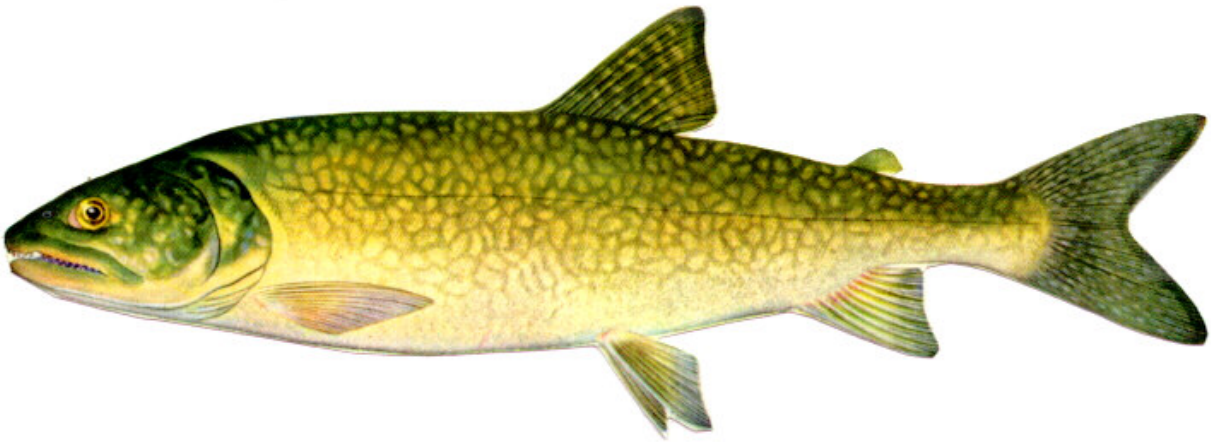
INTERFERENCE INVESTIGATION REPORT

U.S. FISH AND WILDLIFE SERVICE (USFWS)-SARATOGA NATIONAL FISH HATCHERY VS. OVERLAND TRAIL CATTLE COMPANY (TOTCO) NEAR SARATOGA, WYOMING



MAY 2009
GROUND WATER DIVISION
WYOMING STATE ENGINEER'S OFFICE

WITH ASSISTANCE FROM:
WESTON ENGINEERING, INC.
LARAMIE, WYOMING

INTERFERENCE INVESTIGATION REPORT

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COMPLAINT

On August 8, 1998, the State Engineer received a letter from Mr. Ed Stege, Project Leader for the United States Fish and Wildlife Service (USFWS) Saratoga National Fish Hatchery (NFH), in which Mr. Stege discussed the hatchery water system, observations on flow regime during the year, and Lake Creek Lake flow conditions when area irrigation wells are not pumping due to haying operations. This letter is provided as Appendix A. Mr. Stege requested that the State Engineer look into the situation further. The initial letter was followed by a meeting with the United States Fish and Wildlife Service (USFWS) Denver office, an NFH site visit by the Wyoming State Engineer's Office (SEO) personnel, a meeting of SEO personnel related to preliminary investigation, and a subsequent response letter (Appendix B) to Mr. Ed Stege of the NFH from Mr. Richard Stockdale, Ground Water Division Administrator, related to the preliminary investigation and requesting that further investigation should be done under Wyoming Statute §41-3-911 subsection (b) and (c).

A Formal Interference Complaint Investigation Request letter and filing fee dated March 24, 1999, was received by the SEO on March 29, 1999, from the USFWS (Appendix C). The letter requested the SEO to "investigate possible interference to [their] right to use 2.56 cfs from Lake Creek Lake, as adjudicated under Territorial Proof No. 108 and certificated under Proof No. 28839, from local irrigation pumping, particularly that of the Overland Trail Ranch."

Pursuant to the Interference Complaint letter, site visits were made to Lake Creek Lake, Lake Creek, the NFH, and The Overland Trail Cattle Company (TOTCO), for the purpose of facilitating monitoring equipment installation and a monitoring program implementation to assess impacts of pumping irrigation wells on the NFH water rights from Lake Creek Lake. A letter was sent to Mr. Glen Alameda, TOTCO Ranch Manager, advising him of the complaint that had been filed and requesting installation of totalizing flow meters and accurate record keeping of irrigation water use and scheduling (Appendix D).

Along with monitoring and reporting by TOTCO, NFH agreed to install monitoring equipment on the spring-fed Lake Creek Lake, and wells that service the hatchery. Additional monitoring points were selected for Lake Creek, and four unused wells. Monitor wells included one well at NFH, one well at TOTCO, and two wells located east of NFH and south-east of TOTCO on lands then owned by Mylert Armstrong (currently owned by Kelley Cattle Company, LLC.). Monitoring and data collection began in early May 1999 (see Appendix E). A review of available literature and scientific data has been incorporated into this report.

STATUTORY AUTHORITY

W.S. § 41-3-911 provides the statutory framework for interference. It provides an enforceable legal remedy for surface or ground water appropriators whose rights are impaired by an interfering appropriator. The statute is applicable only when the impairment arises between two ground water appropriators, or between a ground water and surface water appropriator.

The statutes relating to interference are:

§*41-3-911 (b):*

Any appropriator of either surface or underground water may file a written complaint alleging interference with his water right by a junior right. Complaints are to be filed with the state engineer and are to be accompanied by a fee of one hundred dollars ($100.00) to help defray costs of investigation. This section is not applicable to interference between two (2) surface water rights. Upon receiving the complaint and fee, the state engineer shall undertake an investigation to determine if the alleged interference does exist. Following the investigation, the state engineer shall issue a report to all interested parties stating his findings. The report may suggest various means of stopping, rectifying or ameliorating the interference or damage caused thereby.

§*41-3-916:*

Where underground waters in different aquifers are so interconnected as to constitute in fact one source of supply, or where underground waters and the waters of surface streams are so interconnected as to constitute in fact one source of supply, priorities of rights to the use of all such interconnected waters shall be correlated and such single schedule of priorities shall relate to the whole common water supply. The state engineer may by order adopt any of the corrective controls specified in W.S. § 41-3-915.

§*41-3-933:*

It is an express condition of each underground water permit that the right of the appropriator does not include the right to have the water level or artesian pressure at the appropriator's point of diversion maintained at any level or pressure higher than that required for maximum beneficial use of the water in the source of supply. The state engineer may issue any permits subject to such conditions as he may find to be in the public interest.

§41-3-102:

(a) Water rights are hereby defined as follows according to use: preferred uses shall include rights for domestic and transportation purposes, steam power plants, and industrial purposes; existing rights not preferred, may be condemned to supply water for such preferred uses in accordance with the provisions of the law relating to condemnation of property for public and semi-public purposes except as hereinafter provided.

(b) Preferred water uses shall have preference rights in the following order:

(i) Water for drinking purposes for both man and beast;

(ii) Water for municipal purposes;

(iii) Water for the use of steam engines and for general railway use, water for culinary, laundry, bathing, refrigerating (including the manufacture of ice), for steam and hot water heating plants, and steam power plants; and

(iv) Industrial purposes.

(c) The use of water for irrigation shall be superior and preferred to any use where water turbines or impulse water wheels are installed for power purposes; provided, however, that the preferred use of steam power plants and industrial purposes herein granted shall not be construed to give the right of condemnation.

FILING A COMPLAINT OF INTERFERENCE

Under Statute W.S. § 41-3-911, a person alleging interference must file a complaint with the State Engineer and pay $100.00 "to help defray the costs of the investigation" (W.S. § 41-3-911(b)).

ADEQUATE WELL

In the case of a ground water appropriator claiming interference, it is a prerequisite that the complainant have an "adequate well" prior to proceeding with the claim.

ADEQUATE DIVERSION STRUCTURE

In the case of a surface water appropriator claiming interference, it is a prerequisite that the diversion structure be in good order and be capable of adjustment for delivery of water. This may include the ability to open a headgate or change the elevation of a diversion dam or weir structure.

REPORT AND RECOMMENDATION

W.S. § 41-3-911 requires the State Engineer to issue a report to all interested parties, stating his findings. The report may suggest various means of stopping, rectifying, or ameliorating the interference or damage caused by such. Depending on the circumstances, the investigation and the completion of the report may take several years.

CONTESTED PROCEEDINGS BEFORE THE BOARD OF CONTROL

Any appropriator who is dissatisfied with the results of the State Engineer's report may proceed under the Administrative Procedures Act, and have the matter heard by the Board of Control (W.S. § 41-3-911(c)). At the hearing, held by the Division Superintendent, all interested parties may present evidence. The Board sits not as a reviewing agency (i.e., not an appeal), but instead hears the matter as a contested case. The State Engineer's report may be offered and considered as evidence, along with any other evidence and testimony the parties may present. The Board then issues its decision, which can be appealed in accordance with the Administrative Procedures Act.

