Delaware Water Supply Coordinating Council Meeting

DRAFT Meeting Minutes
Meeting Date: September 24, 2020
Meeting Location: Virtual Webex Meeting

CALL TO ORDER - Steven M. Smailer, P.G., DNREC, Chairman

Mr. Smailer called the meeting to order at 10:06 a.m. He stated how well the Council has continued to work and accomplish tasks during the quarantine. Mr. Vic Singer asked if today's meeting is considered a formal meeting since the May meeting was informal and Mr. Smailer replied that this meeting is formal.

The meeting attendance list is included at the end of the meeting minutes.

WATER CONDITIONS REPORT – Stefanie Baxter, P.G., Delaware Geological Survey

Mrs. Baxter presented a summary as of September 22, 2020, of hydrologic conditions that is considered a snapshot of water conditions and are tracked on a monthly basis (see attachments titled *Northern Delaware Drought Advisory Guidelines* and *Hydrologic Conditions*).

Mrs. Baxter said, "We have a surplus of water in the northern part of the state because of the intense rain last month."

As stated in Mrs. Baxter's handout:

- Precipitation for a 12-month period at the Wilmington Airport was +4.20" and +4.07" for a 6-month period.

Mrs. Baxter then discussed the stream flows and stated they are dropping a bit and she will be keeping an eye on them.

As stated in Mrs. Baxter's handout:

- Brandywine Creek (30-day moving avg) was at 171 mgd.
- White Clay Creek-Stanton (30-day moving avg) was at 91 mgd and White Clay Creek-Newark (30-day moving avg) was at 36 mgd.

Mrs. Baxter stated, "Well Db24-18 is doing well. It's in the normal range."

As stated in Mrs. Baxter's handout:

- Well Db24-18 at 12.66 (fbls) (normal).

She continued, "Because of the rain we had last month, the Water Conditions Index is solid at 8.14. Anything between 5 and 10 is considered normal so we're doing great. Chlorides at the Christina River near Newport are at 150.36. They are creeping up a bit but the chlorides on the Delaware River as of Monday were actually lower by about 6 miles than they typically are this time of year."

As stated in Mrs. Baxter's handout:

- Water Conditions Index was 8.14.
- Chlorides at 150.36.

Mrs. Baxter stated that the information given in her handout on Hoopes Reservoir, Newark Reservoir, and Aquifer Storage and Recovery have not been updated but she will update everything once they are presented at today's meeting.

She stated, "As of September 21st, the Chlorides on the Delaware River were at RM 71 and typically they are at RM 76. Storage in the NYC Reservoir as of Monday was 76 bg above drought watch."

As stated in Mrs. Baxter's handout:

- Chlorides on the Delaware River as of 9/21/20: Normal RM: 76 and the Current RM: 71.
- NYC DRB Reservoirs (DRBC as of 9/21/20) storage 194.8 bg or 76.1 bg above drought watch.

Mrs. Baxter discussed the Kent County Hydrologic Conditions as of September 22, 2020, and said, "Kent County also has quite a bit of surplus as far as precipitation goes."

As stated in Mrs. Baxter's handout:

- The Kent County Hydrologic Conditions: precipitation Dover 12-month +9.84", 6-month +10.73", 5-month +10.26". Streamflow for the St. Jones at Dover 30-day moving average (August 24-September 22) at 38 mgd and is above normal. Groundwater for Well Mc51-01a, which is located in southwestern Kent County, is at 9.22 fbls and is above normal (normal for September is between 12.0 fbls and 14.6 fbls).

Mrs. Baxter discussed the Sussex County Hydrologic Conditions as of September 22, 2020.

As stated in Mrs. Baxter's handout:

- The Sussex County Hydrologic Conditions: precipitation Georgetown 12-month -0.52", 6-month -0.04", 5-month -0.70". Streamflow for the Nanticoke River at Bridgeville 30-day moving average (August 24-September 22) at 55 mgd and is above normal. Groundwater for Qe44-01, which is near Trap Pond, at 10.31 fbls and is normal (normal for Septmeber is between 8.8 fbls and 11.2 fbls).

Mr. Smailer said, "Things are in the middle right now but in a good way." Mrs. Baxter agreed.

The DGS' full analysis is found on http://www.dgs.udel.edu .

FORECAST SYNOPSIS – Dr. Dan Leathers, State Climatologist

Dr. Leathers presented a Power Point presentation (see attachment titled *Weather Summary and Forecast*).

He began with an update on where we are so far as far as weather and temperatures. As stated in the presentation on the slide titled *January-August Temperature Anomalies*: Dr. Leathers said, "January through August temperature anomalies for the entire United States have been above normal. The northeast portion of the United States is really one of the warmest places across the country." Dr. Leathers said, "Delaware has followed that."

As stated in the presentation on the slide titled *January-August Temperature Anomalies from the 2010-2020 Mean*: Dr. Leathers said that this map zeros in on Delaware and he discussed how the color red means we've had an above normal year so far. He stated these are anomalies compared to the last ten years.

As stated in the presentation on the slide titled *January-August Precipitation Anomalies*: Dr. Leathers said, "If you take a look at the precipitation for the country, the western United States has actually been below normal precipitation this year and the southeast part of the United States has been quite above normal in precipitation. Here in the Mid-Atlantic we've been just a little bit above normal but a lot of variation."

As stated in the presentation on the slide titled *January-August Precipitation Anomalies from the 2010-2020 Mean:* Dr. Leathers said, "The deep green color shows anywhere from 4-8" above normal in precipitation for the year." He continued to discuss and stated how Sussex County hasn't seen much precipitation.

As stated in the presentation on the slide titled *Sussex County DEOS Precip (2020 to 2020) vs. Climatology*: Dr. Leathers said, "This is a cumulative precipitation graph. The dark line is our ten-year normal for Sussex County based on our DEOS data and the green line shows where we are this year." He continued to discuss and he said as you go north those positive anomalies in precipitation increase greatly.

As stated in the presentation on the slide titled *Precipitation – Evapotranspiration January 1-September 19, 2020*: Dr. Leathers said, "This shows what water is coming into the state versus what's going out naturally. Most of the state is above zero which means that we've had more water coming in since January 1 than going out." He added, "Where you see the green is where we've had a lot more water coming in than going out." He also stated that the northern part of the state is really quite wet while Sussex County is near normal or a little bit dry.

Dr. Leathers gave an update on the Autumn Forecast.

As stated in the presentation on the slide titled *ENSO Neutral Conditions*: Dr. Leathers said, "We're coming out of ENSO Neutral Conditions right now and going into an incipient La Niña." He continued to discuss how the blue lines show a prediction of below normal sea surface

temperatures in the Pacific through the early part of the winter season at least or a weak La Niña event.

As stated in the presentation on the slide titled *OND Temperature Distribution for Climate Div. #007*: Dr. Leathers discussed and stated that this shows what our temperatures usually look like during those La Niña events.

As stated in the presentation on the slides titled *OND Precipitation Distribution for Climate Div. #007*: Dr. Leathers stated that we tend to be a little bit dry although there's not as much of a difference.

As stated in the presentation on the slide titled *NOAA Extended Outlook Autumn 2020:* Dr. Leathers said that the left map shows the entire country is expected to be above normal in temperatures and precipitation and for us it looks like above normal conditions.

Dr. Leathers gave an update on the Hurricane Season and said, "The hurricane season has been incredible this year."

As stated in the presentation on the slide titled *Summary of Hurricane Forecasts*: Dr. Leathers stated that this shows what was predicted earlier in the year.

As stated in the presentation on the slide titled *2020 Atlantic Basin Tropical Cyclone Tracks*: Dr. Leathers said, "We've already gone through the whole alphabet and we're in the Greek alphabet now. It's been an extremely busy season." He added that Tropical Storm Isaias helped give us those high precipitation totals in Delaware.

Dr. Leathers added, "Even though we're already in the second letter of the Greek alphabet, we still have more than 1/3 of the hurricane season to go." He added that this time of the year is when we can get some big injections of precipitation in our area from tropical systems.

Mr. Brinson asked if there were any questions. Mr. Singer asked, "Why did they leave out X, Y, and Z when naming hurricanes?" Dr. Leathers replied, "It's hard to come up with that many names." They continued to discuss.

Mr. Smailer discussed the low recharge area in Sussex County (refer back to the slide titled *Precipitation – Evapotranspiration January 1-September 19, 2020*). He said it happens to be very close to the Sentinel Well that is used down there for Groundwater conditions in Sussex County near Trap Pond. Mr. Smailer and Dr. Leathers continued to discuss.

DRBC UPDATE – Chad Pindar, DRBC

Mr. Chad Pindar gave an update on the DRBC Hydrologic Conditions that is released every Monday (see attachment titled *DRBC Hydrologic Conditions Report, September 21, 2020*).

Mr. Pindar stated that the Hydrologic Conditions were already discussed by Mrs. Baxter. He discussed DRBC's assets in Federal Storage. He said, "We've got a reservoir in the Schuylkill

Basin called Blue Marsh and another in Beltzville Reservoir which is in the Lehigh Basin and the Commission can direct releases from both Reservoirs. To date, we have not been required to do so to meet targets and our assets are whole there. FE Walter is another Reservoir in the Lehigh Basin and we do not have daily storage there and that pool is being drawn down as part of their recreation plan. The river is experiencing some additional flows from storage but it's not being directed by DRBC out of FE Walter. It's just part of their normal operations." He discussed the 7-day precipitation totals. He said, "Overall I think things from a storage perspective are pretty good. Reservoir storage is looking good."

WATER UTILITY REPORTS – Water Purveyors

Mr. Smailer stated how he is appreciative of the water purveyors e-mailing their utility reports ahead of time to Mrs. Kimberly Burris so they can be compiled and distributed prior to the meeting and also be included in the meeting minutes.

Artesian – Ginney Eisenbrey reported: Water system delivery in northern New Castle County his recently been in the 18 mgd to 19 mgd range, which is generally typical for September. We began the annual recovery cycle for the Llangollen ASR well in early July. We have currently recovered 75 of the 89 million gallons in storage. We expect to continue recovery until early October and plan to begin the next recharge cycle shortly thereafter. All sources of supply and treatment are currently in operation.

Newark – Mark Neimeister reported: Current Demand: Water usage in the City has increased over the past few months due to the return of the student population (University of Delaware) and now reopened commercial sector. Water production from our Curtis Water treatment plant is slightly over 3 MGD. The City expects the average daily demand to decrease as the fall and winter months approach. Reservoir Levels: As of 9/23/20, the Newark Reservoir was -7 feet from full. Major Projects: In March of 2020, the City started it's roughly $4.5 million-dollar upgrades to the South Well Field Treatment Plant. The upgrades include the removal of the existing water storage tanks, construction of a new groundwater treatment facility, and construction of a new 250,000 gallon water storage tank. The project is nearly 75% complete with an estimated startup date in January 2021.

Mr. Smailer and Mr. Neimeister discussed the stream gage on White Clay and Mr. Neimeister stated that the USGS did talk about putting in a temporary stream gage just down stream of the dam. Dr. Jerry Kauffman also discussed and stated that the dam is deteriorating. Ms. Baxter also discussed the proposal with Dr. Kauffman and Dr. David Wunsch asked Dr. Kauffman who was in charge of removing the dam and he and Dr. Kauffman continued to discuss with Council.

New Castle – Jay Guyer reported: Water Supply Variables: (wells oos, reservoir down, ASR status, treatment facility status) MSC is using our 4 supply wells on a 30-day rotation cycle. All 4 well drawdown and static levels are at normal levels for this time of year. The treatment facility, carbon filtration system, 4 wells, and both elevated tanks are in service and performing without any issues. Miscellaneous Issues: (Special conditions or reports) No issues to report.

Water Demand in MGD: (current status, anticipated future changes to reduce or increase demand)

Month	Daily Average (gal)	Total Pumped (gal)
May	.40	10,587,486
June	.42	13,569,671
July	.46	14,488,700
August	.41	12,603,977
September (MTD as of 21ST)	.52	11,066,032

Demands are average for this time of the year based upon previous years.

Water Infrastructure Activities: (tank painting, reservoir work, wells rehabbed, replaced, added, treatment changes)

- Spring Hydrant Flushing was completed the last week of June / first week of July.
- MSC's contractor abandoned 2 old test wells that were not being used for security reasons.
- MSC is partnering with Calgon Carbon Corporation and STRIDE to conduct a pilot study using several types of carbon and an Ion Exchange Resin to evaluate their performance in the removal of PFAS compounds from drinking water.
- PFAS Sampling was completed in June on our carbon filtration system with results indicating the lead vessel carbon is approximately 75% consumed. The system is performing as designed removing PFOA and PFOS to a non-detect level at the point of entry.
- MSC has been performing routine system maintenance including 2 hydrant replacements and an inline valve replacement.

SUEZ – Larry Finnicum reported: Water Supply: Average day demand year to date is 14.6 MGD from Stanton WTP. TCS has been inflated only to address some sand accumulation in and around the TCS area. The new Clearwell project adding 4 MG of storage at the Stanton Water Treatment Plant went online June 15th. This project added redundancy for distribution pumping leaving the plant as well as more finished water storage to allow for increased operational flexibility. ASR: Renewal Application for the ASR UIC Permit submitted. Operations will be performing some maintenance in the next 2 months in preparation for new recharge period.

Wilmington – Mary Neutz reported: Water Demands: Average Daily Demand in August was 15.9 MGD. The maximum daily demand this summer was 19.597 MGD. Hoopes Reservoir: Currently at 88 ft. Porter Clariflocculator Replacement Project: Of the 6 clariflocculators, 1 had been replaced, 2 and 3 are currently being replaced.

Tidewater – Tawanda Priester reported: Water demand in New Castle County is roughly .677 MGD, Kent County is roughly 1.99 MGD, and Sussex County is roughly 6.29 MGD

Sussex Shores – Not present.

BOWERS BEACH UPDATE – Matthew T. Grabowski, DNREC, Division of Water

Mr. Grabowski presented a Power Point presentation (see attachment titled *Bowers Beach Monitoring Initiative*).

Mr. Grabowski began with his overview as stated in the presentation on the slide titled *Overview*:

- Small Coastal Town (Estimated Population 335).
- Bowers Beach is situated along the Delaware Bay between the St. Jones River to the north and the Murderkill River to the south.
- The Department has received complaints from well owners in Bowers for a number of years regarding elevated chlorides.
    - WSS Conducted a study back in 2006 sampling wells throughout the town
    - Resulted in established GMZ for increased permit review
    - Deep well recommendations
- Most new wells within the town have been constructed in the Cheswold aquifer.
- Fast forward to 2019
    - Department received a chloride complaint regarding a Cheswold well that was constructed in 2013
    - Department sampled and confirmed elevated chlorides
    - First time elevated chlorides observed at this depth (potential construction issue)
    - Department Action
        - Properly address Cheswold well issue
        - Install long term monitoring points

Mr. Grabowski added that the residents are surrounded by salt on almost all fronts in Bowers and their primary water source are domestic wells and they utilize a variety of aquifers.

Mr. Grabowski presented a map of the Bowers project area and discussed Phase I (Abandonment Effort). He said, "The abandonment of a well is the responsibility of the property owner and/or their contractor but we wanted to request an abandonment above and beyond what we normally do for well abandonment issues." He also stated that this is a deep well and it's 355' ft down. He said, "We cost shared with the property owner to do something a little outside the box to try to maximize and improve the abandonment of this well so we contacted the well driller to use a perforation tool." Mr. Grabowski continued to discuss the process with slides showing photos of tools used including the Water Supply Section's downhole camera and drillers.

Mr. Grabowski discussed Phase II (Monitoring Well Construction). He said, "We installed four monitoring wells." He continued to discuss the process and show project photos. Mr. Grabowski also thanked the Delaware Bayshore Initiative for letting DNREC construct these monitoring wells on their property and also allowed DNREC to be part of their project. He added that the wells targeted were in the following aquifers: Columbia, Cheswold, Frederica, and Federalsburg. He said, "These are the primary drinking water sources that people are using in Bowers." He continued, "These wells were drilled in the beginning of March. Everything was lined up. We had people ready to be on sight. A contractor was coming down from New Jersey and then COVID-19 hit and our entire DNREC Division of Water was sent home.

Unfortunately, we didn't have anyone on sight when they were drilling to take photos other than the first day." He added that the project continued without DNREC on site and they did a good job. He continued to show photos of the project where trees were planted, etc. after the wells were drilled. The drilling portion of the project is now complete and photos show that the protective well covers are on.

Mr. Grabowski discussed the Next Steps (Long Term Monitoring). He said, "The Water Supply Section has purchased a number of Aqua Control 600's (or multi-perimeter data sondes) from In-Situ (vendor) to take an active role in monitoring the water quality in the drinking water sources that Bowers is using. They haven't been deployed yet because we're waiting on some telemetry to come in and that has been delayed due to COVID-19 but we're hoping to have them in the fourth quarter of 2020." He added, "It is a way to have quality data to the residents in Bowers but it's also an opportunity to have my Program get interested in going out in the field and engage and learn what equipment is out there." He continued to discuss.

Mr. Grabowski discussed the *Next Steps*:

- Piney Point soil boring (750' ft).
- Informational display in coordination with Delaware Bayshore Initiative.

Mr. Grabowski also discussed the new black and white well tags with QR codes that will take you to a portal when scanned (does not include public wells).

Mr. Grabowski asked if there were any questions. There were none.

AGRICULTURAL IRRIGATION MODEL DEVELOPMENT – Kevin Brinson, Assistant State Climatologist

Mr. Smailer stated to the Council that this was a topic of discussion because it has been asked, "How can we better estimate agricultural water usage statewide for where we don't know exactly what's going on?" Mr. Brinson added, "There is a lot of data we produced through this modeling project."

Mr. Brinson presented a Power Point presentation (see attachment titled *The Delaware Agricultural Irrigation Water Usage Project*).

As stated in the presentation on the slide titled *Project Objective*:

Develop a crop water demand model to estimate agricultural irrigation water usage at the field level for the last 10 years using the best available, location specific input data. **Why?** To help DNREC better understand the potential demand on water resources under varying seasonal weather conditions and improve its ability to allocate the resource more effectively.

As stated in the presentation on the slide titled *A little background…*:

DGS study (2010)

- Estimated irrigation water usage for irrigated fields (2,407) from 2005-2008 for Kent and Sussex Counties.
    - Similar method (crop water demand model), but slightly different data inputs. Weather and soil information were very generalized for region.
    - Found that for a wet year 18 billion gallons to 33 billion gallons in a dry year for agricultural irrigation in Kent & Sussex Counties.
    - Some results were included in 12th Water Report for the WSCC.
        - Noted the 90.8 mgd for peak day water demands in Kent and Sussex County for farm irrigation based on 2007 simulation by DGS study
        - Projected between 55.1 and 99.9 mgd needed for Kent & Sussex Counties by 2020, with as much as 109.9 mgd by 2030 for a peak day.

USGS Study (2013) found generally good agreement between crop water demand model and corn/soybean water use in Georgia.

As stated in the presentation on the slide titled *Model Info & Irrigated Farmland Dataset*:

- Model is based on the FAO's Irrigation and Drainage Paper No. 56 (water balance approach).
- Irrigated farm fields were manually digitized using Google Earth in aerial imagery in 2011 and 2018.
- 2,964 irrigated fields defined covering 152,325 acres statewide.
- Approximately 1/3 of Delaware cropland is irrigated.

