SOUTH PLATTE BASIN ROUNDTABLE

Groundwater Technical Committee

Recommendations

from the South Platte Basin Roundtable
Groundwater Technical Committee
February 2018

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Background

To facilitate discussions on water management issues and encourage locally driven collaborative solutions, nine basin roundtables were established by the Colorado Water for the 21st Century Act. These roundtables represent each of the state's eight major river basins and the Denver metropolitan area. The South Platte Basin Roundtable covers approximately 22,000 square miles in northeast Colorado. The largest cities in the roundtable area are Boulder, Fort Collins, Longmont and Greeley. The projected population in 2050 is estimated to almost double in size to between 1.9 and 2.6 million people. The South Platte Basin Roundtable has established subcommittees to help address the varied needs of the basin, including the Groundwater Technical Committee (Committee). In September of 2014 a Technical Committee was selected to address groundwater issues throughout the basin, including high groundwater, data collection, storage and infrastructure.

In the late 2000's, homeowners began reporting high groundwater levels in the Sterling area, while reports of flooding basements, damaged crops, and septic systems were being relayed from the Gilcrest/LaSalle area. Due to a combination of natural geology and hydrology, irrigation ditch seepage, average to above-average precipitation, increased recharge for augmentation purposes, and decreased groundwater pumping, high groundwater is causing damage to private and public property and agricultural land in the South Platte River Basin. The Committee has been meeting for over three years now, and has been researching and implementing various ways to mitigate and respond to damaging high groundwater.

The engineering firm, Brown and Caldwell was hired to conduct a localized study of the Sterling and Gilcrest La Salle areas in July of 2015. This study examined the water budget for these areas. The Gilcrest-La Salle study area has seen a shift of more water coming into the system. This shift was also seen in the Sterling area. As inflows exceed outflows, the water table rises. The Groundwater Technical Committee has since been implementing and discussing various strategies and programs to try to change the water balance to lower the water table.

What Has Been Tried? Where Should We Go Next?

Three years and many meetings have resulted in a significant amount of discussion, and action. The following describes what the Committee has tried, and what recommendations have come out of those actions and discussions. For a full list of the Committee's activity since inception, see Attachment 1.

Dewatering Wells: The most notable example was the use of an irrigation well east of the Town of Gilcrest (the Lorenz Well) as a dewatering well. Gilcrest was able to partner with a local farmer to provide compensation for any electrical costs associated with pumping the well for dewatering purposes. Pumping the well proved to be a success as groundwater level monitoring documented water levels were reduced at the wastewater treatment plant a quarter mile northwest. The well was pumped into the Big Bend Drain to the Union Ditch, then into the South Platte River. Unfortunately, the Union Ditch would not accept the water during times when there was a call on the South Platte, and the Big

Bend Drain was no longer able to convey the water due to maintenance concerns. The issue with the Big Bend Drain led the Committee to recommend the following::

- **Formalize Drainage Districts**: Drainage districts would allow for more reliable collection of fees to maintain drain ditches in the area and ensure water can properly move out of the system.
    - One specific recommendation is to formalize a district for the Big Bend Drain. AgPros Engineering conducted a survey of the drain and listed priority fixes that would improve its ability to convey water. Without a formal district, however, collecting the fees to conduct these repairs is difficult.
    - Pros: Will help to maintain drainages from reliable fee collection. Improving surface drainage will help groundwater move out of the system more efficiently.
    - Cons: Producers may not be willing to formalize drainage districts.

The Lorenz well has recently changed ownership as well, and previous agreements to pump were not renewed.

The Town of Gilcrest also applied for a HB15-1178 Emergency Dewatering Grant to utilize a local well owned by the school district. Plans were in place to pump the water from the well into a local ditch, which would then convey the water back to the South Platte River. A decision by the Farmers Independent Ditch Company board and shareholders prevented this project from moving forward. They were concerned about added administrative and maintenance associated with accepting the water from the dewatering well.

This project became the catalyst for the Dewatering Improvements Study by JVA and Bishop Brogden, which investigated permanent dewatering solutions for the Town.

The Pawnee Ridge Subdivision in Sterling saw success with a dewatering system that utilized two existing wells for dewatering purposes and a partnership with the local landowners and the Sterling Number 1 ditch to move the water back to the South Platte River. Another Home owner's Association in Fort Morgan saw success in implementing a passive dewatering project for their community. This system utilizes a buried perforated pipe to intercept groundwater as it flows towards the homes. From there it is collected in a vault, then pumped into the Bijou Draw where it flows to the River. The success of these projects came from the willingness of the local stakeholders to work together.

These projects highlighted that dewatering wells are an efficient means to physically remove water from the system, but they need permanent conveyance systems to the South Platte to be a permanent solution. Other recommendations that came from these projects include:

- **Installation of Dewatering Wells:** Constructing a new dewatering well in areas of concern will allow for effective lowering of the water table; however the water still needs to be conveyed back to the South Platte River.

Completion of Wastewater Treatment Plant Dewatering Well: A recommendation of the Dewatering Improvements Study for the Town of Gilcrest (JVA Engineering, 2016), completing and implementing the dewatering well for the wastewater treatment plant will provide the town with some relief. (Completion anticipated in Feb. 2018)

- Pros: Eliminates permission issues. Water can be pumped in areas of highest concern for highest impact.
- Cons: Initial installation is costly, even with an existing pipeline to the South Platte. Requires a conveyance method back to the South Platte River. The existing pipeline used by Gilcrest may need to be enlarged. Use and impact of the new well on the existing pipeline will need to be evaluated.

- **Multi-Use Pipelines**: Using pre-existing pipelines (for effluent/stormwater) is another cost effective means to convey the water back to the South Platte River. One of the recommendations of the Dewatering Improvements Study for the Town of Gilcrest is to enlarge the effluent line from the wastewater treatment plant to the South Platte River, providing more capacity for other dewatering wells to be developed and linked into the system.
  Another recommendation from the Dewatering Improvements Study was to partner with Central Colorado Water Conservancy District (CCWCD) in constructing a multi-use pipeline from north of Town that would tie into the pre-existing effluent line to the South Platte. This would allow for Central to use the pipeline for augmentation wells, delivery of irrigation and recharge supplies to area farms, and Gilcrest to use the pipeline for dewatering purposes.
  - Pros: Multi-use pipelines can take advantage of infrastructure that is already in place. Allows for partnership opportunities with other entities. Can easily provide increased member pumping allocations in CCWCD augmentation plans.
  - Cons: expensive initial cost. Most efficient use of the pipeline would include construction of a regulating reservoir near the end of pipeline and adjacent to the South Platte.

- **Utilize Existing Wells for Dewatering**: Use of the Lorenz well for dewatering showed that using an existing well for both irrigation and dewatering is an effective strategy (Attachment 3). Existing wells should be utilized whenever they can for dewatering purposes.
  - Pros: Less initial cost as well is already in place. Partnerships with well owners can benefit both parties. Could allow for a partnership with CCWCD to use augmentation wells as dewatering wells (this would work best with a multi-purpose pipeline as described above).
  - Cons: Requires permission and cooperation from well owners. Wells may not be in the most ideal location for removing water from targeted areas. Requires conveyance method back to the South Platte River. Pumping costs.

Gilcrest Area Pilot Project: The Lorenz well also shed light on another issue, producers in the area did not want to see the water simply returning to the river, and wanted to put it to beneficial use. Dewatering an area through pumping without putting the water to beneficial use is allowed without augmenting the impacts at the river that result from the pumping. However, when the pumped water is put to beneficial use, state law and water court decrees require that the impacts of the pumping be

replaced at the river. The Gilcrest Area Pilot Project sought to change the water balance by incentivizing farmers to pump more groundwater, while diverting less surface water. The majority of Gilcrest area farms have senior surface rights and also have CCWCD contracts for the use of groundwater as a supplemental irrigation supply. In years that surface supplies are abundant, the area irrigation canals provide considerable surface water and the amount of allotted groundwater pumping by Central is therefore not fully utilized. In an effort to incentivize more groundwater consumptive use and change the area water balance the Committee approved options to participate in the Pilot Project, the first was to pay producers $60 per acre-foot pumped up to their allocation from Central. The second option provided augmentation water to allow producers to pump up to their full contractual amount with Central. Additional augmentation supply to cover the increased pumping was leased from the City Of Aurora for the first year of the pilot, and from the City of Greeley for the second year.

The first year of the pilot participants pumped 690 acre-feet more groundwater compared to their 2013-2015 average. The second year of the pilot, however, participants only pumped 460 acre-feet more than their 2013-2015 average.

These results demonstrated that producers will more likely take their surface supplies over groundwater supplies if available. This could be due to a number of reasons, including fear of abandonment of surface rights if they're not used. Another reason is that it is more fiscally beneficial to use surface water over groundwater in certain cases. As pumping causes wear and tear on producers pumps and sprinklers; it is less expensive to use surface rights when available.

However, the project also demonstrated that increased legal pumping in areas of high groundwater will help lower the water table (Attachment 2).

This project led to the recommendations below:

- **Support Continued Multi-Purpose Storage in the South Platte River:** Increased augmentation supply in the South Platte would allow for more pumping of groundwater under current decrees. Increased storage will allow for more reliable augmentation supply and multi-purpose storage opens up opportunities for partnerships with various entities to ease the financial burdens of creating storage. Augmentation supply is essential to allow additional pumping of groundwater in high groundwater areas. More storage for augmentation will lead to higher pumping quotas, which will allow more pumping and change in the water balance.
    - Pros: Reliable augmentation supply will allows producers to pump more. Multi-purpose storage allows for partnership opportunities.
    - Cons: High initial cost. Producers still may not pump even with a higher quota.

- **Increased Groundwater use in High Groundwater Areas:** Central Colorado Water Conservancy District (Central) augmentation plans currently have the ability to increase pumping allotments by contract. Additional pumping in areas of high groundwater could lead to a decline in water

tables. More multi use storage, gravel pits, and leases from municipalities may be required to provide enough additional pumping to change the water balance.

- Pros: Utilizes the existing augmentation supplies and decreed augmentation plans.
- Cons: Requires willingness from producers. Only a beginning point, more storage will be required in the future to allow for more pumping overall.

- **Lease-Pumping Programs:** Implementation of a lease-pumping program within high groundwater areas that would allow participants to lease their surface rights through an Alternative Transfer Method (ATM), to allow them to irrigate primarily with groundwater, but still use their wells to irrigate.
  - Pros: If the surface rights are leased to another entity, it ensures that the water balance changes back to a higher output than input regime, lowering the water table on a localized scale.
  - Cons: This will require participation from multiple producers in areas of high groundwater to have a regional impact. Storage availability is necessary if the leased surface rights are to be used for future pumping impacts

- **Pilot Projects:** Continue to develop and implement pilot projects to change the water balance in areas of high groundwater. One such Pilot Project has been implemented for the past two irrigation seasons. It incentivized producers to pump more groundwater and use less surface water on their fields. Informal modeling results have shown that the increased pumping did help to reduce the groundwater levels (Attachment 2).
  - Pros: Allows testing of ideas to change the water balance within the confines of Colorado Water Law. Can lead to more permanent solutions based on experimentation.
  - Cons: Temporary. Testing ideas does not always yield effective solutions. Cost of additional augmentation water is a concern. The cost of additional augmentation water from Aurora and Greeley for the two pilot years was at the lower end of the market, the cost was still higher that most producers would be willing to spend individually for the commodities they produce.

- **Cost Share Programs:** Provide cost share for various on farm infrastructure and irrigation management tools that would lead to increased irrigation efficiency that would positively affect the water balance in problem areas. Increased irrigation efficiency leads to less water infiltrating the soil and recharging the aquifer. There are currently several cost share programs administered through NRCS-USDA available for most of these water efficiency practices. Producer participation in this area seems fairly low. The GW Technical committee provided a soil moisture probe system(3) for one irrigator (included mapping, installation and hourly monitoring) and cost shared the second year. A program was offered to area producers to cost share (50%) during the second pilot year with no additional producers wishing to participate. Potential programs include:
  - Sprinkler systems
  - Drip systems

        - Pond and or on farm ditch lining
        - Soil probe installation[1]
        - Soil mapping
        - Tile drain systems[2]
    - Pros: Directly beneficial to producers. Increases efficiency, thereby reducing aquifer recharge from irrigation.
    - Cons: Certain solutions can be expensive (drip irrigation). Irrigator reluctance.

- **Educational Program on HB 17-1233:** Producers were not always willing to provide surface right application data for the Pilot Project, there is a perceived risk of lowering historic consumptive use in participating in pilot projects (ie perceived "use it or lose it" concerns). Recently enacted legislation (HB 17-1233) provides that the reduced water usage that results from participation in a government-sponsored water conservation program, including water conservation pilot programs, will not be considered in analyzing the historical consumptive use of the water right. This will help provide assurance that any years a producer participates in future pilots to reduce the groundwater will not influence any future historical consumptive use analysis.
    - Pros: Dispels use it or lose it myth for participating in pilot programs. Good starting point, inexpensive.
    - Cons: Education does not ensure action.

Other Ideas: As of January 2018, the Groundwater Technical Committee has met 39 times. Throughout all of these meetings, several other ideas have been discussed to varying degrees.

- **Augmentation Well Placement**: Augmentation wells pump groundwater into the river during times when there is not enough surface supply to replace depletions from previous pumping. Incentivizing the placement of augmentation wells in areas of damaging high groundwater would allow these wells to mitigate high groundwater while replacing depletions.
    - Pros: Placement in areas with high groundwater will remove water from the area while replacing irrigation well depletions or return flow obligations associated with water right change decrees. Potential to be permitted for dewatering as well, allowing for cost share opportunities between Central and local stakeholders.
    - Cons: Requires conveyance. Pumping for replacement causes more depletions that must be replaced later.

- **Helicopter Electromagnetic Surveys:** Central recently hired Aqua Geo Frameworks to conduct an electromagnetic survey of the alluvial aquifer in the Gilcrest area. CWCB is partnering with Central to analyze the data to determine if future deployment of this technology will be beneficial. The purpose of this study is to refine the aquifer geometry and properties in order to improve and inform modeling efforts used to manage high groundwater areas.

[1] One producer near Gilcrest has been using soil moisture probes for two irrigation seasons now. The real time data has allowed this producer to accurately determine when the crops need water, and has prevented overwatering of the crops.

[2] Two producers in the Gilcrest area currently use tile drain systems to prevent their fields from being inundated.

- Pros: Provides refined data of aquifer properties.
  Note that the value of an enhanced understanding of the alluvial aquifer through such a survey would be realized only if it is
    - used to accomplish dewatering in the most strategic way,
    - used to guide the distribution of enhanced quotas for pumping in the most strategic way,
    - or used to facilitate the amendment of augmentation plan decrees in water court for Central or other entities, where the amendment leads to development of new unit response functions (URF's) for well pumping depletions or recharge accretions. Ultimately, the net depletion from pumping needs to be replaced, however, Central, or other entities may be able to maximize pumping better with more compressed URF's.
- Cons: High cost.

- **Mapping of Underground Infrastructure:** Create a clearinghouse for all existing underground infrastructure location data. This would also include filling in data gaps to ensure a better understanding of potential routes groundwater may flow, as buried utilities can act as preferred flow paths for groundwater. This data would need to be used in the same way as described above (see Helicopter Electromagnetic Surveys) in order to be valuable.

- **ET Analysis:** The Committee has discussed taking a technical look at evapotranspiration (ET) in areas with high groundwater to:
    - Determine if ET has increased in the area due to high groundwater
        - Quantify how much non-beneficial ET losses may increase based on water table levels (including from phreatophytes, cattails, bare soil, etc.)
    - Pros: Better understanding of ways high groundwater influences the maximized utilization of water in Colorado
    - Cons: Current law does not allow for credit from ET salvage.

- **County Permitting:** New construction in the alluvial aquifer should recognize and study the highly variable nature of groundwater levels in the area and build accordingly.

- **Conveyance Improvements:** The Committee has noticed that areas of high groundwater generally have issues with local water conveyance structures as well. This includes seepage from irrigation delivery ditches, improperly maintained drainage ditches, and general lack of reliable conveyance back to the South Platte for dewatering activities. High groundwater can be mitigated by creating/improving the ways that water flows in and out of the system. Such actions include:
    - Lining delivery ditches in areas of high groundwater to prevent seepage
        - There may be limited opportunity for ditch lining as ditch companies rely on this seepage for recharge credits in their augmentation plans. This seepage can also provide supply to nearby wells.

- Improve drains through maintenance, re-grading, culvert improvements etc. to facilitate movement of groundwater. Weld county public works has changed some culverts located in county right of way.
- Create/enlarge conveyance pipelines to the South Platte to facilitate multiple uses (dewatering, augmentation, wastewater, irrigation supply, stormwater, etc.)
    - Pros: Will move water out of the system more efficiently, helping the water balance shift back towards more sustainable levels.
    - Cons: Some options may not be feasible (depending on cost, water rights, existing wells, etc.).

There is no one solution that will lower the water table in areas of concern, and some recommendations may not be appropriate for certain locations. Though we are confident in the general causes of high groundwater, each area has its own unique challenges that must be accounted for when developing the best methods for lowering the water table.

Funding: The above recommendations will need a funding source. The Committee recommends legislation for a stable funding source to continue to implement solutions to the high groundwater problem in the South Platte Basin. The Committee recommends, at a minimum, $150,000 per year for planning and project development.

USDA-NRCS also has several cost-share programs for qualified producers, and partnerships should be explored to further leverage State and local funds. Applicants who come to the table with match (from one of these cost share programs or otherwise) may receive preferential consideration over those with no match.

Other Resources

HB12-1278 Study of the South Platte Alluvial Aquifer. Colorado State University. December 2013. http://southplatte.colostate.edu/files/report/HB1278%20Final%20Report.pdf
Sterling and Gilcrest/La Salle High Groundwater Analysis. Brown and Caldwell. July 2015. http://cwcbweblink.state.co.us/WebLink/ElectronicFile.aspx?docid=196040&searchid=1e7084a5-1842-435d-bbe8-eda80cbe7902&dbid=0
Dewatering Improvements Study for the Town of Gilcrest. JVA and Bishop Brogden Associates. October 2016. http://cwcbweblink.state.co.us/WebLink/ElectronicFile.aspx?docid=201821&&dbid=0
HB 15-1178 Emergency Dewatering Grant Program Final Report. Colorado Water Conservation Board. October 2017.
http://cwcbweblink.state.co.us/WebLink/0/doc/204532/Electronic.aspx?searchid=7c95b281-5457-48f5-b8b0-cdf2779e9b21

Attachments

1. Summary of Recommendations
2. Summary Table of Efforts Related to High Groundwater in the South Platte Basin 2012-2017
3. Informal Modeling of Gilcrest Area Pilot Project (Willem Schrueder, Prinicpia Mathematica)
4. Gilcrest Waste Water Treatment Plant Groundwater Levels

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Andy Hansen: 4Rivers Equipment
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Ralf Topper: Colorado Division of Water Resources
Reagan Waskom: Colorado Water Institute
Brown & Caldwell
Weld County
City of Aurora
City of Greeley
Local Agricultural Producers

Attachment 1

Summary of Recommendations

Summary of Recommendations

There are generally no simple inexpensive solutions to the high groundwater problems in areas of concern. The following is a list of recommendations made by the South Platte Basin Roundtable Groundwater Technical Committee regarding high groundwater issues in the South Platte Basin. The Committee realizes that some of these recommendations may infeasible or of limited feasibility based on their cost. The Committee also would point out that implementation of some of these recommendations will require considerable cooperation from a multitude of parties.

