake, including studies conducted in outdoor conditions. "Herefords at a temperature that fluctuated from 58° to 122°, with a mean of 90°F, drank about the same amount of water per unit of dry matter ingested as did cows at a near constant temperature of 90°" (Winchester and Morris, 1956). In "Water Intake by Cattle as a Measure of Forage Intake and Quality"[15], the author applied the values of Winchester and Morris (1956) by using the mean temperatures derived from maximum and minimum values. Furthermore, in "Water Intake by Feedlot Steers" (Hicks et al., 1988), the measured water intake at a mean temperature of 75°F (daily temperatures ranging from 61°F to 89°F) was slightly less than that predicted by Winchester and Morris at an ambient temperature of 75°F. The authors propose that this difference is possibly due to different roughage content in the feed. The point here is that although cattle may drink water at a specific time during the day, it does not appear to be a relevant consideration when

[15] Hyder, D. N. (1970). Water Intake by Cattle as a Measure of Forage Intake and Quality. In Range and Wildlife Habitat Evaluation: A Research Symposium. Flagstaff and Tempe, AZ. May 1986. 120-126.

applying the Winchester and Morris water intake rates for cattle. Other than his own opinion, Mr. Fredrickson has not provided any citation supporting the use of “ambient daytime temperature.” The end result is that the “ambient daytime temperature” developed by Mr. Fredrickson increases estimated water use over using a mean temperature.

26. In an apparent defense of their use of “ambient daytime temperature”, the Defendants state that “The data shows that on the average, the actual temperature at which the cow drank was 3.4°F greater than the ambient daytime temperature used in Defendants’ analysis for those particular days” and “Defendants’ analysis is shown to slightly underestimate the actual amount of water consumed for this evidentiary data set” (MSJ, p. 23). The daytime temperature used by the Defendants is based on average daily temperatures obtained from intellicast.com (MSJ, Exhibit G, p. 43). Of course, the temperature over a specific time, such as March 25 through May 7, 2014, will vary from the average temperature computed over a period of several decades. Evidence of a cow drinking water during a particular day, or period of days, when mean temperatures may be above average does not support, and is irrelevant to, the Defendants’ use of the “ambient daytime temperature” to compute historic water use at well 10A-5-W06.

27. The Defendants compare their computed average daily intake for 19.66 gallons per day to information provided by New Mexico State University (NMSU) (MSJ, p. 24), which presents a water intake for cow-calf pairs of 26 gallons per

day. But the NMSU value of 26 gallons for a cow-calf pair is computed for a high temperature of 80°F. And the average annual high temperature is 65.8°F near the Defendants' property.[16] Clearly, comparing water intakes of cattle using different temperatures is of little use in this situation and further calls Mr. Fredrickson's estimates and conclusions into doubt.

28. Also, upon inspection of the computer code provided by Mr. Fredrickson, the temperature term, "MT", is held at a constant value of 80°F where "MT = 80" (MSJ, Exhibit G, p. 94), presumably following the NMSU example. The equation applied in the NMSU example is cited by the National Research Council from "Water Intake for Feedlot Steers" (Hicks et al., 1988) which states that the MT term is the "weekly mean maximum temperature." Even simply substituting daily temperatures would yield better results than completely disregarding temperature variations altogether as done by Mr. Fredrickson.

29. It is also of note that while Mr. Fredrickson has criticized the hydrographic survey report for using animal water consumption for cattle in feedlots (MSJ, Exhibit G, pp. 41), he is now applying equations developed by measuring water consumption in feedlots. The Defendants' opinion of whether or not feedlot water use is applicable to estimate cattle water use in this subfile action is not consistent.

30. In the end, for the reasons stated in the paragraphs above, Mr. Fredrickson's

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[16] The average annual high temperature at the Fence Lake weather station (http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?nm3180)

conclusions that water use consumed by livestock from well 10A-5-W06 amounted to 2.504 AFY in any one year is unsupported, unreasonable, and not a reliable conclusion.

CONSUMPTIVE LOSSES

31. The Defendants claim a water use associated with consumptive and other losses of 415,522 gallons per year or 1.275 AFY (MSJ, p. 25). As described in Mr. Fredrickson's report, these losses are associated with spills while drinking (40,790 gallons), routine maintenance (59,054 gallons), weep hole loss (197,103 gallons), leakage (52,560 gallons), ice removal (6,917 gallons), accidents (10,500 gallons), evaporation (8,904 gallons), and wildlife consumption (39,694 gallons) (MSJ, Exhibit G, p. 68).