As stated in the presentation on the slide titled *Model Data*:

- 2018 Irrigated Farmland for Delaware.
- USDA Gridded SSURGO soil water content.
- USDA CropScape annual crop type data.
    - Only focused on Corn and Soybean.
- USDA Weekly Crop Bulletins for Delaware for crop emergence dates.
- DEOS Weather Data (Rainfall and Reference ET)..

As stated in the presentation on the slide titled *Irrigation Scenarios*:

Scenario #1 – ET Model Method

- 1a: Irrigate whenever available water drops below maximum allowable depletion level. Irrigate same amount (0.4") every time.
- 1b: Same "trigger" as 1a, but irrigate only enough to bring water content back up to 55% of field capacity.

Scenarios #2 - Calendar-based Method

- 2a: Irrigate according to pre-determined seasonal schedule. Irrigate the same amount (0.4") and follow the calendar no matter how much it rains.
- 2b: Follow the irrigation calendar, but if it rains at least one application's worth of irrigation since the last irrigation, then we'll skip an irrigation application. This is the calendar method, but with the use of a rain gage.

Mr. Brinson discussed the Seasonal Water Usage and showed the slides with graphs titled *2010 Simulated Irrigation Water Usage* and *2014 Simulated Irrigation Water Usage* . He said regarding the 2010 slide, "The colors up and down are the cumulative irrigation statewide for 2010. 2010 is the warmest growing season on record for Delaware and also a little on the dryer side." He continued to discuss both slides and also showed a summary.

Mr. Brinson then discussed the Comparison by Scenario and discussed the following slides:

- Delaware Estimated Agricultural Irrigated Water Use (2010-2019) Scenario #1a: ET-based method; Constant Irrigation Amount.
- Delaware Estimated Agricultural Irrigated Water Use (2010-2019) Scenario #1b: ET-based method; Precise Irrigation Amount.
- Delaware Estimated Agricultural Irrigated Water Use (2010-2019) Scenario #2a: Calendar based method; Same irrigation amount every time the calendar calls for it.
- Delaware Estimated Agricultural Irrigated Water Use (2010-2019) Scenario #2b: Calendar based method with a rain gage; Same irrigation amount every time the calendar calls for it.
- Growing Season Rainfall – Statewide Average at Irrigated Farm Fields (2010-2019).

Mr. Brinson then discussed the Seasonal Water Use Comparison and discussed the following slides:

- Seasonal Water Use Comparison Scenario #1a – "Overestimate by Model".
- Seasonal Water Use Comparison Scenario #b – "Underestimate by Model".

Mr. Brinson then discussed the Seasonal Irrigation Maps.

As stated in the presentation on the slide titled *Main Takeaways*:

- How much water is used to irrigate agricultural fields each year depending on the availability of rain during the growing season?
  - Low-end: 17-35.5 billion gallons.
  - High-end: 43-55 billion gallons.
  - Results still needs to be compared to reported water use data, but preliminary comparison suggests model scenario captures "reality" somewhere in between the two main irrigation scenarios.
- Model output available for all fields defined for each day, monthly, year for the last 10 years.
- Method can be replicated and improved for future growing seasons.
- To Do List:
  - Validate model results with best available reported water use data.
  - Create crop water demand "climatology" from daily/monthly model data.
  - Model sensitivity testing.

Mr. Brinson asked if there were any questions. Mr. Richard Wilkins asked, "In your takeaways of 17-55 bg of water used for agricultural irrigation, how many of those gallons of water apply to the agriculture fields are actually going to be migrating down through the soil filtration and actually recharging the aquifer rather than flowing off of the fields and exiting?" Mr. Brinson replied, "This model does not compute run-off or percolation loss. It could be modified,

perhaps, to try to come up with an estimate of that or we can look at other models that are more precise in estimating those amounts." Council continued to discuss.

KENT COUNTY MONITORING NETWORK FINALIZATION – Scott Andres, University of Delaware, DGS

Mr. Andres began by acknowledging the collaborating efforts of the University of Delaware, USGS, Project WiCCED, the City of Dover, U.S. Fish and Wildlife Service, DNREC Division of Fish & Wildlife, DEOS, Artesian, Tidewater, A.C. Schultes, and others.

As stated in the presentation on the slide titled *Project Background*:

- Purpose
  - Modernize and fill gaps in water monitoring infrastructure in Kent County.
  - Project collects data needed for water management and policy planning and decisions.
  - Focus on currently used aquifers throughout Kent County and east Dover area around City wellfield.
- Capital funding approved FY 2017 – ends FY 2021 (~$710K)
  - No administrative costs in budget.
  - Federally funded NEWERNet, WiCCED, + NGWMN overlap and leveraging (~$1.2 M).

As stated in the presentation on the slide titled *Infrastructure Completed*:

- Test borings, logs and wells completed at 10 of 10 proposed sites – plus 2 of 3 additional sites in Dover. More than 8700 feet of wells.
- 2 USGS stream gages re-activated, data analyzed.
- Monitoring stations and wells installed at multiple irrigation systems in east Dover focus area.
- Instrumentation installed and operating in new wells and east Dover.
- Groundwater quality testing completed.
- 3 partial record tide height/salinity gages operated.

Mr. Andres then discussed the *Project Results Overview* and said, "So far there are 3 reports, 2 of them are out now and available for download (Flow Simulations was the first open file report and Results of Drilling is the second open file report) and the other report out this summer (Report of Investigation)." He added that this generated over 7 m gw level observations, over 1.1 m gw salinity observations, and collected over 90 gw samples from wells. He said, "I did not include the surface water salinity. That's probably close to another 800,000 surface water observations." Mr. Andres thanked DNREC for continuing to look at how to automate the field data collection efforts.

Mr. Andres then discussed the *Frederica, Federalsburg, and Cheswold Aquifers*. He stated that these are the most heavily used aquifers in Kent County. He also discussed who uses these aquifers the most and stated they are the City of Dover, Milford, Camden-Wyoming, DAFB and Artesian and Tidewater (public systems). He added they are also heavily used for irrigation and

domestic uses and a little bit of industrial and agricultural uses. He said, "Which aquifers are being pumped for what uses is the biggest challenge." He continued to discuss.

Mr. Andres then discussed the *Piney Point Aquifer* and said "One of the major sources for the City of Dover is the Piney Point aquifer. This is the deepest aquifer we looked at for most of Kent County and is the deepest aquifer available for Kent County."

- Drawdown extends MD-DE-NJ.
- Maximum drawdown centered on Dover and Bridgeton pumping centers.
- Long term sustainability of resource not possible at current pumping and annual drawdown rates

As stated in the presentation on the slide titled *Groundwater Quality at 10 Sites:*

- Mixed story about water quality in confined aquifers. Cautious optimism.
- Nitrate present in Columbia aquifer and shallowest wells in Calvert aquifers.
- Naturally occurring arsenic in Rancocas aquifer.
- Chemical evidence for interaquifer transfer of water between Frederica, Federalsburg, and Cheswold.
- Continuous salinity monitoring found elevated values in Milford aquifer east of Milford and Piney Point at Woodland Beach.

As stated in the presentation on the slide titled *East Dover Focus Area:*

- Working with 3 farmers and Dover Water where previous work predicted greatest risk for salinity issues.
- Leveraged existing wells and added new wells and surface water stations.
- EPSCoR WiCCED constructing density dependent groundwater model and cooperating in field work.

Mr. Andres then discussed the *Salinity Risk – East Dover Site B* slide and it shows the Water/Tide Elevation, Precipitation and Salinity, Tide Elevation with Irrigation Pond and Marsh graphs.

As stated in the presentation on the side titled *Data and Salinity Risk to Crops:*

- Soybeans are "moderately tolerant".
- Corn is "moderately sensitive".
- Lines represent salinity/conductivity PEAKS during summer irrigation season.

As stated in the presentation on the side titled *Continuing Work:*

- EPSCoR WiCCED project adding to the east Dover study. Additional NSF funded sea level rise and salinization just underway.
- Regional groundwater model of confined aquifers being developed with design input from DNREC and Dover: Updates work completed 1980.
- East Dover report in preparation.

As stated in the presentation on the slide titled *Objectives of Flow Model:*

- Modeling goals
    - Developed with input from Dover and DNREC.

- Quantitatively define the relation between water use and groundwater drawdown in the Piney Point, Cheswold, Federalsburg, and Frederica aquifers, past and future.
- Characterize water movement between aquifers.
- What if scenario simulations.
- Columbia aquifer modeled directly but not at high resolution.

DROUGHT INDICATORS UPDATE – Dr. Dan Leathers, State Climatologist

As stated in his presentation, Dr. Leathers said the "Water Conditions Index" has been an affective indicator of water supply across northern New Castle County for several decades. However, is there a way to better monitor diverse water resource variables across the entire state?

Dr. Leathers then discussed in his presentation the relationships between Delaware water resources (streamflow, well levels, soil moisture, etc.) and numerous drought indices at diverse time periods. He stated that these variables include the following:

Palmer Drought Severity Index (PDSI)
Palmer Hydrologic Drought Index (PHDI)
Palmer Modified Drought Index (PMDI)
Palmer Z-Index
Precipitation – Evapotranspiration ($P – E_t$)
Standardized Precipitation Index (SPI)
Standardized Precipitation Evapotranspiration Index (SPEI)
Evaporative Demand Drought Index (EDDI)
Quick Drought Response Index (QuickDRI)
Vegetation Drought Response Index (VegDRI)
Evaporative Stress Index (ESI)
Water Conditions Index (WCI)

He said, "After looking at all these very typical indices that people around the country use, what we're finding is that the one that might be best for us here in Delaware is just looking at **Precipitation – Evapotranspiration ($P – E_t$)**, what's coming in minus what's going out."

Dr. Leathers then discussed the slide titled *Precipitation – Evapotranspiration ($P – E_t$)* and said, "This is a map for the growing season $P – E_t$ from 5/1/20 – 9/19/20." He added, "The green color means there is more water coming in than going out and the brown color means more water going out than coming in during the growing season." He continued to discuss.

Dr. Leathers then discussed *What is the correct "time scale" for water resources applications?*

- One-month – Agriculture?
- Three-months – Streamflow?
- Six-months – Well levels?
- 12 or 18-months – Societal drought?

He stated in his presentation "This is currently being investigated!"

Dr. Leathers discussed the *CEMA Agriculture Dashboard* which he stated is a portal with multiple variables. He added, "This is a work in progress, but we've been able to develop a system where we have all the DEOS data gridded back to 2010 and that includes soil parameters, too."

Dr. Leathers briefly discussed the slide titled *Also Realtime Variables Soil Moisture* showing Volumetric Water Content 9/19/20 and Volumetric Water Content 9/19/20 Departure. He then briefly discussed the slide showing a watershed map that states the information can be aggregated over specific watersheds across the state.

Dr. Leathers then discussed *Future Work* as stated in his presentation:

- Continue to investigate the relationships between $P - E_t$ and water resource variables including streamflow, well levels, soil moisture, and general water quantity and quality over diverse time periods.
- Continue to investigate other possible drought indices and their efficacy for use in monitoring water resources.
- Develop a "Delaware Water Quantity" decision support tool for decision makers across the State. Test this tool and its usefulness with diverse user groups.

SELF-SUFFICIENCY / CONSERVATION PLAN WORKING GROUP – Vic Singer, Working Group Chairman

Mr. Singer discussed with the Council the status of the Working Group and the need of a standardized structure of report content. He stated the statute requires 3 reports. He stated the 3-year report is due in early 2021 and the Council needs to begin working on that report now (the Conservation and Self-Sufficiency of each water supply). The 5-year report is due 2024 (report prepared by the WRA on behalf of the WSCC).

On September 4, 2020, Mrs. Burris e-mailed the work product to date to the WSCC that the Working Group prepared. This is for the report due in early 2021. All comments are welcome regarding this work product to Mr. Singer in writing by January 7, 2021.

Mr. Smailer motioned to put this topic early on the January agenda to vote on adoption. Mr. Singer so moved and Mr. Neimeister seconded. All in favor. None opposed.

Mr. Smailer appreciated the dedication of the Working Group.

FOURTEENTH REPORT TO THE GOVERNOR AND GENERAL ASSEMBLY – DISCUSSION TOPICS – Dr. Gerald Kauffman, Water Resources Center, Water Master

Dr. Kauffman said the Fourteenth Report to the Governor and General Assembly is to be submitted by spring 2021 and should contain updated drought guidelines and the water supply certification work of the working groups.

Dr. Kauffman asked Mrs. Burris to e-mail this one-page summary of the supply and demand estimate through 2030 to the WSCC (Mrs. Burris e-mailed to the WSCC immediately after the meeting on 9/24/20). He said, "We might want to start thinking about updates to the southern New Castle County supply and demands and also incorporate Scott's (Mr. Andres) work and Kevin's (Mr. Brinson) work."

NEW BUSINESS - Steven M. Smailer, P.G., DNREC, Chairman

There was no new business.

PUBLIC COMMENT

There were no public comments.

NEXT MEETING - Steven M. Smailer, P.G., DNREC, Chairman

The next virtual meeting has been tentatively scheduled for Thursday, January 28, 2021, at 10:00 a.m.

MEETING ADJOURNED - Steven M. Smailer, P.G., DNREC, Chairman

Mr. Smailer asked for a motion to adjourn. Mr. Singer motioned and Dr. Leathers seconded. All were in favor. Meeting adjourned at 12:29 p.m.

These minutes are not intended to be a detailed record. They are for the use of the Water Supply Coordinating Council members in supplementing their personal notes and recall of Council discussions and presentations and to provide information to Council members unable to attend. Minutes recorded and submitted by Mrs. Kimberly Burris.

Meeting Attendees are listed below alphabetically, last name first:
Andres, Scott – University of Delaware, DGS
Baxter, Stefanie – University of Delaware, DGS
Brinson, Kevin – Assistant State Climatologist
Budischak, Valann – Delaware Nursery and Landscape
Burris, Kimberly – DNREC, Division of Water, Administration

DiNunzio, Joe – Artesian Water
Eisenbrey, Ginney – Artesian Water
Finnicum, Larry - SUEZ
Grabowski, Matthew – DNREC, Division of Water, Water Supply
Guyer, Jay – Municipal Services Commission
Hokuf, Doug – New Castle County Government
Homsey, Andrew – University of Delaware, Water Resources Agency
Jenner, Charles – Delaware Grounds Management Association
Kauffman, Dr. Gerald – Water Resources Center, Water Master
Kohler, Ellen – Delaware Nature Society
Leathers, Dr. Daniel – State Climatologist
McQuiggen, Rachel – University of Delaware, DGS
Mensch, Keith – Division of Public Health, Office of Drinking Water
Mills, Kate – City of Dover
Murray, Patty – DNREC, Division of Water, Allocations Program
Neimeister, Mark – City of Newark
Neutz, Mary – City of Wilmington
Pindar, Chad – DRBC
Priester, Tawanda – Tidewater Utilities
Rudd, John – Office of the State Fire Marshal
Singer, Victor – Civic League for New Castle County
Smailer, Steven – DNREC, Division of Water, Chairman
Spiegel, Sandi – Division of Public Health
Thaeder, Kathy – Artesian Water
Wilkins, Richard – Delaware Farm Bureau
Wunsch, Dr. David – Delaware Geological Survey
Yorston, Erin – Department of Agriculture

Northern Delaware Drought Advisory Guidelines

Reported by the Drought Advisory Guidelines Subcommittee (DAGS), which is composed of the Delaware Department of Natural Resources and Environmental Control, Delaware Geological Survey, and University of Delaware Water Resources Agency with input from the water purveyors and representatives from the landscaping industry. These drought operating guidelines are designed to provide guidance to the Delaware Water Supply Coordinating Council (WSCC) and the Governor's Drought Advisory Committee (GDAC). Responsibility for providing technical guidance for a move up to or down from Drought Watch is with the WSCC. Responsibility for providing technical guidance for a move up to or down from Drought Warning or Emergency is with the GDAC. Final declaration of drought advisories rests with the Governor.

Indicators	**Drought Watch** **Voluntary Conservation**	**Drought Warning** **Voluntary Conservation**	**Drought Emergency** **Mandatory Restrictions**	**Status Sept. 22, 2020**
Precipitation Wilmington Arprt/Porter Rsvr 12-month	-6.00" to -8.99"	-9.00" to -11.99"	>-12.00"	+4.20"
Precipitation Wilmington Arprt/Porter Rsvr 6-month	-3.00" to -4.50"	-4.50" to- 6.00"	>-6.00"	+4.07"
Brandywine Creek (30-day moving avg)	85 mgd	70 mgd	48 mgd	171 mgd
White Clay Creek - Stanton (30-day moving avg)	42 mgd	37 mgd	31 mgd	91 mgd
White Clay Creek - Newark (30-day moving avg)	19 mgd	16 mgd	13 mgd	36 mgd
Well Db24-18	14 - 14.99 (fbls)	15 - 15.99 (fbls)	16 (fbls)	12.66 (fbls) (normal)
Water Conditions Index	4.0-5.0	3.0-3.99	<3.00	8.14
Chlorides	WCC ≤ 37 mgd for 5 consecutive days at UWD Stanton Intake	Cl > 250 ppm for 3 days at Christina River at Newport	Cl > 250 ppm for 3 days at UWD Stanton Intake	150.36
Hoopes Reservoir (City of Wilmington)	-10 ft (68% capacity)	-12 ft (64% capacity)	-15 ft (57% capacity)	-2.0 ft (5/28/20)
Newark Reservoir	- 10 ft (70% capacity)	-17 ft (52% capacity)	-27 ft (28% capacity)	-2.5 ft (5/27/20)
Monitored				
Aquifer Storage and Recovery	Monitor Status	Monitor Status	Monitor Status	SUEZ: 0.0 mg (5/26/20) AWC: 78.5 mg (5/26/20)
Octoraro Reservoir (Chester Water Authority)	Monitor Status	Monitor Status	Monitor Status	

Marsh Creek Reservoir	Monitor Status	Monitor Status	Monitor Status	
Chlorides on the Delaware River 9/21/2020	Monitor Status	Monitor Status	Monitor Status	Normal RM: 76 Current RM: 71
DRBC Lower Basin Drought Criteria	Monitor Status	Monitor Status	Monitor Status	
NYC DRB Reservoirs (DRBC 9/21/2020)	Monitor Status	Monitor Status	Monitor Status	Storage 194.8 bg or 76.1 bg above drought watch

fbls = feet below land surface
mg = million gallons
mgd = million gallons per day
RM = River Mile
bg = billion gallons

Delaware Geological Survey:
http://dgs.udel.edu

Delaware Environmental Observing System (DEOS)
http://deos.udel.edu

U.S. Geological Survey Streamflows:
http://waterdata.usgs.gov/de/nwis/current/?type=flow

Delaware River Basin Commission:
http://www.state.nj.us/drbc

Delaware Geological Survey
State of Delaware
University of Delaware • Delaware Geological Survey Building
Newark, Delaware 19716-7501

Kent County Hydrologic Conditions – September 22, 2020

PRECIPITATION
Dover - running surplus/deficit
12-month: +9.84" 6-month: +10.73" 5-month: +10.26"

STREAMFLOW
St. Jones at Dover – 30-day moving average (August 24 - September 22)
38 mgd
Status: above normal

GROUNDWATER
Well Mc51-01a
9.22 fbls
Status: above normal (normal for September is between 12.0 fbls and 14.6 fbls)

Sussex County Hydrologic Conditions – September 22, 2020

PRECIPITATION
Georgetown - running surplus/deficit
12-month: -0.52" 6-month: -0.04" 5-month: -0.70"

STREAMFLOW
Nanticoke River at Bridgeville – 30-day moving average (August 24 - September 22)
55 mgd
Status: above normal