The recommendations include potential solutions and studies to help mitigate and further understand the damaging high groundwater. Note that more in depth discussion of how the Committee arrived at these recommendations can be found in the previous section of this document. Items in this document are separated based on overarching subject matter and the order in which they are presented in no way reflects the priority of one recommendation over another.

Water Administration and Alternative Water Management

Increased Groundwater use in High Groundwater Areas: Central Colorado Water Conservancy District (Central) augmentation plans currently have the ability to increase pumping allotments by contract. Additional pumping in areas of high groundwater could lead to a decline in water tables. More multi use storage, gravel pits, and leases from municipalities may be required to provide enough additional pumping to change the water balance.

- Pros: Utilizes the existing augmentation supplies and decrees.
- Cons: Requires willingness to participate from producers. As discussed below, Central will need additional augmentation supplies, including storage, to allow additional pumping.

Support Continued Multi-Purpose Storage in the South Platte River: Increased augmentation supply in the South Platte would allow for more pumping of groundwater under current decrees. Increased storage will allow for more reliable augmentation supply and multi-purpose storage opens up opportunities for partnerships with various entities to ease the financial burdens of creating storage. Augmentation supply is essential to allow additional pumping of groundwater in high groundwater areas. More storage for augmentation will lead to higher pumping quotas, which will permit that additional pumping.

- Pros: Reliable augmentation supply will allow producers to pump more. Multi-purpose storage allows for partnership opportunities.
- Cons: High initial cost. Producers still may not pump even with a higher quota. The past two water years have experienced normal to above average river supply and farmers usually prefer to use their surface water and save their pumping allocation for late season insurance if the river supply diminishes (dry year).

Lease-Pumping Programs: Implementation of a lease-pumping program within high groundwater areas that would allow participants to lease their surface rights through an Alternative Transfer Method (ATM), to allow them to irrigate primarily with groundwater", but still use their wells to irrigate.

- Pros: If the surface rights are leased to another entity, it ensures that the water balance changes back to a higher output than input regime, lowering the water table on a localized scale.
- Cons: This will require participation from multiple producers in areas of high groundwater to have a regional impact. Storage availability is necessary if the leased surface rights are to be used for future pumping impacts

Augmentation Well Placement: Augmentation wells pump groundwater into the river during times when there is not enough surface supply to replace depletions from previous pumping. Incentivizing the placement of augmentation wells in areas of damaging high groundwater would allow these wells to mitigate high groundwater while replacing depletions.

- Pros: Placement in areas with high groundwater will remove water from the area while replacing irrigation well depletions or return flow obligations associated with water right change decrees. Potential to be permitted for dewatering as well, allowing for cost share opportunities between Central and local stakeholders.
- Cons: Requires conveyance. Pumping for replacement causes more depletions that must be replaced later.

Studies and Further Research

Pilot Projects: Continue to develop and implement pilot projects to change the water balance in areas of high groundwater. As discussed earlier
one such Pilot Project has been implemented for the past two irrigation seasons. It incentivized producers to pump more groundwater and use less surface water on their fields. Informal modeling results have shown that the increased pumping did help to reduce the groundwater levels (Attachment 3).

- Pros: Allows testing of ideas to change the water balance within the confines of Colorado Water Law. Can lead to more permanent solutions based on experimentation.
- Cons: Temporary. Testing ideas does not always yield effective solutions. Uncertain long term augmentation water sources and associated volatile water market costs.

Helicopter Electromagnetic Surveys: Central recently hired Aqua Geo Frameworks to conduct an electromagnetic survey of the alluvial aquifer in the Gilcrest area. CWCB is partnering with Central to analyze the data to determine if future deployment of this technology will be beneficial. The purpose of this study is to refine the aquifer geometry and properties in order to improve and inform modeling efforts used to manage high groundwater areas.

- Pros: Provides refined data of aquifer properties.
  Note that the value of an enhanced understanding of the alluvial aquifer through such a survey would be realized only if it is
  - used to accomplish dewatering in the most strategic way,

    - used to guide the distribution of enhanced quotas for pumping in the most strategic way,
    - or used to facilitate the amendment of augmentation plan decrees in water court for Central or other entities, where the amendment leads to development of new unit response functions (URF's) for well pumping depletions or recharge accretions. Ultimately, the net depletion from pumping needs to be replaced, however, Central, or other entities may be able to maximize pumping better with more compressed URF's.
- Cons: High cost.

ET Analysis: A technical look at evapotranspiration (ET) in areas with high groundwater to:

- Determine if ET has increased in the area due to high groundwater
    - Quantify how much non-beneficial ET (Evapotranspiration) losses may increase based on water table levels (including from phreatophytes, cattails, bare soil, etc.)
- Pros: Better understanding of ways high groundwater influences the maximized utilization of water in Colorado
- Cons: Current law does not account for credits from ET salvage.

Mapping of Underground Infrastructure: Create a clearinghouse for all existing underground infrastructure location data. This would also include filling in data gaps to ensure a better understanding of potential routes groundwater may flow, as buried utilities can act as preferred flow paths for groundwater.

County Permitting: New construction should recognize and study the highly variable nature of groundwater levels in the area and build accordingly.

Town of Gilcrest

Installation of Dewatering Wells: Constructing a new dewatering well in areas of concern will allow for effective lowering of the water table; however the water still needs to be conveyed back to the South Platte River.

- **Completion of Wastewater Treatment Plant Dewatering Well**: A recommendation of the Dewatering Improvements Study for the Town of Gilcrest (JVA Engineering, 2016), completing and implementing the dewatering well for the wastewater treatment plant will provide the town with some relief. (Completion anticipated in Feb. 2018)
- Pros: Eliminates conveyance permission issues. Wells can be placed in areas of highest concern for highest impact.
- Cons: Initial installation is costly, even with an existing pipeline to the South Platte. Requires a conveyance method back to the South Platte River. The existing pipeline used by Gilcrest may need to be enlarged. Use and impact of the new well on the existing pipeline will need to be evaluated

Multi-Use Pipelines: Using pre-existing pipelines (for effluent/stormwater) is another cost effective means to convey the water back to the South Platte River. One of the recommendations of the Dewatering Improvements Study for the Town of Gilcrest is to enlarge the effluent line from the wastewater treatment plant to the South Platte River, providing more capacity for other dewatering wells to be developed and linked into the system.

Another recommendation from the Dewatering Improvements Study was to partner with Central Colorado Water Conservancy District (CCWCD) in constructing a multi-use pipeline from north of Town that would tie into the pre-existing effluent line to the South Platte. This would allow for Central to use the pipeline for augmentation wells, delivery of irrigation and recharge supplies to area farms, and Gilcrest to use the pipeline for dewatering purposes.

- Pros: Multi-use pipelines can take advantage of infrastructure that is already in place. Allows for partnership opportunities with other entities. Can easily provide increased member pumping allocations in CCWCD augmentation plans.
- Cons: expensive initial cost. Most efficient use of the pipeline would include construction of a regulating reservoir near the end of pipeline and adjacent to the South Platte.

Utilize Existing Wells for Dewatering: Use of the Lorenz well for dewatering showed that using an existing well for both irrigation and dewatering is an effective strategy (Attachment 4). The Town should utilize whatever pre-existing wells they can for dewatering purposes.

- Pros: Less initial cost as well is already in place. Partnerships with well owners can benefit both parties.
- Cons: Requires permission and cooperation from well owners. Wells may not be in the most ideal location for removing water from targeted areas. Requires conveyance method back to the South Platte River. Pumping costs.

Individual Irrigator Options

Cost Share Programs: Provide cost share for various on farm infrastructure and irrigation management tools that would lead to increased irrigation efficiency and/or dewatering of problem areas. Increased irrigation efficiency leads to less water infiltrating the soil and recharging the aquifer. Potential programs include:

- Sprinkler systems
- Drip systems
- Pond lining
- Soil probe installation[3]
- Soil mapping
- Tile drain systems[4]

[3] One producer near Gilcrest has been using soil moisture probes for two irrigation seasons now. The real time data has allowed this producer to accurately determine when the crops need water, and has prevented overwatering of the crops.

[4] Two producers in the Gilcrest area currently use tile drain systems to prevent their fields from being inundated.

- Pros: Directly beneficial to producers. Increases efficiency, thereby reducing aquifer recharge from irrigation.
- Cons: Certain solutions can be expensive (drip irrigation).

Educational Program on HB 17-1233: Producers were not always willing to provide surface right application data for the Pilot Project, there is a perceived risk of lowering historic consumptive use in participating in pilot projects (ie use it or lose it myth). Current law provides that the reduced water usage that results from participation in a government-sponsored water conservation program, including water conservation pilot programs, will not be considered in analyzing the historical consumptive use of the water right. This will help provide assurance that any years a producer participates in future pilots to reduce the groundwater will not influence any future historical consumptive use analysis.

- Pros: Helps reduce
- use it or lose it fear for participating in pilot programs. Good starting point, inexpensive.
- Cons: Education does not ensure action.

Regional Delivery Systems

Conveyance Improvements: Create/improve the ways that water flows in and out of the system to mitigate high groundwater including:

- Lining delivery ditches in areas of high groundwater to prevent seepage
    - There may be limited opportunity for ditch lining as ditch companies rely on this seepage for recharge credits in their augmentation plans. This seepage can also provide supply to nearby wells.
- Improve drains through maintenance, re-grading, culvert improvements etc. to facilitate movement of groundwater
- Create/enlarge conveyance pipelines to the South Platte to facilitate multiple uses (dewatering, augmentation, wastewater, irrigation supply, stormwater, etc.)

- Pros: Will move water out of the system more efficiently, helping the water balance shift back towards more sustainable levels.
    - Cons: Some options may not be feasible (depending on cost, water rights, existing wells, etc.).

Formalize Drainage Districts: Drainage districts would allow for more reliable collection of fees to maintain drain ditches in the area and ensure water can properly move out of the system.
One specific recommendation is to formalize a district for the Big Bend Drain. AgPros Engineering conducted a survey of the drain and listed priority fixes that would improve its ability to convey water. Without a formal district, however, collecting the fees to conduct these repairs is difficult.

- Pros: Will help to maintain drainages from reliable fee collection. Improving surface drainage will help groundwater move out of the system more efficiently.
- Cons: Producers may not be willing to formalize drainage districts.

Funding

The above recommendations will need a funding source. The Committee recommends legislation for a stable funding source to continue to implement solutions to the high groundwater problem in the South Platte Basin. The Committee recommends, at a minimum, $150,000 per year for planning and project development / implementation. Applicants who come to the table with match (from one of these cost share programs or otherwise) may receive preferential consideration over those with no match.

Attachment 2

Summary Table of GWTC Activities 2012-2017

Summary of Efforts Related to High Groundwater in the South Platte Basin 2012 through 2017

	Date	Efforts to Investigate and Address High Groundwater	Funding Source & Amount
1	Spring 2012	DWR Pilot Projects initiated in Sterling and Gilcrest-LaSalle areas, with Ralf Topper from DWR as the lead.	CWCB $162,821
2	July 1, 2012	HB12-1278 goes into effect for study of the South Platte alluvial aquifer by the Colorado Water Institute	CWCB $940,000
3	July 2012	First of five annual severance tax grants (through 2016) to Colorado State University for their review of SPDSS regional alluvial groundwater model and development of a refined model for the Gilcrest-LaSalle area	CWCB $250,000
4	Dec. 31, 2013	HB12-1278 report completed on South Platte River Alluvial Aquifer Study	
5	Sept. 19, 2014	First South Platte Basin Roundtable (SPBRT) Groundwater Technical Committee (GWTC) meeting. GWTC has met a total of 26 times through June 2016, mostly at CCWCD's office in Greeley, but also at LSPWCD's office in Sterling, with some public attendance at many of the meetings	
6	Sept. 30, 2014	Colorado Geological Survey: "Gilcrest/LaSalle Pilot Project Hydrogeologic Characterization Report"	CWCB (cost included in #1)
7	Nov. 18, 2014	GWTC white paper: "Initial Recommendation, South Platte Alluvial Aquifer Groundwater Monitoring Network"; later incorporated into HB15-1166, described in #14 (also see #26 below)	
8	Nov. 21, 2014	GWTC tour of Gilcrest area high groundwater issues	
9	Jan. 12, 2015	GWTC tour of Sterling area high groundwater issues	
10	Feb. 12, 2015	Tour of Gilcrest-LaSalle area for State's High Groundwater Analysis, including DWR, CWCB, and Brown & Caldwell personnel; numerous sites were visited, with comments and observations from Ralf Topper from DWR.	
11	March 2015 to present	Gilcrest-area dewatering using the Lorenz well – a temporary solution where the Town of Gilcrest is pumping the Lorenz irrigation well and discharging the water into the Big Bend Drain, where it is conveyed to the Union Ditch and then to the South Platte River.	CWCB $20,000 DOLA $15,000
12	May 21, 2015	Update on high groundwater issues given by CWCB staff to CWCB at the Board's May meeting in Sterling.	
13	June 5, 2015	Tour of Gilcrest-LaSalle area for State's High Groundwater Analysis, including Glen Fritzler, Bob Winter, Senator Marble, and CWCB and Brown & Caldwell personnel; numerous sites were visited with discussions with area farmers.	

14	July 1, 2015	HB15-1013 goes into effect for (1) pilot projects for alternative methods of lowering the water table in areas along the South Platte River experiencing damaging high groundwater; and (2) analysis by DWR of new recharge structures on their potential effects on groundwater levels. HB15-1166 goes into effect for the South Platte River alluvial aquifer groundwater monitoring network. HB15-1178 goes into effect for an emergency dewatering grant program for the Gilcrest and Sterling areas, to be administered by CWCB.	(1) No funding for pilot projects; (2) $41,959 from General Fund for DWR recharge structure analysis $60,000 **Total $580,000** General Fund: FY2016 $165,000 FY2017 $290,000 CWCB: $125,000
15	July 2015 Approved by CWCB	Criteria and guidelines for HB15-1013 and HB15-1178, as developed by CWCB and DWR staff, were approved by CWCB	
16	July 2015 Approved by CWCB	Gilcrest-area dewatering using the School well – a second, temporary solution where the Town of Gilcrest proposed to pump the School irrigation well and discharge the water into the Farmer's Independent Ditch, which would convey it to the South Platte River. Gilcrest applied for $90,000 for this project from the HB15-1178 Emergency Dewatering Grant Fund at the July 2015 CWCB Board meeting. The project was approved on the condition that Gilcrest obtain the necessary permissions to convey the water to the South Platte. Unfortunately the Farmer's Independent Ditch Company board voted to not allow Gilcrest to discharge water into their ditch, so the application was withdrawn and the project did not move forward.	HB15-1178 Grant $90,000 **NOT USED** due to FIDCo denial of Gilcrest request to use ditch to convey dewatering water
17	July 2015	Brown and Caldwell report: "Sterling and Gilcrest/LaSalle High Groundwater Analysis"	CWCB $99,700
18	Feb. 2016	Sterling area HB15-1178 grant application effort for Country Club Hills and Pawnee Ridge was abandoned by consultant due to numerous issues with rights-of-way for a pipeline, lack of a formal entity to take responsibility into the future, lack of response and/or very high cost estimates from area contractors, and lack of cooperation from homeowners and HOAs. Homeowner in Country Club Hills is independently pursuing a dewatering project for his property. The City of Sterling is aware of the grant program but has decided not to apply at this time.	
19	Feb. 4, 2016	Public meeting held in Gilcrest for proposed pilot project for lowering groundwater levels in Gilcrest area; well attended by public and potential participants (see also #24)	
20	Feb. 29, 2016	Brown and Caldwell letter report: "Gilcrest Modeling Scenario Evaluation Results"	SPBRT $25,000