LOCATION

The NFH, TOTCO, irrigation wells, and Lake Creek Lake (collectively referred to as the Study Area) are located in the Saratoga Valley of South-Central Carbon County, Wyoming. The Study Area is located approximately four miles north and east of the town of Saratoga, Wyoming, in an area locally known as Lake Creek Flats (Figure 1). The vicinity is currently a mixture of rural residential subdivisions, irrigated agricultural production, agricultural range livestock production (including TOTCO), and the NFH.

The Saratoga Valley was settled during the 1860-1870's period in the westward expansion, including precious and semi-precious metal mining, logging and timber harvest, livestock production, railroad, and tourism. The Town of Saratoga was officially named in 1884. Agricultural production, both historically and currently, is predominantly cattle and sheep grazing with supporting haying operations to provide winter forage.

NFH

The NFH was established in 1911 as a trout breeding and rearing facility. Currently the facility is used as a brood stock hatchery for Lake, Brown, Rainbow, and Cutthroat trout species and a research facility for the endangered Wyoming Toad.

TOTCO & IRRIGATION WELLS

TOTCO is a cattle ranching operation with supporting hay and forage production utilizing center pivot and flood irrigation methods from both surface and ground water sources. TOTCO irrigated lands named in this investigation are located approximately 1-1.5 miles north northeast of the NFH.

LAKE CREEK LAKE

Lake Creek Lake is a spring fed natural lake. The water from Lake Creek Lake is utilized by the NFH in their trout breeding and rearing facility. Lake Creek Lake is located approximately 3,000 feet from the NFH.

CLIMATE

The climate of the Saratoga Valley is typical of semi-arid intermountain basins. Climate is characterized by low precipitation and high evapotranspiration, a wide range of daily temperatures, and a short growing season. The National Weather Service has a weather station at the Saratoga Airport, approximately five miles south, which has a comparable climatic regime to the Study Area.

Annual precipitation can vary widely, having a long term annual average of 10.23 inches. Precipitation is mainly comprised of spring rain/wet snow (March-June) and summer thunderstorms (June-August). Precipitation from snow fall occurs during winter months; the effective snow water equivalents are much lower than the snow-fall amounts. Wyoming has high evapotranspiration rates due to high solar radiation (effect of high elevation of approximately 6,800 ft above MSL) and high average daily wind speed (NOAA 2004).

Average daily wind speed fluctuates on a seasonal basis with strongest winds occurring during winter months and lower average daily wind speed during summer months. Predominant wind direction is to the east or north east (Curtis and Grimes, 2004).

The Saratoga Valley also experiences large fluctuations in seasonal and diurnal temperatures. Large fluctuations in temperatures are due to warm and cold air masses being trapped between the Sierra Madre, Medicine Bow Mountains on the south, west and east, and Pass Creek Ridge and Elk Mountain on the North and Northeast. The air masses can become trapped in the valley by temperature inversion or influenced by down slope/up slope winds.

The average growing season for perennial vegetation and forages (40° F spring to 24° F fall temperature) is 170 days, generally regarded as April 15 to October 1 (Pochop 1992, Martner 1986, NOAA 2004). For annual crops such as barley, oats, etc., the effective number of growing season days is shortened due to germination temperature requirements.

PHYSIOGRAPHY

The Study Area lies in the central portion of the Saratoga Valley which is part of the Southern Rocky Mountain Physiographic Sub-province (Montagne 1991). The Saratoga Valley is bounded on the east by the Medicine Bow Mountains, on the Southwest by the Sierra Madre Mountains, and on the North by Pass Creek Ridge/Divide (Montagne 1955, Stephens and Bergin 1959). As stated earlier, the immediate investigation area is known as Lake Creek Flats. Lake Creek, tributary to the North Platte, drains this area to the west directly to the North Platte River which flows to the north.

GEOLOGY

The Saratoga Valley is a synclinal basin structure that developed during Late Mesozoic-Early Cenozoic time, generally referred to as the Laramide Orogeny. The Saratoga Valley has an inconsistent structural symmetry, characterized by the varying thrust directions of the North and South parts of the Medicine Bow Mountains, the Park Range, the Sierra Madre Mountains, Independence Mountain Fault, and Pass Creek Ridge (Weitz and Love 1952, Montagne 1955, Love and Christiansen 1985, and Montagne 1991). The tectonic activity is characteristic of basins and ranges of the Western United States and results in warping and normal faulting as seen in the Saratoga Valley. The Saratoga Valley shows evidence of repeated structural changes resulting in periods of aggradation and degradation. The periodic change from aggradation to degradation makes it possible for a varying stratigraphic column to exist in a small area such as the Saratoga Valley or the even smaller area specific to this investigation.

The presence of rocks of Precambrian, Triassic, Jurassic, Cretaceous, Tertiary, and Quaternary ages are discussed in the literature as being evident from outcrops in the Saratoga Valley (Visher 1952, Montagne 1955, Stephens and Bergin 1959, Love and Christiansen 1985, Montagne 1991). In the specific area of this investigation, lack of detailed well construction information makes it difficult to accurately ascertain the presence of all of the above. Seismic surveys may have been conducted across this area; however, no specific data have been uncovered by researching Wyoming Oil and Gas Conservation Commission, Wyoming Geological Survey, or U.S. Geological Survey records. Due to expense and accessibility, seismic data were not investigated further.

BEDROCK GEOLOGY

Bedrock in the area of this investigation is derived from units of Tertiary to Precambrian age. The primary bedrock units include: the Medicine Bow, Lewis Shale, Mesaverde, Steele Shale, Niobrara, Frontier, Mowry Shale, Thermopolis Shale, and Cloverly Formations of Cretaceous age, various units of Jurassic to Mississippian age, and undivided Precambrian age granite, granite gneiss, and schists (Visher 1952, Montagne 1955, Stephens and Bergin 1959, Love and Christiansen 1985, and Montagne 1991). Evidence or actual geologic control showing bedrock stratigraphy is sparse in and surrounding the Study Area. A search of oil and gas records of the Wyoming Oil and Gas Conservation Commission revealed the State #1 Oil/Gas well located in NW¼NW¼, Section 1, Township 17 North, Range 84 West, encountered the Cloverly, Morrison, Nugget, and Jelm units from 1067 feet to 1702 feet below land surface. These formations represent the early Cretaceous to Late Triassic period.

SURFICIAL GEOLOGY

Surficial geologic deposits covering the Study Area are comprised of Alluvium and Tertiary age North Park Formation. Some authors have grouped the Tertiary age units into a single unit and described them as an upper and lower sequence of the North Park or Browns Park Formation due to the lack of a clearly defined boundary to easily separate them (Visher 1952, Montagne 1955, and Montagne 1991). Both an upper and a lower unit are present in the Study Area and will be referred to as the North Park Formation following recent literature. These are the predominant surface units throughout the Saratoga Valley. The North Park Formation is the surface formation present in the Study Area (McGrew 1951, Weitz and Love 1952, Montagne 1955, Montagne 1991, Flanagan and Montagne 1993).

The North Park Formation in the Saratoga Valley consists of a basal conglomerate overlain by calcareous to siliceous siltstones and sandstones which vary in color from green, gray, tan, to white. The middle and upper part of the formation consist of conglomerate, sandstone, limestone, and volcanic ash (Visher 1952, Montagne 1955, Montagne 1991, and Flanagan and Montagne 1993). Literature suggests that normal faulting occurred during and after deposition during the Neogene, possibly resulting in faults in the Lake Creek Flats and Pass Creek Flats area of the Saratoga Valley (Visher 1952, Flanagan and Montagne 1993).

HYDROLOGY

General hydrology of the Saratoga Valley includes both surface water and ground water components. The Saratoga Valley contains a major river drainage, the North Platte River, and tributaries fed by snow melt and ground water discharge, alluvium that can be both gaining or losing for different reaches, and ground water systems both influenced and not influenced by surface water. In general, surface water is a result of runoff caused by snowmelt, contributions from stored ground water during periods of no snow melt, and runoff due to precipitation events. A generalized concept of the ground water system discussed on a regional basis by Richter (1981) is characterized by three general types of ground water sources:

1. partially saturated elevated and highly dissected outcrops,

2. saturated sandstones having limited aerial extent, and

3. saturated alluvium.