GROUNDWATER
Qe44-01 (Trap Pond)
10.31 fbls
Status: normal (normal for September is between 8.8 fbls and 11.2 fbls)

fbls = feet below land surface
mgd = million gallons per day

Delaware Geological Survey
http://www.dgs.udel.edu

U.S. Geological Survey Streamflows
http://waterdata.usgs.gov/de/nwis/current/?type=flow

Delaware Environmental Observing System (DEOS)
http://www.deos.udel.edu

Phone: 302-831-2833 • Fax: 302-831-3579 • Email: delgeosurvey@udel.edu • Web Address: www.udel.edu/dgs

Weather Summary and Forecast

Water Supply Coordinating Council Meeting

September 24, 2020

Center for Environmental Monitoring and Analysis (CEMA)
Office of the Delaware State Climatologist

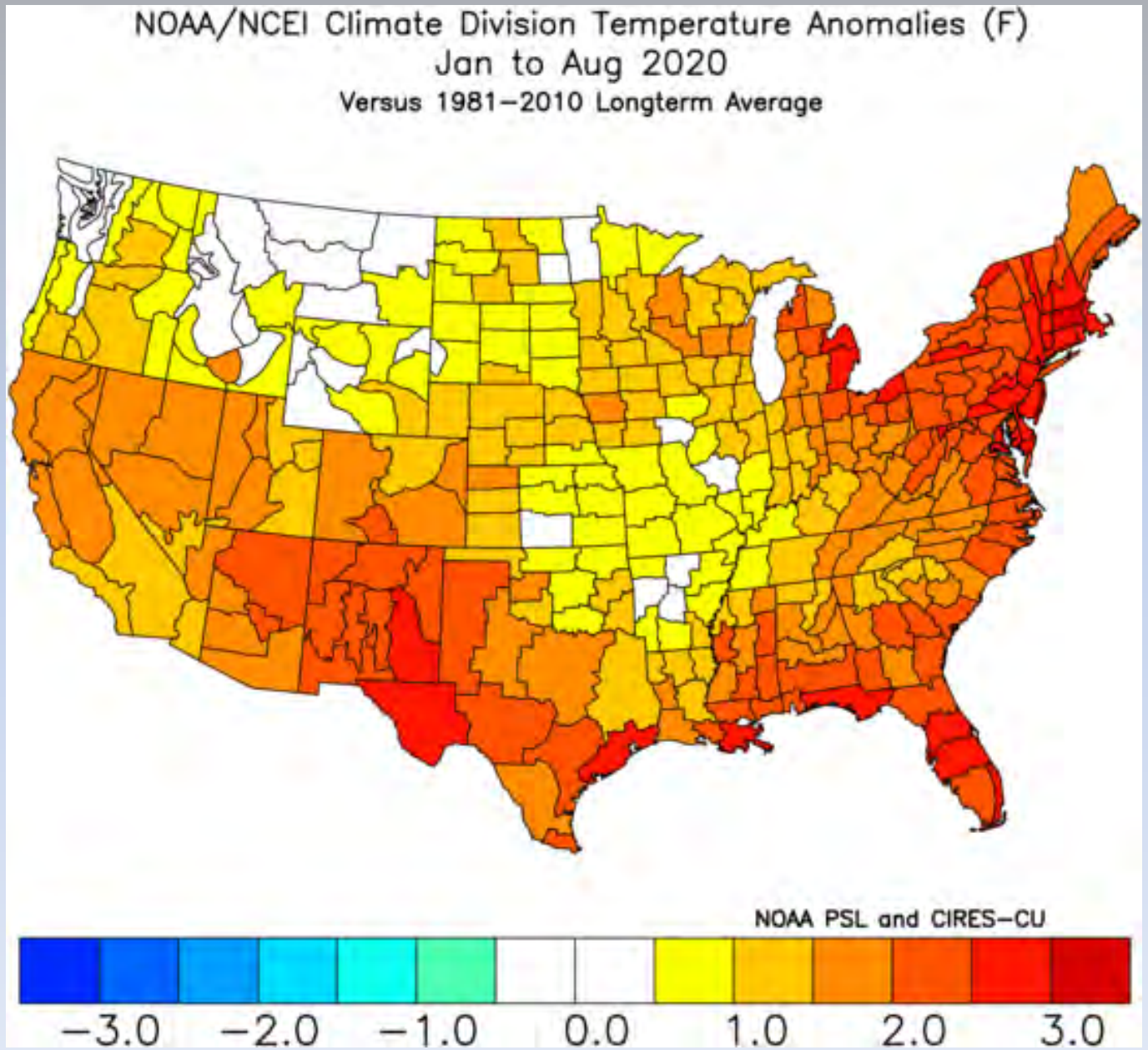
CEMA

College of Earth, Ocean, and Environment

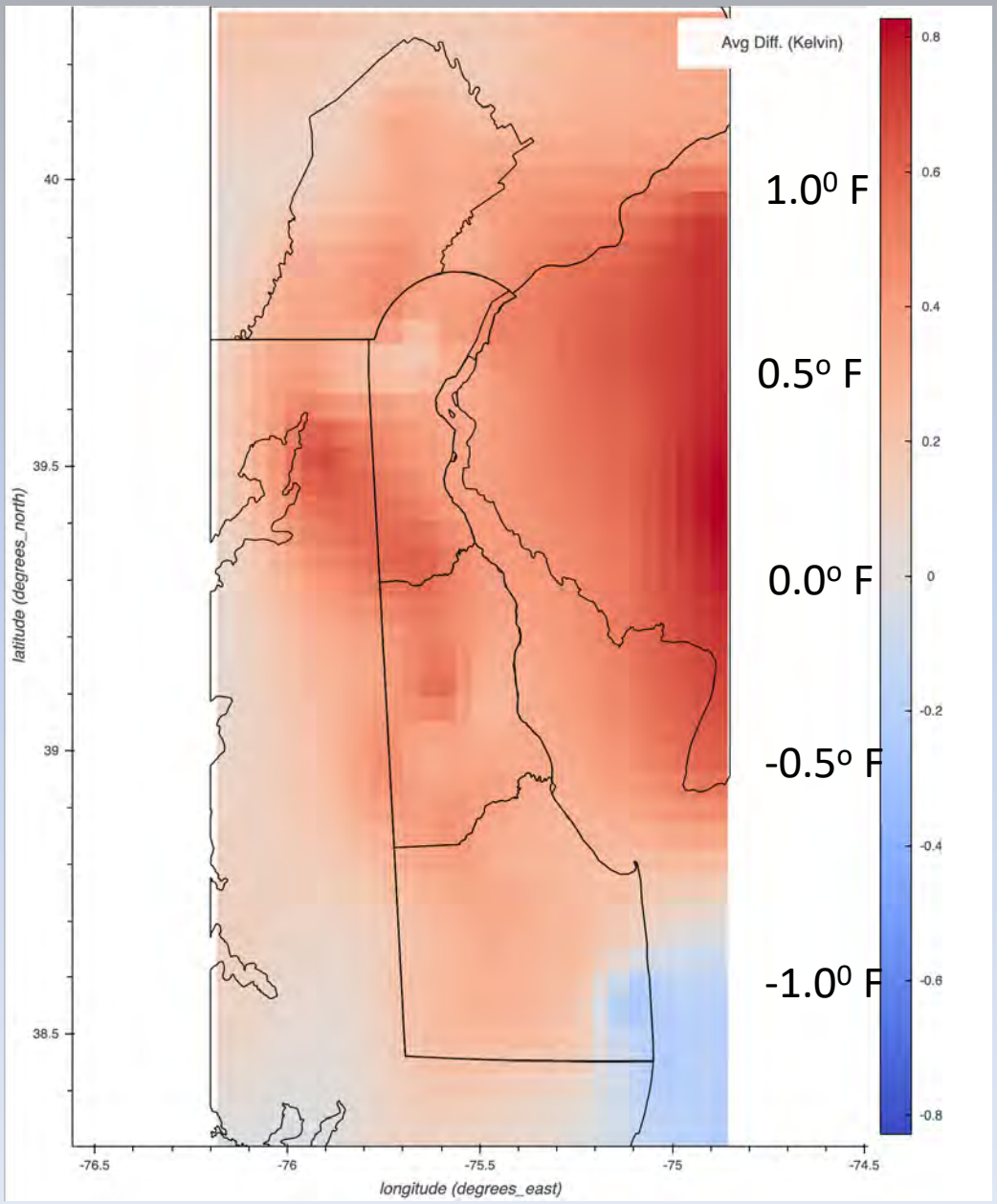
www.deos.udel.edu
DEOS

2020 Year-to-Date Weather Summary

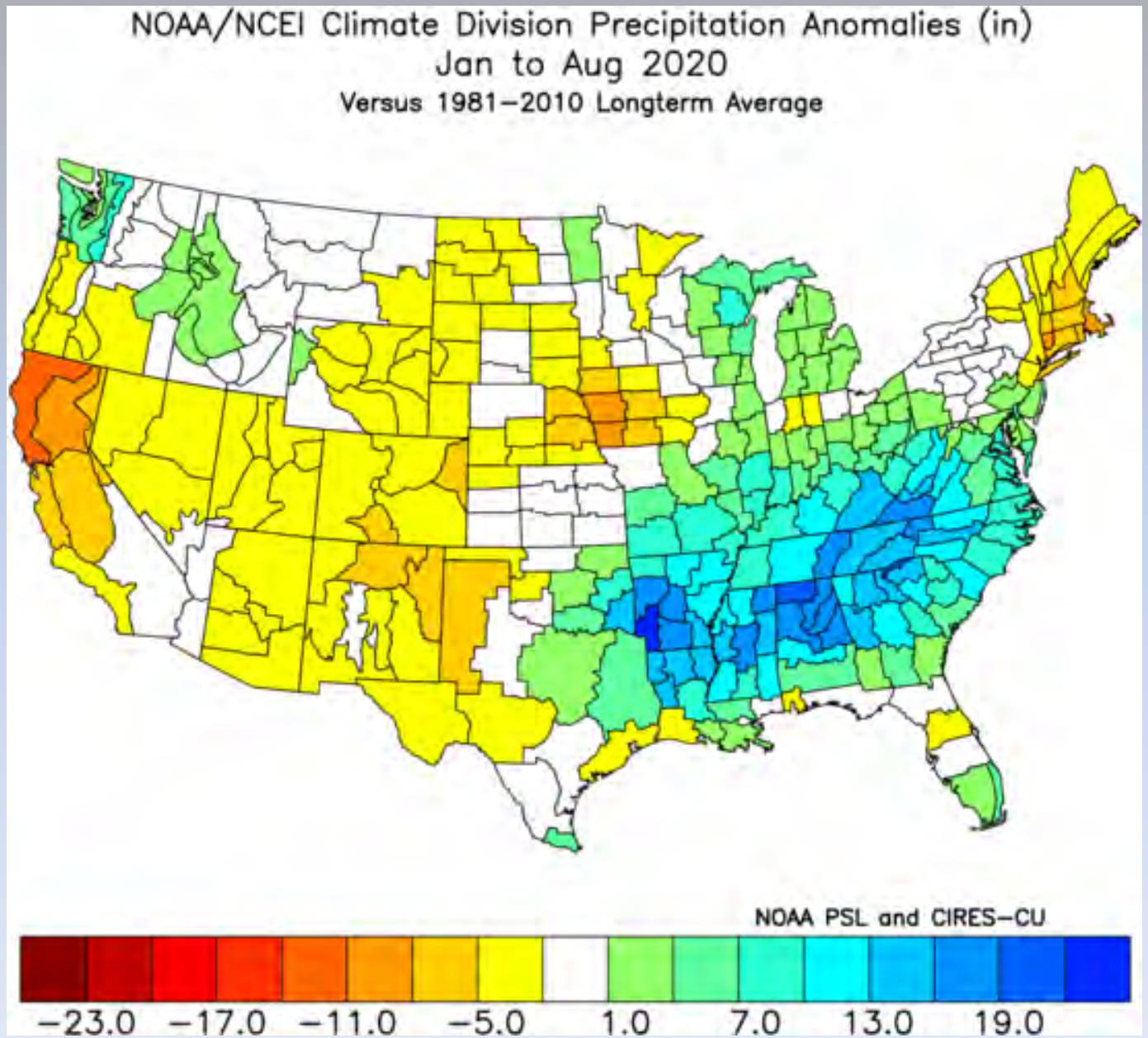
January – August Temperature Anomalies



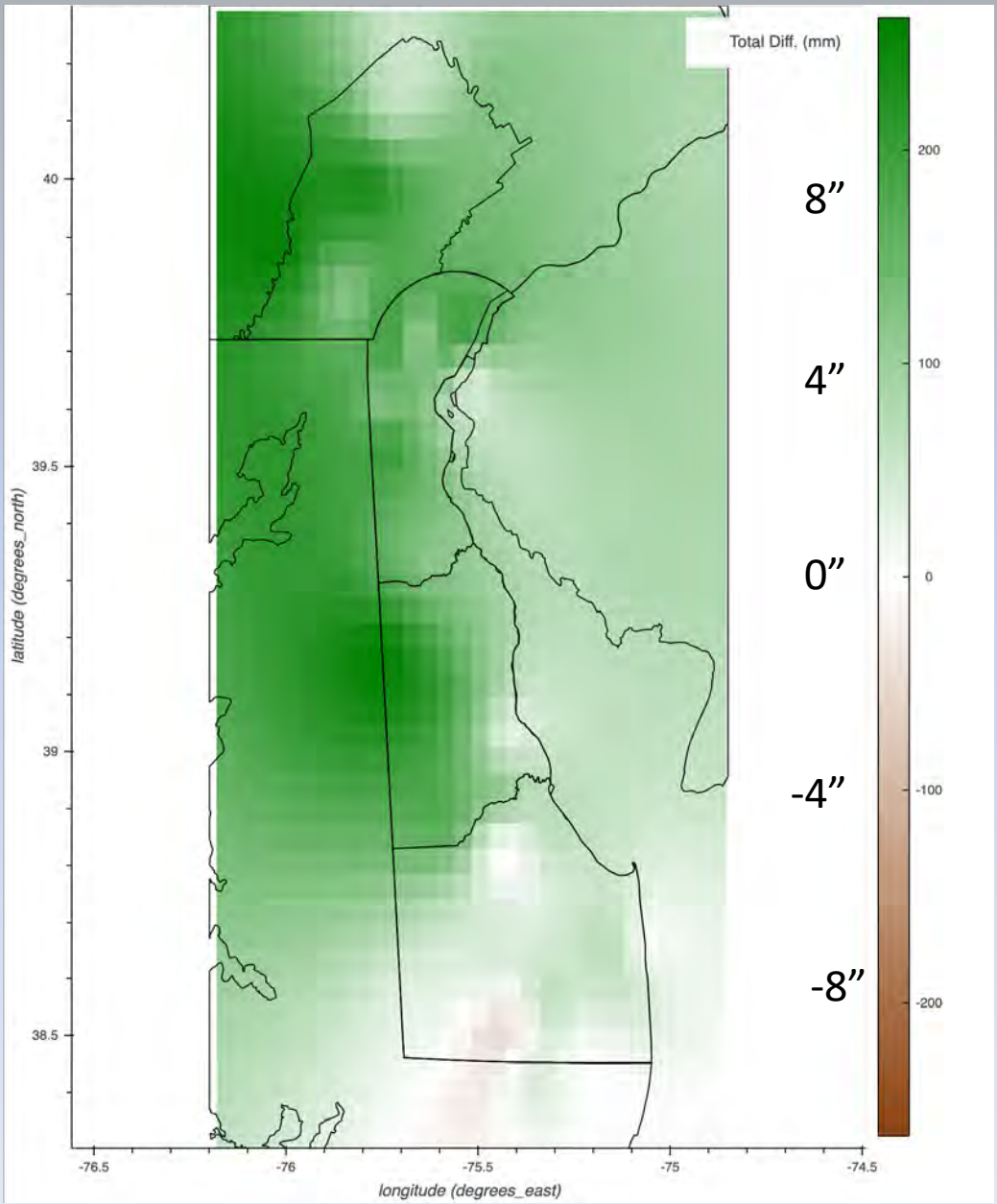
January – August Temperature Anomalies from the 2010 – 2020 Mean