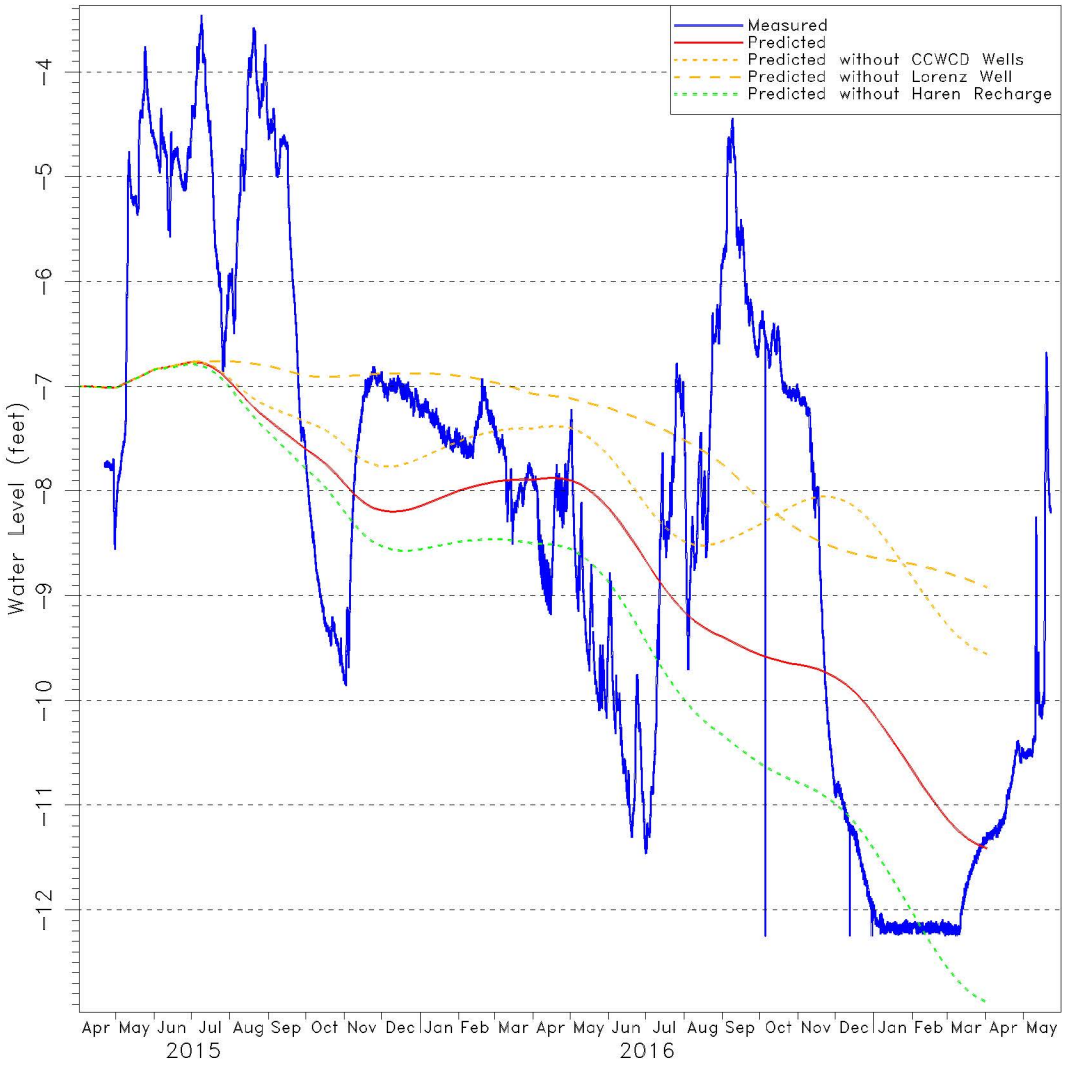
21	Mar. 2016 Approved by CWCB; ongoing	Permanent dewatering plan for the Town of Gilcrest – Gilcrest applied for and was awarded a HB15-1178 grant to hire the engineering team of JVA and Bishop-Brogden Associates to study the existing groundwater conditions in the Town and propose three alternative designs to alleviate the high groundwater.	HB15-1178 Grant $139,800
22	June 2016	Survey of the Big Bend Drain – CWCB hired AgPros, a Greeley agricultural engineering and surveying firm, to survey the Big Bend Drain and prepare a report of recommendations for areas of the drain where flow conditions could be improved. The Big Bend Drain is a key drainage leading from the Gilcrest area to east of LaSalle, and currently the ditch has areas of poor drainage and areas where it floods into adjacent fields if the flow is high.	CWCB $15,300
23	June 2016	Instrumentation of farm field – A Gilcrest-area farm (also a participant in the pilot project below) agreed to have their field's soil type mapped at two different levels (50 cm and 150 cm), the elevation profile mapped, and soil moisture sensors installed that would provide real-time information regarding the need to irrigate. The 4 Rivers/John Deere office in Greeley did the survey and installation. The objective is to gage the effectiveness of precision irrigation management in reducing excess irrigation, thereby reducing percolation to the groundwater table.	CWCB $4,013
24	July 2016 ongoing	Pilot project near Gilcrest – incentivizes farmers with wells in Central's WAS and GMS augmentation plans within a defined study area to pump more groundwater than usual and forgo an equal amount of surface water diversions in an effort to lower the groundwater table; includes data monitoring while the pilot project is ongoing.	HB15-1178 Grant $140,329.50 (July 2016, Year 1) $107,355.60 (May 2017, Year 2)
25	July 2016	Brown & Caldwell, SPDSS Alluvial Groundwater Model Update completed; modeling scenarios still to be performed	CWCB $450,000
26	July 2016 ongoing	Purchase of 25 dataloggers with satellite telemetry, with the installation of 20 into South Platte alluvial monitoring wells by yearend	HB15-1166 (cost included in #14)
27	September 2016	Permanent Dewatering System for Pawnee Ridge Homeowner's Association approved for funding through HB 15-1178. A pipeline was installed to convey water out of the subdivision from two existing dewatering wells. The water then flows into the Sterling No.1 ditch via a new headgate, and then to the South Platte River.	HB15-1178 Grant $128,407
28	July 2017	Permanent dewatering well near the Gilcrest Waste Water Treatment Plant approved for partial funding through HB15-1178. $54,263.76 was provided by a DOLA grant.	HB15-1178 Grant $57,986.30 HB17-1248 Grant $56,120.52
		Working Relationships Formed as a Result of GWTC Efforts to Address High Groundwater	
		Town of Gilcrest	
		Central Colorado Water Conservancy District	
		City of Aurora	
		Colorado State University	
		West Greeley Conservation District	
		4 Rivers / John Deere of Greeley	
		City of Greeley	
		Entities Who Have Expressed Interest in Collaboration with GWTC	
		Weld County	
		United Water and Sanitation District	

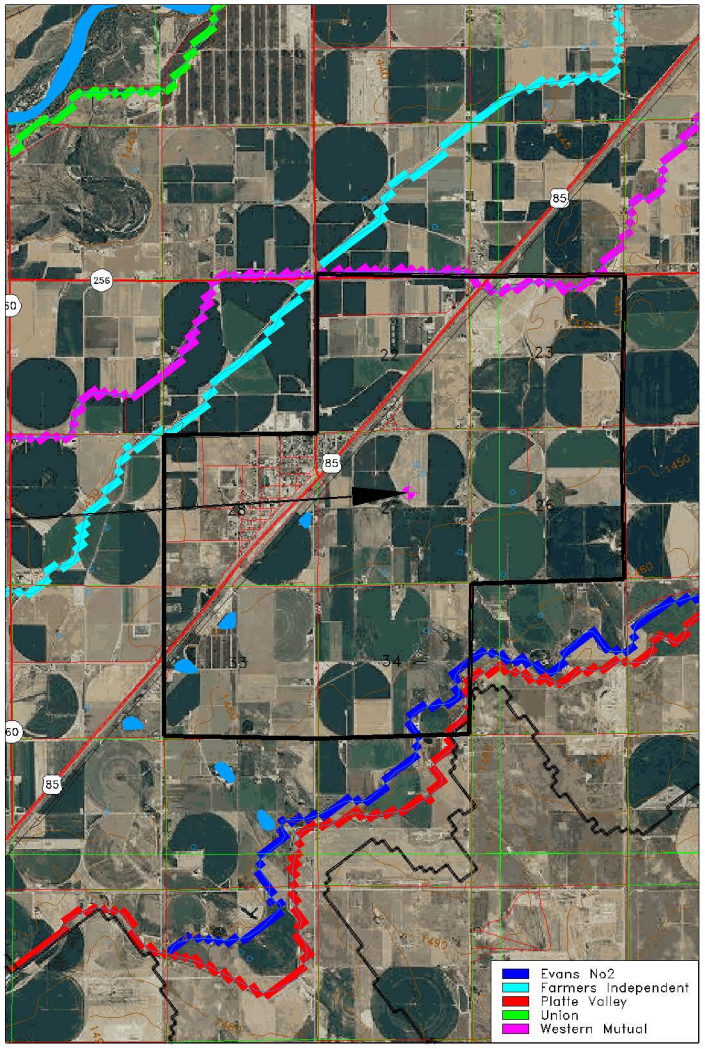
Attachment 3

Informal Modeling of the GIlcrest Area Pilot Project

MW1: Lorenz West

SPDSS Change Model





MW2: Lorenz South

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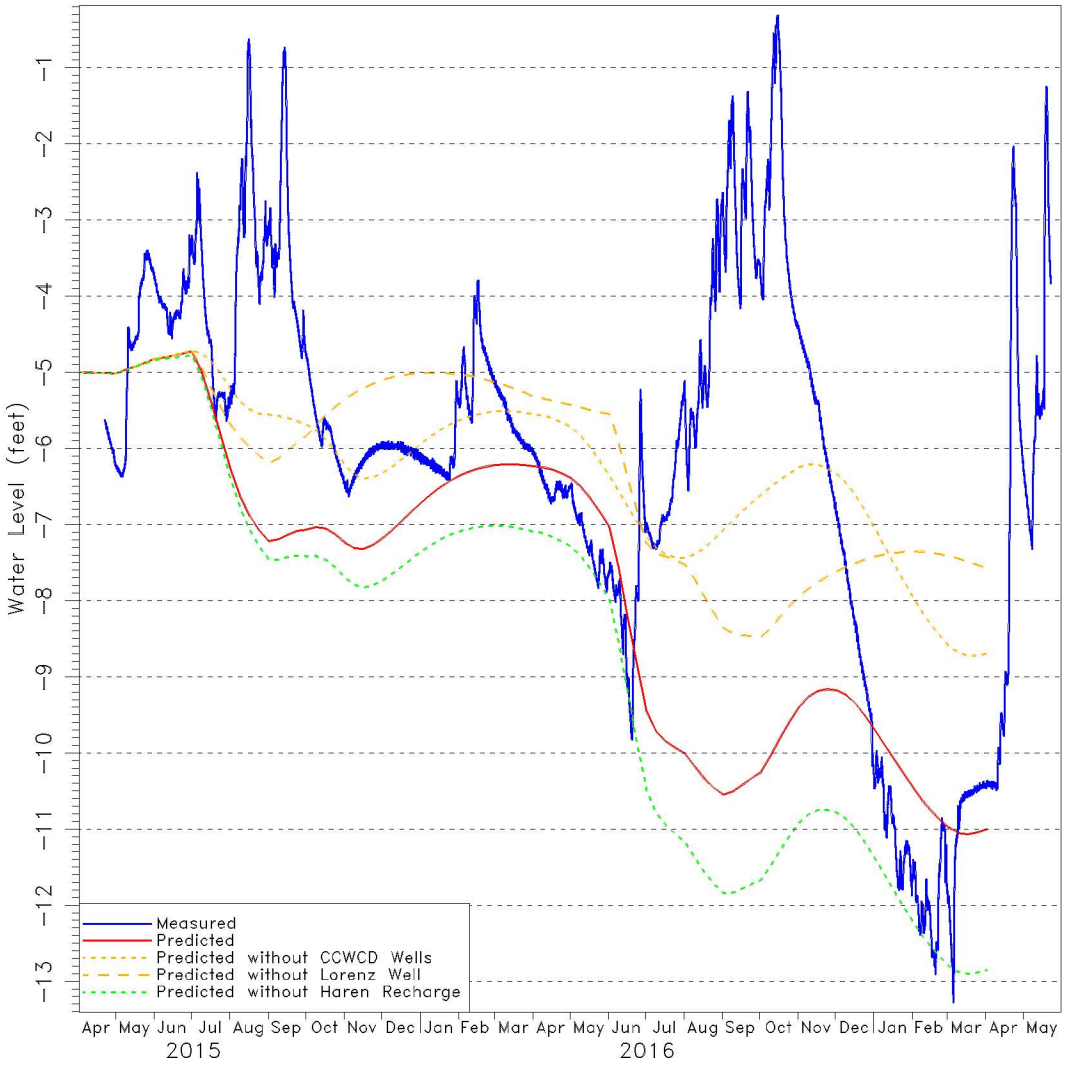

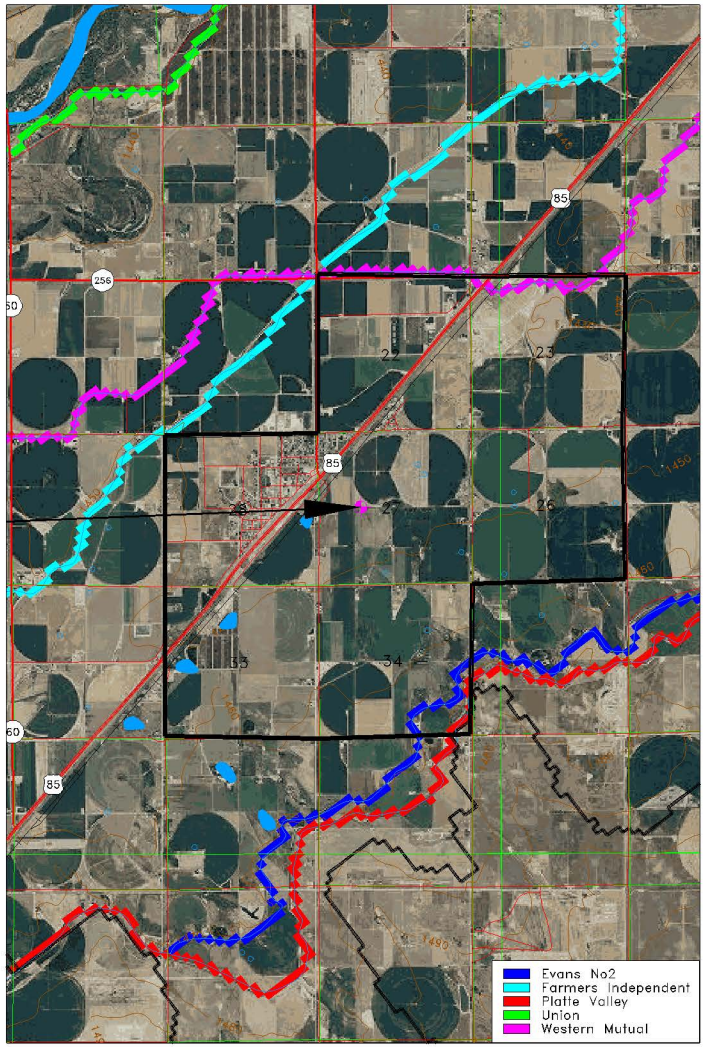

MW3: Lorenz North

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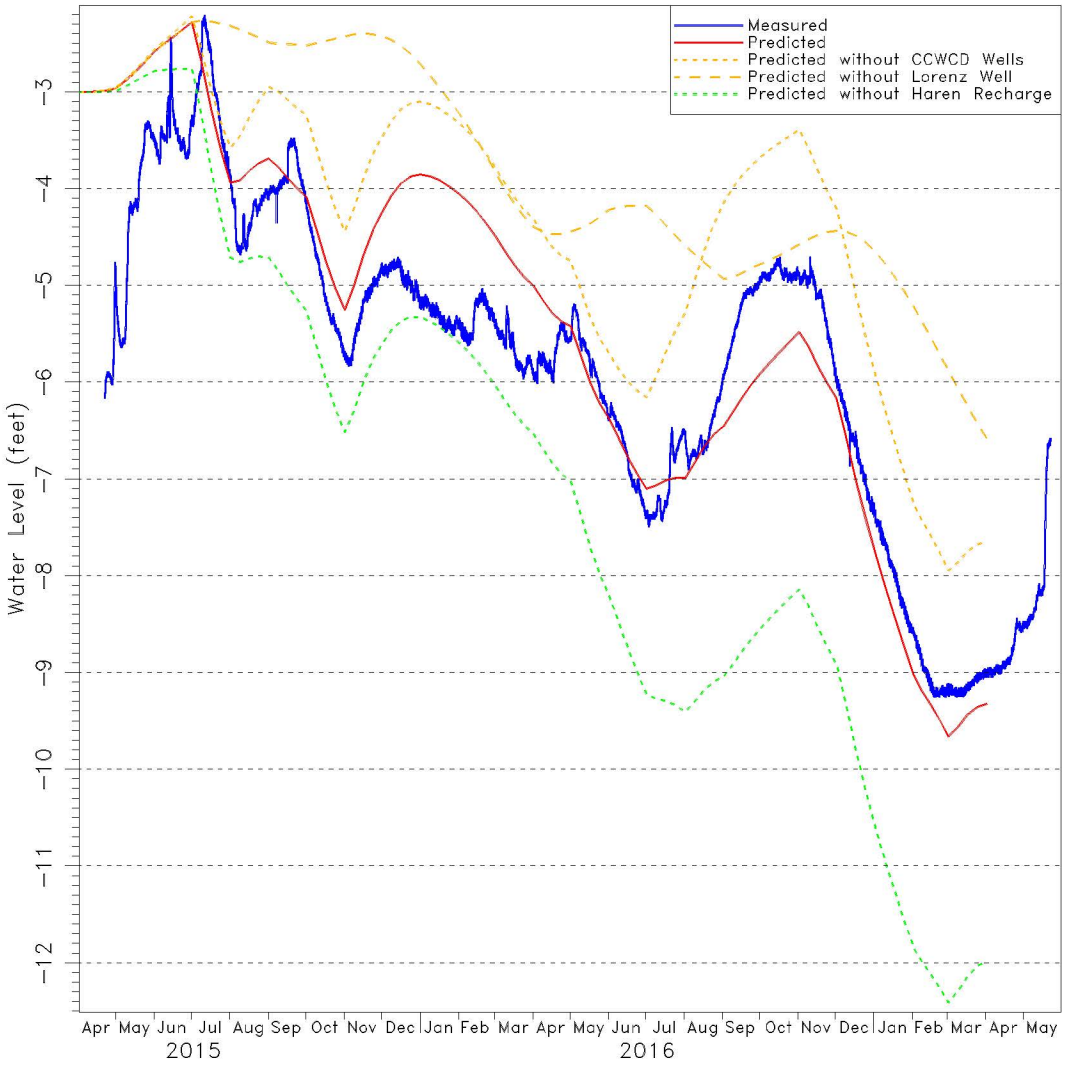