SURFACE WATER HYDROLOGY OF LAKE CREEK AND LAKE CREEK LAKE

Lake Creek is the main surface water hydrologic feature in the Study Area. Lake Creek originates on the west slope of the Medicine Bow Mountains with large numbers of tributaries sourcing from Pennock Mountain. Lake Creek includes drainage area covered by the USGS Hydrologic Unit number 101800020605 South Fork Lake Creek and 101800020606 Lake Creek –North Platte River. Respective acreage for each unit is 27,903 and 29,444 for a total of 57, 347 acres. The publication by Lowry, Rucker, and Wahl (1973) describes the surface water hydrologic conditions in a succinct fashion. Excerpts from that report follow:

> "*Streamflow varies with respect to both time and geographic location. The time variation at a particular site is caused by changes in precipitation, vegetation, temperature, and consumptive use by man.*"

> "*Although relative magnitudes will differ, seasonal runoff pattern at this site is generally indicative of streams in the area. The aerial variations in streamflow are influenced primarily by the physical and climatic characteristics of the drainage basins.*"

The effect of snowmelt from basin level and higher elevation area contributions to the stream flow regime can easily be seen by looking at hydrographs for stream flow in the Saratoga Valley. Three distinct periods of flow can be recognized:

1. an April-May response to low elevation snowmelt,

2. a May-June large response due to high-elevation mountain snow-pack melt, and

3. June-July responses due to summer thunderstorm precipitation.

In some areas the summer discharge due to precipitation is dampened by reservoir storage releases. In the case of Lake Creek, there are no large reservoirs that store and release water for irrigation.

SPRING HYDROLOGY

Spring hydrology in the Study Area is discussed separately due to the scarcity of evidence related to surface water or ground water influences. The hydrogeologic characteristics of Saratoga Valley's natural springs are complex. In 1952, Visher implicated faulting as the control mechanism for springs issuing from the North Park Formation of the Saratoga Valley. Additional evidence for fault control is given by Montagne (1991) and Cooley (1983). Cooley (1983) prepared a map of prominent lineaments based on the use of Landsat imagery which shows a lineament that passes through the Study Area. Montagne (1991) describes a brittle fracture system caused by the down warp of the Saratoga Valley now covered by tertiary deposits. The tertiary deposit, formally the North Park Formation, displays incompetence and does not allow the expression of faults to be seen at the surface. The fact that the fracture system is postulated but not proven makes it a difficult issue. Montagne (1991) states that other features can provide evidence of associated structures that are not expressed at the surface including vegetation, breccia fragments, silicified zones, spring lines, and presence of gouge.

A conceptualized spring hydrology frame work is based on geologic interpretations by Weston (2007) and Hinckley (2007). This fame work postulates that local highly permeable sands, gravels, and conglomerates created by Platte River channel facies occur north and east of the NFH in the area of the TOTCO irrigation wells. Moving westward, these channel facies tend to pinch out and result in predominant geologic conditions of overbank and lower permeability flank facies. The ground water flow from highly permeable zones on the east or northeast to zones of lower permeability westward creates a boundary condition that results in discharge to the spring system present at the surface throughout the area, namely at the spring-fed Lake Creek Lake and a series of springs that fall on a northwest-southeast trend line.

GROUND WATER HYDROLOGY

Ground water hydrology of the Saratoga Valley includes water bearing units of several different geologic formations, including formations ranging in age from Cambrian to Quaternary. Hinckley Consulting (2003), in a technical proposal for engineering and exploration services to the Wyoming Water Development Commission, considered the Tertiary-age North Park Formation to be the best target for exploration based on water quality and accessibility. Most of the basin relies upon Tertiary or Quaternary age deposits for reliable water supplies (Visher 1952, Lenfest 1986, and Richter 1981). Only the uppermost portion of the Tertiary Aquifer, the North Park Formation, is relevant to this investigation.

The North Park Formation is composed of discontinuous, lenticular, interbedded siltstone, shale, fine to course grained sandstone, fine to course grained basal conglomerate, yellowish-grey tuff, and volcanic ash (Visher 1952, Montagne 1955, Stephens and Bergin 1958, Richter 1981, Lenfest 1986, and Montagne 1991). In parts of the Saratoga Valley, the Tertiary aquifer is under unconfined conditions. In the central part of the Saratoga Valley, including the Study Area, the North Park Formation is structurally depressed and laterally continuous and exhibits semi-confined conditions (Weston Engineering, Inc. 2007).

Aquifer recharge is a result of precipitation infiltration and leakage from surface water sources. Ground water flow in the Study Area is controlled by the Overland Divide, the Saratoga Divide, and a fracture system believed to be linked to faults or fractures in lower rock units (Richter 1981, Cooley 1983, and Montagne 1991). A generalized depiction of ground water flow for the cretaceous rocks is presented by Richter (1981) and Hinckley Consulting (2007) and

shows water to be flowing toward the North Platter River in a northwesterly direction on the west side of the river and a southwesterly to westerly direction on the east side of the river and south of the Saratoga Divide.

Transmissivity values for the North Park Formation in the general area of this investigation have a highly variable range. Lowry et. al. (1973) reported transmissivity values of 4,000 to 5,000 ft^2/day (29,720 to 37,400 gpd/ft), Richter (1981) reported a range of 9,000 to 14,000 ft^2/day (67,320 to 104,720 gpd/ft), and Hinckley Consulting (2007a, 2007b) reported a range of 56 to 15,775 ft^2/day (420 to 118,000 gpd/ft) in their draft report for the Saratoga Test Well Level II study, funded by the Wyoming Water Development Commission.

GROUND WATER DATA FROM WYOMING WATER DEVELOPMENT COMMISSION'S GROUND WATER EXPLORATION PROGRAM FOR THE TOWN OF SARATOGA

Two ground water projects have been completed under Wyoming Water Development Commission funding in the Saratoga Valley. The purpose of these projects is to find a reliable long-term water supply for the Town of Saratoga, but they also provide valuable information on water resources and area geology. Several items are of particular interest to this interference study, including geologic information, aquifer characterization, and barometric effects.

The various projects and reports prepared for ground water exploration in the Saratoga Valley have increased the amount of data available for addressing area ground water resources. These reports have been previously cited in this document and some information will not be covered again; however, there are items that have not been referenced which may have bearing on this investigation. The first item is barometric response of the North Park Formation, and the second is aquifer parameter calculation from test pumping under the exploration program.

Hinckley (2007b) found that barometric response was readily evident in both production wells and monitor wells tested from 2003 to 2006. Results of plotting water depth versus barometric pressure for the Saratoga 2003 Monitor Well indicate that water levels fluctuate approximately 0.15 feet for a corresponding change in barometric pressure of 0.32 inches of mercury (in-hg). The correlation of barometric pressure to water depth below land surface for the Saratoga 2005 Well No. 2 shows a direct correlation of water level with barometric pressure for an approximate seven day recovery test after pumping.

Aquifer exploration and testing reported by Hinckley (2007b) provides calculated values for transmissivity for pumped and non pumped wells. Hinckley's results show a range in transmissivity of 420 gpd/ft to 125,000 gpd/ft; most values fall between 20,000 to 125,000 gpd/ft. This wide range of transmissivity values follow previous results reported by Lowry et. al. (1973) and Richter (1981).

WATER RIGHTS

PRIORITY OF RIGHTS FOR INVESTIGATION

The Saratoga Valley has a long history of development and is one of the earlier areas to be settled and have water rights appropriated and recorded. Records of appropriation on many of the drainages in the valley have priority dates that begin in the Wyoming Territorial time frame of 1869 until 1890, prior to Wyoming being admitted to the Union as the 44th state on March 27, 1890. With a long history of water appropriation, it is inevitable that changes will occur and that keeping the water right documents in step with the actual use of the water is paramount. The changing nature of water rights is present in this investigation and this section aims to set the framework for the current status of both surface and ground water appropriations related to the Study Area and this investigation.

SARATOGA NATIONAL FISH HATCHERY WATER RIGHTS

The interference complaint letter in Appendix C lists surface water rights under Territorial Proof No. 108 and Permit No. 6128E. Proof No. 108 has a priority date of June 1878 for 1.50 cubic feet per second (cfs) and Permit No. 6128E has a priority date of April 28, 1965, for 1.06 cfs. Appendix F contains copies of these water rights.

Surface water rights that supply the NFH have undergone many changes and clarifications subsequent to the original surface water filing covered under Territorial Proof No. 108 having priority date of June 1878 and originally appropriated by Fred Geddis for irrigation of 100 acres having a total flow rate of 1.5 cfs. This water right was changed from irrigation to fish culture purposes and given a preferred use by a Board of Control order. Table 1 lists pertinent history leading up to the current water appropriation status for the NFH appropriation under Territorial Proof No. 108. Information in Table 1 was compiled from Wyoming State Board of Control records and USFWS correspondence.