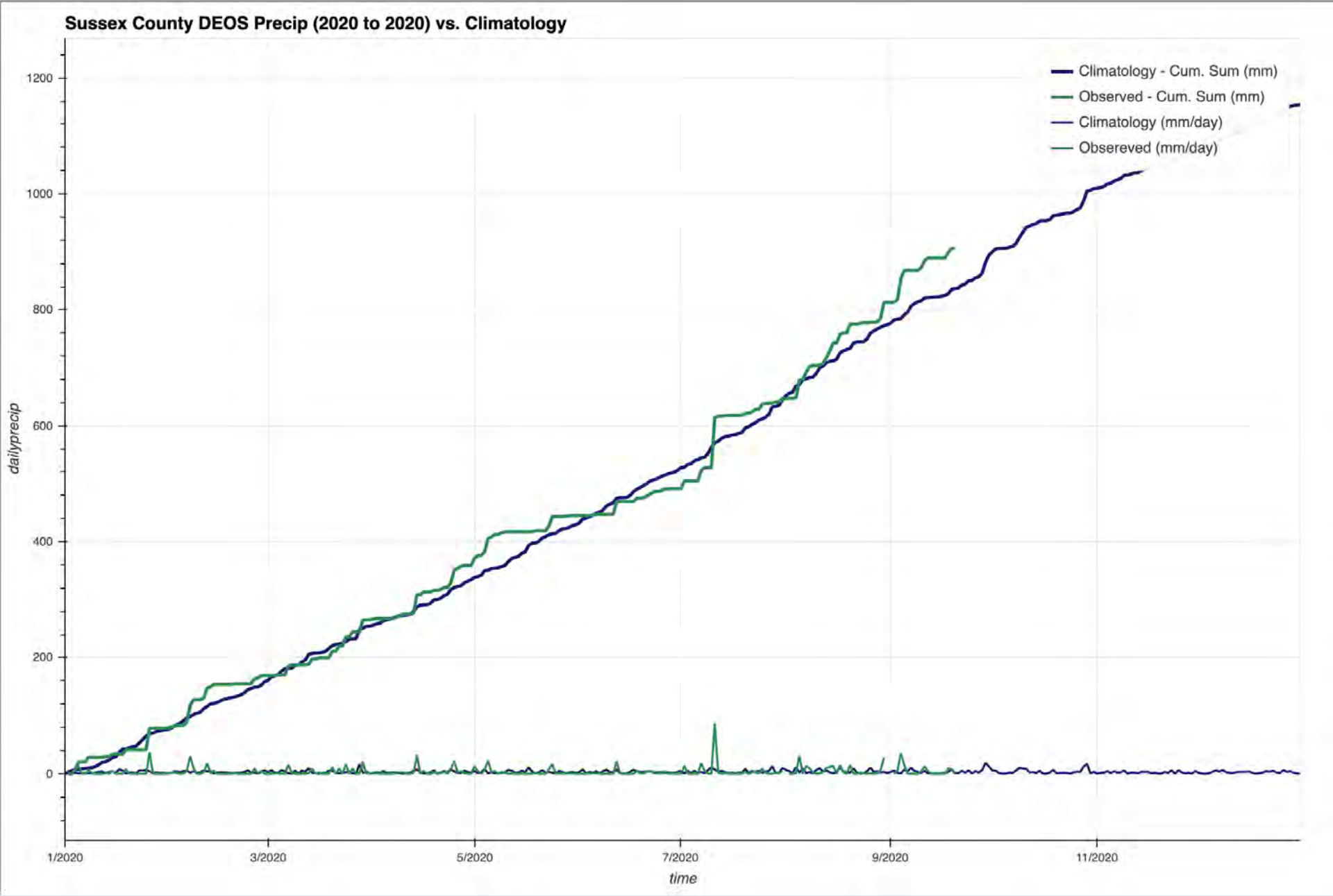


January – August Precipitation Anomalies

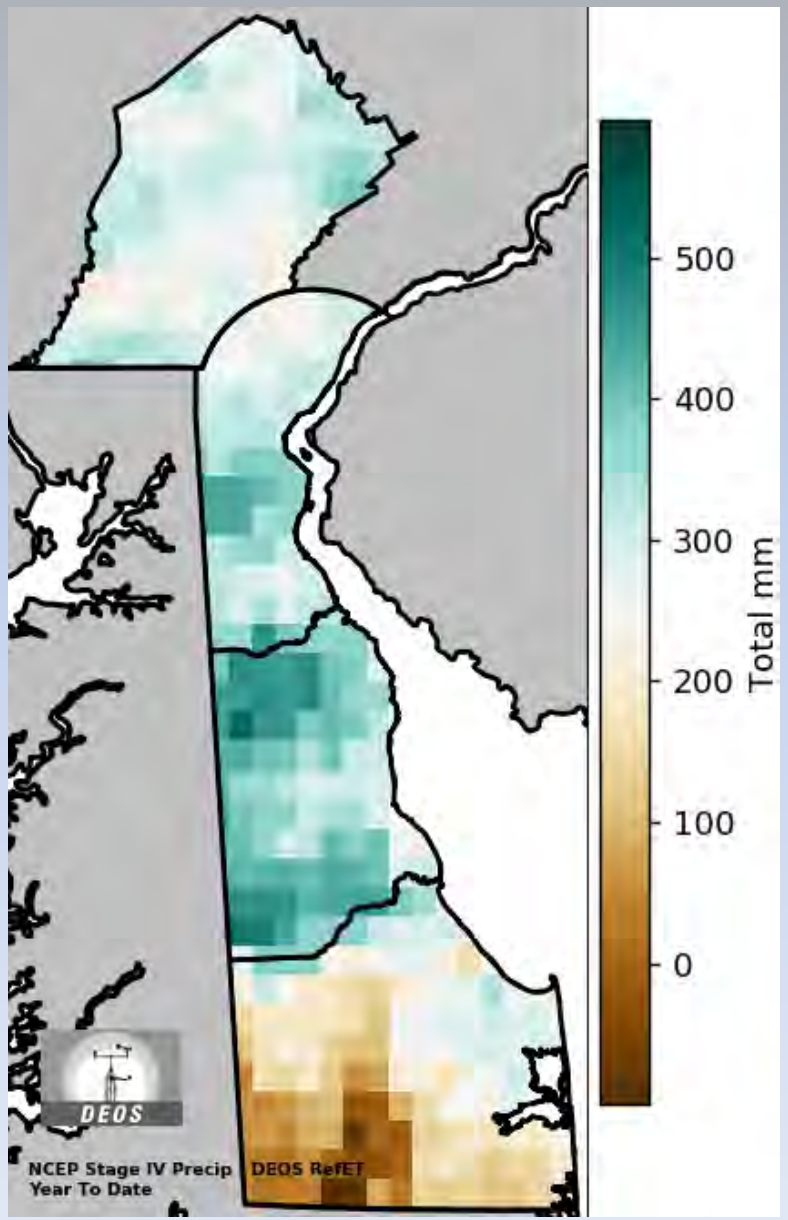


January – August Precipitation Anomalies from the 2010 – 2020 Mean



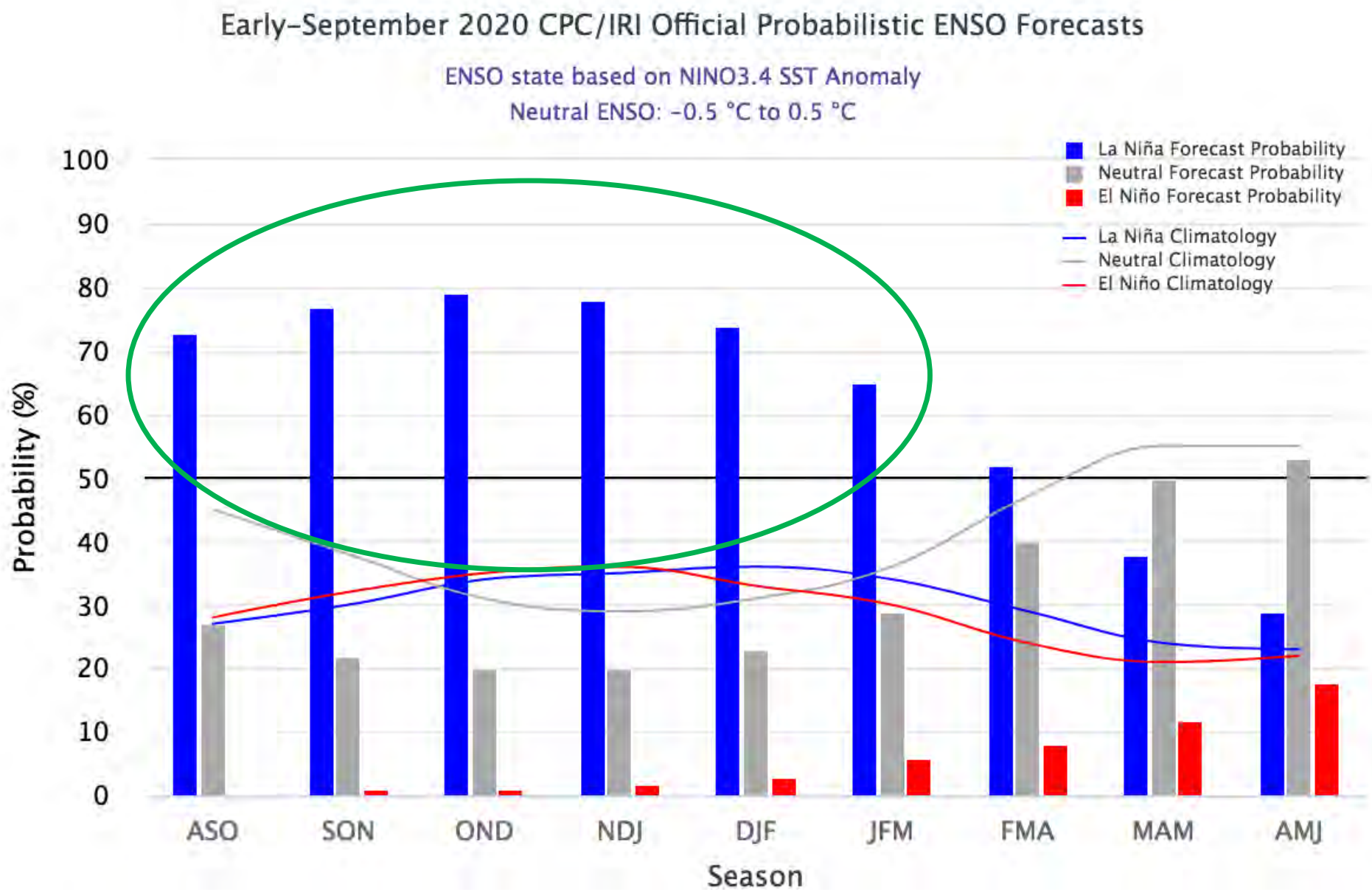

Sussex County DEOS Precip (2020 to 2020) vs. Climatology
Climatology - Cum. Sum (mm)
Observed - Cum. Sum (mm)
Climatology (mm/day)
Obsereved (mm/day)
dailyprecip
1200
1000
800
600
400
200
0
1/2020
3/2020
5/2020
7/2020
9/2020
11/2020
time

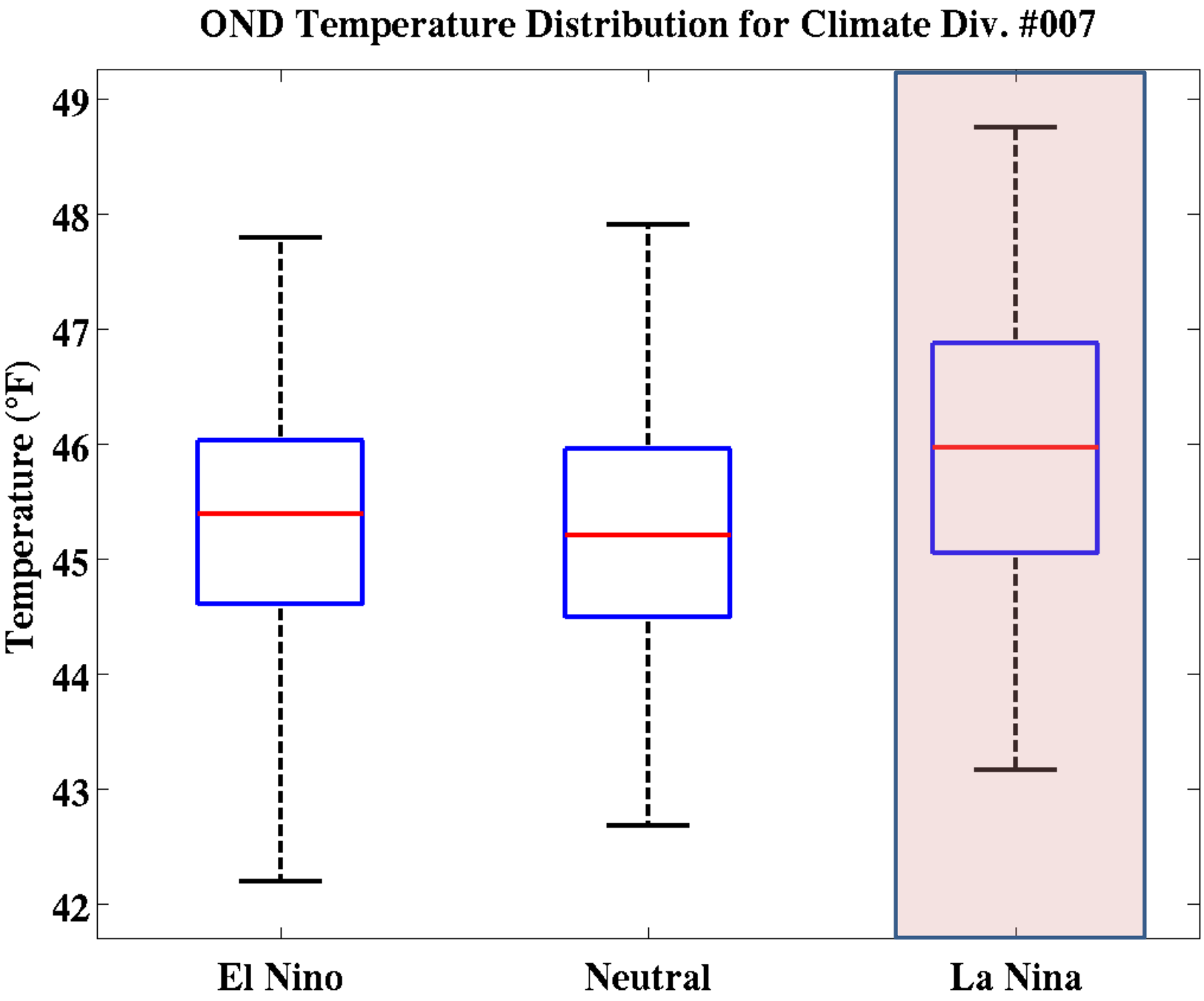
Precipitation – Evapotranspiration
January 1 – September 19, 2020

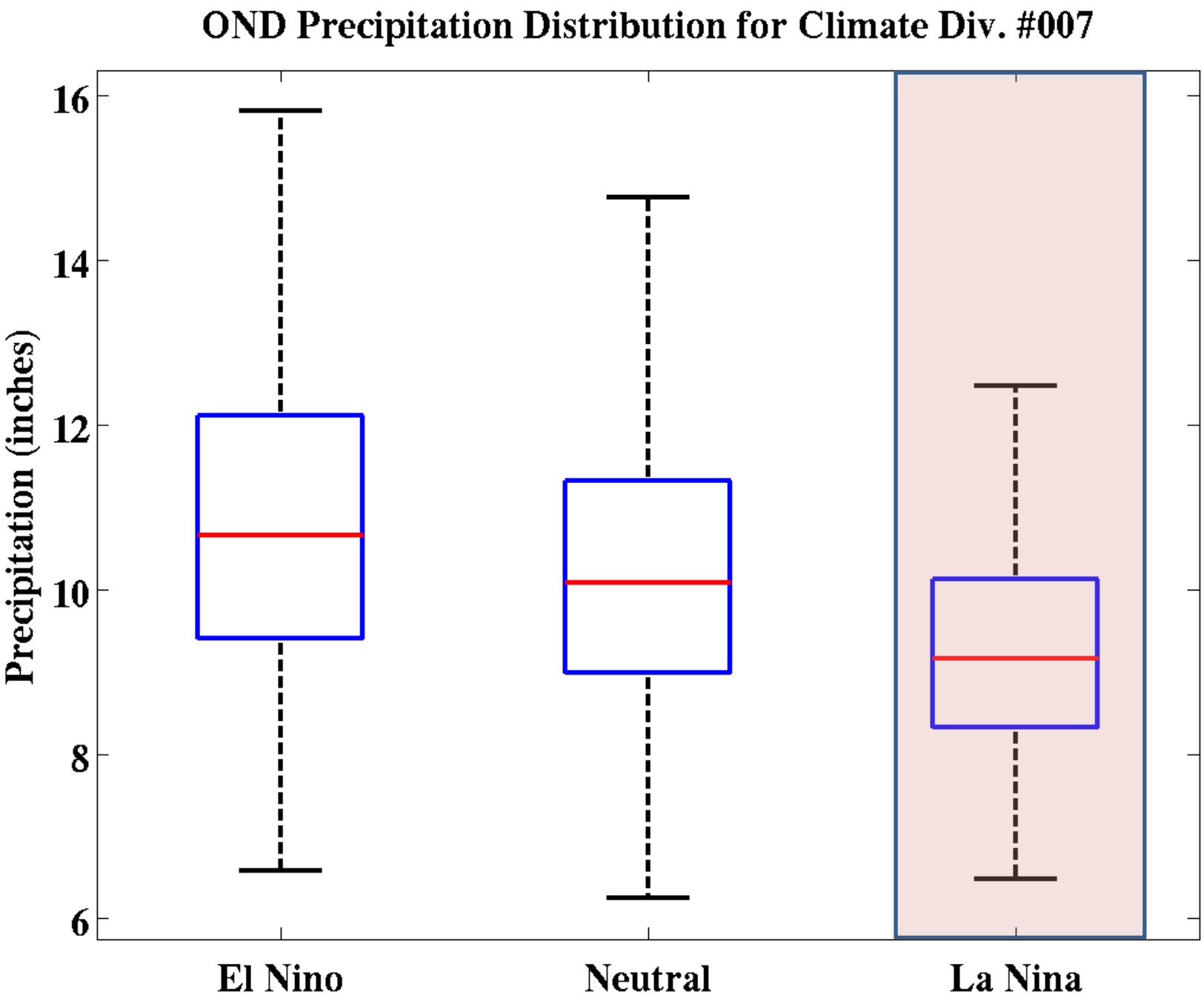


Autumn Forecast

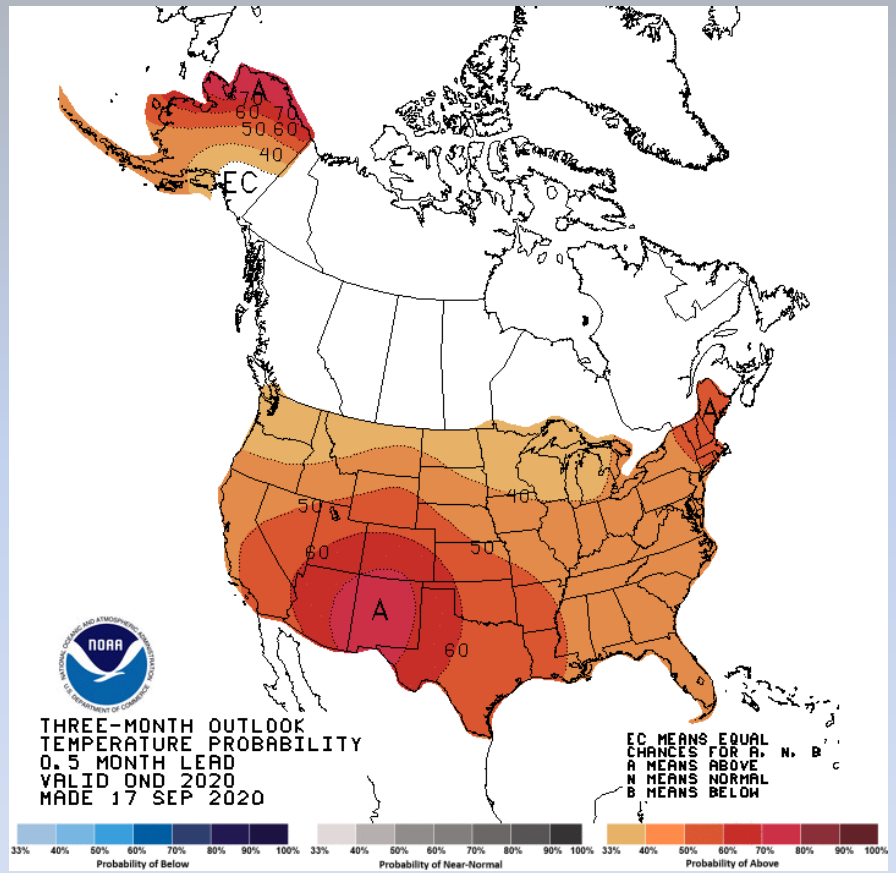
ENSO Neutral Conditions



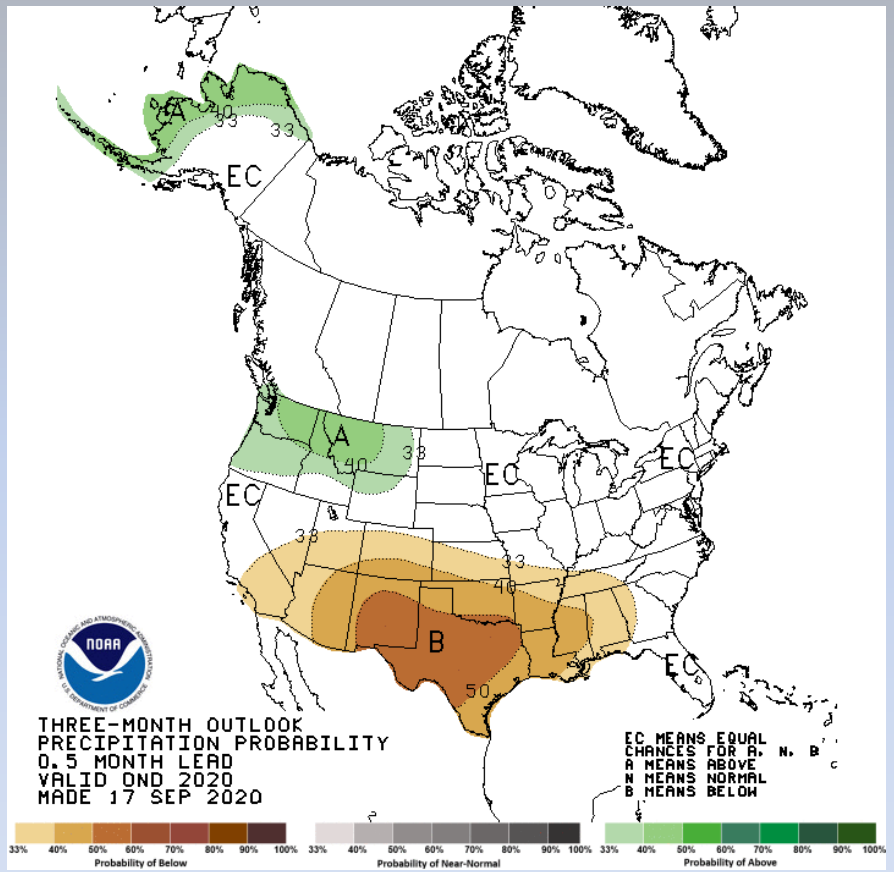

OND Temperature Distribution for Climate Div. #007
Temperature (°F)
49
48
47
46
45
44
43
42
El Nino
Neutral
La Nina