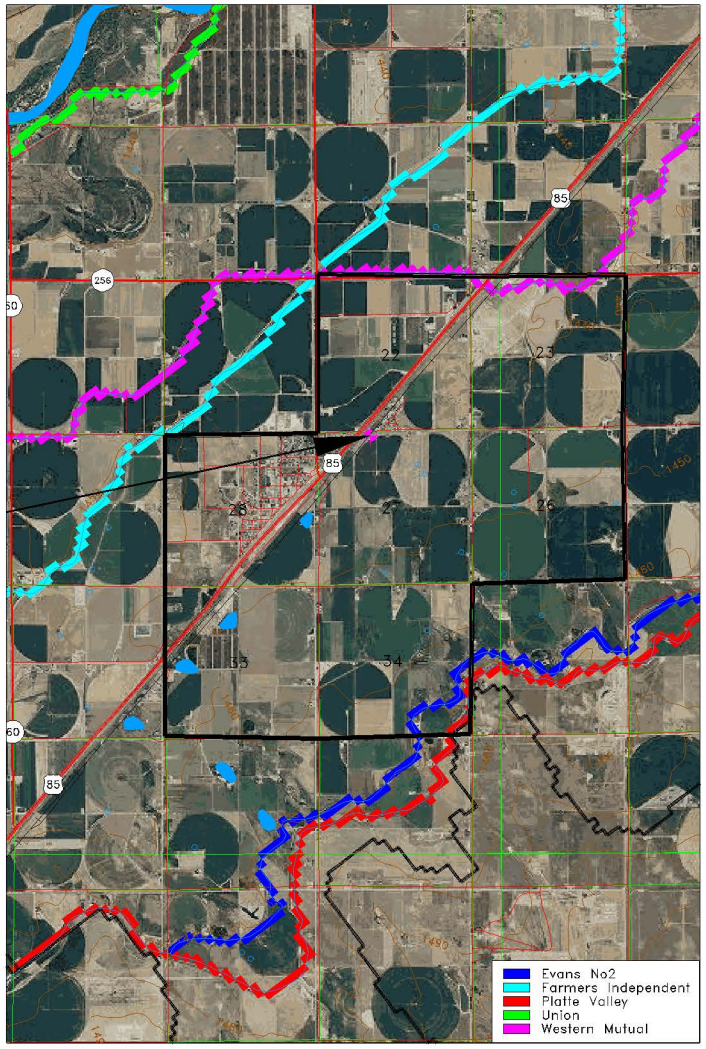

MW4: Fritzler East

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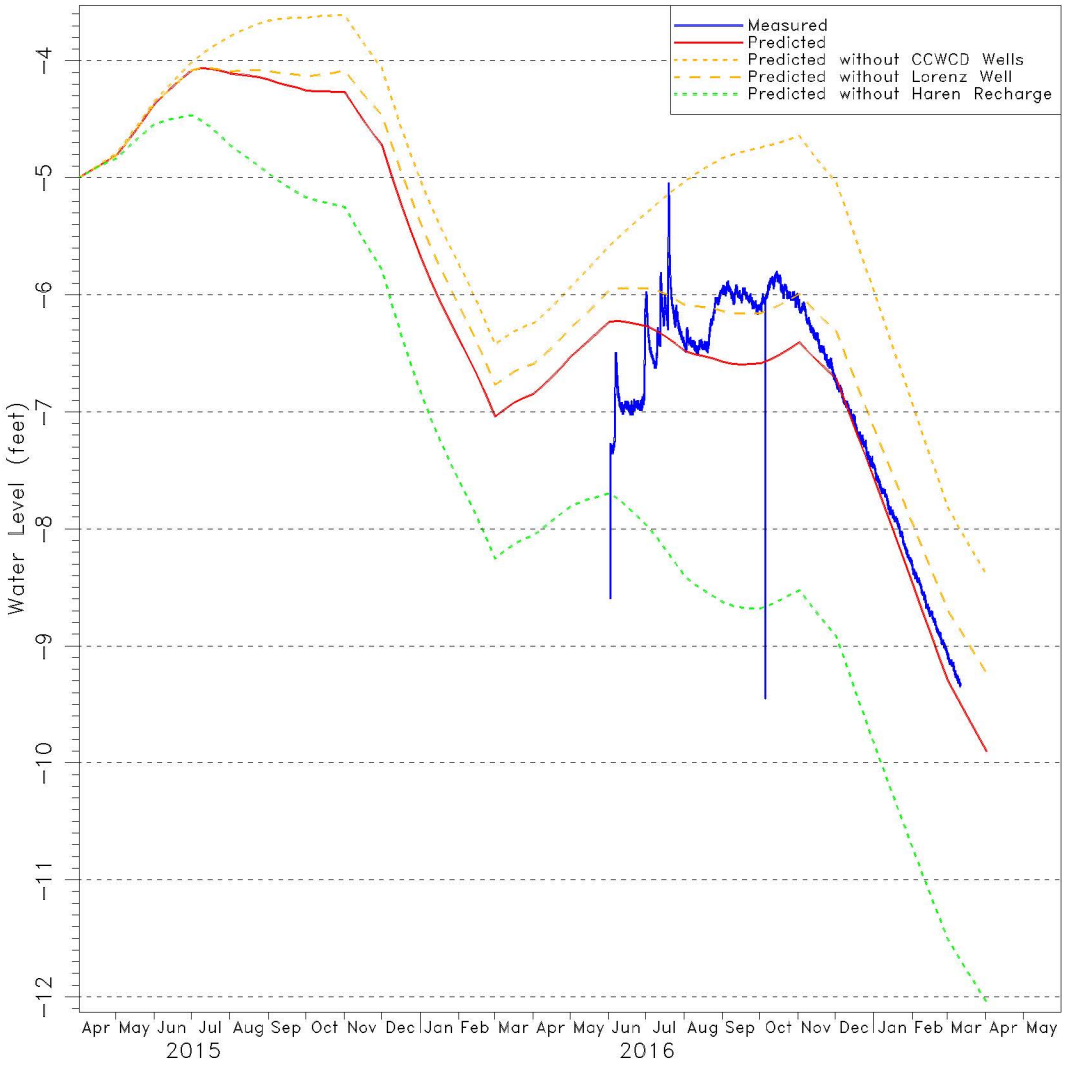

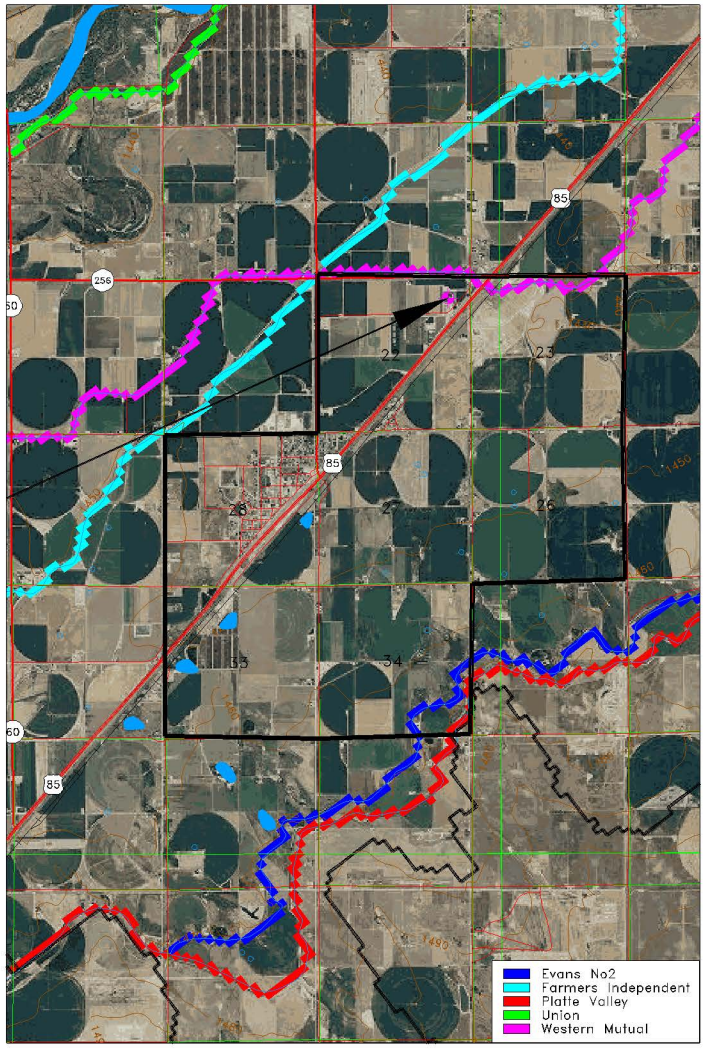

MW5: Fritzler Central

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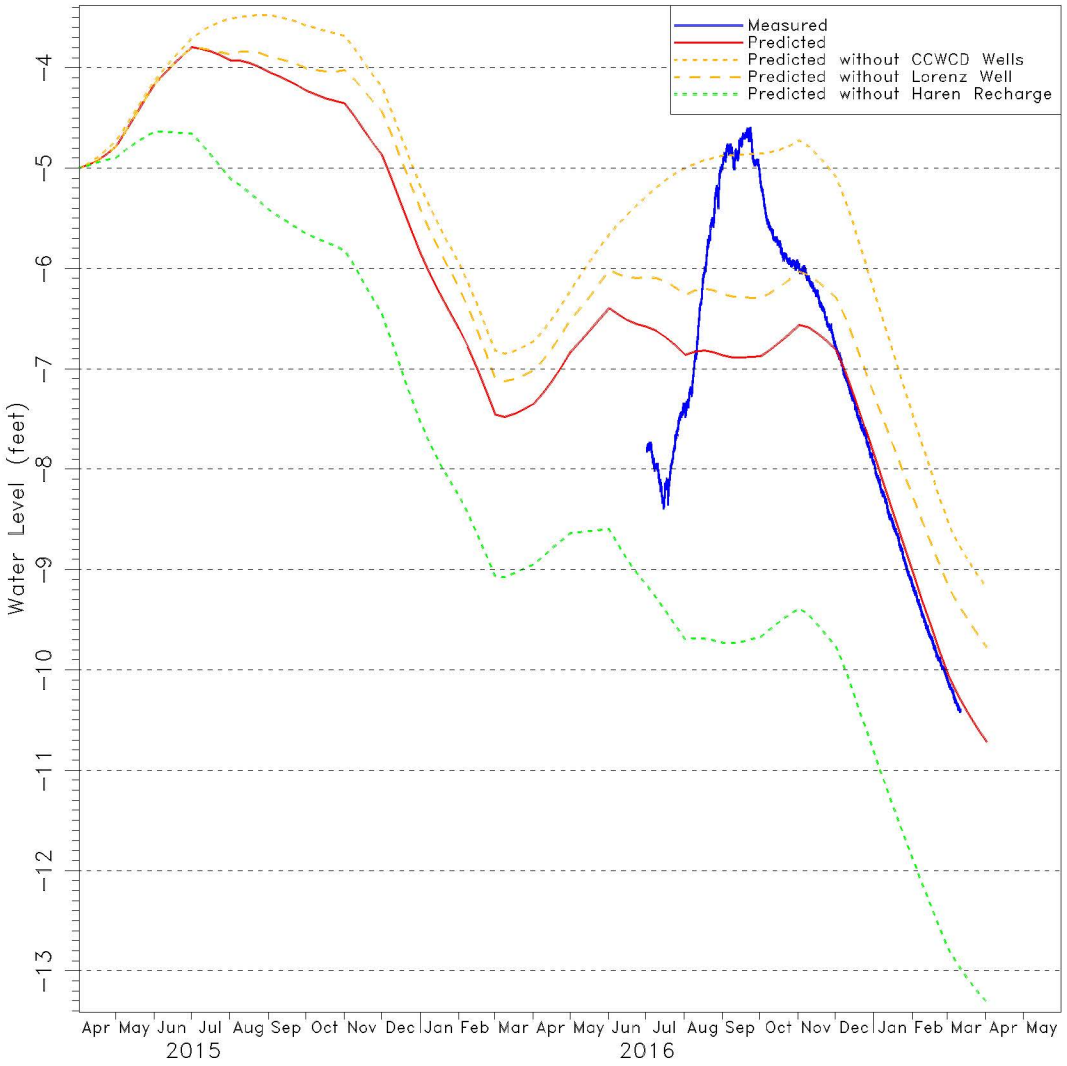

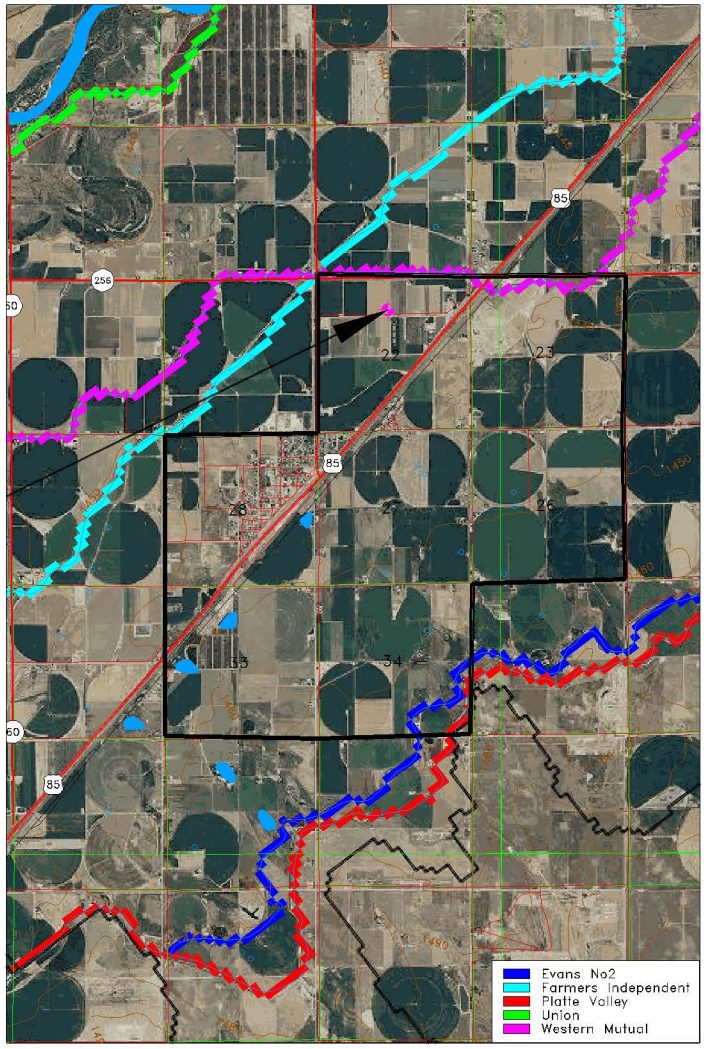

MW6: Fritzler West

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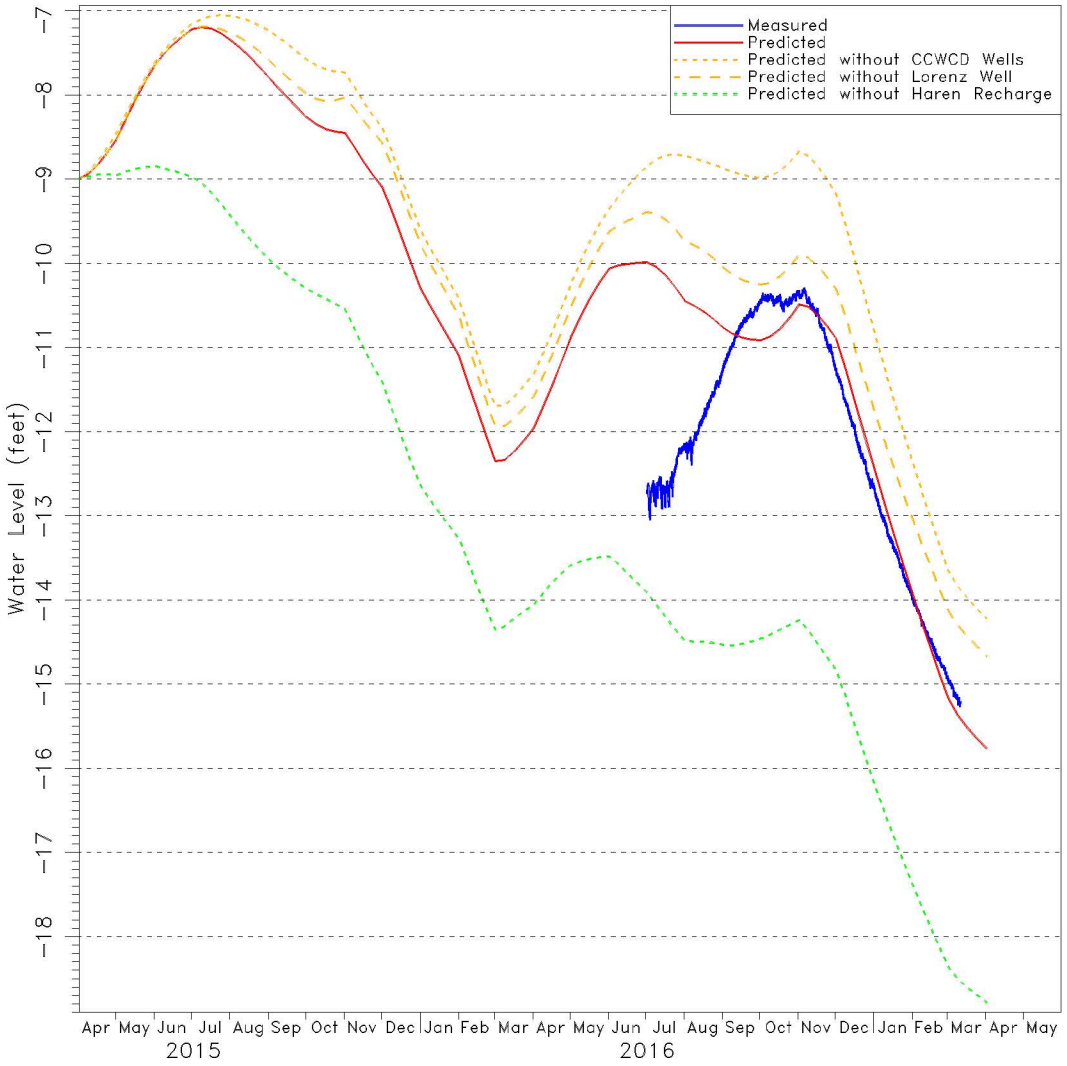

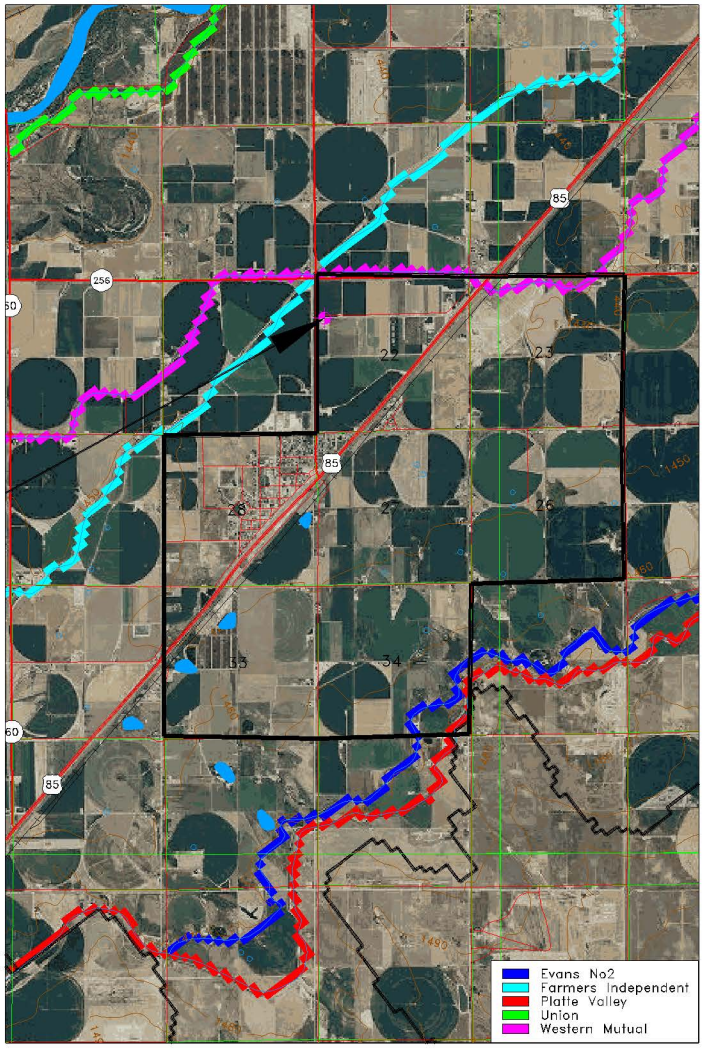

MW7: Weideman

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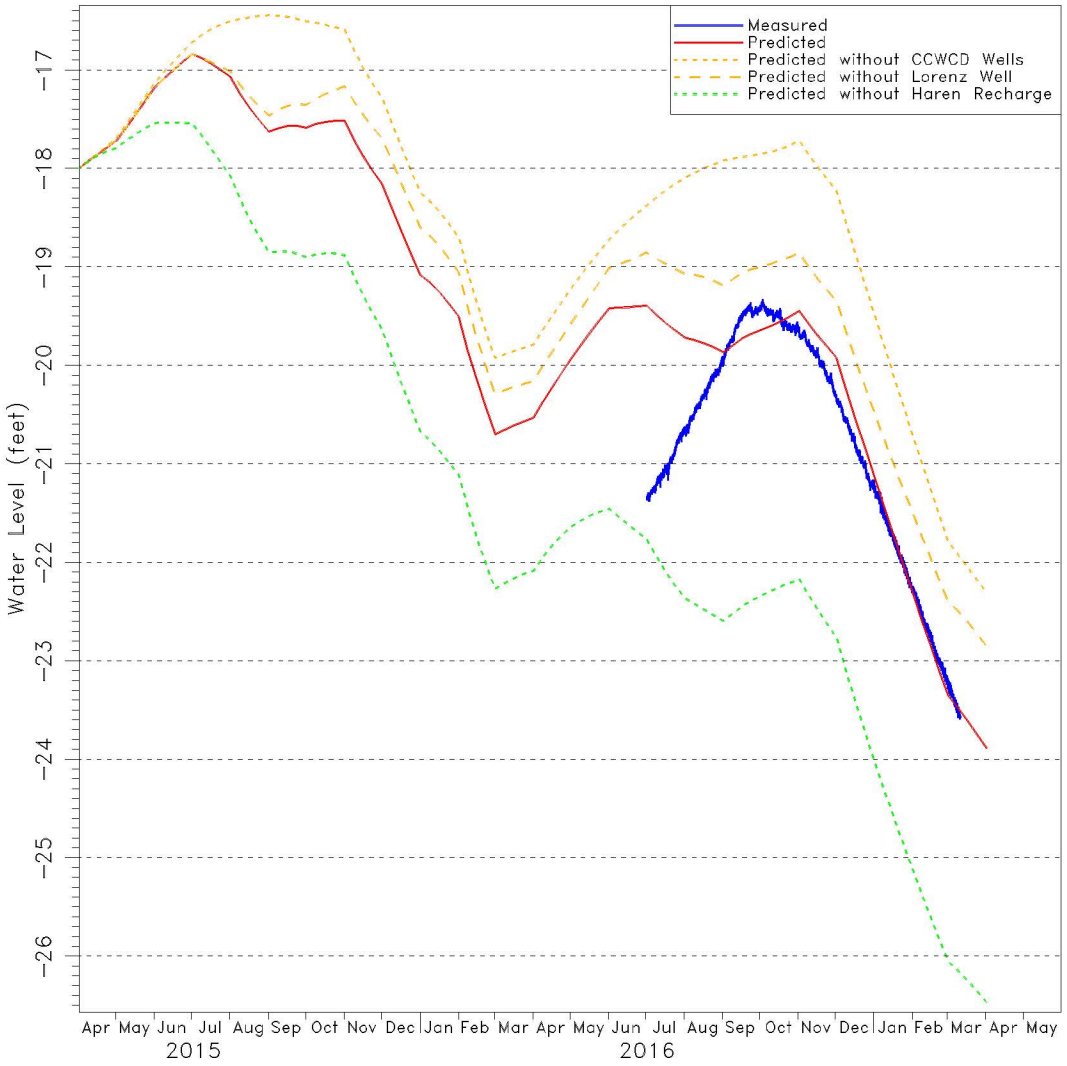