Permit No. 6128E has a priority of April 28, 1965, and is an enlargement of Lake Creek Lake Overflow. The enlargement is for 1.06 cfs. Both Territorial Proof No. 108 and Permit No. 6128E are delivered via pipeline from Lake Creek Lake to the NFH. Figure 2 shows the location of Lake Creek Lake.

A proof was taken on Permit No. 6128E under Proof No. 28839; however, during the field inspection, no flow-rate observations were made. As reported by Edward Stege on August 8, 1998 (Appendix A), the NFH's conveyance structure was constructed under the assumption that "…the spring water had the potential to fluctuate between 800 and 1200 gallons per minute (gpm)…" This letter further goes on to explain that peak flows from Lake Creek Lake usually occur in late fall and winter and extend into the early spring, with the hatchery usually bypassing approximately 100 gpm during peak flow. This letter seems to indicate that peak flow from Lake Creek Lake is generally about 1300 gpm (or 2.90 cfs). This trend is further substantiated by documents submitted to the Board of Control in regard to relocating one of the NFH's ground water wells. Appendix G contains documents submitted to the Board of Control for Petitions I-U-2003-1-9 and I-U-2003-10. These documents include Annual Water Use Reports and a few monthly Record of Water Use forms. Some of these documents include comments regarding the actual water use and flow variation from Lake Creek Lake.

The NFH also appropriates ground water for both domestic use and fish culture purposes. Table 2 shows ground- and surface-water appropriations for the NFH.

THE OVERLAND TRAIL CATTLE COMPANY GROUND WATER RIGHTS

TOTCO is an active agricultural production operation. This operation includes cattle production and irrigated forage production. Irrigated forage production utilizes both surface and ground water sources. Surface water rights are direct flow rights from Lake Creek. The surface water rights from Lake Creek are not under the purview of this investigation. Regulation and administration of surface water rights are handled with direct application of prior appropriations. The ground water rights associated with the irrigated agriculture component of TOTCO operations have been identified as the alleged cause of interference experienced by the NFH water right under Territorial Proof No. 108 and Permit No. 6128E. TOTCO water rights associated with this interference investigation are also shown in Table 2. Copies of these permits and associated documents are contained in Appendix F. Ground water well locations are shown on Figure 2.

Of particular note is the TOTCO Tuttle No. 5 well (Permit No. U.W.44639). This borehole was originally drilled in the NW¼SW¼ of Section 17, Township 18 North, and Range 83 West, as the Tuttle No. 8 well (Permit No. U.W.106506). By Board of Control Petition I-U-2002-1-3, TOTCO was allowed to change the location of the Tuttle No. 5 well from SE¼SE¼ to the NW¼SW¼ of Section 17, Township 18 North, Range 83 West (essentially trading the priority, name, and permit number of the Tuttle No. 8 and No. 5 wells). Subsequently, the Tuttle No. 8 permit (U.W.106506) was cancelled. Although this petition was approved part of the way through the study period, according to SEO records, the well located in SE¼SE¼ did not have a pump in place during the study period, and the well located in NW¼SW¼ was the production location. To avoid confusion regarding these two boreholes, this well will herein after be referred to as the Tuttle No. 5 well with Permit No. U.W.44639. No further reference to cancelled well Tuttle No. 8 (Permit No. U.W.106506) will be made.

OTHER WATER RIGHTS RELEVANT TO THE INVESTIGATION

There are additional ground water rights for irrigation or miscellaneous use in the area that were not being used at the time of the investigation. Two (2) permitted idle irrigation wells were used as monitor wells, Ravenscroft #2 (Permit No. U.W. 701) and Dot #2 (Permit No. U.W. 69086). These wells were not being used for irrigation purposes at the time of this study; they have since been reactivated and will be addressed in a separate investigation. A third un-permitted well, TOTCO Middle Pivot Well (MPW), was incorporated into the monitoring activities. The TOTCO MPW has an unclear history and little is known of its drilling and construction. There is no current permitted use of this well nor has any use been documented. A fourth well located at the NFH, Saratoga Well No. 5 (Permit No. U.W. 84588), was utilized for monitoring from June 4, 1999 thru August 15, 2000, after which the well was brought online as a production well providing water for fish culture use at the hatchery. Copies of these permits and associated documents are contained in Appendix F. Well locations are shown on Figure 2.

RELEVANT HYDROGEOLOGIC SETTING OF WATER RIGHTS

The TOTCO and NFH ground water wells and the two monitoring wells are completed in the North Park Formation. The springs in Lake Creek Lake also discharge from the North Park Formation (Richter 1981).

DISCUSSION REGARDING SENIOR WATER RIGHTS

Inspection of Table 2 will show that the water rights in question have varying priority dates. The NFH claims interference to both Territorial Proof No.108 as well as Permit No. 6128E. Table 2 shows six water rights in the study area that are senior in priority to Permit No. 6128E. Consequently, the NFH's Territorial Proof No. 108 is considered senior in standing to TOTCO's Eaton No. 2 well; however, the Eaton No. 2 well is senior to Permit No. 6128E. Because one of the TOTCO ground water rights in question is senior in priority to Permit No. 6128E, the bulk of the following sections will concentrate on the most senior water right, Territorial Proof No. 108.

DATA, DATA ANALYSIS, AND OBSERVATIONS

Many types and sources of data have been assimilated to address the question of potential interference for this report. This section presents the available climate data, Lake Creek Lake overflow data, monitor well data, ground water well pumping data, and water quality data.

CLIMATE DATA

As discussed earlier, the Saratoga Valley can have differing weather patterns and climatic conditions than that of other areas of south-central or south-east Wyoming. The highly variable weather patterns and lack or absence of recorded climate data havehas limited the amount of analysis that can be performed. Of particular interest to the study areis the lack of barometric pressure data. Barometric pressure can have measurable effects on ground water levels in aquifer systems; these effects can be seen in confined, semi-confined, and unconfined aquifers (Freeze and Cherry 1979, and Rasmussen and Crawford 1997). Sunny and clear weather is generally associated with more frequent and larger scale high pressure systems and, as a result, higher than average barometric pressure is associated with droughts (Roth, Crow and Mahoney 1977).

Barometric efficiency of a well can give an indication of confined versus unconfined nature of the aquifer (Freeze and Cherry 1979). The use of barometric efficiency or correction to water levels and then comparing the corrected ground water levels to water levels from producing wells, spring stage (elevation of water surface at spring pool), or spring discharge could yield important information related to interconnection or source of water. Unfortunately there is little or no historic barometric pressure data for the Study Area or the larger Saratoga valley. This will be discussed in later sections.

LAKE CREEK LAKE OVERFLOW HYDROGRAPHS

Preparation for this investigation required recording the stage and calculation of the outflow from Lake Creek Lake Outlet that serves the appropriations under Territorial Proof No. 108 and Permit No. 6128E. Data collected from July 1999 through November 2001 were obtained by SEO personnel utilizing a datalogger with water level recording instrumentation installed in the lake outlet; data between September 29, 2001 and January 29, 2007 were collected visually by NFH personnel from staff gage readings. These data are compiled in Appendix E. Results from these readings were compiled into flow rates and are presented on Figure 3. Figure 3 shows lines depicting both the 1.5 cfs appropriation granted under Territorial Proof No. 108 as well as the 1.06 cfs enlargement granted under Permit No. 6128E. The hydrograph for Lake Creek Lake overflow was analyzed to see if, and how often the discharge of the spring was below the appropriation amount. Figure 3 indicates that there are times when the senior appropriation under Territorial Proof No. 108 cannot be satisfied (1.5 cfs is equal to 673.2 gpm). A simple analysis for ranking the percent of time flow is below the 1.5 cfs appropriation was performed on data collected. Analysis shows that approximately 22 percent of the time, flow does not meet the appropriation provided under Territorial Proof No. 108. Analysis further shows that approximately 46 percent of the time, flow does not meet the appropriation provided under Permit No. 6128E. Data contained on Figure 3 were obtained from the USFWS and were used by Weston Engineering Inc. in preparation of their technical report; for more information, see the Weston Engineering, Inc (2007) citation.

As previously mentioned, there are little historical monitoring data available for Lake Creek Lake. From correspondence mentioned previously, the NFH reports the flow of Lake Creek Lake outlet to be approximately 1,300 gpm. Actual use reports which are contained within Appendix G are shown in Table 3 and on Figure 4. Table 3 and Figure 4 also show results from Lake Creek Lake outlet observed during the study period.

The analysis for percent of time the senior appropriation was not met (22 percent) shows that there is a need for investigating the source for fluctuations in flow from the Lake Creek Lake Outlet. Further investigation into production records and production times will be evaluated for potential interrelatedness.