OND Precipitation Distribution for Climate Div. #007
Precipitation (inches)
16
14
12
10
8
6
El Nino
Neutral
La Nina

NOAA Extended Outlook Autumn 2020

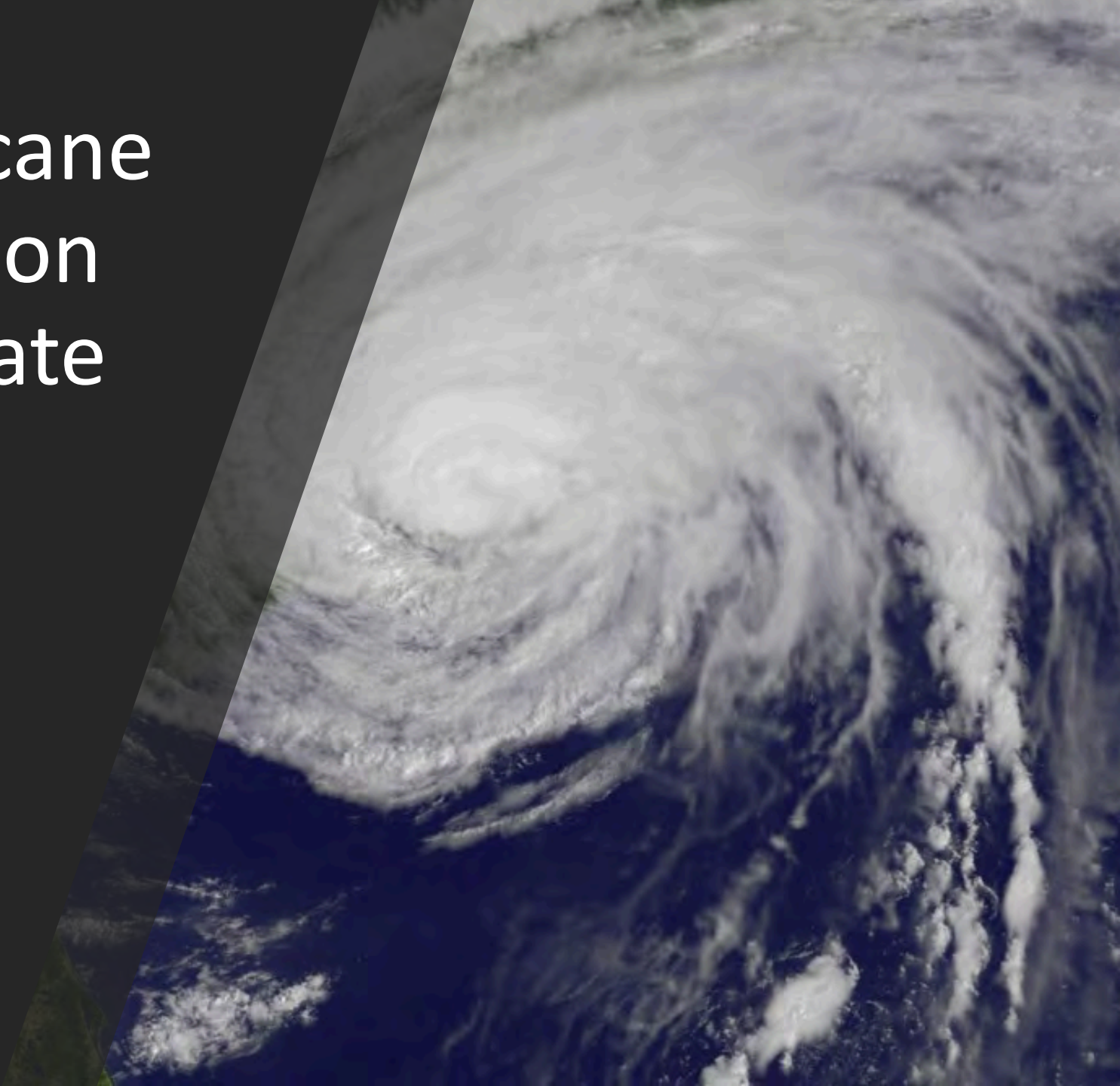


Temperature

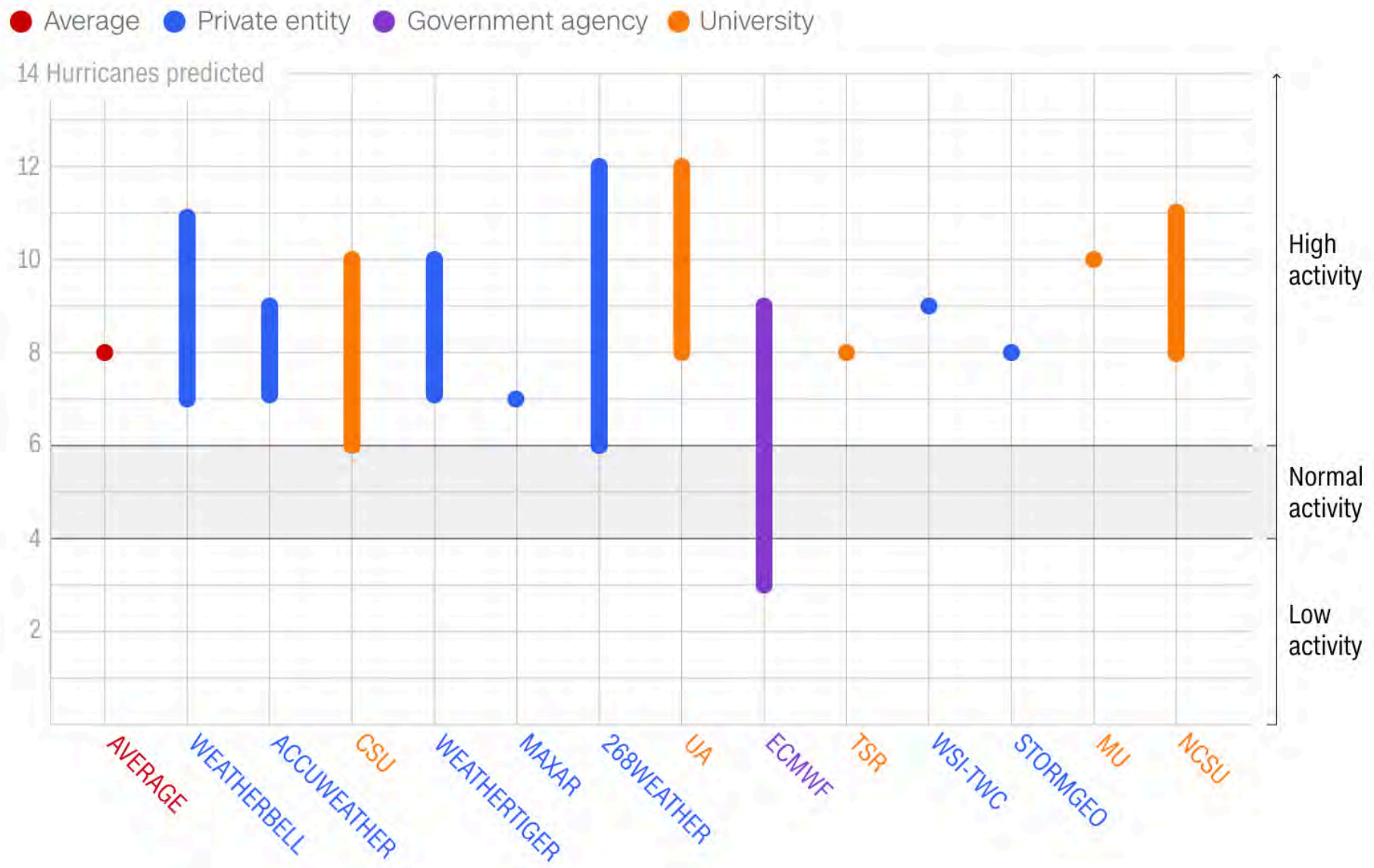


Precipitation

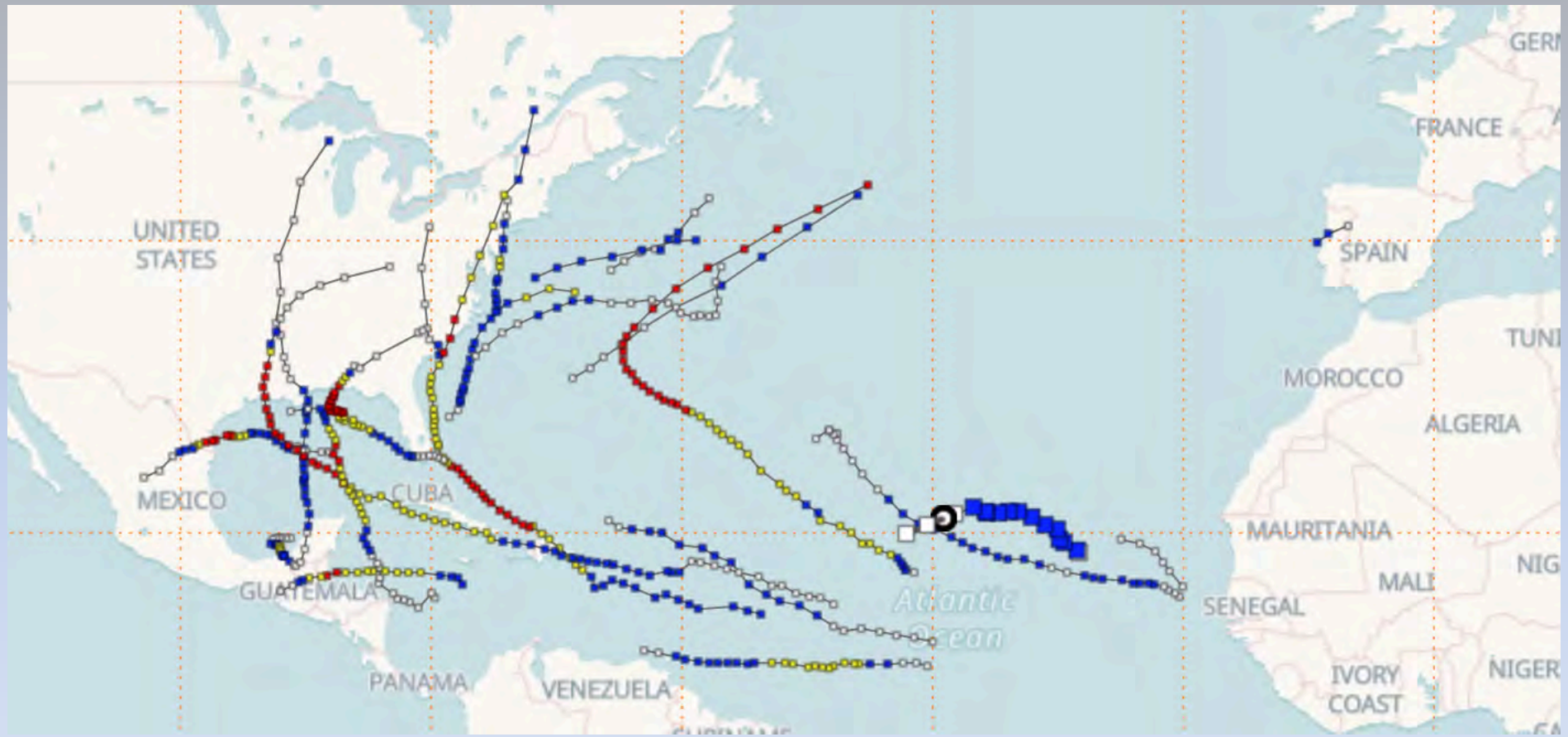
Hurricane Season Update



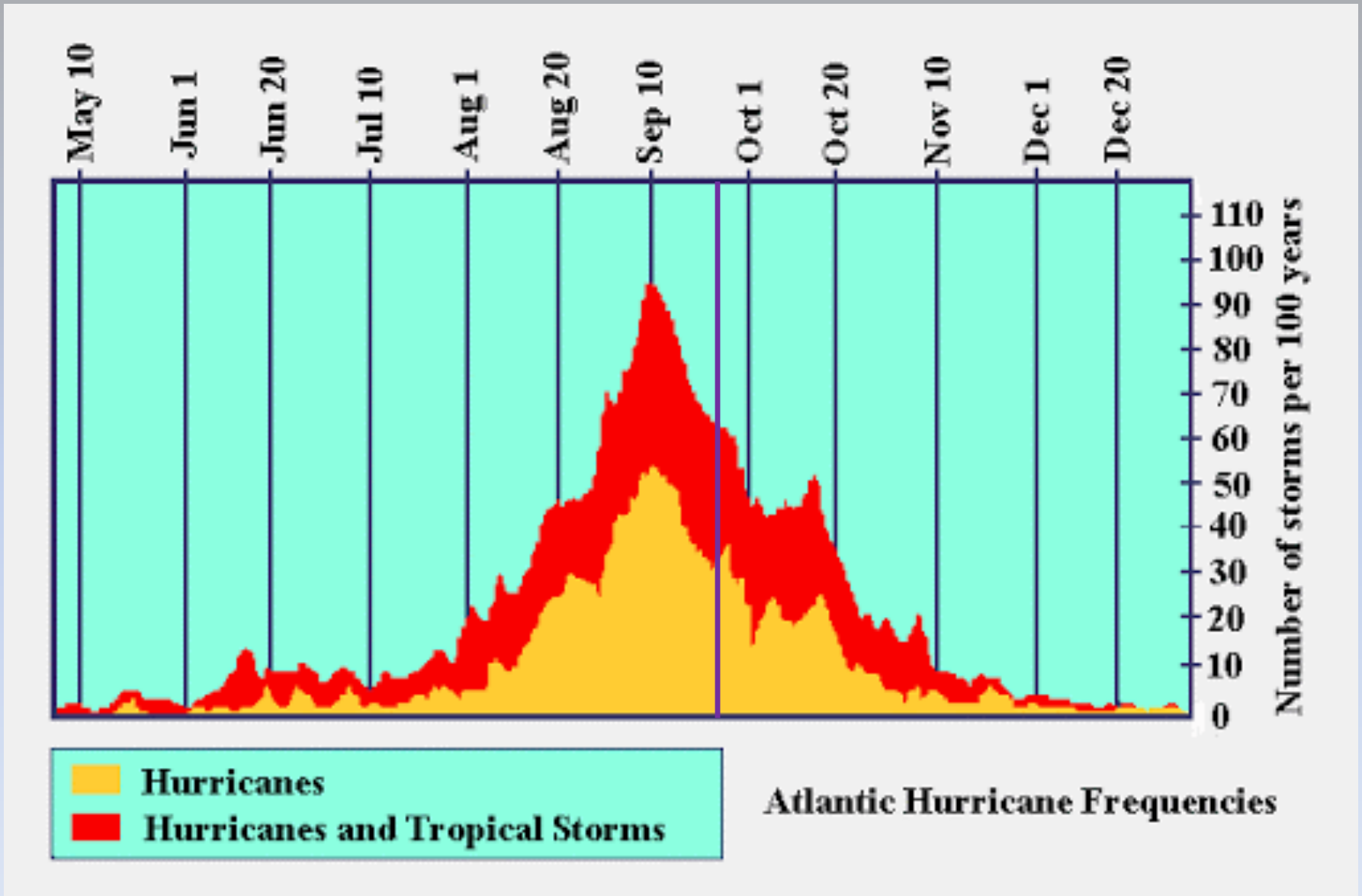
Summary of Hurricane Forecasts

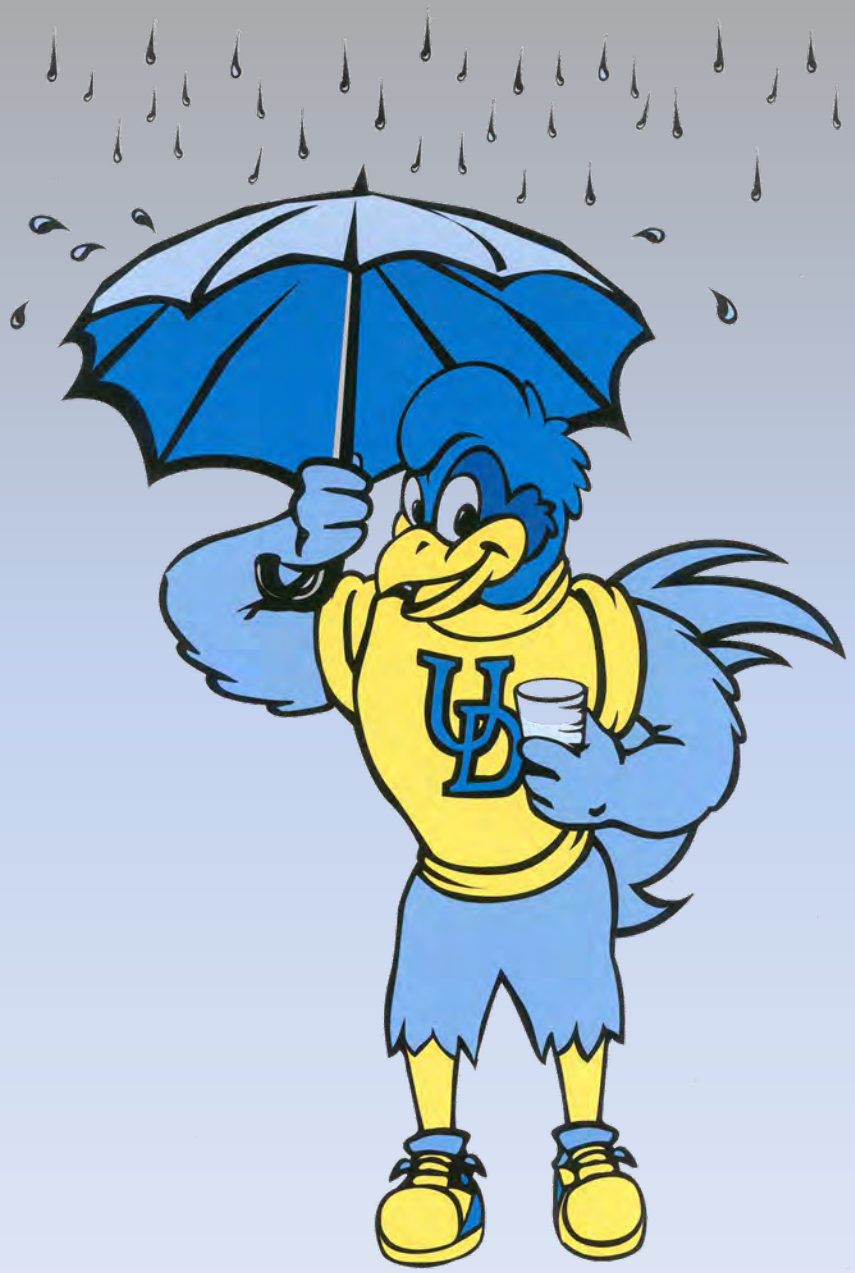


2020 Atlantic Basin Tropical Cyclone Tracks



Sustained Wind Speed: tropical storm >= 34kt/39mph strong tropical storm >= 50kt/58mph hurricane >= 64kt/74mph


May 10
Jun 1
Jun 20
Jul 10
Aug 1
Aug 20
Sep 10
Oct 1
Oct 20
Nov 10
Dec 1
Dec 20
110
100
90
80
70
60
50
40
30
20
10
0
Number of storms per 100 years
Hurricanes
Hurricanes and Tropical Storms
Atlantic Hurricane Frequencies



Questions?