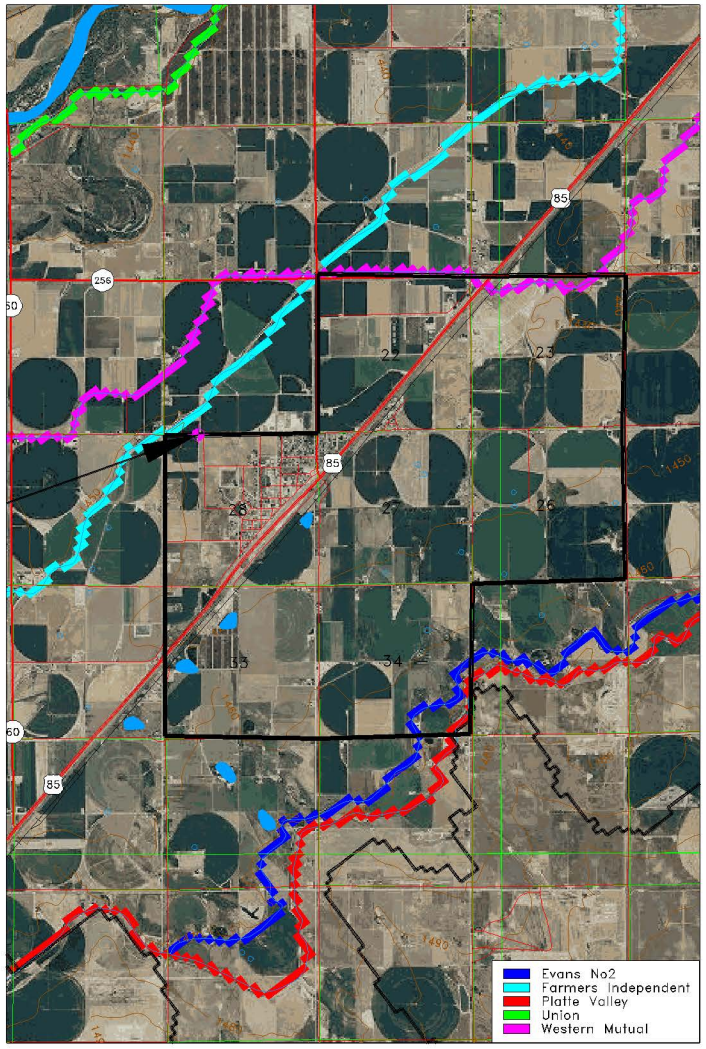

MW8: Ulrich West

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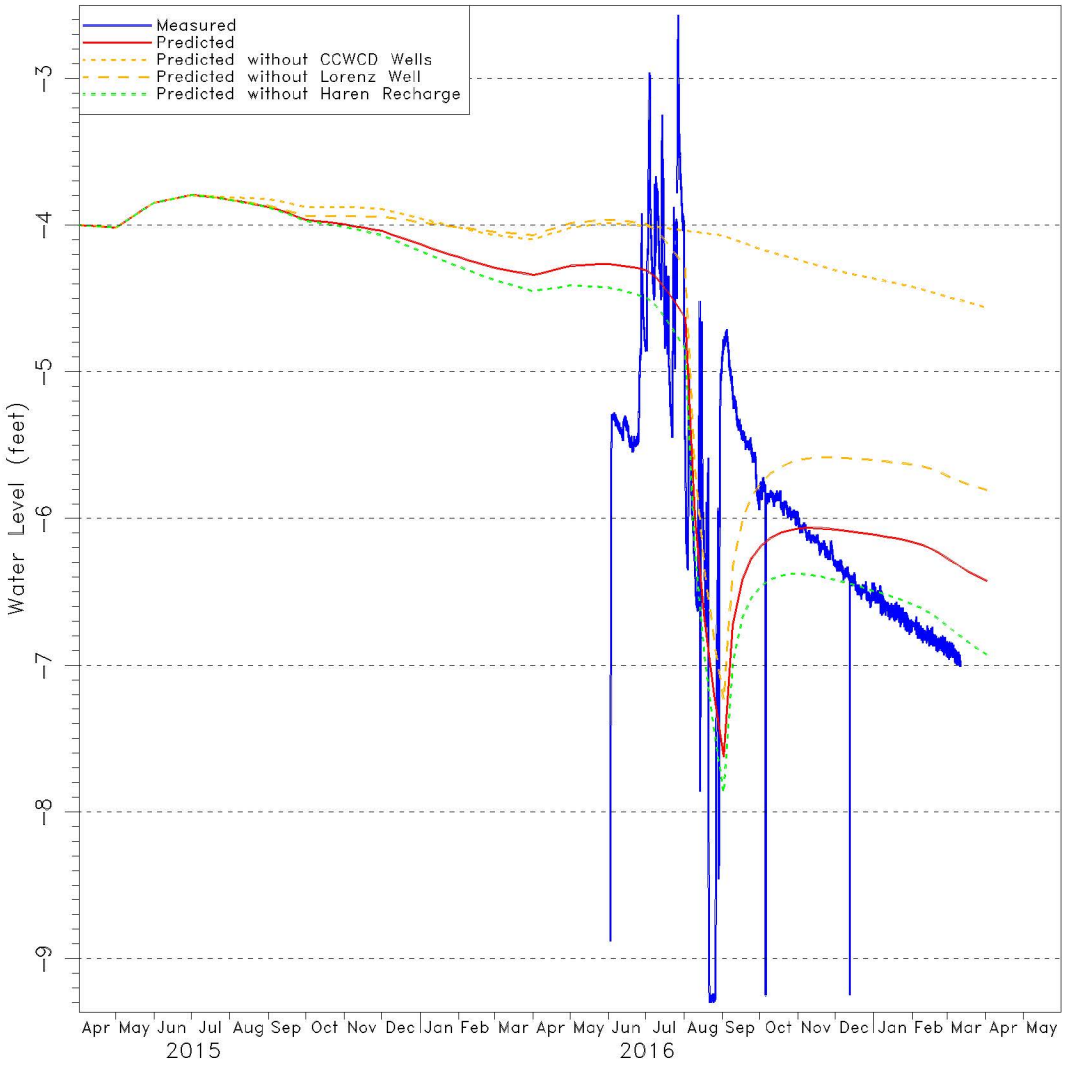

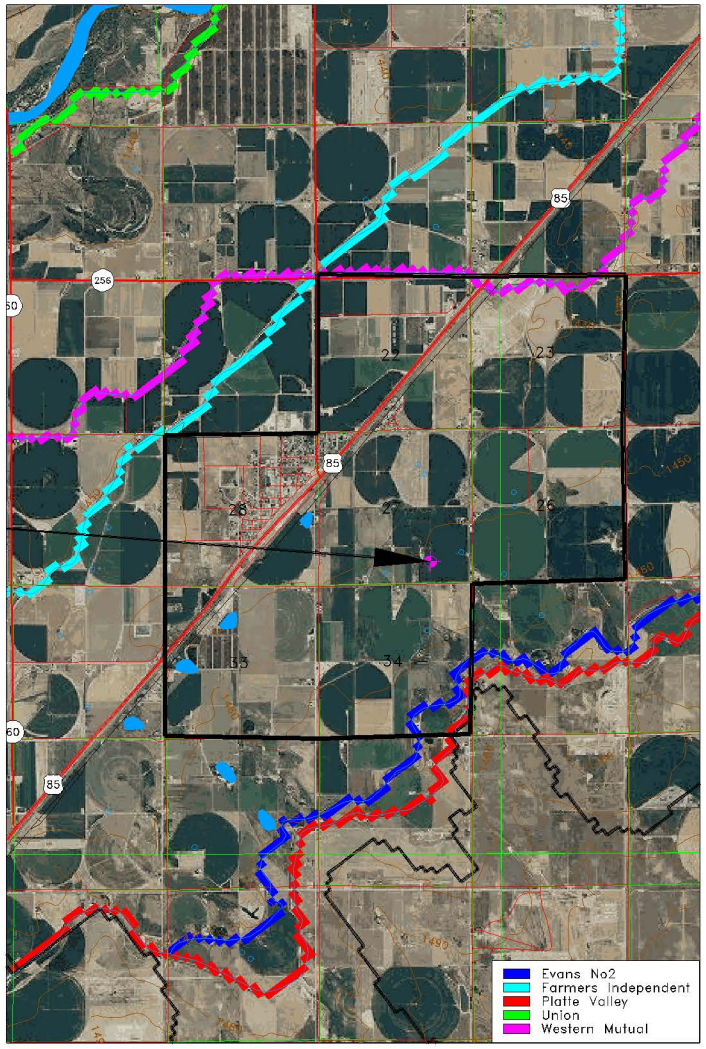

MW9: Ulrich East

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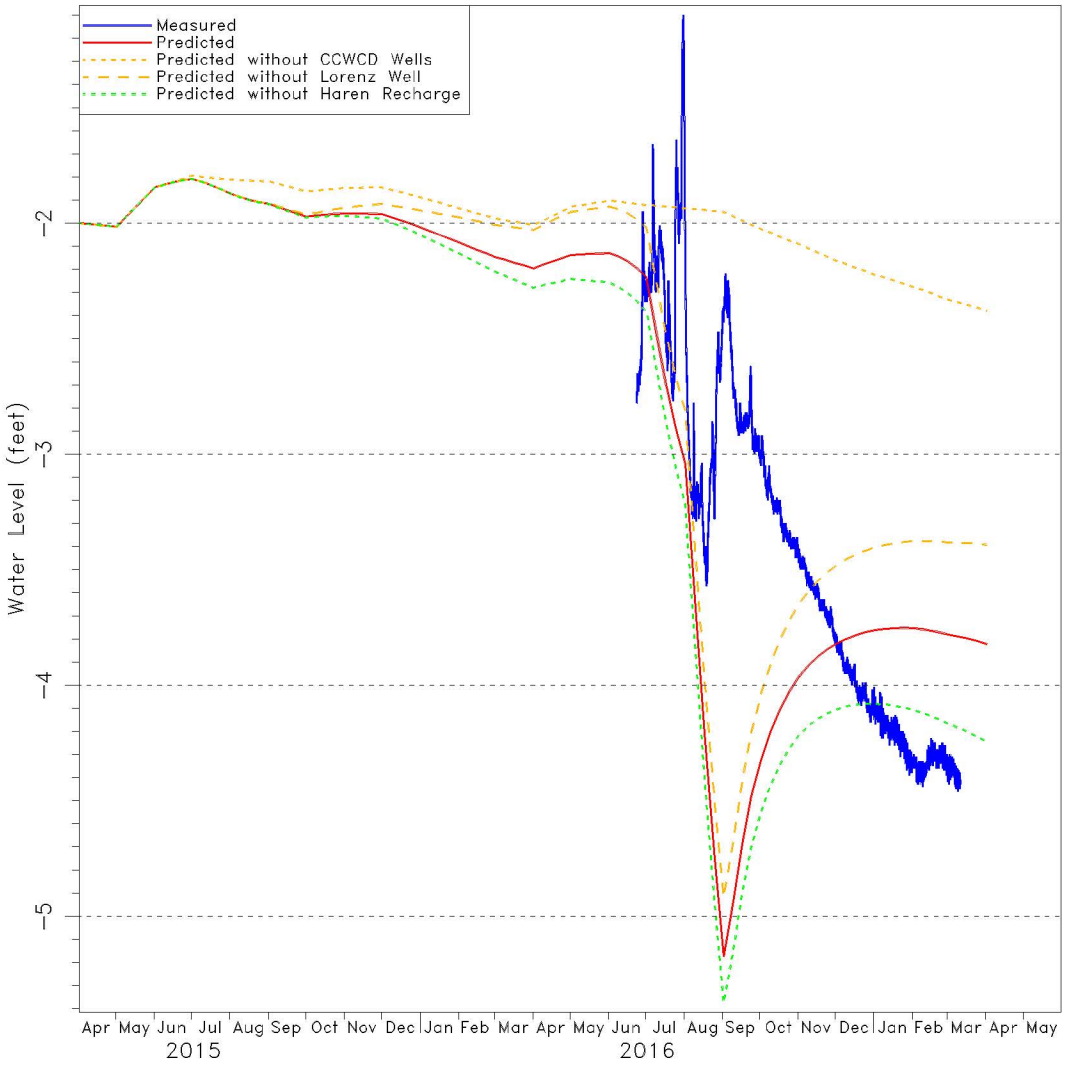
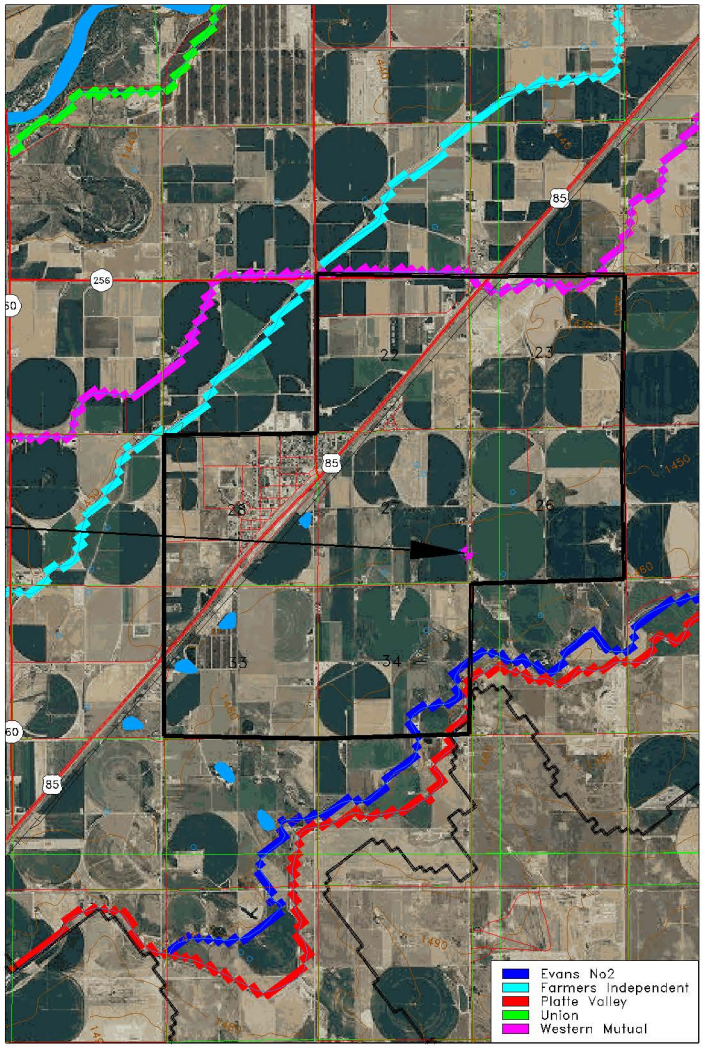
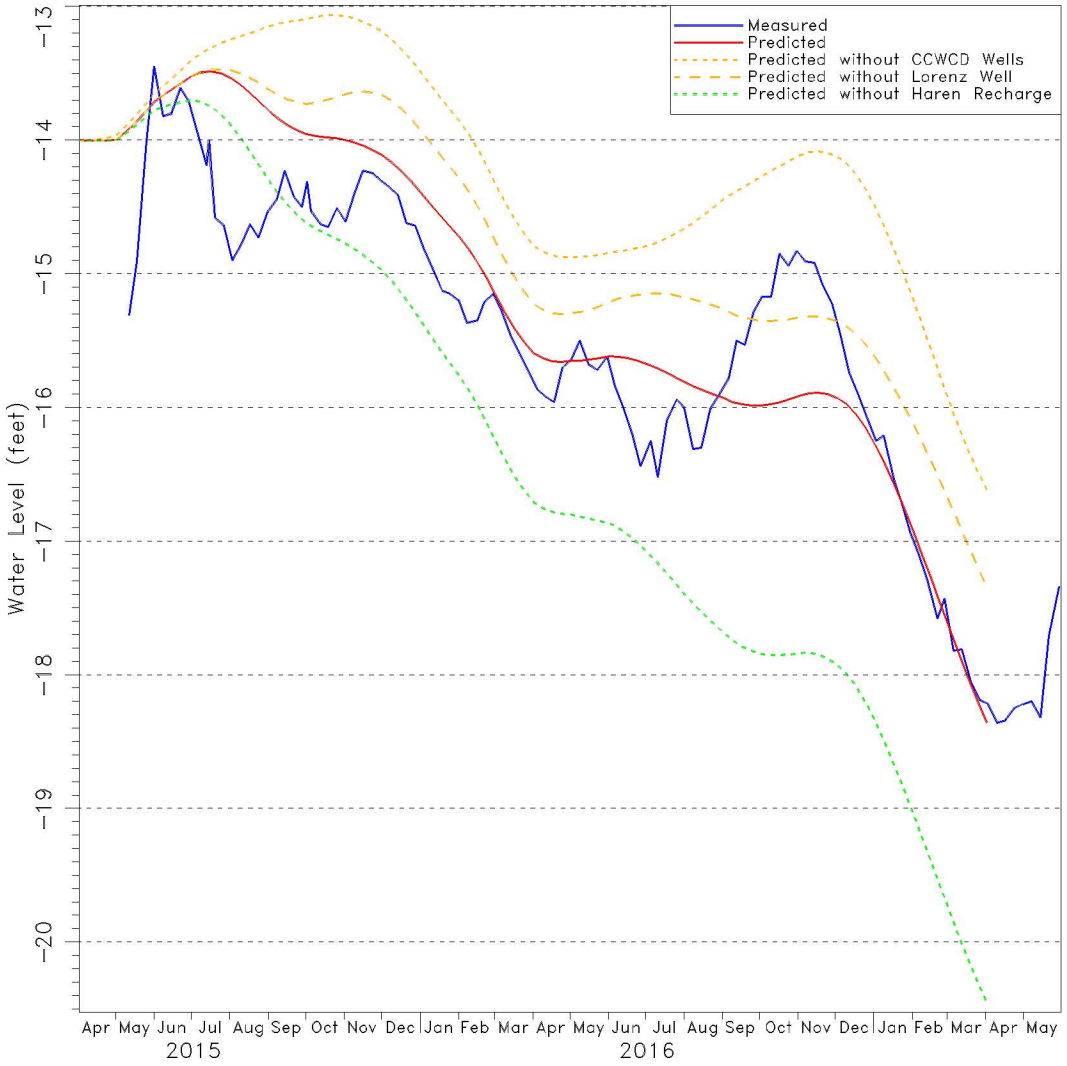
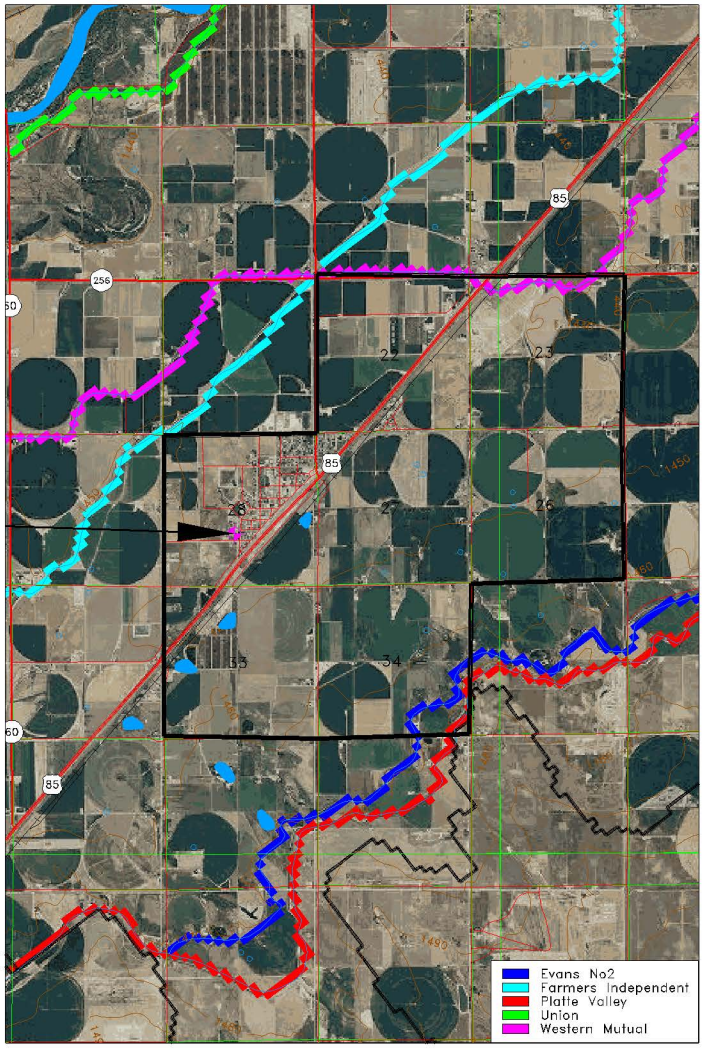




