INTERFERENCE INVESTIGATION REPORT

PETTIGREW #1

VS.

CITY OF GILLETTE



Pumping Station for Gillette Waterworks, 1912 (Obtained from [www.wyomintalesandtrails.com](http://www.wyomintalesandtrails.com))

MAY 2012

GROUND WATER DIVISION

WYOMING STATE ENGINEER’S OFFICE

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# INTRODUCTION

On June 15, 2022, the Wyoming State Engineer’s Office (SEO) received a letter from Mr. Daniel B. Frank, a lawyer representing Mr. Gabriel Ruiz, requesting a formal Interference Investigation. The letter requested the SEO evaluate potential damage to the Sherard Well No. 6, Permit No. U.W. 5461 by the Bill Ward No. 2 Well, Permit No. U.W. 8539, and Enl. Bill Ward No. 2 Well, Permit No. U.W. 12665. This letter is included in Appendix A.

## Complaint

Mr. Ruiz contends that pumping from the Bill Ward No. 2 Well (and it’s enlargement) draws down the level of the water in the gravel pit to the extent that it interferes with his Sherard Well No. 6 water rights for fish culture and recreational purposes. Mr. Ruiz requested an interference investigation pursuant to Wyo. Stat. § 41-3-911(b).

Mr. Ruiz also believes that his Sherard Well No. 6 water rights and the Gross-Wilkinson Ranch, LLC’ Bill Ward No. 2 are from the same source of supply, being the LaGrange Aquifer, and requested correlation of the priorities of water rights from this supply into a single schedule pursuant to Wyo. Stat. § 41-3-916. Mr. Ruiz suggested that it may be appropriate for the state engineer to adopt by order any of the corrective controls specified in

Wyo. Stat. § 41-3-915.

1. Valid water rights appear to exist for each of the wells in question.
3. The wells are 60 feet deep and are screened in the alluvium (LaGrange Aquifer).
4. The priority date of the Sherard Well No. 6 (05/14/1970) is senior to the priority date of the Bill Ward No. 2 Well (03/17/1971).
5. The Sherard No. 6 Well is permitted for Irrigation Use and Miscellaneous Use; the remarks section of the permit does state that the permit is for fish culture and recreational purposes.
6. The Bill Ward No. 2 Well is permitted for Irrigation Use. The remarks section of the permit states that the property owners (at the time) agreed that Permit No. U.W. 5461 (Sherard No. 6) would have first right to use of the water.

AUTHORITY

W.S. § 41-3-911 provides the statutory framework for interference. It provides an enforceable legal remedy for surface water or groundwater 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.  Authority to order interfering appropriator to cease withdrawals of water; hearing complaints by appropriators.

* 1. Whenever a well withdrawing water for beneficial purposes shall interfere unreasonably with an adequate well developed solely for domestic or stock uses as defined in W.S. 41‑3‑907, whether in a control area or not, the state engineer may, on complaint of the operator of the stock or domestic well, order the interfering appropriator to cease or reduce withdrawals of underground water, unless such appropriator shall furnish at his own expense, sufficient water at the former place of use to meet the need for domestic or stock use. In case of interference between two (2) wells utilizing water for stock or domestic use as defined in W.S. 41‑3‑907, the appropriation with the earliest priority shall have the better right.
  2. 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.
  3. Any interested appropriator who is dissatisfied with the results of the foregoing procedure may proceed under the applicable provisions of the Wyoming Administrative Procedure Act [§§ 16‑3‑101 through 16‑3‑115]. If a hearing is to be held, it shall be held before the appropriate water division superintendent. The superintendent shall report to the board of control at its next meeting. The board shall issue its order to include findings of fact and conclusions of law.

§***41‑3‑916. Priority of rights when 1 source of supply.***

*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. Express conditions limiting rights of appropriator; additional conditions.***

*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. Preferred uses; defined; order of preference.***

(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.*

# GEOLOGIC AND HYDROGEOLOGIC OVERVIEW

The City of Gillette is located in northeastern Wyoming and is within the Powder River structural basin. The Powder River Basin was formed during the Laramide orogeny and comprises an area of more than 22,000 square miles. The basin is bounded to the east by the Black Hills Uplift, to the southeast by the Hartville Uplift, to the south by the Laramie Mountains and Casper Arch, and to the west by the Big Horn Mountains. The basin is bounded to the north by the Cedar Ridge Anticline in Montana. (Bartos and Ogle, 2002)

## Stratigraphy

In the Gillette area, the most exploited groundwater-bearing strata include the Tertiary-age Fort Union and Wasatch Formations. Sediments comprising both formations are interpreted to be continental in origin and include fluvial, lacustrine, and swampy depositional environments (Bartos and Ogle, 2002).