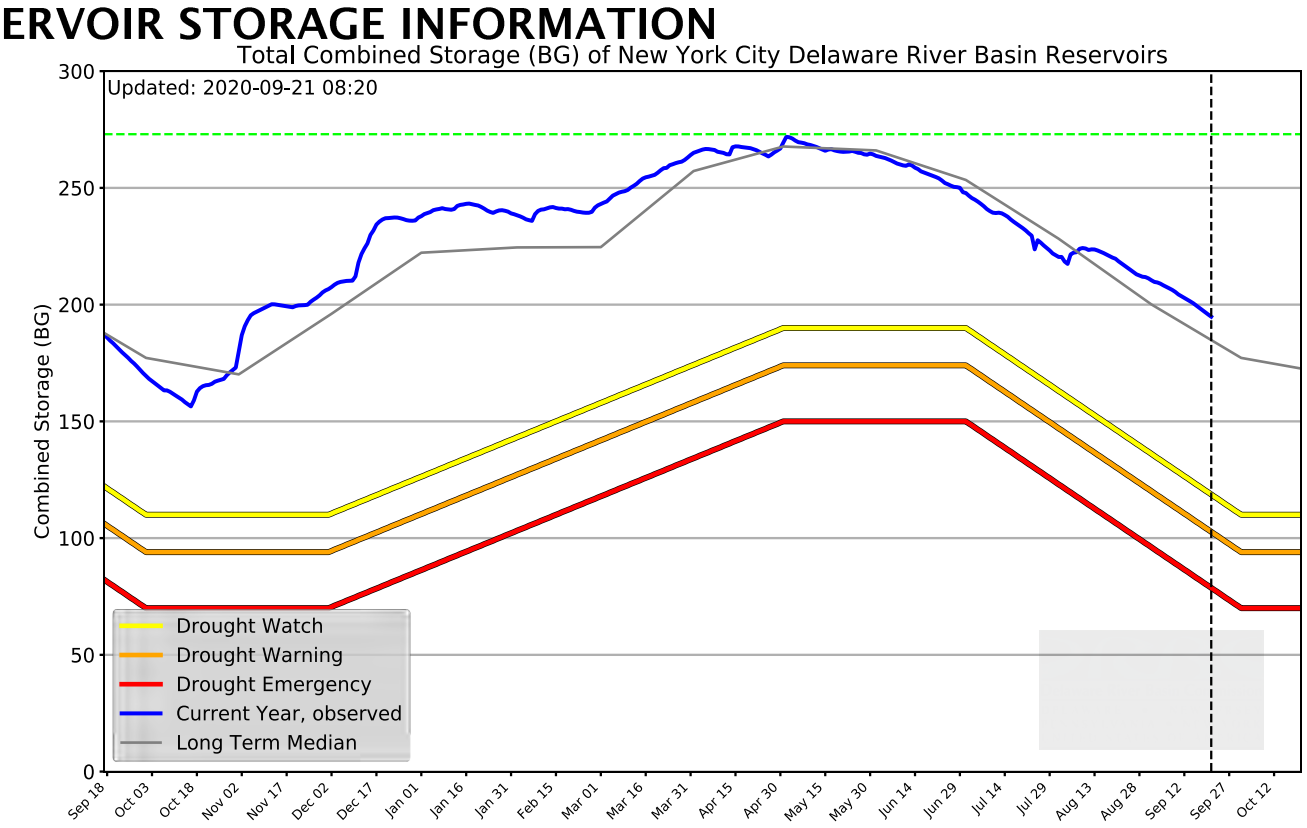
HYDROLOGIC CONDITIONS REPORT, SEPTEMBER 21, 2020

Delaware River Basin Commission
DELAWARE • NEW JERSEY
PENNSYLVANIA • NEW YORK
UNITED STATES OF AMERICA

RESERVOIR STORAGE INFORMATION

NEW YORK CITY	Usable Storage (BG)	(%)
Neversink	28.5	82.2
Pepacton	109.1	78.3
Cannonsville	57.2	61.2
NYC Total	194.8	72.8
LOWER BASIN		
FE Walter	1.1	17.7
Beltzville	13.5	100.1
Blue Marsh	5.8	100.4

Most Recent Update: 2020-09-21 08:20



BASIN WIDE DROUGHT STATUS: NORMAL

Usable Storage	Cannonsville	Pepacton	Neversink	Total
BG	57.2	109.1	28.5	194.8
%	61.2	78.3	82.2	72.8

BG above drought watch = 76.1
BG above drought warning = 92.1
BG above drought = 116.1
BG above median = 10.0
BG above one year ago = 15.3

7-Day Precipitation Totals

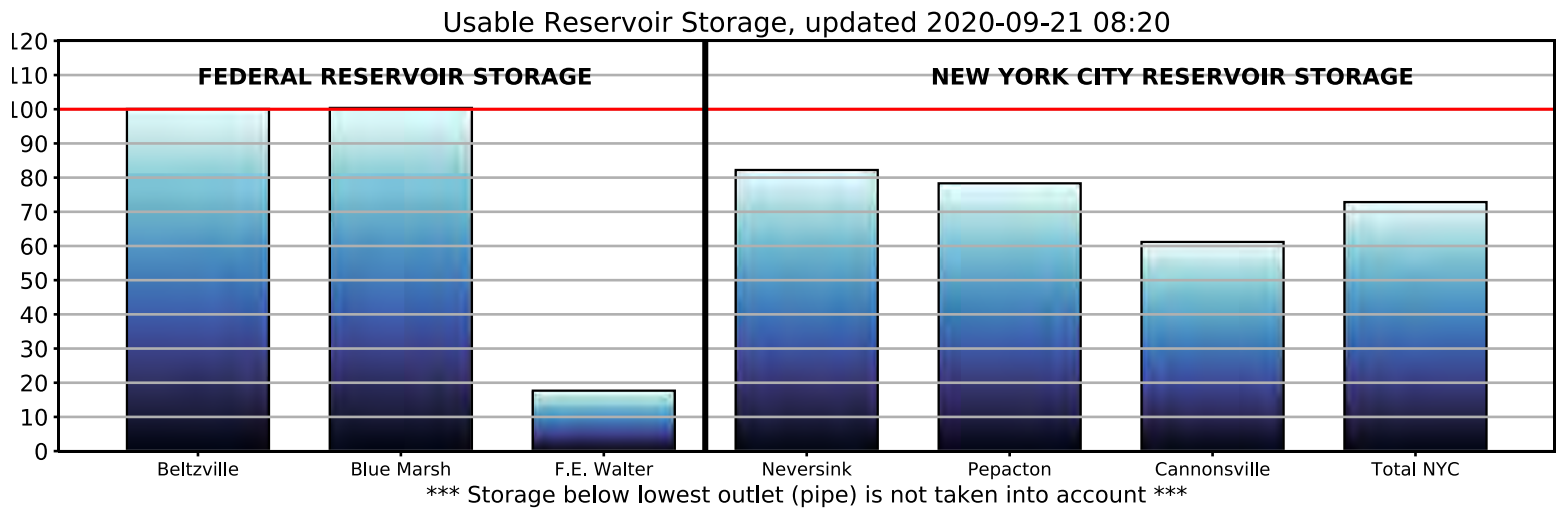
Upper Basin: 0.05 in

Middle-upper basin: 0.0 in

Middle-lower basin: 0.04 in

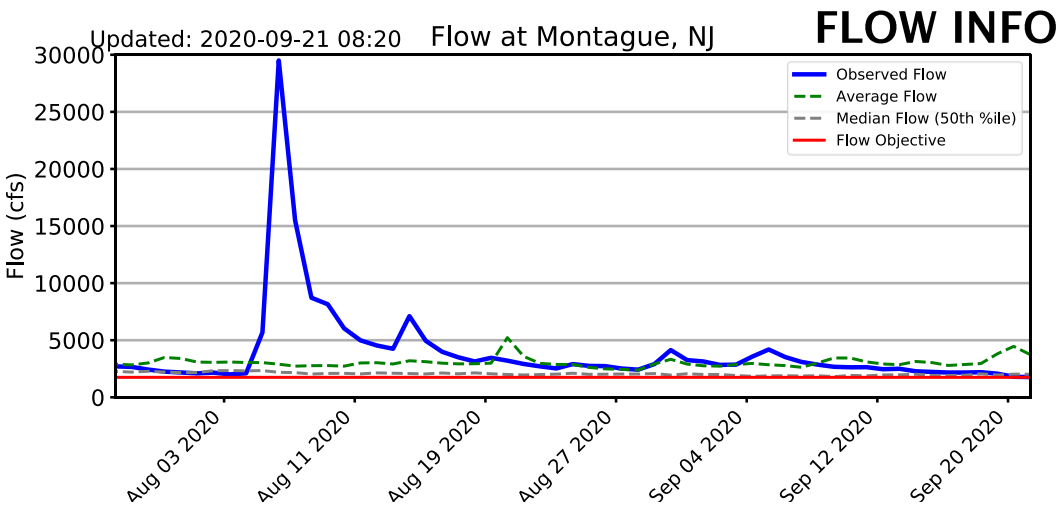
Near Delaware Bay: 0.36 in

**7-Day Precipitation Totals are calculated as an average of totals reported by MARFC from counties within the Delaware River Basin.

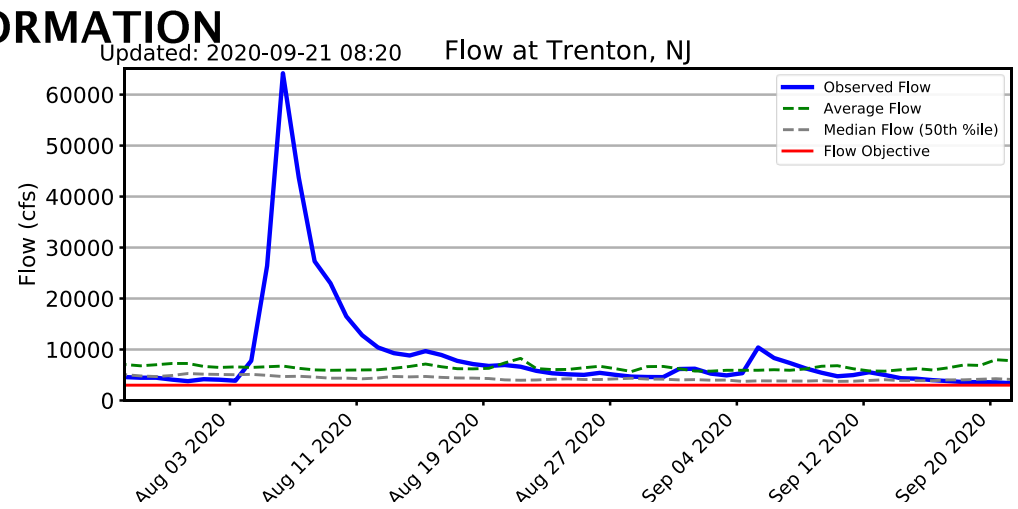


USACE Reservoir storage calculated from 8:00 AM USGS Gage Elevations; NYC Storage calculated from 8:00 AM AHPS elevation data. FE Walter storage based on maximum recreation reservoir storage

FLOW INFORMATION



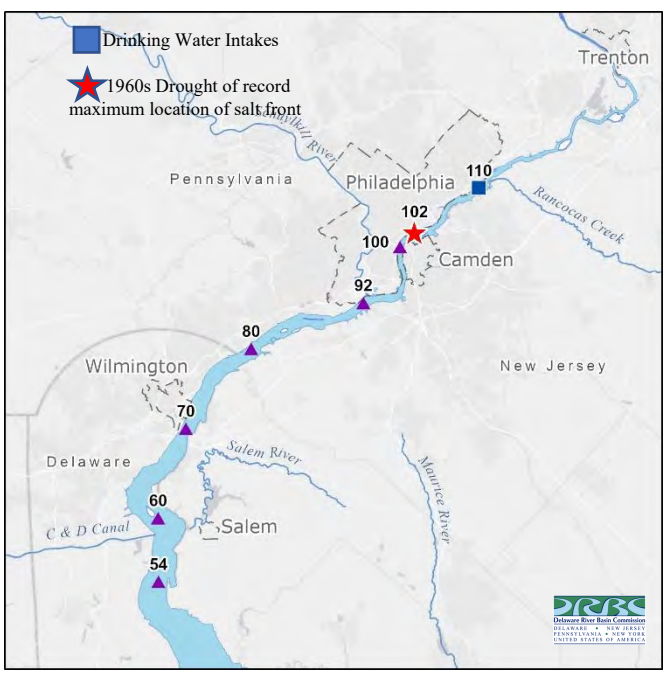
The average daily flow for the last seven days at Montague was 2059 cfs.

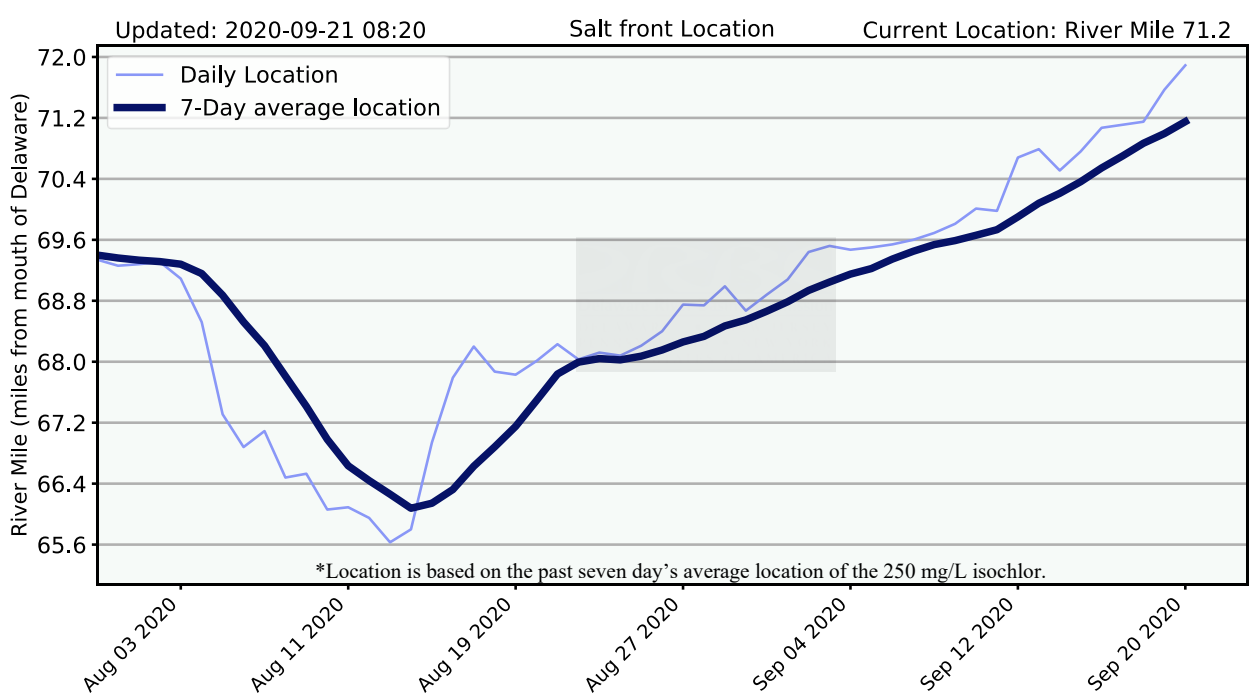


The average daily flow for the last seven days at Trenton was 3739 cfs.

SALT FRONT INFORMATION

SALT FRONT (river mile) This Week: 71.2 Last Week: 70.2 September Median: 76





Note: DRBC does not calculate the location of the saltfront below river mile 54.

Questions? Suggestions?
Contact: Anthony.Preucil@drbc.gov

***All data is provisional and subject to change

BOWERS BEACH MONITORING INITIATIVE

MATTHEW T. GRABOWSKI

WATER SUPPLY SECTION

OVERVIEW

- SMALL COASTAL TOWN (ESTIMATED POPULATION 335)
- BOWERS BEACH IS SITUATED ALONG THE DELAWARE BAY BETWEEN THE ST. JONES RIVER TO THE NORTH AND THE MURDERKILL RIVER TO THE SOUTH
- THE DEPARTMENT HAS RECEIVED COMPLAINTS FROM WELL OWNERS IN BOWERS FOR A NUMBER OF YEARS REGARDING ELEVATED CHLORIDES.
  - WSS CONDUCTED A STUDY BACK IN 2006 SAMPLING WELLS THROUGHOUT THE TOWN
  - RESULTED IN ESTABLISHED GMZ FOR INCREASED PERMIT REVIEW
  - DEEP WELL RECOMMENDATIONS
- MOST NEW WELLS WITHIN THE TOWN HAVE BEEN CONSTRUCTED IN THE CHESWOLD AQUIFER.
- FAST FORWARD TO 2019
  - DEPARTMENT RECEIVED A CHLORIDE COMPLAINT REGARDING A CHESWOLD WELL THAT WAS CONSTRUCTED IN 2013
  - DEPARTMENT SAMPLED AND CONFIRMED ELEVATED CHLORIDES
  - FIRST TIME ELEVATED CHLORIDES OBSERVED AT THIS DEPTH (POTENTIAL CONSTRUCTION ISSUE)
  - DEPARTMENT ACTION
    - PROPERLY ADDRESS CHESWOLD WELL ISSUE
    - INSTALL LONG TERM MONITORING POINTS


S Bayshore Dr
S Flack Ave
Middle Dr
Maple Ln
Mulberry Dr
Cooper Ave
Hubbard Ave
Clifton Cubbage Dr
Murderkill Ave
Davidson St
© 2020 Google
Google Earth
1992
Imagery Date: 6/13/2018 39°03'39.11" N 75°24'06.32" W elev 3 ft eye alt 2109 ft