Nelson

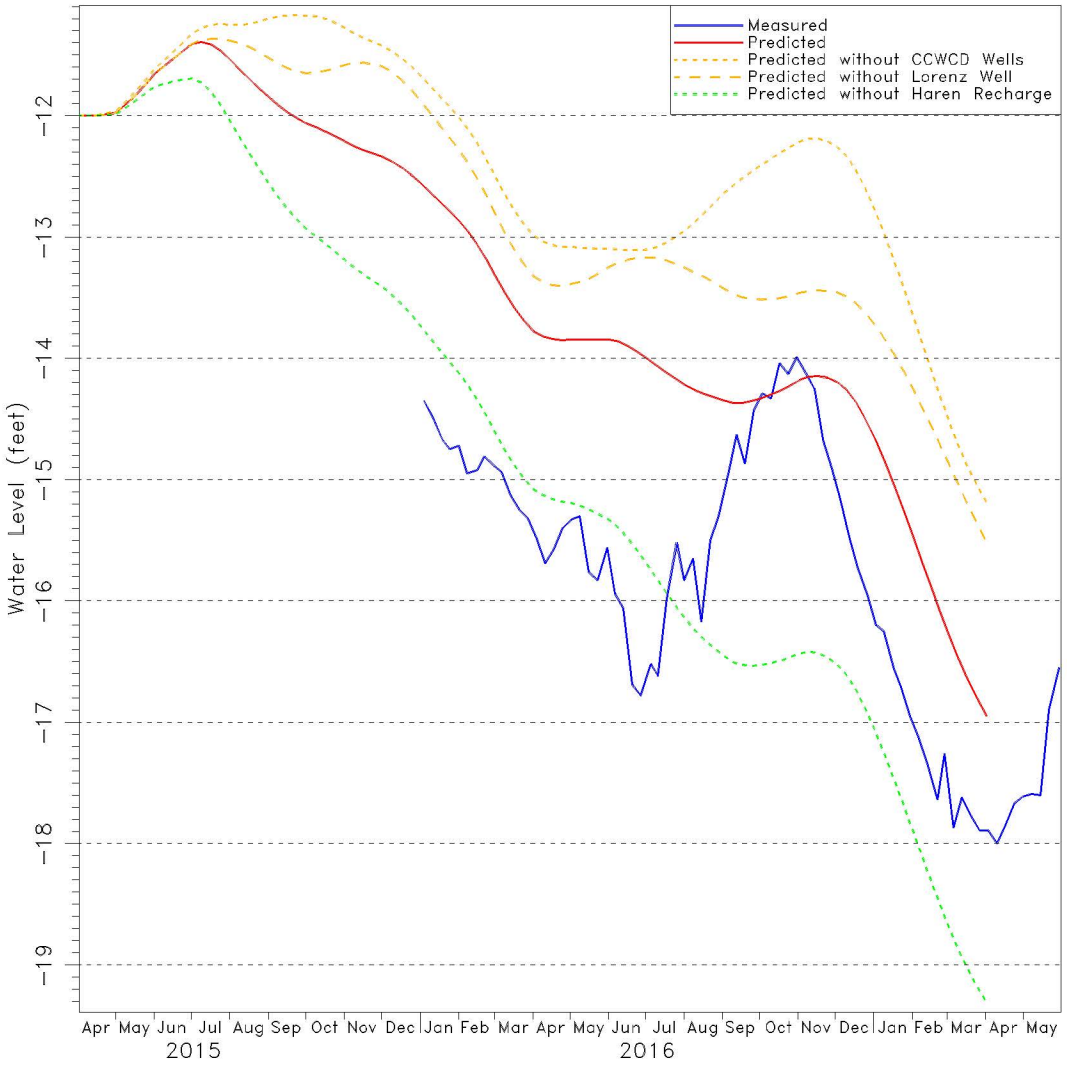
SPDSS Change Model

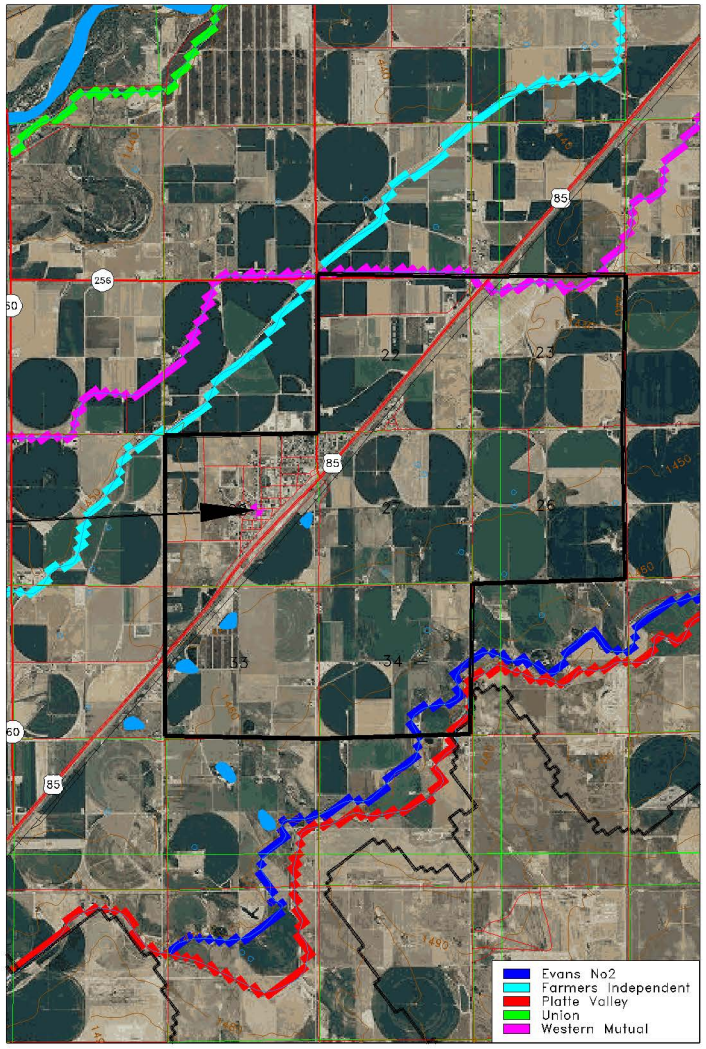




Main & Elm

SPDSS Change Model





5th Street

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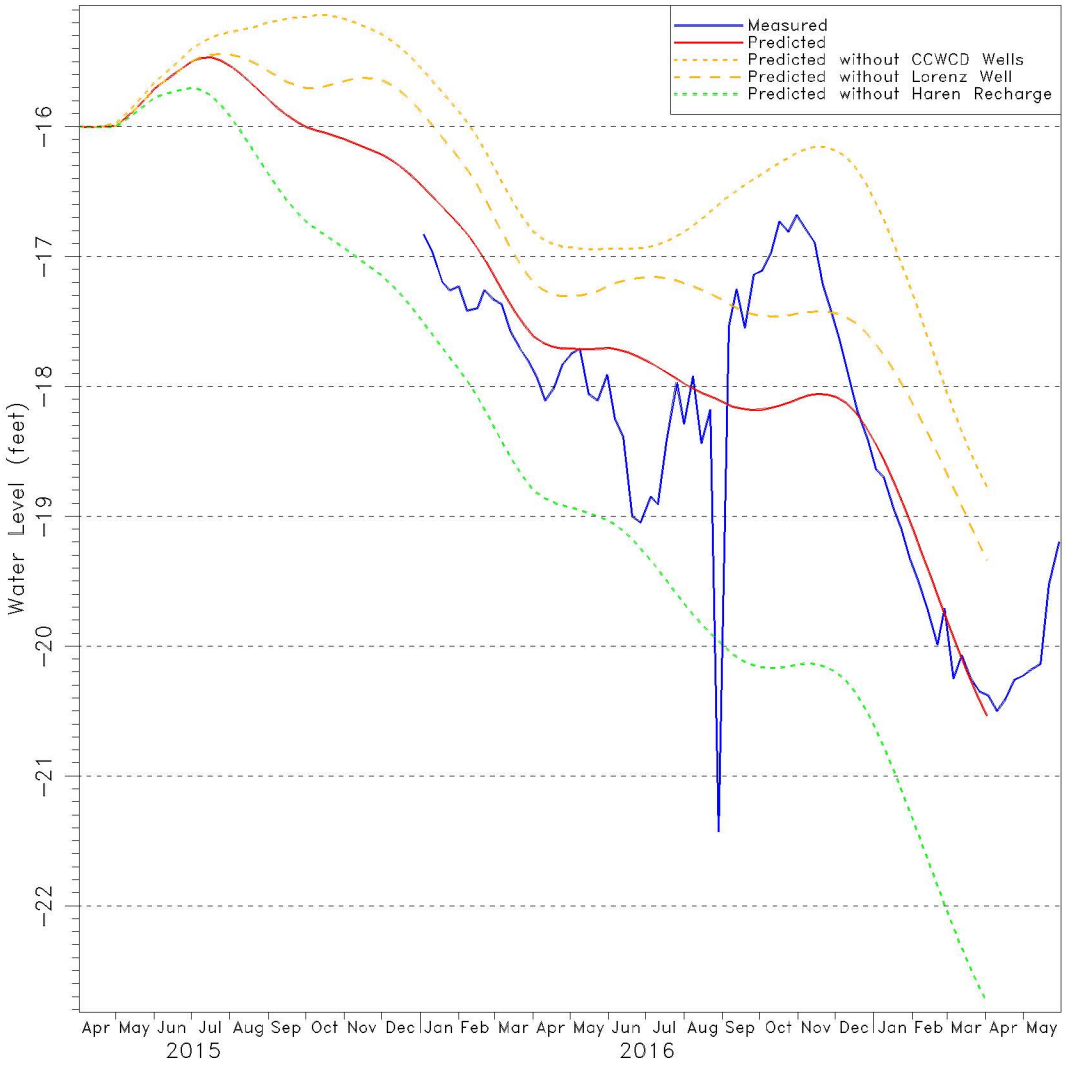

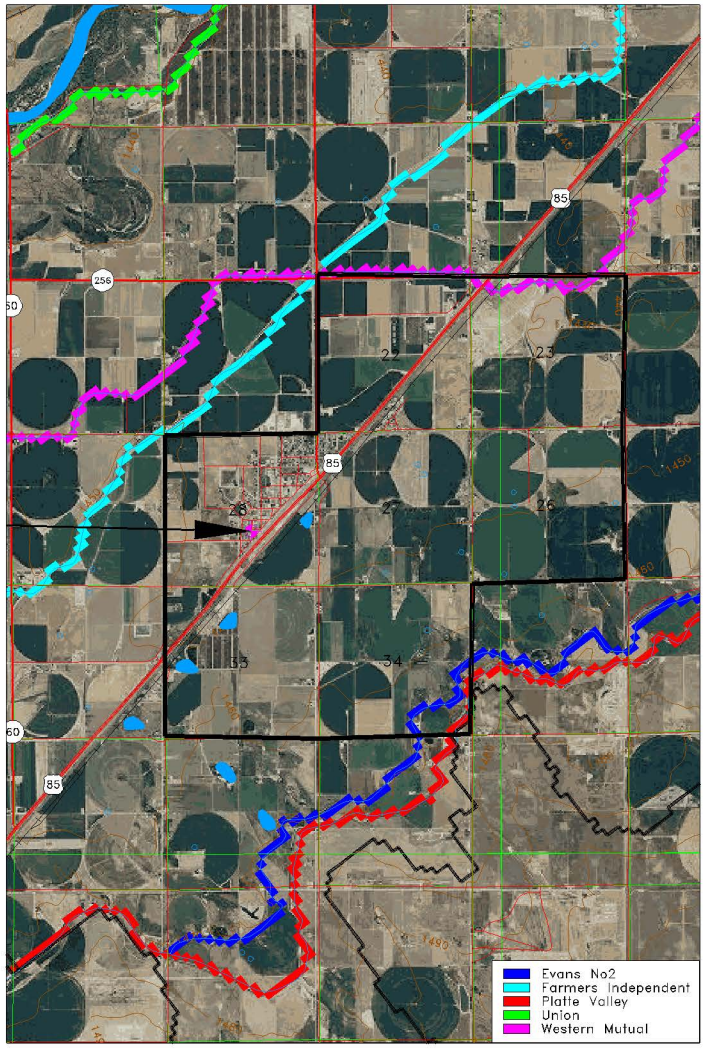

Town Hall

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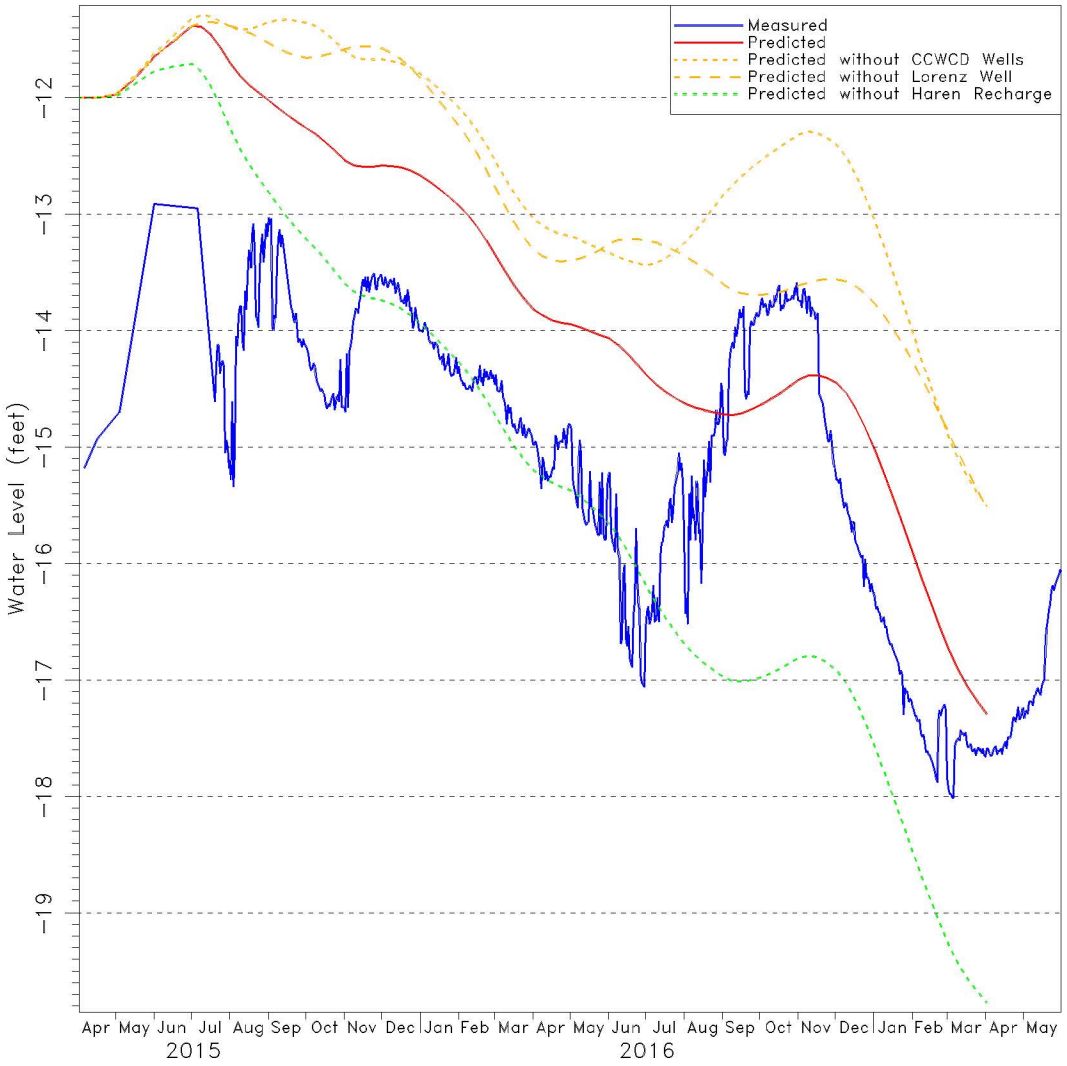