The Paleocene Fort Union Formation generally contains fine-grained unconsolidated sandstone, massive claystone, claystones with interbedded fine-grained sands, and silt. The sandstones occur as lenticular bodies which are laterally continuous for up to several miles; however, thin sandstone lenses may be continuous for less than a few thousand feet (SEO, 1995). Within the Powder River Basin, the Fort Union Formation consists of three members. The oldest is the Tullock Member, which grades upward into the Lebo Member (sometimes referred to as the Lebo Shale Member) (Bartos and Ogle, 2002). The uppermost, and youngest, member is the Tongue River. Near Gillette, the Fort Union Formation is approximately 2,500 feet thick based on logs of wells which penetrate the formation (SEO, 1995).

The Tullock and Tongue River Members consist of lenticular, discontinuous, fine to medium-grained sandstone beds interbedded with fine-grained sediments such as siltstone, claystone, mudstone, carbonaceous shale, limestone, and thin coal beds. Coal beds are, however, more common, thicker, and laterally continuous in the Tongue River Member. The thickest and most laterally continuous coal beds in the Tongue River Member consist of a zone known as the Wyodak-Anderson coal zone. This coal zone is composed of different coal beds that split, merge, re-split, and/or pinch out. The Lebo Member consists primarily of shale or mudstones interbedded with lesser amounts of sandstone, siltstone, and sparse, very thin coal beds. (Bartos and Ogle, 2002)

The surface formation in both Gillette and the Investigation area is the Eocene Wasatch Formation. The thickness averages about 490 feet (Crist, 1991). The Wasatch Formation “consists primarily of fine- to coarse-grained lenticular, discontinuous sandstone beds interbedded with fine-grained sediments such as shale, siltstone, claystone, and mudstone (Bartos and Ogle, 2002).”

According to Bartos and Ogle (2002), the contact between the Fort Union and Wasatch Formations remains controversial; however, they also note that a common method for distinguishing the contact is to consider the top of the Wyodak-Anderson coal zone as the contact, even though the Wyodak-Anderson coal zone is contained within the Tongue River Member of the Fort Union Formation. Crist (1991) used this same method for the contact between the Fort Union and Wasatch Formations.

Hydrogeology

Hydrogeologic units roughly correspond to Formations and Members within the Tertiary aquifers. The Wasatch aquifer is comprised of water-bearing strata of the Wasatch Formation and any portion of the Fort Union Formation above the Wyodak-Anderson coal zone. Bartos and Ogle (2002) identify the Wyodak-Anderson coalbed aquifer as being distinct and separate from the Tongue River aquifer which accounts for water-bearing strata of the lower Tongue River Member. Crist (1991) divided the near-Gillette Fort Union Formation into two hydrogeologic zones. These zones consist of an upper zone corresponding to the base of the Wyodak-Anderson Coal bed through the Lebo Shale member. The lower aquifer corresponds to the Tullock Member.

Fort Union Aquifer Monitoring Plan and Preliminary Aquifer Management Plan

The SEO initiated the Fort Union Formation Aquifer Monitoring Plan (Monitoring Plan) and Preliminary Aquifer Management Plan in 1995, in cooperation with the City of Gillette, Campbell County, and the Wyoming Water Development Commission to develop a better understanding of the Fort Union Aquifer, monitor aquifer impacts, and develop an aquifer management strategy, in light of growing demand. As part of the Monitoring Plan, several dedicated Fort Union Formation monitoring wells were constructed in the immediate area of Gillette and equipped with continuous water-level recording devices. The SEO has also collected water-level data from several subdivision water supply wells in the area since the late 1970s.

The data obtained from the monitoring wells and subdivision water supply wells indicate that, in general, static water levels have declined 100-200 feet in the area since the monitoring wells were completed in 1995. Data also indicate that pumping from the aquifer is exceeding recharge to the aquifer, and the amount of water stored in the aquifer is decreasing, at least in the immediate area of Gillette.