MONITOR WELL DATA

Under this project, the SEO negotiated access and equipped four unused wells with continuous water level recording devices and began a water level monitoring program. Data were collected between September 1999 and October 2002. The location of the spring, monitor wells, and irrigation wells are shown on Figure 2. All water levels are referenced to land surface datum. Three of the four wells were used for the duration of the investigation; the Saratoga Well No. 5 well was brought into production prior to the completion of data collection. Data collected from the four monitor wells are presented in Appendix E. Water Level data from these sites will be used with reported well production and Lake Creek Lake Overflow discharge to assess potential impacts.

IRRIGATION- AND HATCHERY-WELL PRODUCTION

The previous sections lead to an analysis of factors that may result in or cause the seasonal trend indicated in the combined hydrographs for the monitor well water levels and gage height from Lake Creek Lake Outlet. This analysis will focus on comparison of hydrographs versus production from TOTCO and NFH wells.

Production monitoring and reporting for TOTCO irrigation wells was ordered by the State Engineer's Office under the terms of this investigation and data were recorded and reported for the 2000, 2001, and 2002 irrigation seasons. These data are available in Appendix E. Production and pumping reports from June 1999 through January 2007 for the NFH wells were requested and obtained from the USFWS for use in this investigation, and are available in Appendix E.

Figure 5 shows average instantaneous well field production rates for TOTCO and NFH versus discharge rate for Lake Creek Lake Outlet. Rates are shown in both gpm and cfs. Figure 5 is similar to Figure 13 in Weston Engineering's (2007) report; however, errors were found in their data for NFH well field production as well as TOTCO well field production. These data were corrected in preparation of Figure 5 for this report. The figure is not intended to reflect a one-for-one pumping rate to spring decline; it compares trends in well production rates and Lake Creek Lake Outlet. For 2000, 2001, and 2002, production data are available for TOTCO, NFH wells, and Lake Creek Lake Outlet. Those three years indicate that from early spring to fall, Lake Creek Lake flow decreases and average well yield increases. This seasonal trend coincides with increased irrigation, higher evapotranspiration rates, and lower precipitation and runoff. The graph shows that both well fields increase their water use during this time period. Figure 5 also shows that NFH well pumping represents essentially a constant 1,000 gpm draw on the aquifer in the Study Area.

Usefulness of the production records is limited due to the frequency of data collection. Figure 5 shows nodes which correspond to actual data recording events. Close inspection of the nodes and the lines which connect them gives some degree to the data density for each corresponding data set. For example, the SEO does not have data available pertaining to NFH ground water well production rates from September 29, 2000 through November 4, 2001. It is also important to mention that although Figure 5 shows periods of diminished flow, the water in Lake Creek Lake was never exhausted.

Although the letter in Appendix D specifically requested that TOTCO keep a detailed log of the pumping schedules including dates, times and durations of pumping, TOTCO either did not record these data or did not make these data available to the SEO. TOTCO production data are obtained from totalizer readings on the well discharge lines. These totalizers were typically recorded on a weekly frequency; however, sometimes three (3) weeks elapsed between readings. Because the SEO only received totalizer readings, the determination of flow rate is an average between two adjacent recording events. For this reason, figures following Figure 5, which show TOTCO well production, depict production as an average flow rate over a given recording period. This gives the graph a somewhat blocky appearance; however, it is a reasonable representation of the available data.

The data do allow some level of comparison for well field production versus flow from Lake Creek Lake Outlet. Figure 6 shows Lake Creek Lake Outlet discharge rate and average production for TOTCO irrigation wells from 2000 through 2002. Figure 6 is a result of the same dataset as Figure 5; however, omitting the 2003 through 2006 data yields a finer scale. Figure 6 shows correlation between the pumping of TOTCO irrigation wells and a decline in production from the Lake Creek Lake outlet.

As shown on Figure 6, a drop in Lake Creek Lake flow is shown after May 5, 2000. This corresponds to a TOTCO average pumping rate of 2,133 gpm between May 3 and 12. After May 12, the average TOTCO pumping rate dropped to 81 gpm, and correspondingly, on May 13, Lake Creek Lake flow increased. Examination of this early portion of the 2000 irrigation season shows a nearly unmistakable correlation between pumping the TOTCO irrigation wells and decline of Lake Creek Lake flow; however, other areas in Figure 6 do not show the same correlation. Between September 4 and 11, 2001, the average pumping rate from TOTCO irrigation wells drops from 3,740 to 1,973 gpm. This same time period is marked by a decline in flow from Lake Creek Lake. Also worth noting is that Lake Creek Lake experienced a general increase in flow rate between August 26 and September 6, 2001, which is prior to the decline in TOTCO production. Figure 6 also shows that Lake Creek Lake flow increased steadily after September 30, 2001; however, the production from TOTCO irrigation wells did not substantially decline until after October 2, 2001.

Close inspection of Figures 5 and 6 shows a gap in Lake Creek Lake overflow data between August 29 and September 28, 2002. During this time period, the NFH personnel lowered the elevation of the weir structure in order to increase the water delivered to the NFH. Data collected during this time period are crucial to understanding what effect the head created by the water column in Lake Creek Lake may have on spring flow within the lake. Figure 7 shows the gauging results measured from Lake Creek Lake overflow during the weir board drop. The period between August 29 and September 3, 2002 appears jagged due to daily dropping of the weir structure elevation. In general, the water level was recorded before and after removing a weir board, therefore, during this timeframe two levels are recorded daily. The period between

September 23, and 28, 2002, are similarly jagged due to hatchery personnel re-inserting weir boards and recording height above the weir board both before and after inserting the new board. The diversion structure's weir board elevation was not changed between September 3 and 23, 2002. Specific details relating to the operation of the weir structure were not provided to the SEO; however, Figure 7 also illustrates Lake Creek Lake flow under the assumption that all sections of the diversion structure were set at the same elevation. If any areas of the diversion structure were not at the same elevation as the others, this calculated flow rate will not be accurate.

Monitor well data for Ravenscroft No.2, Dot No.2, Saratoga Well No.5, and TOTCO well field production are plotted on Figure 8. This figure shows that the production from the well field can be observed in other area wells completed in the North Park Formation. Figure 9 shows the correlation of TOTCO well field pumping to the water level in the Anschutz Middle Pivot well (MPW). The MPW is in close proximity to the TOTCO irrigation wells. Both figures are adopted from Weston (2007) and show a response of water level to pumping from water bearing zones in the North Park Formation. These figures also show a 2- to 5-foot decline in water levels during the three irrigation seasons shown. Figure 9 shows a sharp downward trend at the beginning of the water level data for the MPW monitor well; these data are related to a simple slug test that was performed to assess the well's communication with the water bearing formation into which it is completed. Calculation of aquifer parameter data was not performed on this simple slug test due to lack of detailed time intervals necessary to perform the calcuations.

In order to better illustrate the relationship between TOTCO production rates and Lake Creek Lake overflow production, plots were generated to compare production from each individual TOTCO irrigation well and the Lake Creek Lake overflow. Figures 10, 11, 12, 13, 14, 15, and 16 show the plots of Lake Creek Lake overflow versus production from TOTCO irrigation wells Tuttle No.2, Tuttle No.1E, Eaton No.2, Tuttle No.7, Tuttle No.5, Tuttle No.6, and Tuttle No.3, respectively.

Figure 17 shows overflow of Lake Creek Lake plotted against the cumulative total of TOTCO irrigation well pumping (differentiated by well). This chart shows the average pumping rate between totalizer readings, shown as individual wells which add to the total. This chart helps illustrate which wells appear to provide the most impact to the flow rate from Lake Creek Lake. For example, between May 3 and 12, 2000, pumping occurred in Tuttle No.6, Tuttle No.5, and Eaton No.2. From May 4 to May 13, 2000, flow from Lake Creek Lake decreased from 2.81 cfs to 1.96 cfs. These three wells were pumped very little between May 12 and 26, 2000. After May 13, 2000, flow from Lake Creek Lake increased.

WATER QUALITY COMPARISON

The SEO collected water samples from several sources to analyze for major chemical constituents on July 21, 2000. Samples were analyzed on August 17, 2000, by Wyoming Department of Agriculture Analytical Services using the rural health series analyte list. The analysis included concentrations of calcium (Ca), magnesium (Mg), potassium (P), sodium (Na), carbonate (CO_3), bicarbonate (HCO_3), chloride (Cl), fluoride (F), Nitrate (NO_3), Nitrite (NO_2), Sulfate (SO_4), total dissolved solids (TDS), total alkalinity (as $CaCO_3$), hardness (as $CaCO_3$), ph, conductivity, and sodium absorption ratio (SAR). This is not a comprehensive list of analytes that could have been tested, but rather a suite of analytes were run to show potential interconnectedness between the spring and area wells.