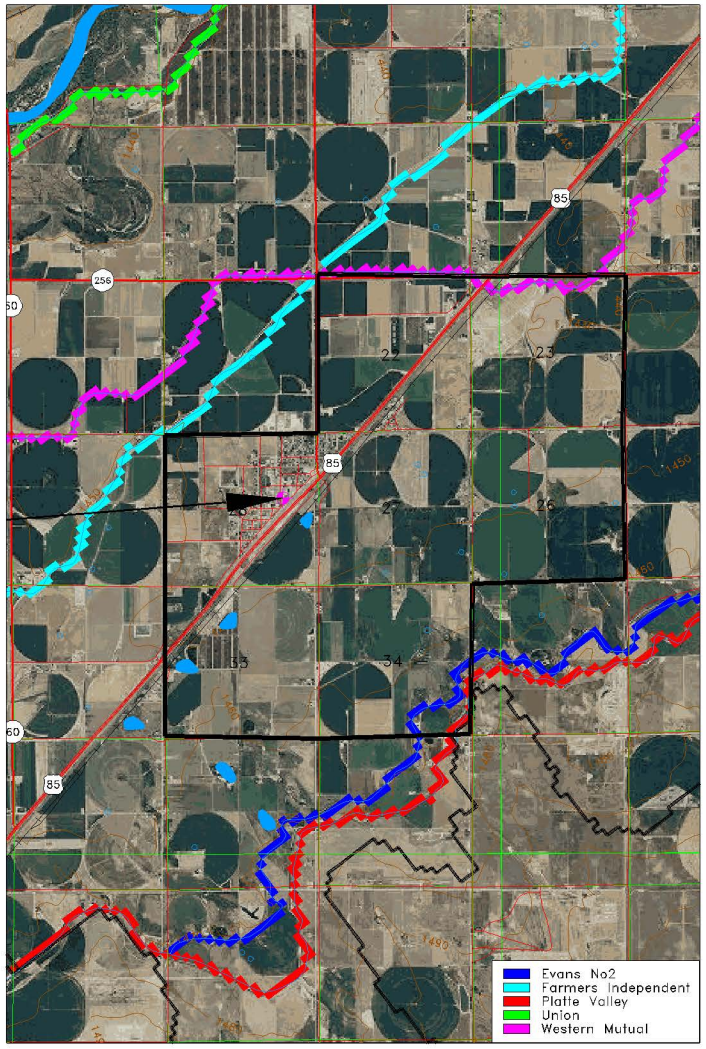

GMP

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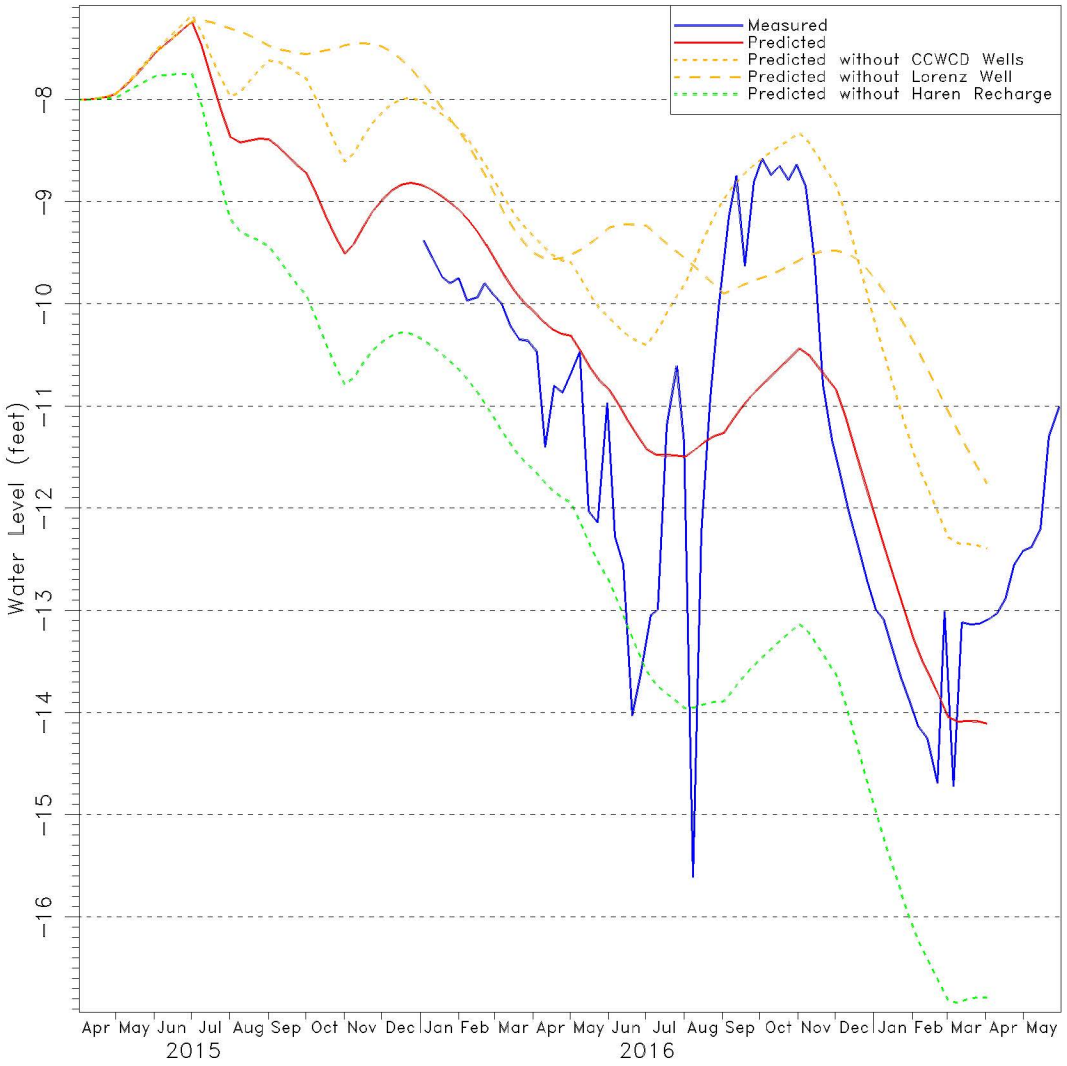

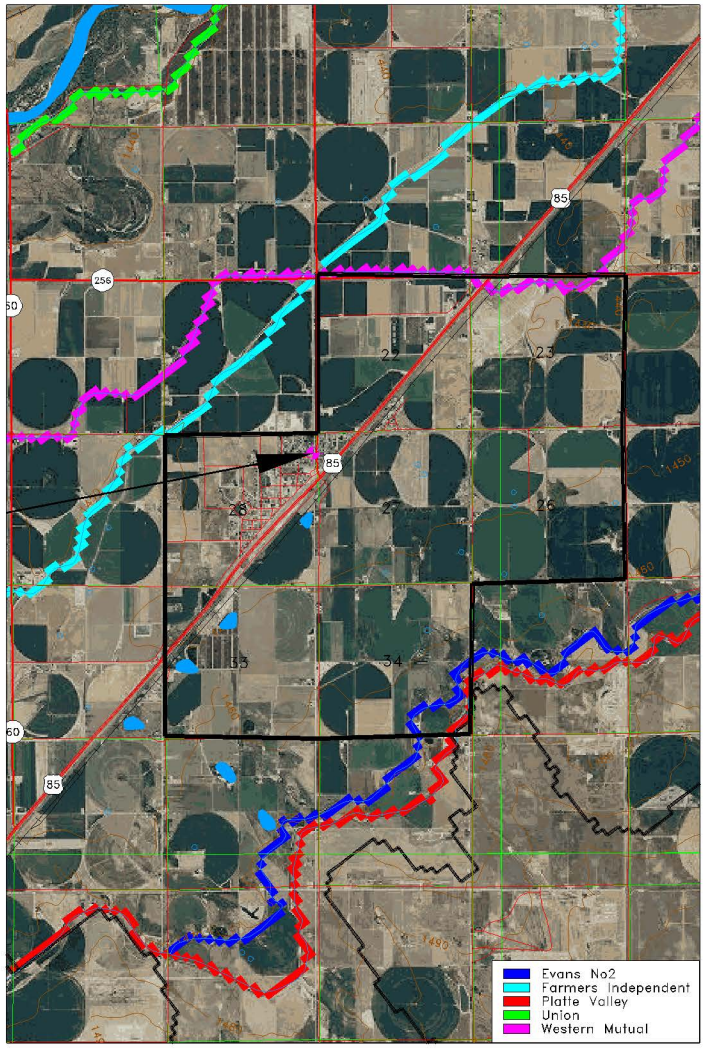

WWTP Wet

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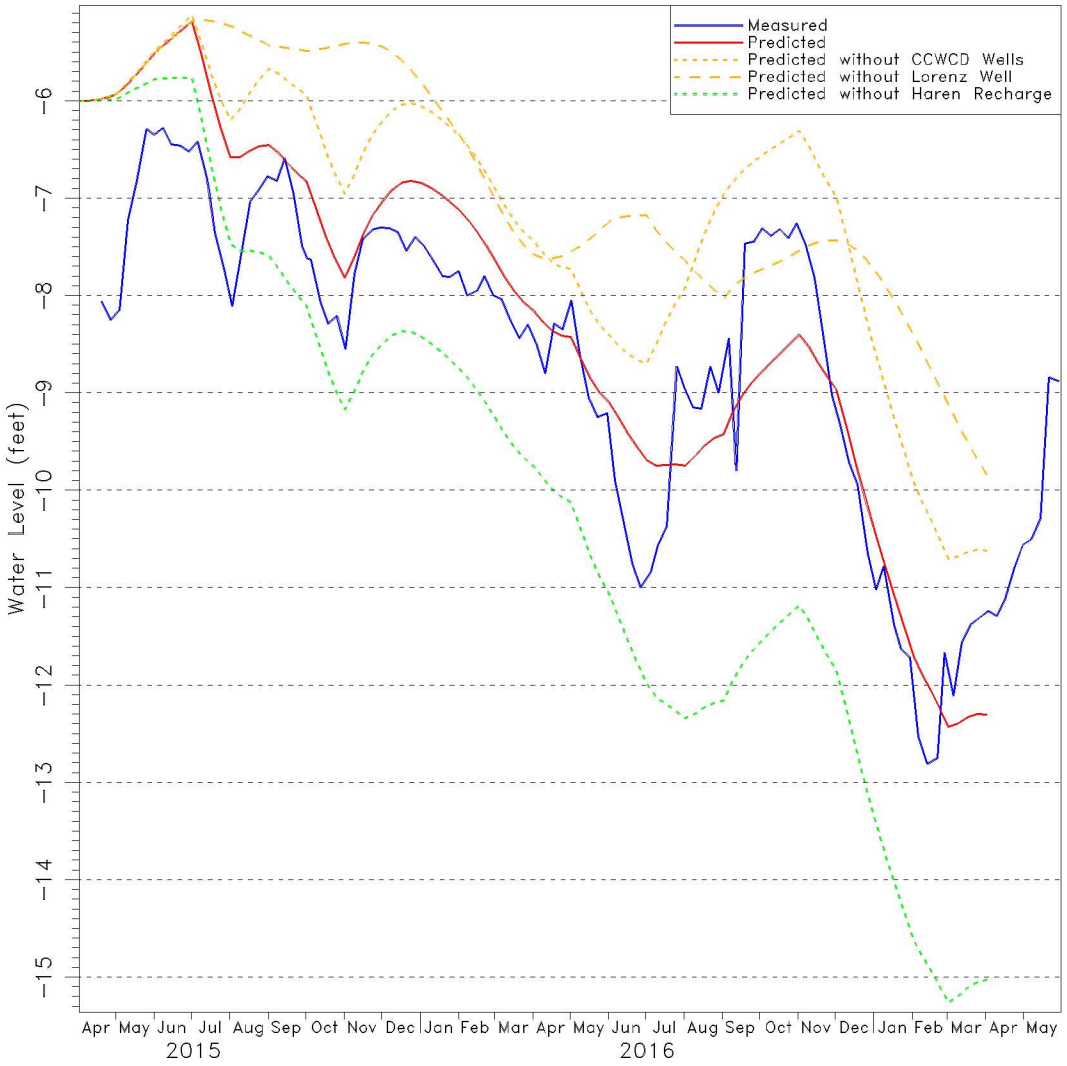

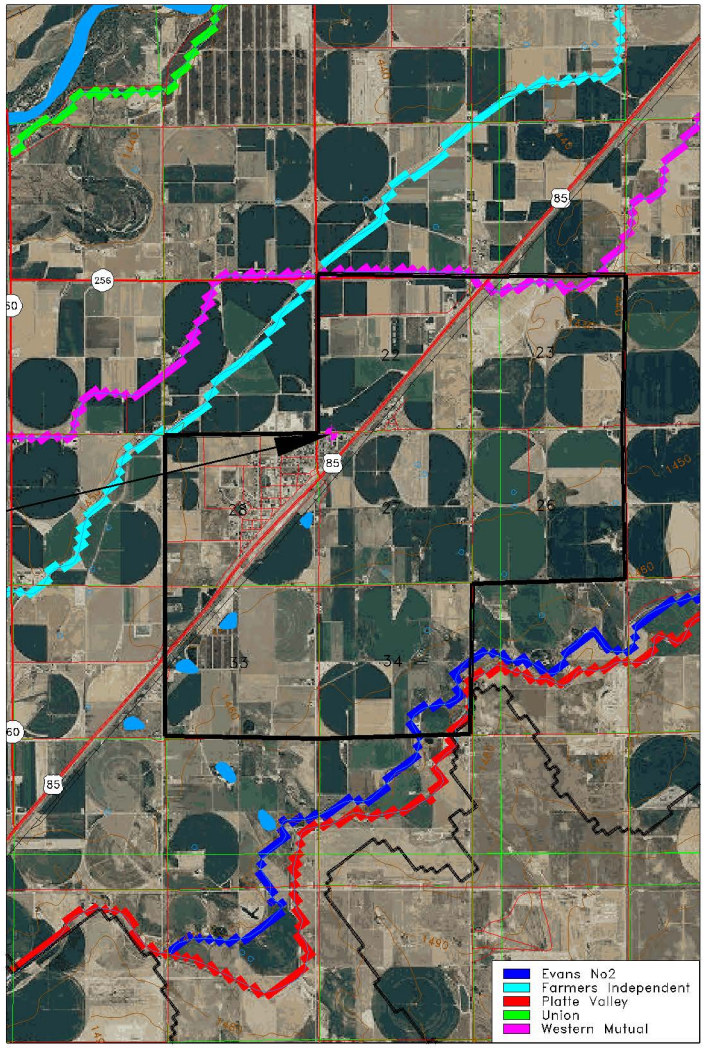

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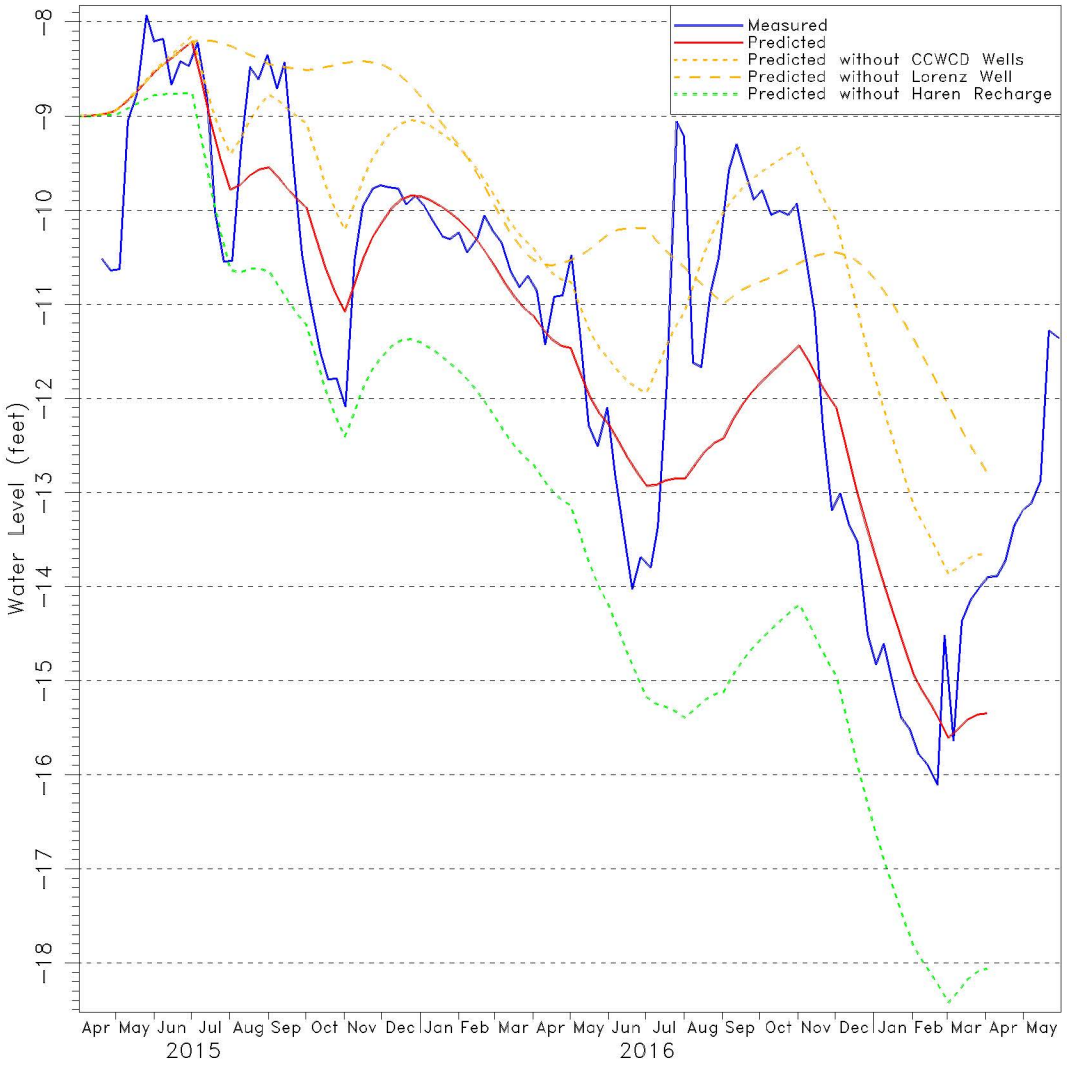