WATER RIGHTS

Appendix B provides copies of the permit documentation for the Pettigrew #1, S-12, S-18, S-19, and S-27 wells. Figure 1 illustrates the location of selected area groundwater wells. Summaries for completion and permit information for the wells referenced in this report are included on Table 1. Additionally, detailed information regarding the construction is provided below.

**The Pettigrew #1 Well**

The Pettigrew #1 well is permitted as Permit No. U.W. 11026, with a priority date of November 5, 1971. The well is located in T50N, R73W, Section 33, NE¼, SW¼. The permit allows the water from the well to be used for Domestic use at one single family dwelling located on Lot 10, Westridge Subdivision, Campbell County, Wyoming.

The Pettigrew #1 well was relocated and deepened on August 15, 2001, pursuant to an approved relocate and/or deepen request received November 2, 2000, and approved on November 7, 2000. The original Pettigrew #1 was completed to a depth of 322 feet. The current Pettigrew #1 is completed to 1,264 feet and is screened at various depths between 1,060 and 1,184 feet below land surface (bls).

1. **The S-12 Well**
2. The S-12 well is permitted by Permit Nos. U.W. 42007 and U.W. 190123, with priority dates of November 22, 1976 and May 7, 2008, respectively. The current S-12 well is located in T50N, R72W, Section 34, NW¼, NW¼. Permit No. U.W. 42007 is permitted for production of up to 350 gpm. Permit No. U.W. 190123 authorizes a maximum instantaneous flow of 100 gpm for a combined total of 450 gpm.
3. The S-12 was relocated during 2007. The original S-12 was completed to 2,300 feet bls and was variously screened from 1,534 to 2,295 feet bls. The current S-12 well is completed to 2,162 feet bls and is variously screened from 1,376 to 2,132 feet bls.
4. **The S-18 Well**
5. The S-18 well is permitted by Permit No. U.W. 41830, with a priority date of February 23, 1978. The current S-18 well is located in T50N, R72W, Section 33, SW¼, SE¼. Permit No. U.W. 41830 is permitted for production of up to 150 gpm.
6. The S-18 was relocated during 2010 and is located approximately 136 feet west-southwest of the original S-18 well location. The original S-18 well was drilled to a total depth of 1,689 feet bls and was variously screened from1,060 to 1,656 feet bls. The current S-18 well was drilled to a depth of 1,693 feet bls and is variously screened from 1,054 to 1,512 feet bls.

The S-19 Well

1. The S-19 well is permitted by Permit Nos. U.W. 41831 and U.W. 193940, with priority dates of February 23, 1978 and September 15, 2010, respectively. The S-19 well is located in T50N, R72W, Section 33, SW¼, NE¼. Permit No. U.W. 41831 authorizes a maximum instantaneous flow of 125 gpm. Permit No. U.W. 193940 authorizes a maximum instantaneous flow of 215 gpm, for a combined total of 340 gpm.
2. The S-19 was relocated during 2010 and is located approximately 130 feet south-southeast of the original S-19 well location. The original S-19 well was drilled to a total depth of 1,753 feet and was screened variously from 1,062 to 1,706 feet bls. The current S-19 was drilled to a depth of 1,725 and is screened variously from 1,040 to 1,695 feet bls.

**The S-27 Well**

1. The S-27 well is permitted by Permit Nos. U.W. 109197 and U.W. 193941, with priority dates of November 10, 1997 and September 15, 2010, respectively. The S-27 well is located in T50N, R72W, Section 32, NW¼, SE¼. Permit No. U.W. 109197 authorizes a maximum instantaneous flow of 150 gpm and U.W.193941 authorizes a maximum instantaneous flow of 35 gpm for a combined flow rate of 185 gpm.
2. The S-27 was relocated during 2010 and is located approximately 93 feet east-northeast of the original S-27 well location. The original S-27 well was drilled to a total depth of 2,535 feet and was screened at various depths between 1,345 and 2,478 feet bls. The current S-27 was drilled to a depth of 1,740 and is variously screened from 1,176 to 1,690 feet bls.
3. Relocations
4. The City of Gillette relocated and completed the S-12, S-18, S-19, and S-27 wells at predominantly shallower depths than the original well completions. The wells were completed shallower in order to insure increased production and to obtain slightly better quality water (by avoiding fluoride concentrations present in the lower Fort Union Aquifer) than the original completions.
5. The G-MON-4 Well
6. The G-MON-4 well is used for groundwater-level measurement purposes by the SEO. The G-MON-4 well is permitted by Permit No. U.W. 95665. The G-MON-4 well is located in T50N, R72W, Section 21, SE¼, SE¼. The G-MON-4 well is variously screened from 940 to 2,200 feet bls.
7. The G-MON-5 Well
8. The G-MON-5 well is used for groundwater-level measurement purposes by the SEO. The G-MON-5 well is permitted by Permit No. U.W. 95666. The G-MON-4 well is located in T50N, R72W, Section 28, SE¼, SE¼. The G-MON-5 well is variously screened from 1,120 to 1,770 feet bls.