32. The Defendants claim a loss of 40,790 gallons, or 0.125 AFY, associated with water lost by the animals while drinking as 5% of the total livestock requirement (MSJ, Exhibit G, pp. 55-56). Mr. Fredrickson does not provide any measurements supporting his assumed 5% value. Furthermore, this loss was included as part of the water intake measured by the studies applied in Mr. Fredrickson's analysis. The study titled "Influence of Increasing Temperature, 40° to 105°F on Milk Production in Brown Swiss Cows, and on Feed and Water Consumption and Body Weight in Brown Swiss and Brahman Cows and Heifers"[17], which was applied by Winchester and Morris when developing their

[17] Ragsdale, A. C., Thompson, H. J., Worstell, D. M., and Brody, S. (1951). Influence of Increasing Temperature, 40° to 105°F on Milk Production in Brown Swiss Cows, and on Feed and Water Consumption

water intake rates, reported that "the given water consumption data represents the total amount supplied to the water cups, including spillage from lapping and slobbering." Winchester and Morris also noted that "only a small fraction [of water] is wasted, even at high ambient temperatures." Mr. Fredrickson's value of 5% is unsupported and, given the above comments from the studies on which he relies, is likely already included as part of the water intake rates of the cattle.

33. The Defendants claim a loss of 59,054 gallons, or 0.181 AFY, associated with water lost during routine maintenance related to trough cleaning. This quantity was computed by Mr. Fredrickson assuming the drinkers were cleaned twice per week, each time using 615 gallons of water (MSJ, Exhibit G, p. 56). But Mr. Fredrickson's assumption here appears unsupported. In his testimony, Mr. Cox stated that he never regularly cleaned the drinkers at well 10A-5-W06 when he operated cattle at the ranch (Cox Dep., p. 52). In apparent disregard of Mr. Cox's testimony, the Defendants claim that their proposed cleaning schedule is based on "reported practices and recommendations." Mr. Fredrickson cites "Water Use and Conservation at Texas High Plains Beef Cattle Feedyards"[18] which reports for a 50,000 head feedlot a drinking trough cleaning schedule of about every two to three days (MSJ, Exhibit G, p. 56). Clearly, this is the reported practice for a single, and very large, feedlot. It would be more

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and Body Weight in Brown Swiss and Brahman Cows and Heifers. University of Missouri Agricultural Experiment Station Research Bulletin 471. Columbia, MO.

[18] Parker, D. B., Perino, L. J., Auvermann, B. W., Sweeten, J. M. (2000). Water Use and Conservation at Texas High Plains Beef Cattle Feedyards. Journal of Applied Engineering in Agriculture, 16(1), 77-82.

appropriate to review the practices at multiple feedlots before coming to any conclusion regarding typical cleaning practices. Based on data provided by 520 feedlots throughout the central and western United States, the average number of days between routine cleaning of water troughs is 12.7 days in the summer to 15.7 days in the winter with larger feedlots (8,000+ head) cleaning troughs approximately twice as often as small feedlots.[19] In the end, Mr. Fredrickson's proposed cleaning schedule is far more frequent than the typical reported practice at feedlots, has no apparent connection to historic use of water at well 10A-5W06, and was not ever practiced by Mr. Cox.

34. The Defendants claim a loss of 197,103 gallons, or 0.605 AFY, associated with a supposed weep hole in the well's drop pipe (MSJ, p. 25). The Defendants have not made any actual measurement of the water flow through the weep hole and this estimate is based on Mr. Fredrickson's general observations of water drop in the standpipe while filling water jugs (Fredrickson Dep., pp. 138-139). The Defendants recognize that this water is never brought to the surface and "losses are returned to the annular space between the drop pipe and the well casing or borehole." The Defendants assert that "weep hole losses are free to enter bedrock fractures and unconsolidated strata" but provide no documentation of that this is in fact occurring. Furthermore, the Defendants claim that all

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[19] Animal and Plant Health Inspection Service. (2000). Part III: Health Management and Biosecurity in U.S. Feedlots, 1999. National Animal Health Monitoring System, U.S. Department of Agriculture. Fort Collins, CO.