ABANDONMENT EFFORT
PHASE I


DANGER

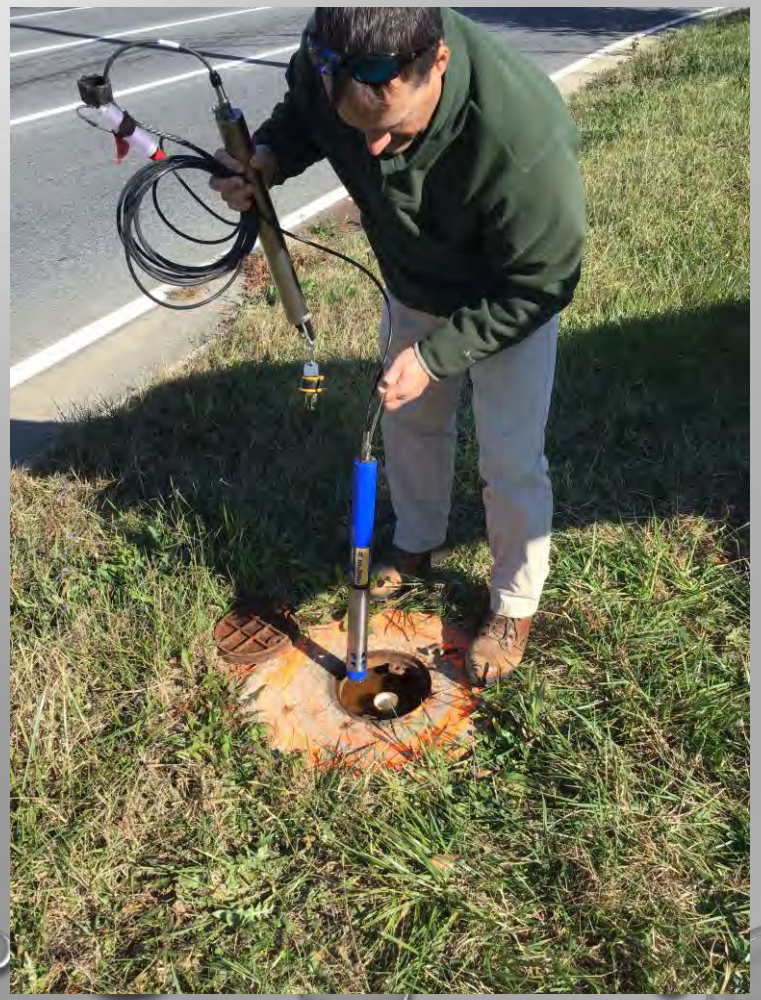

MONITOR
CAM CONTROL
FORWARD
DOWN VIEW
SIDE VIEW
MENU
INC
CLEAR
DEC
STOP
FORWARD
REVERSE
MIN
MAX
OFF
LAVAL UNDERGROUND SURVEYS


Plate 2: Sussex County Cross Sections
0000.1ft
R-CAM 1000
SAMSUNG


L8000
Rubbermaid
Commercial Products

MONITORING WELL CONSTRUCTION PHASE II

NEXT STEPS
LONG TERM MONITORING



NEXT STEPS

- PINEY POINT SOIL BORING (750’ FT)
- INFORMATIONAL DISPLAY IN COORDINATION WITH DELAWARE BAYSHORE INITIATIVE

Delaware BAYSHORE BYWAY

QUESTIONS

The Delaware Agricultural Irrigation Water Usage Project

Water Supply Coordinating Council Meeting

September 24, 2020

Project Objective

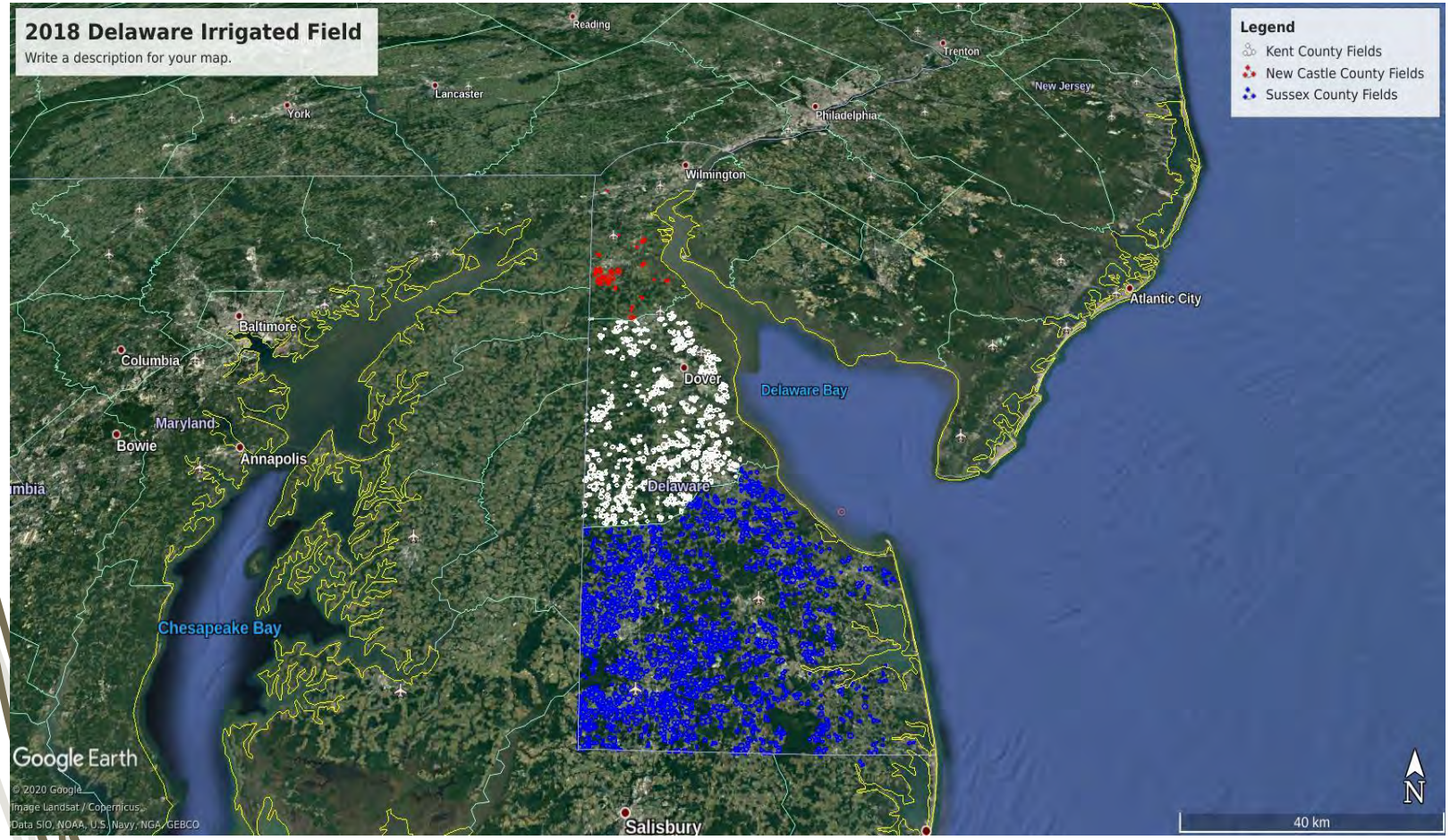
Develop a crop water demand model to estimate agricultural irrigation water usage at the field level for the last 10 years using the best available, location specific input data.

WHY? To help DNREC better understand the potential demand on water resources under varying seasonal weather conditions and improve its ability to allocate the resource more effectively.

A little background…

- DGS study (2010)
  - Estimated irrigation water usage for irrigated fields (2,407) from 2005-2008 for Kent and Sussex Counties
    - Similar method (crop water demand model), but slightly different data inputs. Weather and soil information were very generalized for region.
    - Found that for a wet year 18 billion gallons to 33 billion gallons in a dry year for agricultural irrigation in Kent & Sussex Counties
    - Some results were included in 12th Water Report for the WSCC
      - Noted the 90.8 mgd for peak day water demands in Kent and Sussex County for farm irrigation based on 2007 simulation by DGS study
      - Projected between 55.1 and 99.9 mgd needed for Kent & Sussex Counties by 2020, with as much as 109.9 mgd by 2030 for a peak day.
- USGS Study (2013) found generally good agreement between crop water demand model and corn/soybean water use in Georgia.

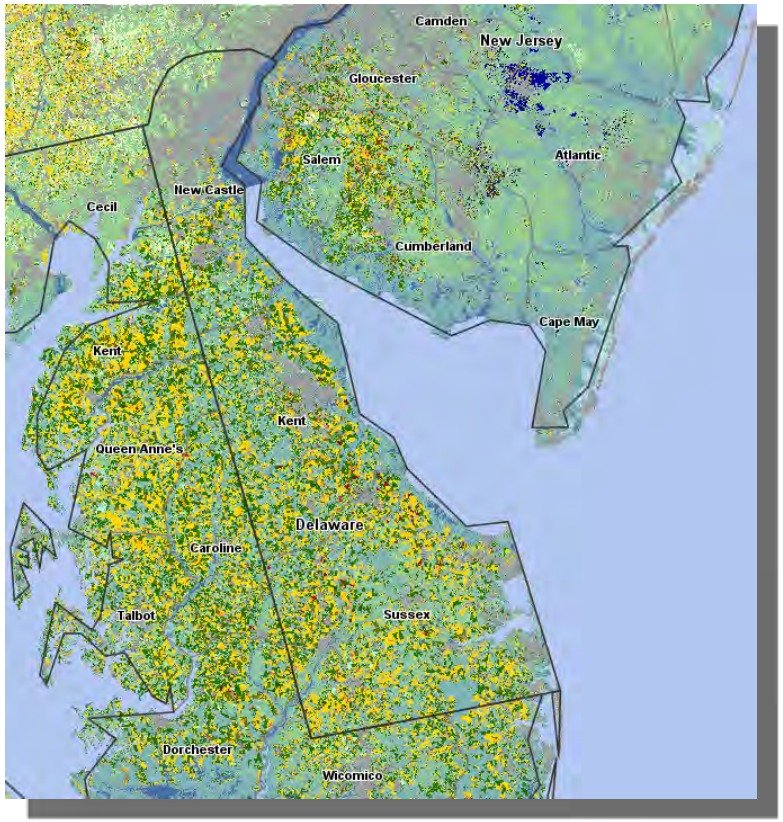
Model Info & Irrigated Farmland Dataset



- Model is based on the FAO's Irrigation and Drainage Paper No. 56 (water balance approach)
- Irrigated farm fields were manually digitized using Google Earth in aerial imagery in 2011 and 2018.
- 2,964 irrigated fields defined covering 152,325 acres statewide
- Approximately 1/3 of Delaware cropland is irrigated.

Model Data

- 2018 Irrigated Farmland for Delaware
- USDA Gridded SSURGO soil water content
- USDA CropScape annual crop type data
  - Only focused on Corn and Soybean
- USDA Weekly Crop Bulletins for Delaware for crop emergence dates
- DEOS Weather Data (Rainfall and Reference ET)

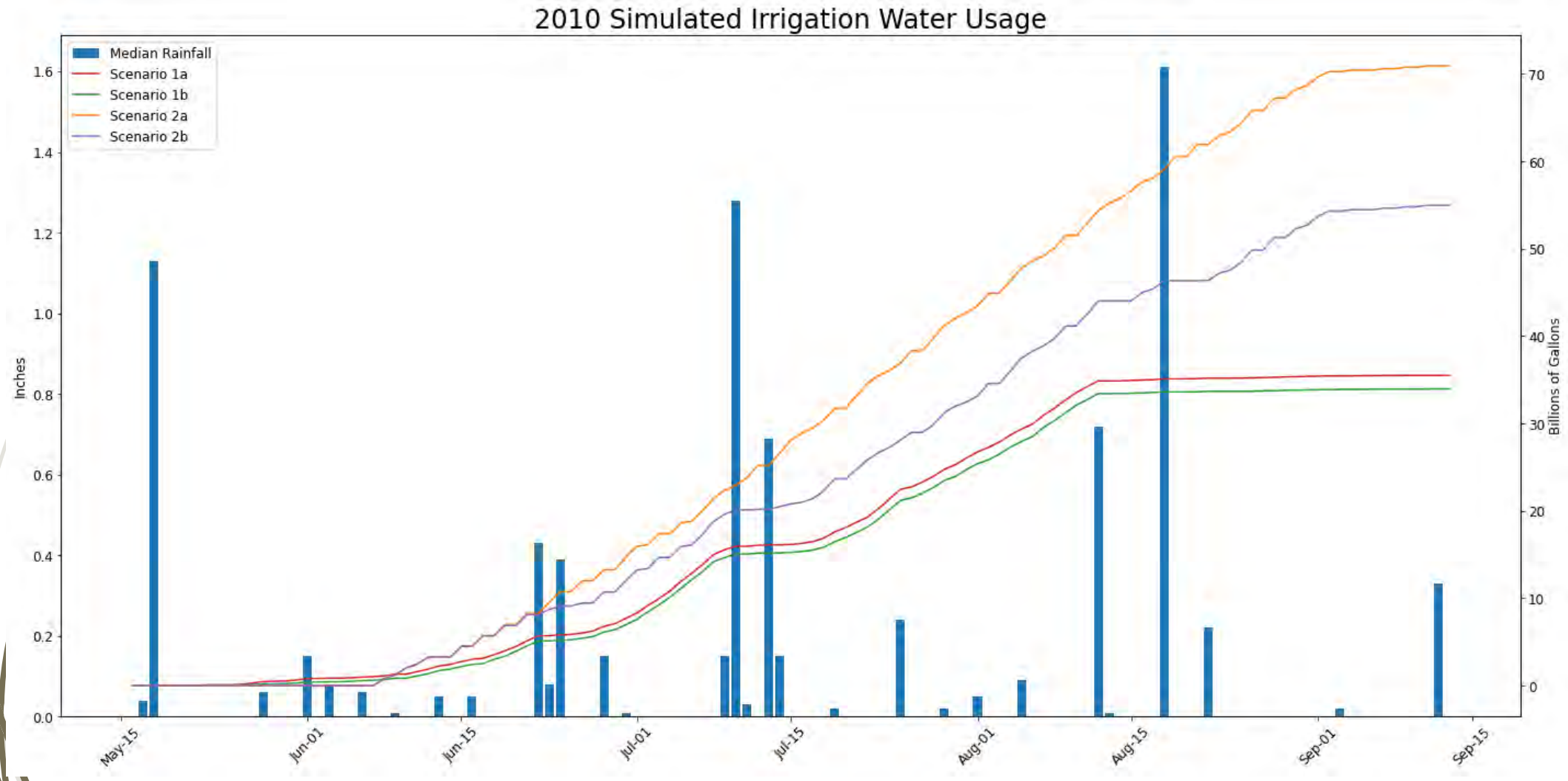


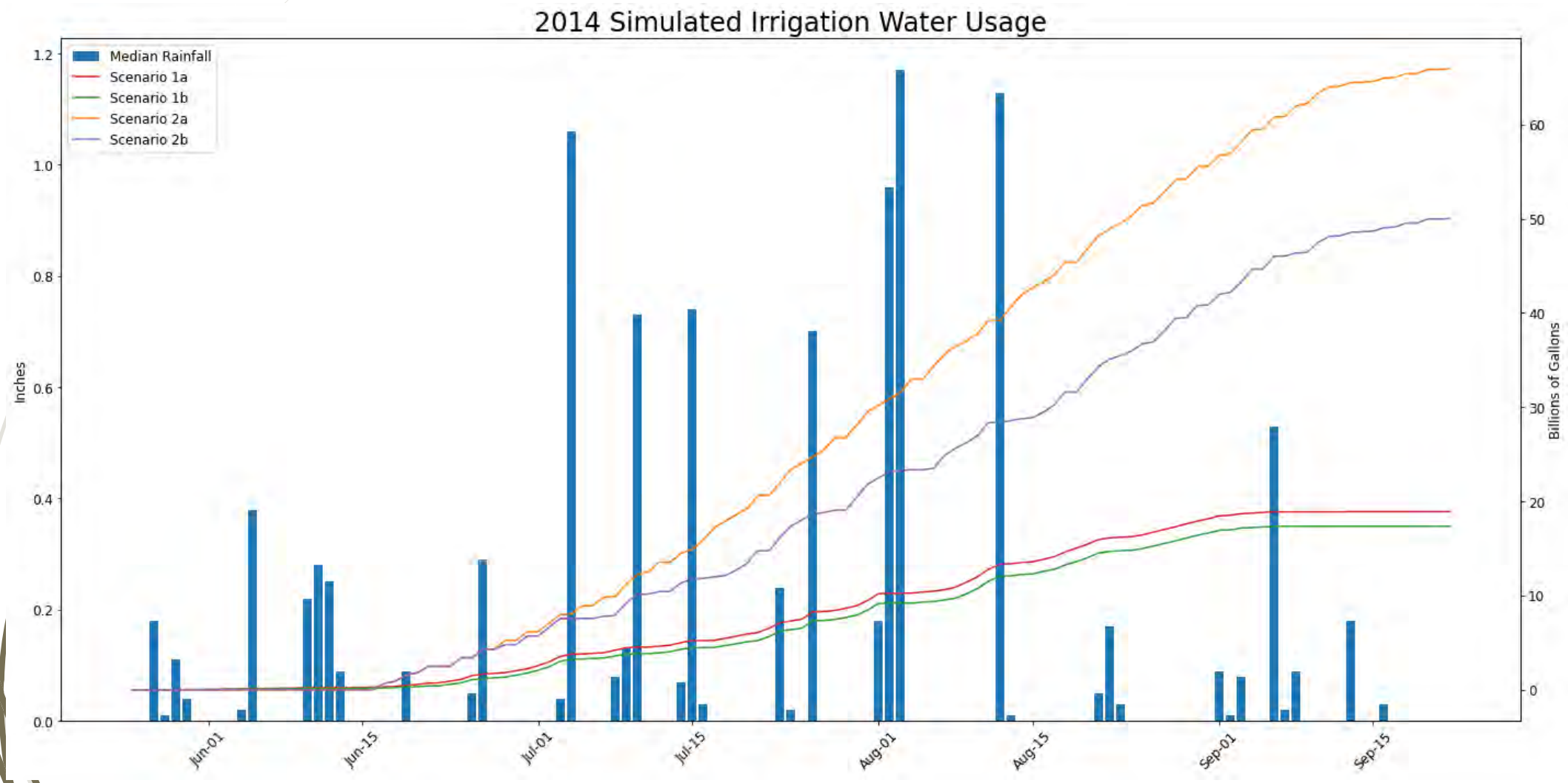
2019 USDA Cropscape Data

Irrigation Scenarios

- Scenario #1 – ET Model Method
  - 1a: Irrigate whenever available water drops below maximum allowable depletion level. Irrigate same amount (0.4") every time.
  - 1b: Same "trigger" as 1a, but irrigate only enough to bring water content back up to 55% of field capacity.
- Scenarios #2 - Calendar-based Method
  - 2a: Irrigate according to pre-determined seasonal schedule. Irrigate the same amount (0.4") and follow the calendar no matter how much it rains.
  - 2b: Follow the irrigation calendar, but if it rains at least one application's worth of irrigation since the last irrigation, then we'll skip an irrigation application. This is the calendar method, but with the use of a rain gage.