Figure 18 shows a modified Schoeller/Spider plot of water chemistry normalized to Lake Creek Lake Outlet. The modified diagram uses a normalization of sample data relative to the data for Lake Creek Lake Outlet. The normalized plot of analytical data is not a strict indicator of well connectedness to the spring; however, it is useful in the overall methodology of determining the level of connection within the regional ground water flow regime. Comparison of Figure 18 to Figure 2 indicates that ground water changes from east to west and follows the previously discussed trend of decreasing water quality from shallower to deeper into the Saratoga Valley. Examination of Figure 18 indicates that Tuttle #6 (farthest east of wells that had samples taken) and Eaton #2 (next well to the west) have very similar analytical concentrations as the Lake Creek Lake spring pool.

Combining the observations illustrated in Figures 12, 16, 14, 15, 17, and 18, a strong correlation is shown between pumping Eaton No. 2, Tuttle No. 3, Tuttle No. 5, and Tuttle No. 6 and the flow of Lake Creek Lake. Figure 19 shows these four wells plotted against flow from Lake Creek Lake.

WATER PRODUCTION EFFECTS ON HYDROLOGIC SYSTEM

The investigation and this report would be remiss if production trends of water sources for both appropriators were not discussed in further detail. It is difficult to perform an intensive review of production and use for each of the appropriations due to the small dataset collected during the investigation and lack of historic production reports as mentioned in previous sections. Due to lack of formal production reporting, the history of development and use of water resources by each appropriator must be examined.

When looking at the previous sections of this report, the history of appropriation, the history of development of the agricultural operation at TOTCO, and the construction activities at the NFH, it becomes apparent that the use of water at both operations has changed from the original intent of the water rights in question. Agricultural operation and method of application have changed dramatically over time and the method of application of water can have notable effects on return flow and recharge to the ground water resource. Cuenca (1989) has many chapters that deal with increasing the efficiency of application and use of water; most of the sections deal with the aspect of using the water to the fullest extent by minimizing losses to the hydrologic system. If one looks at the application of irrigation water from a historic perspective, i.e. flood type application, there are much larger losses to the subsurface (potential for recharge) than under a system with greater application efficiency (i.e. a center pivot or side roll sprinkler system).

Table 4 presents the volumes of irrigation water produced by TOTCO. This table shows the quantity of water applied to both center-pivot-irritated and flood-irrigated acreages. Table 4 shows that 93 inches of water were applied to the flood-irrigated acres during 2001. The table only shows that volume of water applied through ground water pumping; many of the flood-irrigated lands are also irrigated using surface-water rights. This means that likely more than 93 inches of water were applied to the flood-irrigated lands during 2001.

Also of note are the changes to appropriations that serve the NFH. Some of the water that is now associated with appropriations to the hatchery would historically have been used as irrigation supply to lands upgradient of the hatchery and would have been applied using flood irrigation as a means of application, potentially resulting in losses to the subsurface. Not only has the potential for losses from lower application efficiency type of irrigation been reduced or eliminated, loss (potential recharge) through ditch bed infiltration has been eliminated by changing the means of

conveyance to a pipeline. The system at the hatchery has also been upgraded to include a larger number of raceways and a different means of conveyance of water away from the hatchery after it has been used for fisheries use.

All of the above should be considered when discussing the hydrologic system that is being examined. Specific results of changes to the hydrologic system by increased system efficiency of both agricultural and hatchery water use would be very difficult to address in a fashion other than the conceptual basis just presented.

SUMMARY AND CONCLUSIONS

Available data demonstrate a correlation between pumping the TOTCO and NFH well fields to the Lake Creek Lake discharge rate. Without accurate weather data, daily wellfield pump readings, and dedicated monitoring wells, it is not possible to quantitatively assess the impacts of either wellfield on the Lake Creek Lake spring discharge. Since no historic flow regime exists for Lake Creek Lake, and given the reported dynamics of Lake Creek Lake flow, it is difficult to determine if the currently observed flow regime varies with respect to season (and has for the recorded history of Lake Creek Lake) or if the flow reduction is completely due to wellfield pumping. Perhaps the most convincing argument for the impact is the observation that Lake Creek Lake's discharge increases following a discontinuation of irrigation well pumping, and appears to approach steady-state conditions around the first of January each year. This seems counterintuitive to the idea that the aquifer system is largely influenced by precipitation recharge. This approach, however, does not rule out the effects of barometric pressure on Lake Creek Lake. The potential effects of barometric pressure on the springs which feed Lake Creek Lake are unknown; Saratoga Valley-specific research performed by Hinckley Consulting indicates that effects on the North Park aquifer may be quite large. The TOTCO and NFH wells are completed in the North Park Formation. The springs in Lake Creek Lake produce water from the North Park Formation. No direct correlation can be made regarding the impacts of the NFH wells, as they rarely cease pumping. Due to the proximity of the NFH wells and Lake Creek Lake and the similarity in geology, the pumping of the NFH wells likely negatively impacts the discharge rate of Lake Creek Lake. Due to the fact that the NFH wells were rarely idle during the investigation, their exact impact on Lake Creek Lake flows could not be ascertained. Furthermore, there is no documented history of Lake Creek Lake flow prior to the existence of the NFH wells.

From July 23, 1999, through January 28, 2007, the average flow rate for Lake Creek Lake overflow was 2.63 cfs. This flow rate is 75 percent more than the allocation of 1.5 cfs provided by Territorial Proof No. 108. Furthermore, this average flow rate is more than the combined appropriations (2.56 cfs) mentioned in the interference complaint letter (Appendix D).

Overall water use at NFH has increased significantly since expansion of the hatchery in the 1960's. It is believed that the NFH could not operate in its present form by relying solely on the water available through Territorial Proof No. 108.

While the NFH claims that they are unable to obtain their permitted amount of water, at no point during the investigation was water unavailable in Lake Creek Lake. In fact, at only one point during the investigation was the elevation of their weir structure lowered. As shown on Figure 7, the overflow of Lake Creek Lake responded by increasing flow as the weir structure was lowered. Furthermore, this increase in flow rate was accompanied by very high production rates from TOTCO irrigation wells. These data seem to indicate that, during peak irrigation demand, the NFH may need to lower the elevation of their weir structure. In general, the SEO does not guarantee a particular static water level and it is an appropriator's responsibility to use water if it is available at the appropriator's point of diversion. This particular concept is applicable due to the fact that the FWS does not possess storage rights on Lake Creek Lake.

TOTCO applies a total amount of water to some of its lands which is far in excess of published crop irrigation requirements for the crops.

Lake Creek Lake (and spring) flow is likely controlled by a number of factors at this site including infiltration of precipitation, infiltration from losing streams, discharge from local well withdrawal, losses to gaining streams, barometric pressure, and head pressure. The only way to determine the magnitude of potential impact from the TOTCO wells to Lake Creek Lake would be to conduct experiments which isolate the features of interest. This is particularly problematic, because isolating TOTCO as well as NFH pumping would have detrimental impacts to both operations.

RECOMMENDATIONS

Given the limited dataset available, it is not possible to say with certainty that the source of interference is solely due to pumping from the TOTCO well field. There is, however, a strong correlation, particularly to a small subset of TOTCO's wells. Given this, the SEO did note that there may be a variety of methods for ameliorating the effects of interference. The following recommendations are presented as potential amelioratory methods, and are presented in no particular order:

1. Take no action. The average flow rate for Lake Creek Lake over the study period was 2.63 cfs. This rate is higher than the territorial appropriation of 1.5 cfs. This average flow rate is also higher than the combined appropriations (2.56 cfs) mentioned in the interference complaint letter (Appendix D). Also, the SEO notes that during the time the NFH claims a shortage of water, there was still water available at the NFH diversion structure. The SEO, as a matter of course, does not guarantee a particular water level available at any appropriator's diversion structure. Instead it is the appropriator's duty to utilize water available at the point of diversion, which may involve the appropriator altering their method of obtaining the water. If the NFH chooses not to change the elevation of their weir structure, utilize a pump to remove water from Lake Creek Lake, or some other method to capture available water, the SEO does not recognize that a shortage actually exists. From a theoretical perspective, lowering the head of Lake Creek Lake would lower the head effect on the spring and therefore increase the spring flow rate. Figure 7 shows that when such an experiment was conducted, Lake Creek Lake flow rate did increase. Based on correspondence between the SEO and NFH personnel, the SEO understands that the NFH maintains a volume of water in Lake Creek Lake as an emergency supply of water in the event that the hatchery loses power to their ground water wells. Neither a storage nor reservoir right has ever been granted for Lake Creek Lake or its overflow.