GROUNDWATER LEVEL DATA

As part of the Fort Union Formation Monitoring Plan, the SEO maintains a network of groundwater monitoring wells in and around the City of Gillette. The groundwater monitoring wells in the vicinity of the Pettigrew Interference Complaint are shown on Figure 1. Data collected from G-MON-4 and G-MON-5 during 2010 and 2011 indicate abnormal declines in water levels. Raw data collected from the G-MON-4 and G-MON-5 are presented in Appendix C.

Figure 2 presents the hydrograph for the G-MON-5 groundwater monitoring well from 1994 through 2011. As shown on the figure, the water level has up to 50-feet of annual variation, but, in general, tends to indicate water levels of 750 to 840 feet bls. The hydrograph also indicates that the water level in G-MON-5 dropped about 160 feet between mid-June 2010 and late-January 2011. Figure 3 presents a more detailed view of the May 2010 through December 2011 timeframe. As shown on Figures 2 and 3, there are time intervals where the SEO is missing water-level data for the monitoring well. In general, these instances are due to limitations of the monitoring equipment. The data-recording device works with a float which is suspended in the well by a cable. The recorder is only capable of measuring certain “swings” in water levels. In this instance, the recorder was not capable of recording all of the variations in water levels.

Figure 4 presents the hydrograph for the G-MON-4 groundwater monitoring well from 1994 through 2011. As shown on the figure, the water level fluctuates, in general, about 50 feet or less on a seasonal basis. The water level tends to vary between 625 and 775 feet bls. The hydrograph also shows that the water level declined almost 130 feet between mid-June and mid-December 2010. Figure 5 presents a more detailed view of the G-MON-4 hydrograph from May 2010 to December 2011. This hydrograph also shows missing data, which is due to the same limitations of measuring devices already mentioned.

Appendix D presents the City of Gillette’s reported water-level data. Figure 6 presents the results of static-water level measurements conducted by the City of Gillette for area Fort Union wells. The data are not detailed enough to draw many detailed observations; however, the monitoring data do show almost 160 feet of decline in the measured static-water level within the S-18 well. Figure 7 presents the results of pumping water-level measurements conducted by the City of Gillette for the same area Fort Union wells. In general, pumping water-level measurements tend to be anywhere from 150 to 350 feet deeper than static-water level measurements.

Last, but not least, according to information provided by Mr. Gary Pettigrew, the static water level in the Pettigrew #1 was 736 feet bls in 2001. Mr. Pettigrew also provided that the static water level in the Pettigrew #1 was measured to be 861 feet bls on August 12, 2011. The Statement of Completion of Well or Spring associated with the Pettigrew #1 indicates that the static water level at the time of completion for the Pettigrew #1 was 754 feet bls.

WATER PRODUCTION DATA

Conditions and Limitations placed on the City of Gillette’s water rights require that the City report (on an annual basis) the monthly volumes produced from each of their wells. Table 2 presents monthly production from January 2005 and extending through December 2011. Figure 8 presents these same data. Additionally, Appendix E provides production information as reported by the City of Gillette. The figure provides stacked columns to convey what portion of the total monthly production is provided by each well. The figure also illustrates (as does the table) that some wells do not typically provide much contribution to the monthly pumping. Close inspection will show that the S-9 and S-12 wells do not typically provide much contribution; however, starting in August of 2010, these wells provided much more water to the overall monthly volume. It is also apparent when reviewing Figure 8 that the City of Gillette pumped much more water per month during the late 2010 to early 2011 time frame than any other point in the recent past. Table 3 depicts the monthly production as an average gallon per minute flow rate.