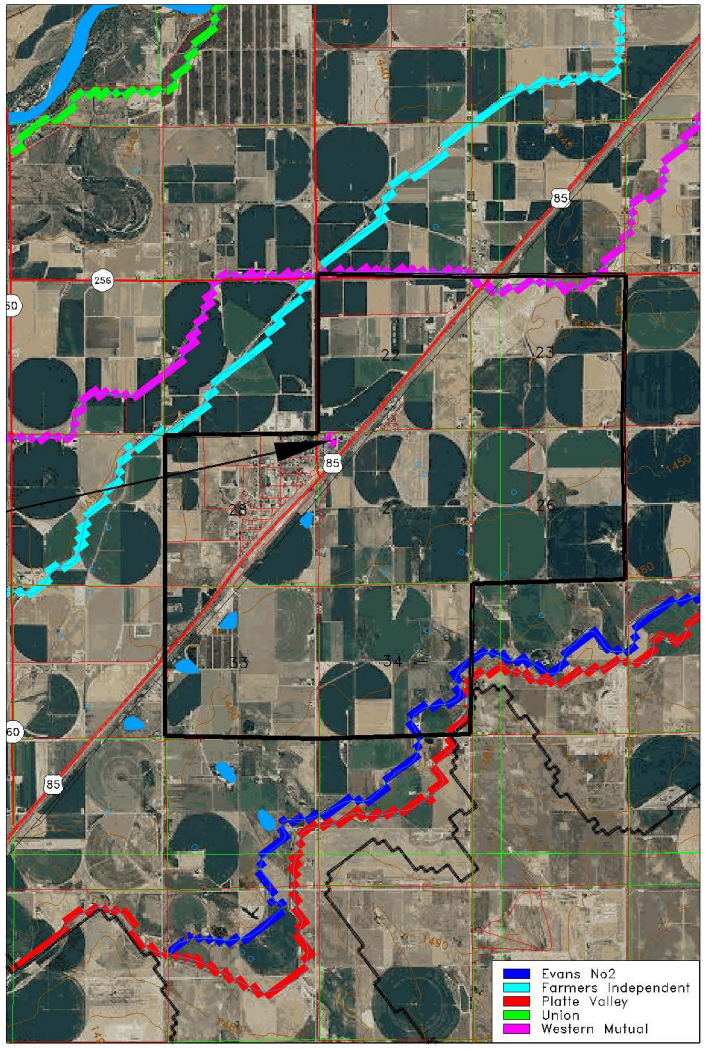

WWTP East

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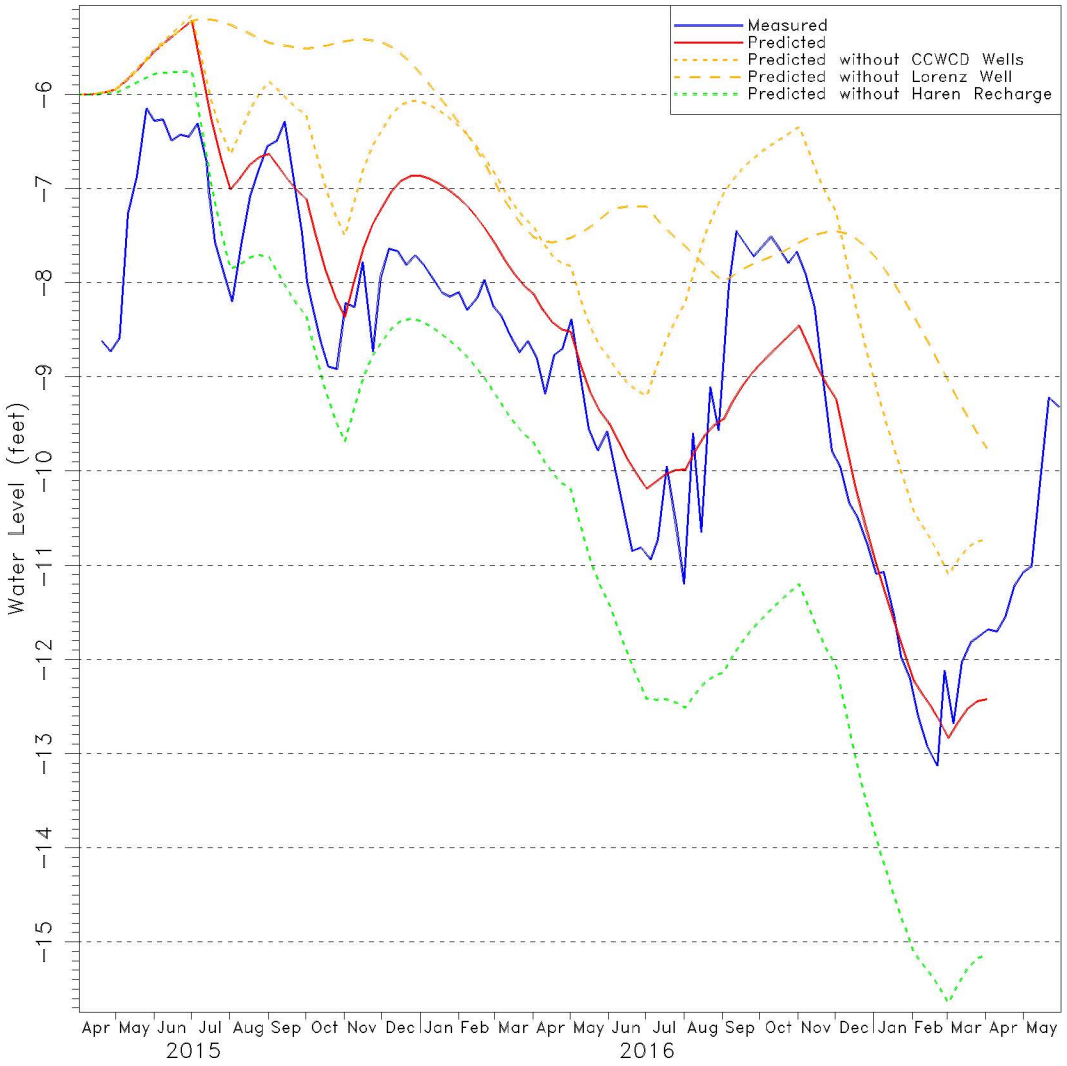
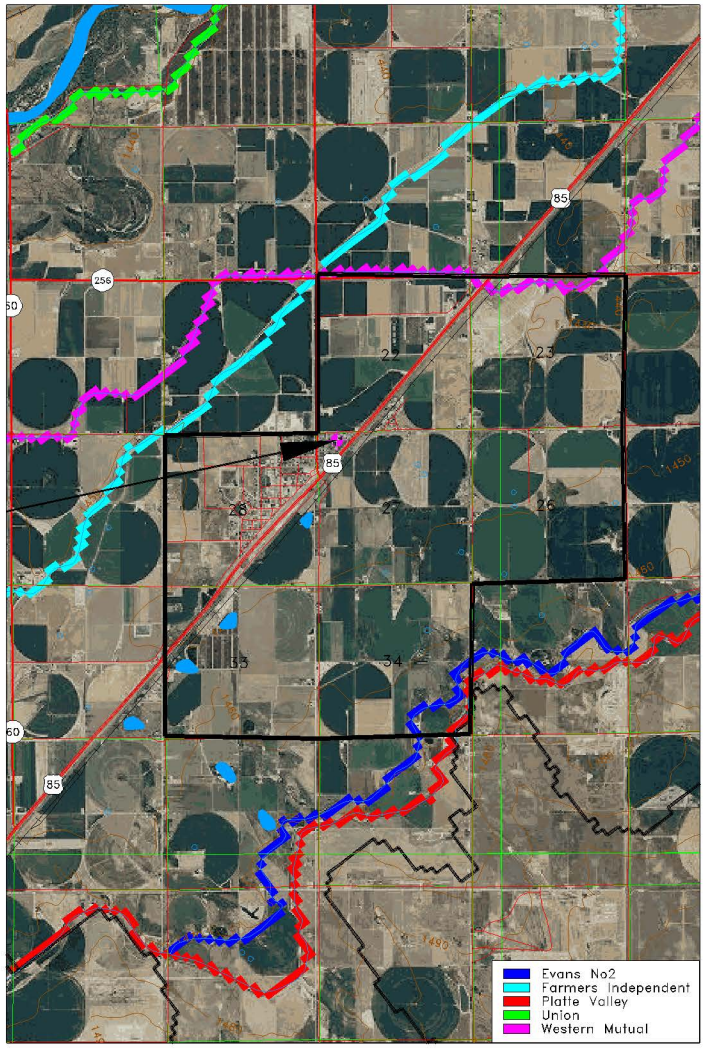
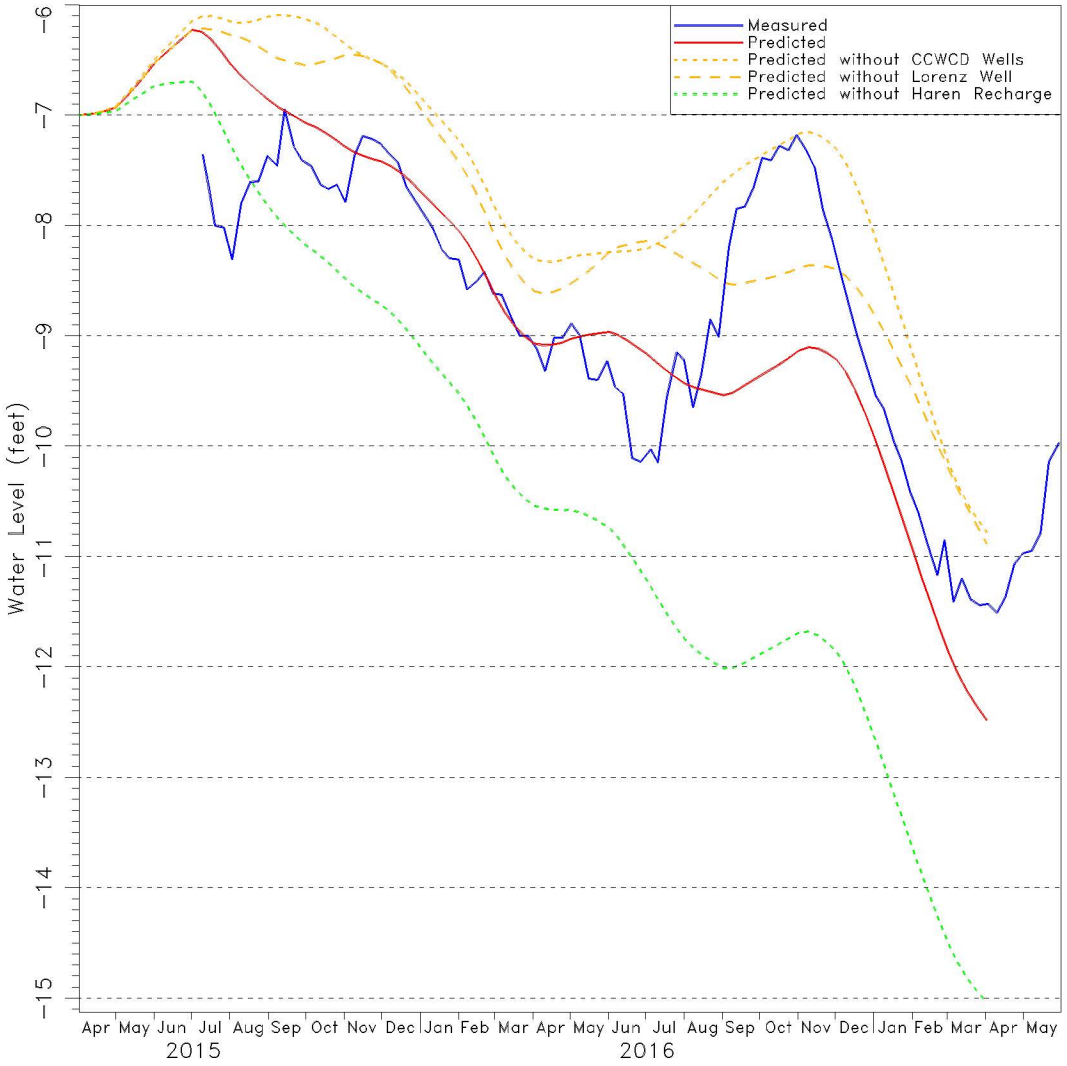
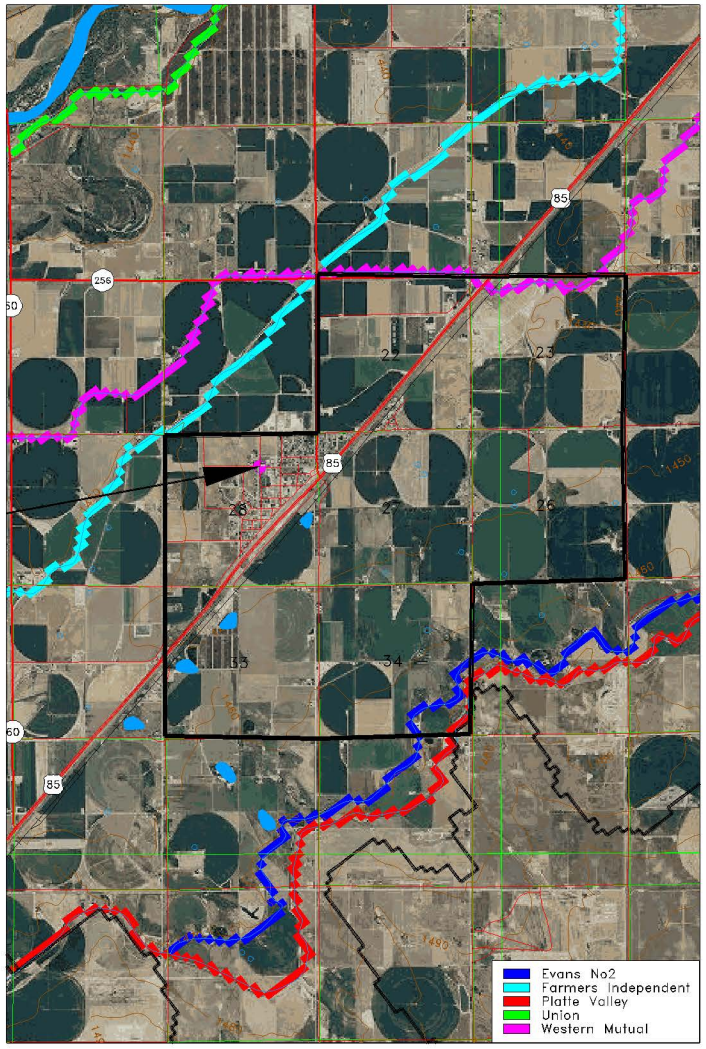




RE1

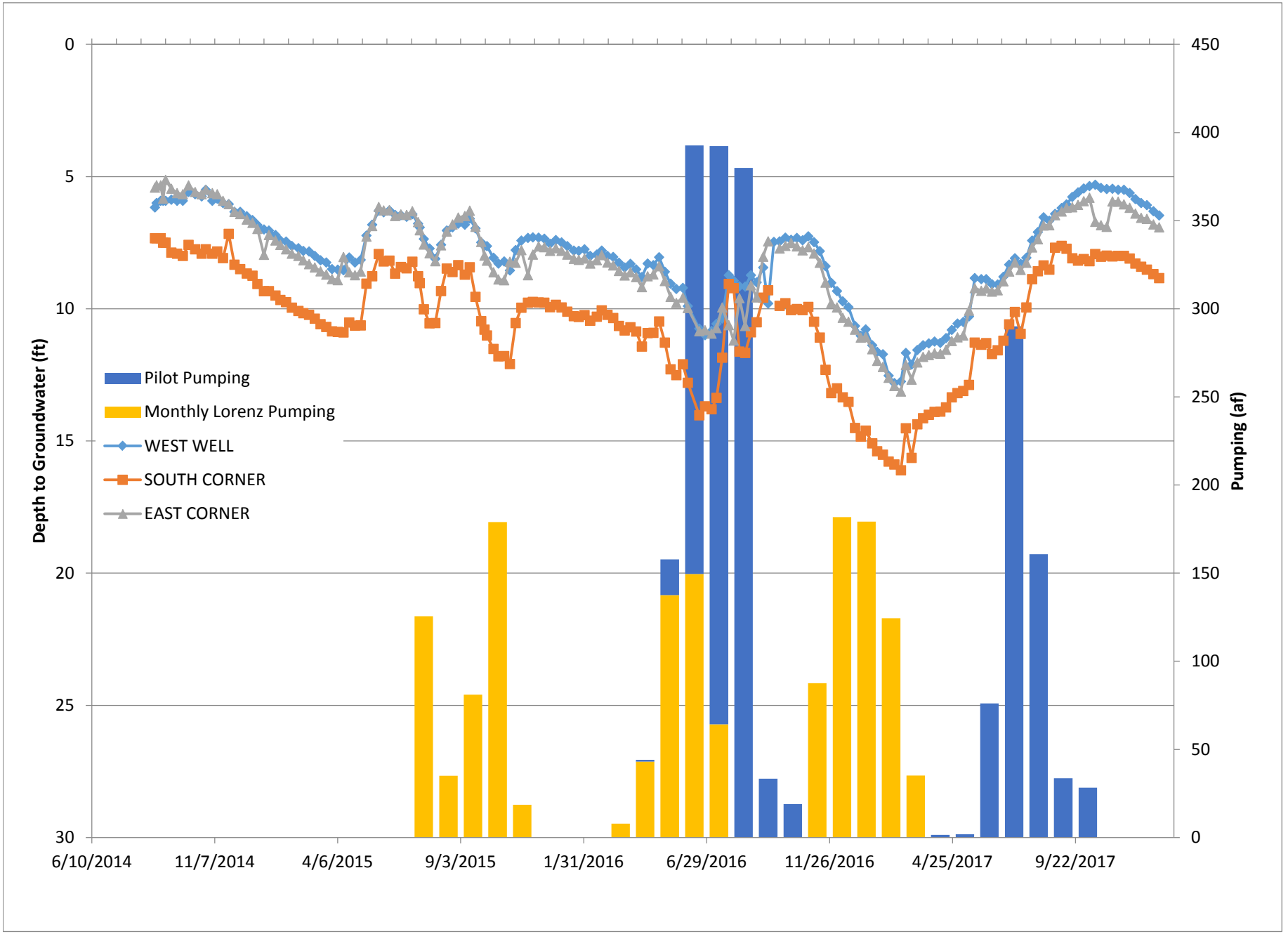
SPDSS Change Model





Attachment 4

Gilcrest Waste Water Treatment Plant Groundwater Levels


Depth to Groundwater (ft)
Pumping (af)
0
5
10
15
20
25
30
450
400
350
300
250
200
150
100
50
0
Pilot Pumping
Monthly Lorenz Pumping
WEST WELL
SOUTH CORNER
EAST CORNER
6/10/2014
11/7/2014
4/6/2015
9/3/2015
1/31/2016
6/29/2016
11/26/2016
4/25/2017
9/22/2017