2. Redistribute water. A TOTCO well or other well could be used to deliver the water deficit that Lake Creek Lake may be experiencing during the summer irrigation season. As part of this potential solution, the NFH could divert water from their hatchery effluent back to the TOTCO irrigation sites. A significant amount of work to design and build the infrastructure may be required; however, the NFS could receive steady flow from the TOTCO well and in return TOTCO could receive nutrient-enhanced (and warmer) water for irrigation use. The SEO notes that during a meeting between the SEO, TOTCO, and the NFH on August 7, 2000, TOTCO suggested running a pipeline from one of the irrigation wells to Lake Creek Lake in order to deliver the perceived water deficit. This offer was refused by NFH representatives; however, this suggestion could still be part of the solution.

3. Redesign conveyance structure. If the NFH requires and desires to utilize a steady flow rate from Lake Creek Lake, perhaps it is necessary to redesign the conveyance structure or design some storage mechanism.

4. Petition the Board of Control for a change in Point of Diversion. The NFH could petition the BOC to change the point of diversion of Territorial Proof No. 108 into a

well borehole. There is no guarantee that such a petition would be granted by the Board of Control.

5. Reduce irrigation application amounts by TOTCO. As shown in Table 4, the flood-irrigated acres receive up to 93 inches of ground water applied during the irrigation season, which is far in excess of the amount generally recognized as necessary to grow any type of crop in this immediate area. These inches are in addition to the surface water applied. Appropriate application amounts could be determined based on work by Pochop et. al. (1992).

6. Rotate ground water withdrawals. A rotation agreement could be devised wherein junior TOTCO wells and those wells that show the greatest impacts are rotated instead of operated simultaneously. This agreement could be approached by utilizing the information available on Table 2 in conjunction with Figures 17 and 19. A similar approach could be used to rotate the operation of NFH wells. As shown on Figure 5, peak seasonal flows during 2001 and 2005 were much higher than the permitted flow rates from Lake Creek Lake. Reducing the NFH well field pumping during these times will likely benefit all parties.

7. Strict priority regulation. This process could shut off all or a portion of all junior rights in an attempt to satisfy the senior right of 1.5 cfs from Lake Creek Lake. This call for regulation could turn off all or a portion of TOTCO and NFH wells (with the possible exception of domestic use on Saratoga Well No.3). NFH production wells would not be exempt from priority regulation. Since the exact relationship between pumping of individual wells and reductions in flow of Lake Creek Lake outlet could not be determined, any regulation effort that falls short of complete regulation of all junior rights would likely have to occur in a "trial and error" fashion, which is still likely to be significantly disruptive to both operations.

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CHRONOLOGY OF EVENTS

- 8/8/1998 – Letter from Ed Stege, Saratoga National Fish Hatchery, to SEO requesting a preliminary investigation of the hatchery's water right; water from the spring has been decreasing.
- 8/11/1998 – Meeting w/ USFWS in Denver. Attending: Dick Stockdale, SEO; John Lawson, Chair; Blain – Boyle; Bill Hahn, GW Specialist.
- 10/14/1998 – Phone call from Dick Stockdale to Jack Gibson regarding res box in filter station; 3-4 day delay when Anschutz pumps; Stege at Hatchery would not lower static pressure by pulling boards; Hatchery water rights; Hatchery does not want to give Anschutz info.
- 1/19/1999 – Meeting in Cheyenne. Attending were: Ray Murphy, Kevin Boyce, Randy Tullis and Dick Stockdale. Discussed the situation.
- 3/5/1999 – Letter from SEO to Ed Stege, Saratoga Fish Hatchery regarding his request for a preliminary investigation of the fish hatchery's water rights; Very little data exist regarding the pumpage of the irrigation wells or the Lake Creek Lake flow therefore it was not possible to reach any conclusions of potential water right interference; Jeff Fassett recommended they file a written complaint; the installation of water measuring devices would be necessary if a complaint was filed.
- 3/24/1999 – Interoffice Memo from Jack Gibson to Dick Stockdale, regarding the 3/22/1999 meeting he attended with Cheryl Williss, USFWS; Patti Fiedler, USFWS and Ed Stege, Saratoga Fish Hatchery. Topics were: what kind of instrumentation would be required to proceed with the interference investigation; tour of general vicinity of the spring.
- 3/25/1999 – Search request for water rights around Saratoga Fish Hatchery received from Ken Bottle, USFWS.
- 3/29/1999 – Receipt date of Letter from Cheryl Williss, USFWS requesting an interference investigation of Territorial Proof No. 108 from irrigation wells owned by Overland Tail Ranch.
- 3/29/1999 – Memorandum from Dick Stockdale to Randy Tullis, transmittal of interference investigation letter and recommendation to start a comprehensive file.
- 4/6/1999 – Letter from SEO to Cheryl Williss, USFWS, regarding the transmittal of Receipt # 6146 for the $100 interference investigation fee and future visit of SEO personnel to the site.
- 4/16/1999 – Letter from Cheryl Williss, USFWS to Jack Gibson, SEO regarding meeting of 3/22/1999 and transmittal of a table summarizing the chronology of the Fish Hatchery's water rights.

- 5/10/1999 – Memorandum to the File by Kevin Boyce, SEO, regarding 5/4/1999 field visit to Saratoga.

- 5/24/1999 – Meeting in Saratoga. Attending were: Ed Stege, Saratoga Fish Hatchery; Patti Fiedler, USFWS; Kevin Boyce, SEO; Jack Gibson, SEO; Dick Stockdale, SEO. Topics discussed were: New Well; diversion structure; pipeline capacity; existing wells; Measurement of SWL hatchery well – 24.77'.

- 6/8/1999 – Letter from SEO to Overland Trail Land & Cattle Co. advising them that an interference complaint had been filed by the Fish Hatchery and to advise that meters need to be installed on each of the eight (8) irrigation wells

- 6/30/1999 – Meeting in Cheyenne. Attending were: Glen Alameda Overland Trail Ranch; 2 other representatives of Overland Trail Ranch; Jack Gibson, SEO; Ray Murphy, SEO; Kevin Boyce, SEO; Dick Stockdale, SEO. Topics were: General nature of Interference Investigation; metering of Overland Trails' irrigation wells; installation of rain gages; equipping out-of-service irrigation wells as monitor wells; water quality samples; length of time for collecting data not known.

- 7/2/1999 (FAX received 6/30/1999) – Original Letter from Wade Waldrip to SEO, stating that he represents Overland Trail & Cattle Co and that they will comply in all respects to the interference complaint. Also asks about impartiality of the State, who responsible for data collection and frequency.

- 8/27/1999 – Memorandum to the File by John Harju, SEO, regarding a reconnaissance trip on 8/26/1999.

- 9/7/1999 – Memorandum to the File by John Harju, SEO regarding the 8/31/1999 trip to Saratoga to install monitoring equipment on the inactive well on the Anschutz property; Flow rates on irrigation wells running that day were taken. (See memo in the Overland Trail Data File)

- 11/18/1999 – Letter from SEO to Glen Alameda, Overland Trail Land & Cattle requesting copies of irrigation well information collected during the 1999 irrigation season.

- 11/24/1999 – Letter from Wade Waldrip to SEO, advising State Engineer that meters had been installed on all irrigation wells in the Eaton Unit. They were not able to install the meters in time to collect manydata from the 1999 irrigation season. Sent SWL measurements for the eight (8) wells. (See Overland Trail Data File)

- 12/1/1999 – Letter from SEO to Wade Waldrip, thanking him for the transmittal of water level data and inquiring as to whether any data werecollected from the meters.

- 12/15/1999 – Letter from Cheryl Williss to SEO, transmittal of data.

- 1/12/2000 – Interoffice Memo from Jack Gibson to Dick Stockdale, transmittal of SWL and meter readings on Anschutz wells.

- 1/13/2000 – Meeting in Cheyenne. Attending were: Wade Waldrip, Attorney; Tom Thompson, Attorney; Glen Alameda, Anschutz; William Miller, Anschutz; John Parker, Anschutz; Frank Carr, Consultant; John Harju, SEO; Jack Gibson, SEO and Dick

Stockdale, SEO. Topics were: Time schedule for investigation; metering information; data collection.