Figure 9 presents the City of Gillette’s production from the Fort Union Aquifer. This figure presents the calendar year totals as well as a 12-month running total. The figure illustrates that, in general, the City of Gillette pumps between 1,100 and 1,300 acre-feet of water from the Fort Union during an average calendar year. The figure also illustrates that the City pumped about 1,670 and 1,566 acre-feet for calendar years 2010 and 2011, respectively. This is significant because the City’s permits essentially allow 1,500 acre-feet on an average annual basis. It is also significant to note that between August 2010 and July 2011, the City pumped 2,463 acre-feet from its Fort Union Aquifer wells. This is about double the City’s normal production.

Close inspection will show that during the month of June 2011, the flow rate for the S-18 well exceeded the permitted instantaneous flow rate.

GROUNDWATER MODELING

The Ground Water Division utilized the Theis equation (from Fetter, 2001) to calculate potential drawdown at the Pettigrew #1 well due to pumping the S-12, S-18, S-19, and S-27 wells. The Theis method makes several key assumptions with regard to the modeled wells and the aquifer conditions. These assumptions include:

1. the aquifer is homogeneous, isotropic, and of uniform thickness within any cone(s) of depression,
2. the aquifer receives no recharge during pumping,
3. any pumped well fully penetrates the aquifer and produces water from the full thickness of the aquifer,
4. any discharge and associated decline in head is instantaneous,
5. pumped wells are 100% efficient,
6. water flow is laminar, and
7. the potentiometric surface is horizontal when pumping starts.

In addition to standard Theis assumptions, the method assumed that impacts to a monitored well (in this case the Pettigrew #1 well) are additive in the case of multiple pumping wells (Fetter, 2001). The Ground Water Division also assumed that the Pettigrew #1, S-12, S-18, S-19, S-27, G-MON-4, and G-MON-5 wells are all completed in the Fort Union Aquifer. The Ground Water Division obtained aquifer parameter data from reports associated with re-completion of the S-12, S-18, S-19, and S-27 wells. These data are compiled on Table 4.

Figure 10 shows the results of modeling the drawdown which might have been experienced at the Pettigrew #1 well due to pumping the S-12 well. The model uses a range of Transmissivity and Storage values, reported monthly flow rates, and measured approximate distances to estimate a drawdown over time. This effort indicates that pumping the S-12 well might have produced a drawdown of approximately 5 to 12 feet during June 2010. The same model indicates that between June and December 2010, pumping the S-12 well could produce a drawdown of 25 to 42 feet.

Figures 11, 12, and 13 present similar modeling efforts for the S-18, S-19, and S-27 wells, respectively. As illustrated on Figure 11, the pumping from the S-18 well probably would not have produced a significant, measurable, effect before August 2010; however, by January 2011, the drawdown could have ranged from 40 to almost 60 feet. Similar observations can be made from the charts shown on Figure 12 and 13.

Figure 14 illustrates the potential cumulative effects at the Pettigrew #1 well from pumping the S-12, S-18, S-19, and S-27 wells. Using all of the before mentioned assumptions, it appears that the pumping of these wells from June through December 2010 could have produced impacts between about 95 and 150 feet of drawdown (with maximum drawdown of up to 165 feet actually occurring around December 1st).

In order to assess the potential accuracy of the modeling, the Ground Water Division modeled cumulative drawdown due to pumping the S-12, S-18, S-19, and S-27 wells and modified the distance to compare predicted impacts with water levels observed in the G-MON-5 monitoring well. Those potential computed impacts as compared with the G-MON-5 hydrograph are presented on Figure 15. As shown on this figure, the predicted values are not greatly different than observed values.

MODEL INTERPRETATION

The hydrograph does show declines beginning after the model predicts; however, this shift is likely due to the model using an average flow rate for the entire month. More detailed data regarding the beginning of pumping and the actual production rates could certainly alter the modeled drawdown to more closely align with the observed drawdown. This certainly makes sense in consideration that pumping may have started after June 1, 2010 and would have been at a (gallon per minute) flow rate greater than the entire month average.

Comparison of the hydrograph and predicted curves between November 1, 2010 and January 1, 2011 also shows a unique signature. The steep drawdown between November and December is clearly mimicked in both predicted and observed data, as well as a slight increase and then gradual decrease during the month of December. This feature is most probably attributable to a decrease in production of the S-19 well.