"existing infrastructure appears to be original to the well installation" (MSJ, Exhibit G, p. 7). As such, Mr. Fredrickson's observed water drop could just as likely be due to water leaking back through the aging pump mechanism check valves or perhaps leaks in the drop pipe itself. Mr. Fredrickson did not consider these possibilities in his analysis.

35. The Defendants claim a loss of 52,560 gallons, or 0.161 AFY, associated with water lost due to leakage in the storage and delivery system (MSJ, Exhibit G, pp. 60-61). The Defendants do not appear to have made any measurement of leakage or have kept any record of leakage loss. This estimate is based on Mr. Fredrickson's noted water level drop of "about a foot" in the main holding tank over a week period (Fredrickson Dep., pp. 140-142). Mr. Fredrickson goes on to state that he accounted for evaporation by subtracting 4 feet of annual evaporation divided by 52 weeks, which is about a in inch of evaporation per week. This approach, however, assumes equal evaporation occurs throughout the year which is not true. If Mr. Fredrickson's observation occurred during a hot, sunny week in the middle of summer, evaporation will be much greater than if his observation occurred over a cool, cloudy week in the fall. Since the weather when Mr. Fredickson made his observations is not known, his claim to "about an inch" of evaporation cannot be verified. Thus, although Mr. Fredrickson has attempted to account for evaporation, a component of this leakage may still be due to evaporation depending upon when his observations occurred. Furthermore, this is based entirely upon Mr. Fredrickson's

observations of the well infrastructure today. Mr. Cox very clearly stated in his testimony that he did not remember any leaks at this well when he operated cattle on his ranch (Cox Dep., p. 75).

36. The Defendants claim a loss of 6,917 gallons, or 0.021 AFY, associated with water lost due to ice removal during winter months (MSJ, Exhibit G, pp. 62). Mr. Fredrickson assumes an average ice thickness of 4 inches removed every other day mid-December until March based upon Mr. Cox's testimony. However, Mr. Cox never gave an estimate to how thick the ice buildup would be. Mr. Fredrickson stated that "in a 10 degree C temperature difference [below zero], about four inches of ice will develop over that period" (Fredrickson Dep., p. 146). Thus, although no formula is provided in his report, it appears that Mr. Fredrickson assumed the mean temperature was -10°C (14°F) during the ice formation period. Mr. Fredrickson further states that "Daily average temperatures are at or below freezing from December 7 through February 1" (MSJ, Exhibit G, p. 62). Based upon the temperature information provided by Mr. Fredrickson, the average daily temperature from December 7 through February 1 is 30.5°F, or 1.5°F (0.8°C) below freezing on average.[20] Although the average daily temperature is indeed below freezing during this period, it appears to be much warmer than the temperatures assumed by Mr. Fredrickson in his ice thickness calculation as he described in his testimony. Also, Mr.

[20] Mr. Fredrickson obtained daily average temperature data for Fence Lake, NM from www.intellicast.com for use in his analysis (MSJ, Exhibit G, p. 43).

Fredrickson computes a volumetric loss for ice formed in the troughs without converting the depth of ice (4 inches) to depth of liquid water, which ignores the volume change of water during freezing. Thus, Mr. Fredrickson's conclusions with respect to loss associated with ice are at best significantly overstated.

37. The Defendants claim a loss of 39,694 gallons, or 0.122 AFY, associated with water used for wildlife consumption (MSJ, Exhibit G, pp. 65-67). This estimate is not based on any measured quantity of water by the Defendants (Fredrickson Dep., p. 150). The Defendants have game cameras set up which photograph animals when they come to water at the well. However, Mr. Fredrickson has not produced any daily record of animals utilizing the well to support his conclusion that 15 mule deer and 20 elk visit the well daily for 75% of the year (MSJ, Exhibit G, pp. 66-67). Furthermore, the Defendants' observations have been made many years after cattle operations ceased at the well. Although Mr. Fredrickson believes that the wildlife use today is representative of wildlife use during cattle operations (Fredrickson Dep., p. 151), a report titled "Responses of Elk and Mule Deer to Cattle in Summer"[21] states that cattle presence "cause changes in distribution of both elk and mule deer." Thus, even if Mr. Fredrickson's animal counts could be verified, there is no basis to assume that those numbers are representative of past wildlife use at the well during Mr. Cox's cattle operation.