- 1/13/2000 – Letter from Wade Waldrip to SEO sending flow meter readings for wells located on Eaton Ranch. Requested hydrographs of Armstrong Wells and the monitor well located near the fish hatchery. (See Overland Trail Data File)

- 5/12/2000 – Memorandum to the File by John Harju, SEO regarding a routine trip to Saratoga to retrieve data from recorders & measure SWL of Anschutz Wells. (See Overland Trail Data File)

- 6/12/2000 – Memorandum to the File by Larry Porter, SEO regarding the installation of water level recorders on two (2) wells.

- 6/14/2000 – E-Mail from Bern Hinckley to Dick Stockdale. Bern was requesting data on behalf of Overland Trail Ranch.

- 6/14/2000 – Note to File by Dick Stockdale. No information on the investigation is to be given out without his permission; written requests should be made.

- 6/15/2000 – Phone call from Ed Stege, Fish Hatchery to Dick Stockdale regarding staff gage readings and the hatchery was already experiencing problems. (See USFWS Data File)

- 6/20/2000 – Meeting in Saratoga. Attending were: Jack Gibson, Randy Tullis, John Harju and Dick Stockdale. Topics were: Record keeping; interconnectivity; Overland Trails' haying schedule.

- 6/29/2000 – Letter from Thomas Thompson to SEO, advising that he has replaced Wade Waldrip as representative for Overland Trail Land & Cattle Co., asking about status of interference complaint, requesting additional data provided by USFWS, if any.

- 6/29/2000 – Letter from Cheryl Williss, USFWS, to SEO sending a disk containing Lake Creek Lake spring pool data logger readings, outside staff gage readings & graph of the spring's provisional discharge. (See USFWS Data File)

- 7/25/2000 – Memorandum to the File by John Harju, SEO, regarding 7/25/2000 visit to perform routine data collection duties and to collect water samples.

- 7/31/2000 – Phone call from Ed Stege, Saratoga Fish Hatchery, to Dick Stockdale, hatchery has more fish, oxygen is low for remaining fish. Dick asked about bringing the un-used well on-line. Ed Stege said he would have to check with his bosses and that money may be an issue.

- 8/1/2000 – Phone call from Cheryl Willis and Patty Fiedler, USFWS, to Dick Stockdale in regards to getting more water for the fish hatchery. Dick suggested that SEO could facilitate a meeting between USFWS and Overland Trail Ranch. USFWS wanted Dick to call and see what Overland Trail has to say.

- 8/2/2000 – Phone call from Dick Stockdale to Kurt Kelly, attorney representing Overland Trail. Dick stated the purpose of the call was to see if Overland Trail Ranch would be willing to meet with USFWS to discuss ways to increase the flow of the fish hatchery

spring. Kurt Kelly was informed if USFWS called for regulation some of Overland Trails' wells would be shut-off and that the situation was urgent. Kurt Kelly is to check and get back with Dick.

- 8/7/2000 – Meeting in Cheyenne. Attending were: Jeremy Manley, SEO; Bill Miller, Anschutz Corp; Glen Alameda, Overland Trail Cattle Co; Ed Stege, Saratoga Fish Hatchery; Cheryl Williss, USFWS; Bern Hinckley, Consultant for Anschutz; John Parker, Anschutz; Carl Taylor, USFWS; Patti Fiedler, USFWS; Jack Gibson, SEO; Dick Stockdale, SEO. Topics were: Current status at hatchery; Anschutz offered to run a line from the 1E well to the hatchery (USFWS pay pumping costs); USFWS could still dredge the spring; Hatchery would like to develop the resources they have and not depend on the ranch for water; Bringing the #5 well on-line; Regulation.

- 8/21/2000 – Letter from Thomas Thompson to SEO, transmittal of data. (See Overland Trail Data File)

- 8/22/2000 – Phone from USFWS to Jeremy Manley, SEO regarding the #5 Well. Pump installed and plans were to bring it on line quickly.

- 8/24/2000 – Memorandum to the File by Jeremy Manley, SEO regarding a phone call about the status of the #5 Well. Brought on-line 8/23/2000.

- 8/25/2000 – Memorandum to the File by Jeremy Manley, SEO regarding his trip on 8/15/2000 to Saratoga to retrieve data from recorders and to hand measure the #5 Well. The Anschutz irrigation wells were also measured. (See memo in Overland Trail Data File)

- 8/28/2000 – Memorandum to the File by Jeremy Manley, SEO regarding the topics discussed at the 8/7/2000 meeting.

- 8/28/2000 - Memorandum to the File by Jeremy Manley, SEO regarding the 8/28/2000 phone conversation with Ed Stege, Saratoga Fish Hatchery on the status of the #5 Well. The well went on-line 8/23/2000 and due to power problems has been down since 8/27/2000. Flow meter had arrived but had not been installed.

- 10/19/2000 – Letter from Cheryl Williss, USFWS to SEO, sending a disk containing Lake Creek Lake spring pool data logger readings, outside staff gage readings from the Lake Creek Lake Spring pool, production values from USFWS well nos. 1, 2,4, & 5, electronic and hard copy of computation file & graph of the spring's provisional discharge. (See USFWS Data File)

- 12/8/2000 – Letter from Thomas Thompson to SEO requesting any data submitted by USFWS.

- 12/18/2000 – Letter from SEO to Thomas Thompson, transmittal of requested data.

- 12/21/2000 – Letter from SEO to Thomas Thompson, transmittal of one data item inadvertently omitted.

- 3/21/2001 – Letter from SEO to Cheryl Williss, USFWS, transmittal of data products.

- 4/20/2001 – Meeting in Cheyenne. Attending were: Pat Tyrrell, SEO; Frank Carr, Water Right Services; John Parker, Overland Trail Land & Cattle; Glen Alameda, Overland Trail Land & Cattle; Bill Miller, Anschutz Corp.; Jack Gibson, SEO; John Harju, SEO; Dick Stockdale, SEO; John Barnes, SEO; Allan Cunningham, Board of Control. Topics were: Reinstatement of Permit No. 2787Res; Interference Issue; Pipeline to Hatchery Partially Plugged; Data Collection to Continue.

- 9/5/2001 – Letter from Ralph Morgenweck, Regional Director, USFWS (signed by Elliot Sutta) to SEO asking when the findings of their complaint could be expected.

- 10/10/2001 – Letter from SEO to Elliot Sutta, USFWS, advising that SEO was still collecting data and the data would be analyzed for accuracy to render a finding.

- 11/19/2001 – Letter from Cheryl Williss, USFWS, to SEO sending outside staff readings from the Lake Creek Lake spring pool AND graph and spreadsheet of spring's provisional discharge. (See USFWS Data File)

- 9/13/2002 – Letter from Ralph Morgenweck, Regional Director, USFWS, to SEO asking when the SEO will be make an official conclusion and write the report.

- 1/31/2007 – Meeting in Saratoga. Attending were representatives from USFWS, SEO, and Weston Engineering, Inc.

- 7/13/2006 – Letter from Megan A. Estep, USFWS to the SEO requesting an additional Interference Investigation due to alleged interference by Kelly [sic] Land and Cattle Company.

- 9/17/2007 – Letter from Gary G. Mowad, Acting Deputy Regional Director, USFWS, to the SEO requesting immediate assistance regarding low flow rate from Lake Creek Lake, and asks the SEO to immediately curtail the junior pumping at TOTCO.

- 9/20/2007 – Letter from the SEO to Gary G. Mound [sic], USFWS, advising that the SEO would not regulate TOTCO pumping until after publication of the final report on interference and also advising that a call for regulation would impact the hatchery's ability to pump ground water.

- 2/13/2008 – Letter from Gary G. Mowad, Acting Regional Director, USFWS, to the SEO requesting all data and investigative material, and informing of a potential call for regulation.

- 2/19/2008 – Telephone message from USFWS to the SEO regarding a Public Records Information Act Request.

- 2/27/2008 – Letter from Lisa Lindemann, SEO, to Gary G. Mowad, Acting Regional Director, USFWS, informing that the SEO had compiled the records related to USFWS's Public Records Information Act Request.

- 6/13/2008 – Freedom of Information Act visit by Jack Cunningham, United States Bureau of Reclamation Technical Services Center.

- 11/20/2008 – Telephone call from Megan Estep, USFWS, to Jeremy Manley, SEO, regarding report delivery timeline.

- 11/20/2008 – Telephone call from Jeremy Manley, SEO, to Megan Estep, USFWS, regarding monitoring and hatchery-construction data not delivered to the SEO.
- 12/12/2008 – Letter from Jeremy Manley, SEO, to Megan Estep, USFWS, reiterating supporting information requested in an 11/20/2008 telephone call, and requesting a response.
- 12/29/2008 – Letter from Megan Estep, USFWS to Jeremy Manley, SEO, regarding monitoring and hatchery-construction data.