One noticeable difference does appear in comparing the predicted to actual drawdowns at the G-MON-5 monitoring well. The actual drawdowns are greater than the Theis calculations might indicate. This could be due to any number of reasons, including, but not limited to:

1. The values used for Transmissivity and Storativity could be inaccurate.
2. The distance between wells as modeled could be inaccurate.
3. The assumptions of the model are sufficiently different so as to not portray the aquifer system precise enough.
4. Other wells which are not included in the model are impacting the water levels within the G-MON-5 monitoring well.

The Ground Water Division understands that other wells in the area are completed in, and draw water from, the Fort Union Formation. There are at least two wells which serve a subdivision located in the immediate vicinity of the project and these wells are shown on Figure 1. It is very likely that pumping these wells could produce impacts to the water level within the G-MON-5 monitoring well, and, due to the relative location, could produce impacts to the Pettigrew #1 well. For model simplicity (and due to lacking data), these wells were not included in drawdown calculations.

Additionally, the City of Gillette has many other Fort Union aquifer wells which could impact the G-MON-5 monitoring well and the Pettigrew #1 well. For simplicity, and because of the greater distances, these wells were not included in modeling efforts.

CONCLUSIONS AND RECOMMENDATIONS

The State Engineer’s Office – Ground Water Division conducted a formal Interference Investigation focused on the Pettigrew #1 well and some of the City of Gillette’s wells. During the course of this investigation, the Ground Water Division focused on the City of Gillette’s S-12, S-18, S-19, and S-27 wells. Based upon a review of available information it is apparent that:

1. Valid water rights appear to exist for each of the wells in question.
2. The Pettigrew #1 well is completed at the shallowest depth of the wells in question.
3. The pump in the Pettigrew #1 is set at 950 feet bls. The total depth of the well is 1,280 feet and the static water level reported on the *Statement of Completion and Description of Well or Spring* is 754 feet bls. The pump in the Pettigrew #1 could be lowered to allow water to be produced from the well.
4. As part of relocation and re-completion efforts, the City’s current wells now have multiple screens at depths shallower than the original wells.
5. Hydrograph data collected between June 2010 and January 2012 from the State Engineer’s Office monitoring wells in the vicinity indicate recent abnormal declines in area water levels. The hydrographs also indicate that water levels have returned to similar values present before June 2010.
6. Increased pumping of the City of Gillette’s Fort Union wells most probably created a greater impact on area water levels than previously experienced.
7. Predicted drawdowns at the Pettigrew #1 well from pumping the S-12, S-18, S-19, and S-27 wells indicates that drawdown could have approached 165 feet purely from pumping the referenced City of Gillette wells for a 6-month period.
8. Several City of Gillette wells were activated and pumped starting in mid-2010 which do not typically see much use.
9. The City of Gillette exceeded the average annual production cap for Fort Union Wells during both 2010 and 2011.
10. The City of Gillette’s S-18 well shows a production flow rate (in gallons per minute) which exceeds that amount authorized by permit.
11. Other wells producing from the Fort Union Formation could certainly impact water levels in and surrounding the Pettigrew #1 well. Those impacts are relatively unknown, but expected to be smaller in magnitude than the City of Gillette’s nearby wells.
12. When Mr. Pettigrew initially expressed concern regarding the water levels in and surrounding his wells (mid August 2010), cumulative pumping from the City of Gillette’s area Fort Union wells could have produced a drawdown ranging from 30 to 60 feet at the Pettigrew #1. State Engineer’s Office monitoring well hydrographs do not indicate large-scale anomalies or drawdowns in the area prior to this time frame.

Based upon the conclusions presented above, the Ground Water Division has identified potential solutions for ameliorating the impacts which were likely experienced at the Pettigrew #1 well. These solutions are presented in no particular order.

1. Take no action. As the hydrographs illustrate, area water levels have recovered to levels present before the City of Gillette started heavier pumping.
2. Lower the pump in the Pettigrew #1.
3. Restrict the City of Gillette’s pumping to the permitted maximums.
4. Modify the Conditions and Limitations for the City of Gillette to allow no more than 1,700 acre-feet in any one 12-month period as opposed to calendar year.
5. Require the City of Gillette to provide water to Mr. Pettigrew during periods of extended heavy pumping.
6. Regulate the system under prior appropriations strategy. The Pettigrew #1 well holds a senior priority date over the nearby City of Gillette wells.

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#### Tables

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