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[21] Coe, P. K., Johnson, B. K., Kem, J. W., Findholt, S. L., Kie, J. G., Wisdom, M. J. (2001). Responses of Elk and Mule Deer to Cattle in Summer. Journal of Range Management 54, A51-A76.

Pursuant to 28 U.S.C. § 1746, I declare under penalty of perjury that the foregoing is true and correct. Executed on this 14th day of September, 2016.

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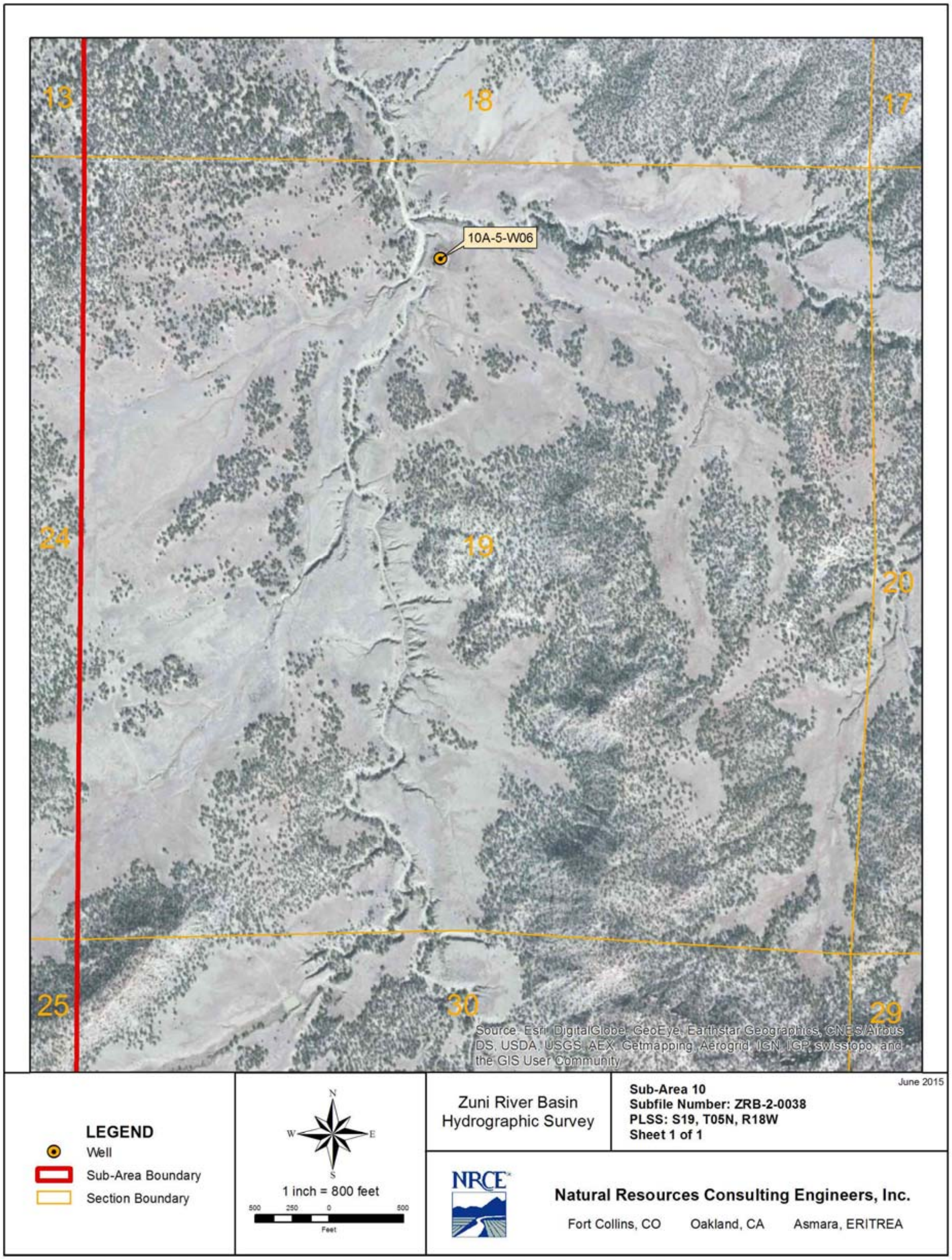

Attachment A – Hydrographic Survey Map for Subfile ZRB-4-0169