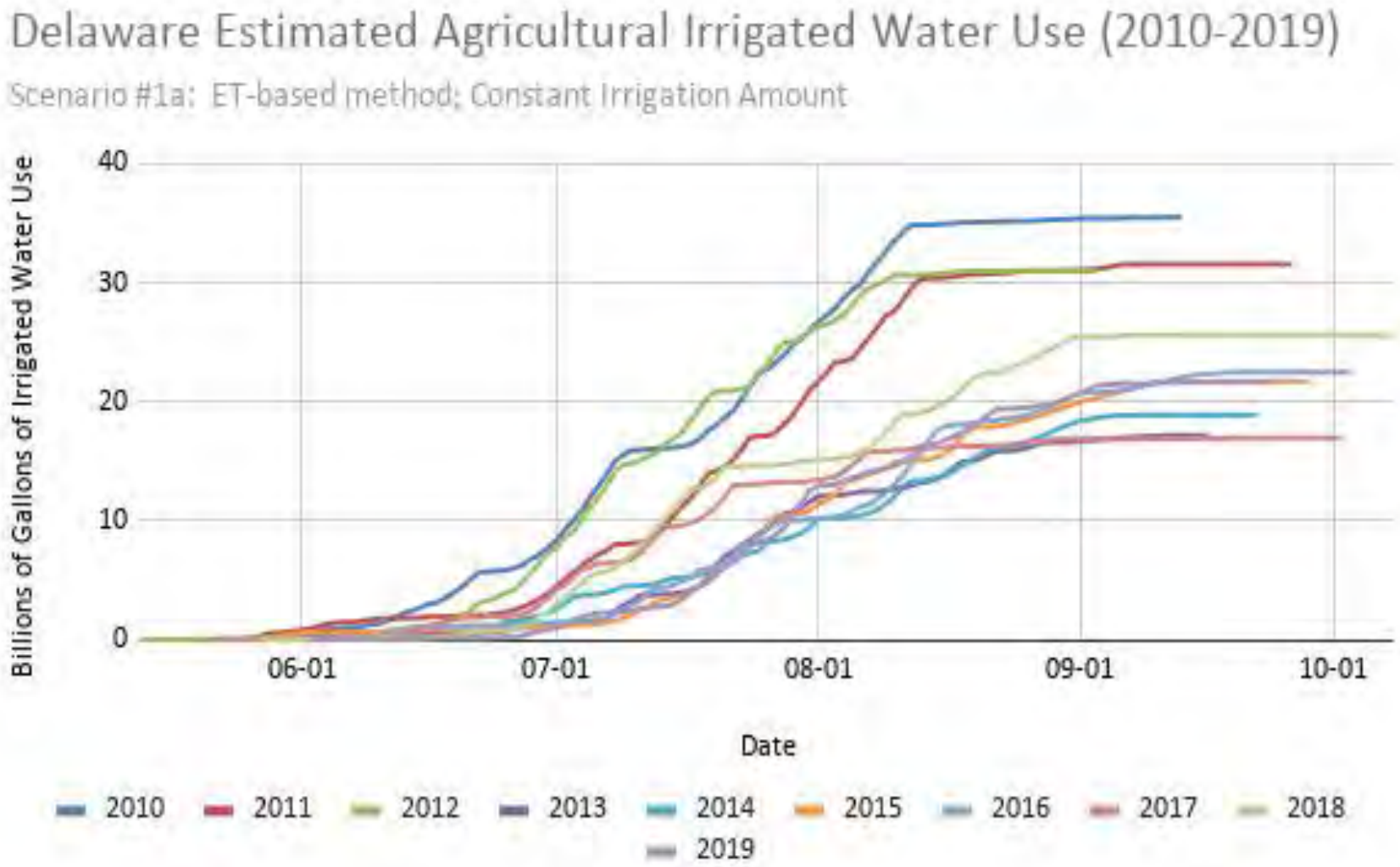
Seasonal Water Usage

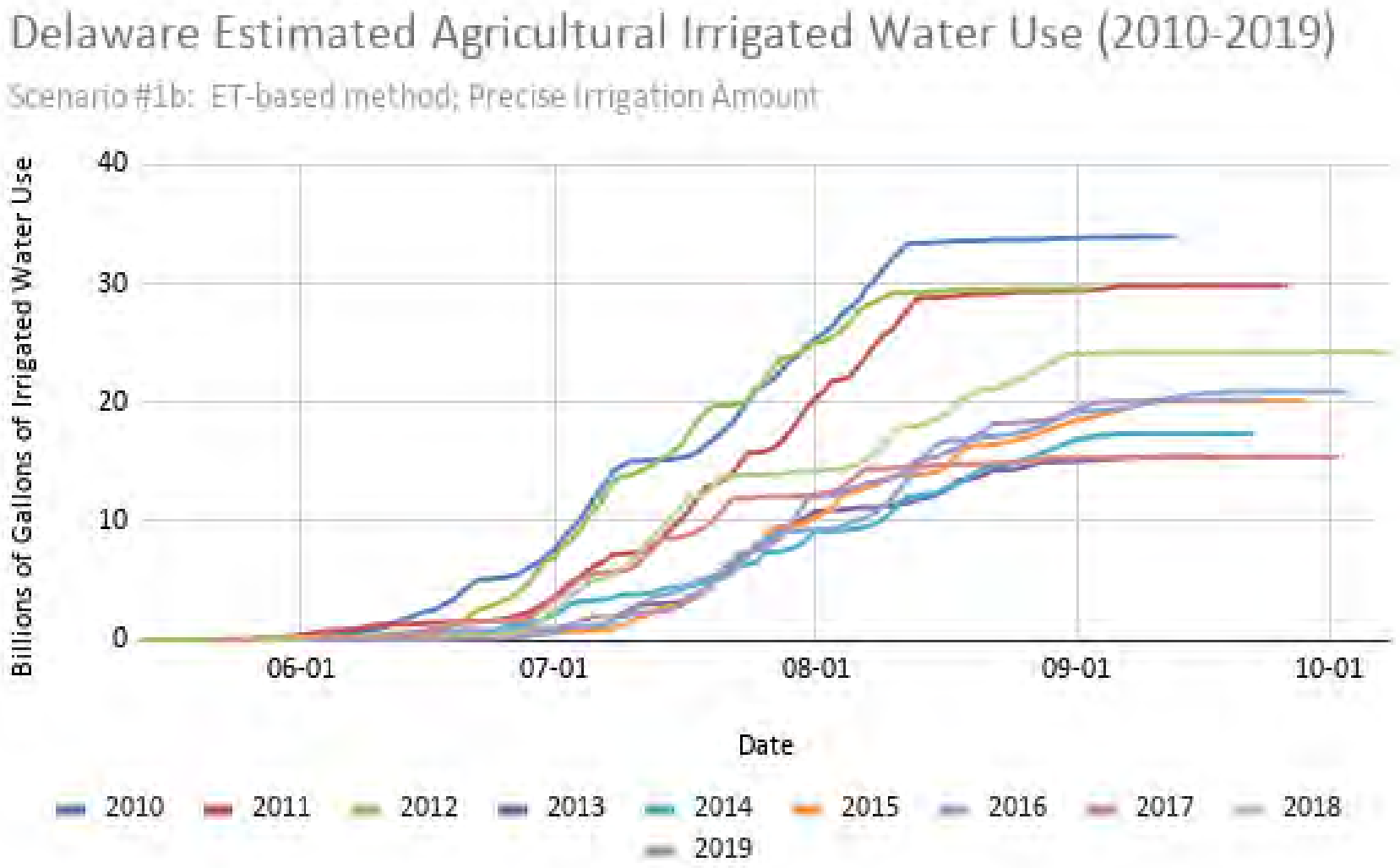

2010 Simulated Irrigation Water Usage
Median Rainfall
Scenario 1a
Scenario 1b
Scenario 2a
Scenario 2b
Inches
Billions of Gallons
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
0
10
20
30
40
50
60
70
May-15
Jun-01
Jun-15
Jul-01
Jul-15
Aug-01
Aug-15
Sep-01
Sep-15

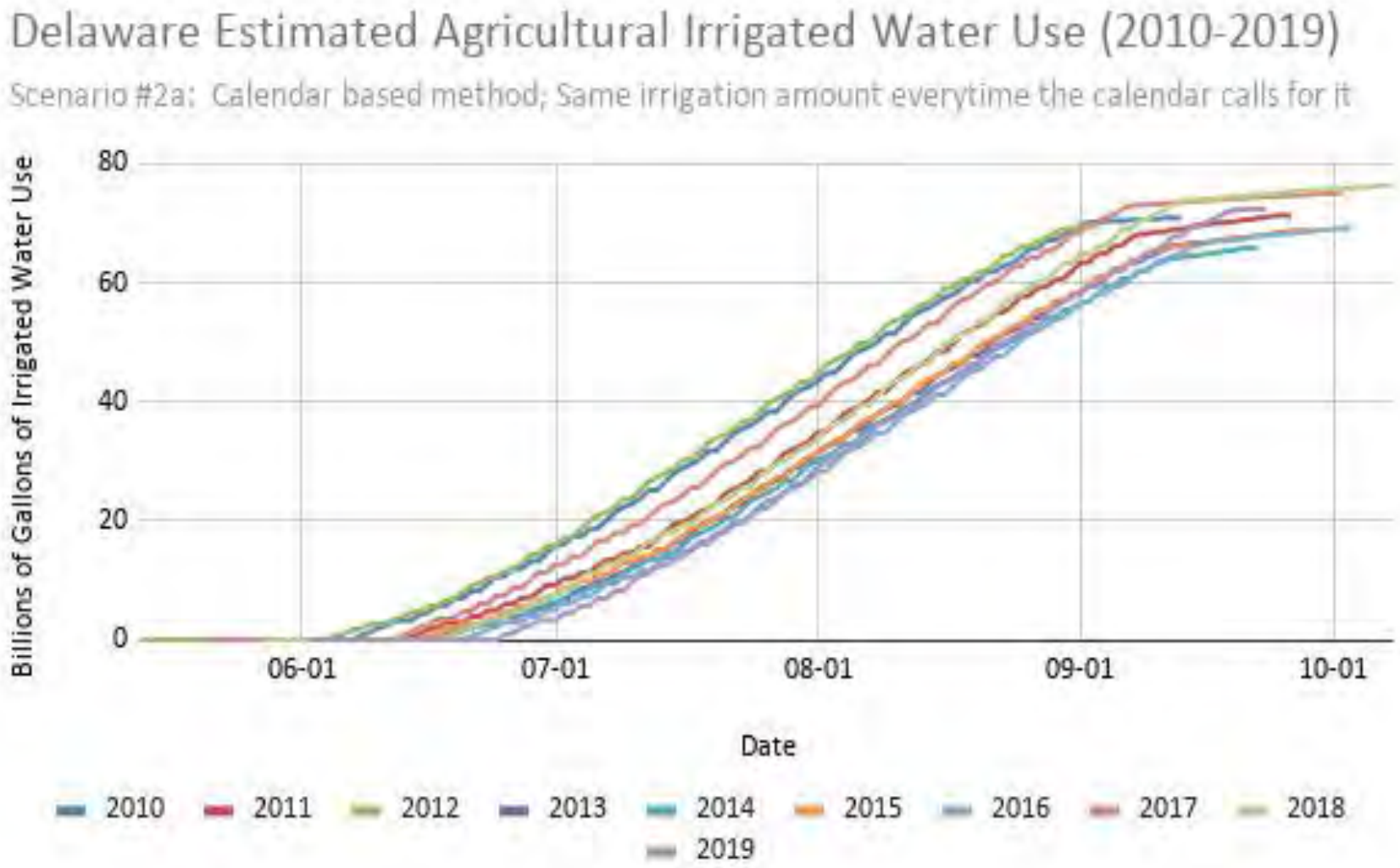

2014 Simulated Irrigation Water Usage
Median Rainfall
Scenario 1a
Scenario 1b
Scenario 2a
Scenario 2b
Inches
Billions of Gallons
0.0
0.2
0.4
0.6
0.8
1.0
1.2
0
10
20
30
40
50
60
Jun-01
Jun-15
Jul-01
Jul-15
Aug-01
Aug-15
Sep-01
Sep-15

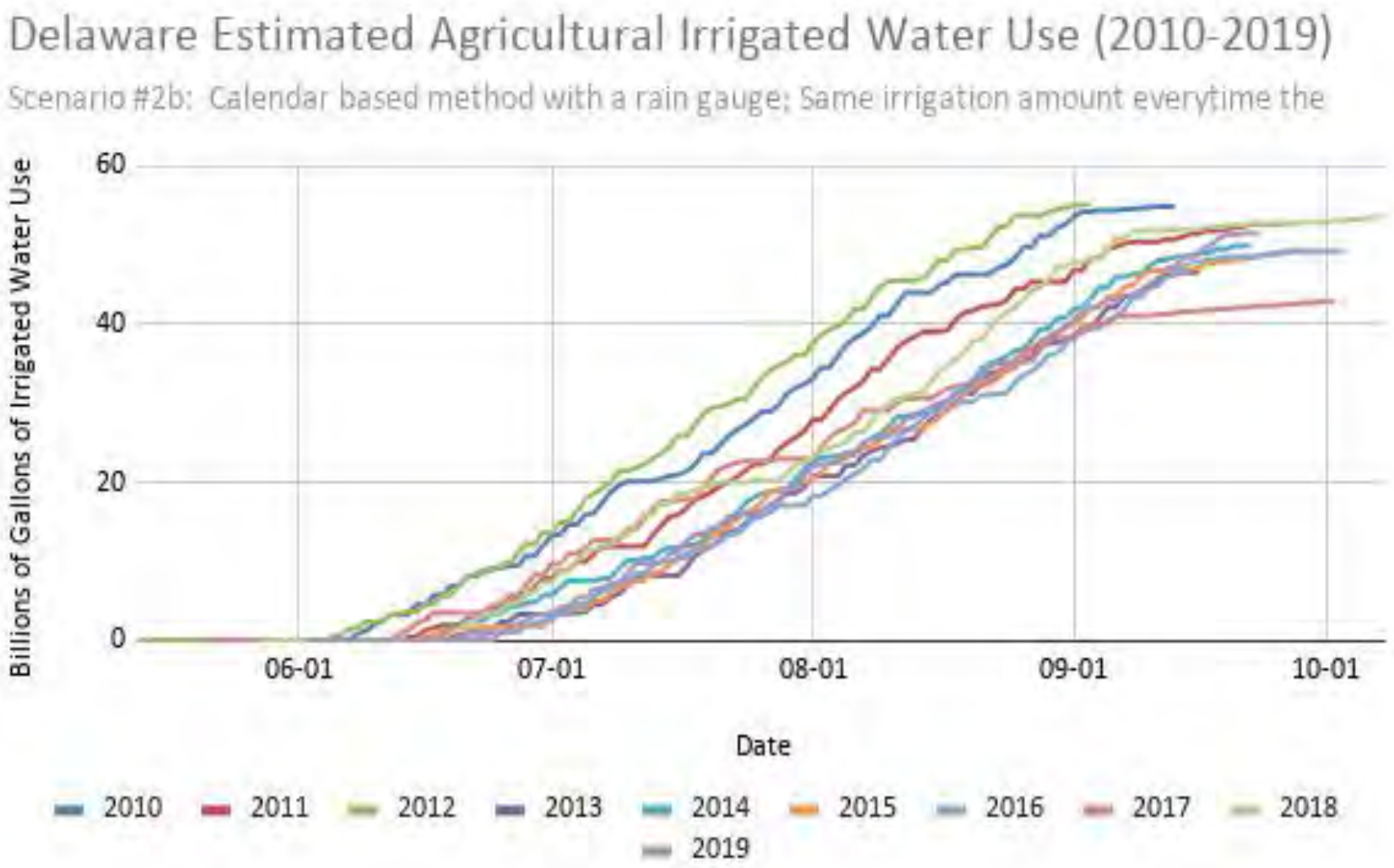
Year	Irrigation Volume	Seasonal Rainfall	81-10 Departure
2010	35,517,980,963	21.36	-1.93
2011	31,587,643,729	24.91	1.62
2012	31,058,962,924	26.27	2.98
2013	17,193,277,659	30.39	7.10
2014	18,914,646,418	21.29	-2.00
2015	21,718,129,290	23.69	0.40
2016	22,516,687,328	31.01	7.72
2017	16,994,209,440	30.11	6.82
2018	25,652,655,386	32.91	9.62
2019	21,679,275,854	21.86	-1.43

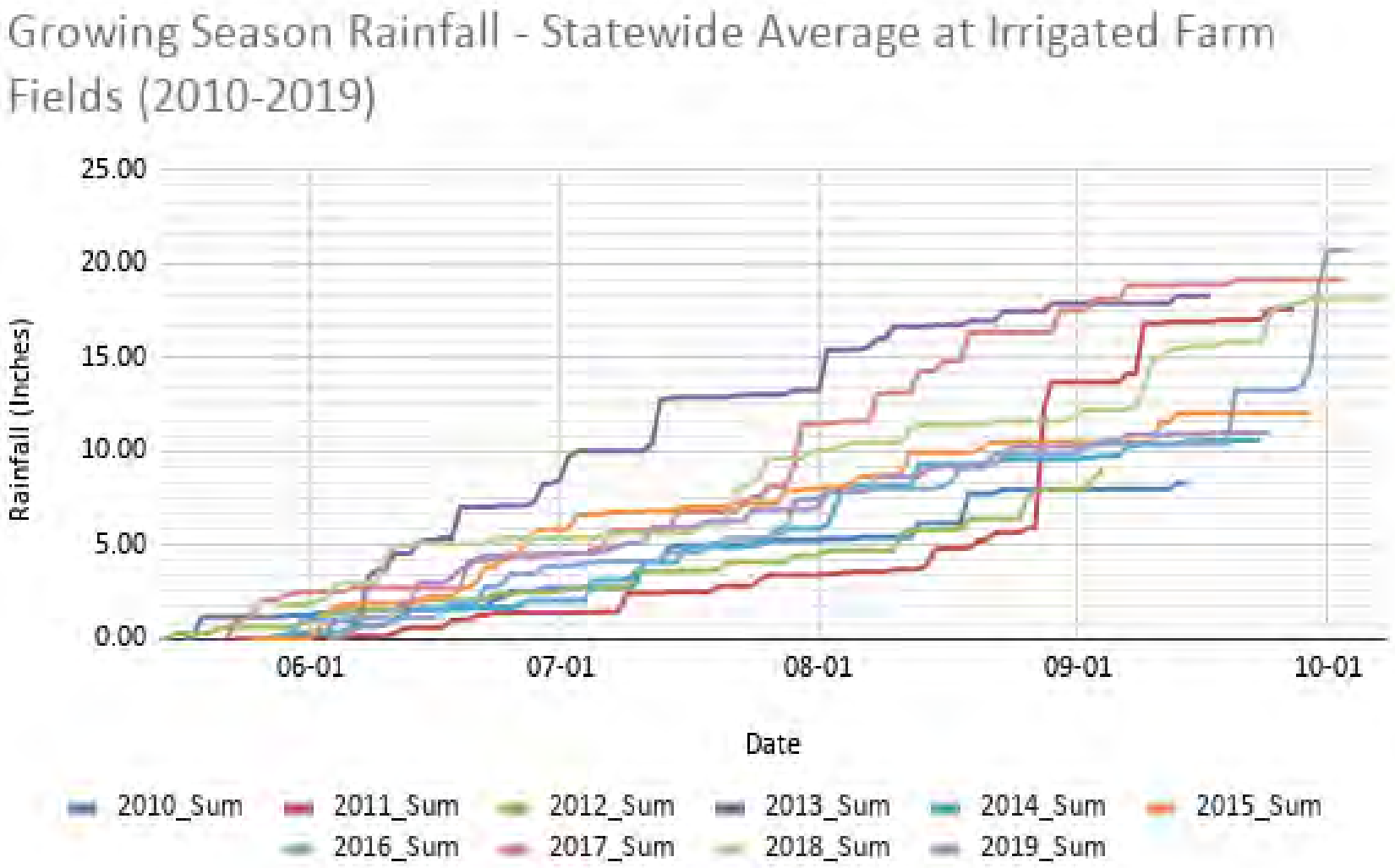
Comparison by Scenario


Delaware Estimated Agricultural Irrigated Water Use (2010-2019)
Scenario #1a: ET-based method; Constant Irrigation Amount
Billions of Gallons of Irrigated Water Use
40
30
20
10
0
06-01
07-01
08-01
09-01
10-01
Date
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019

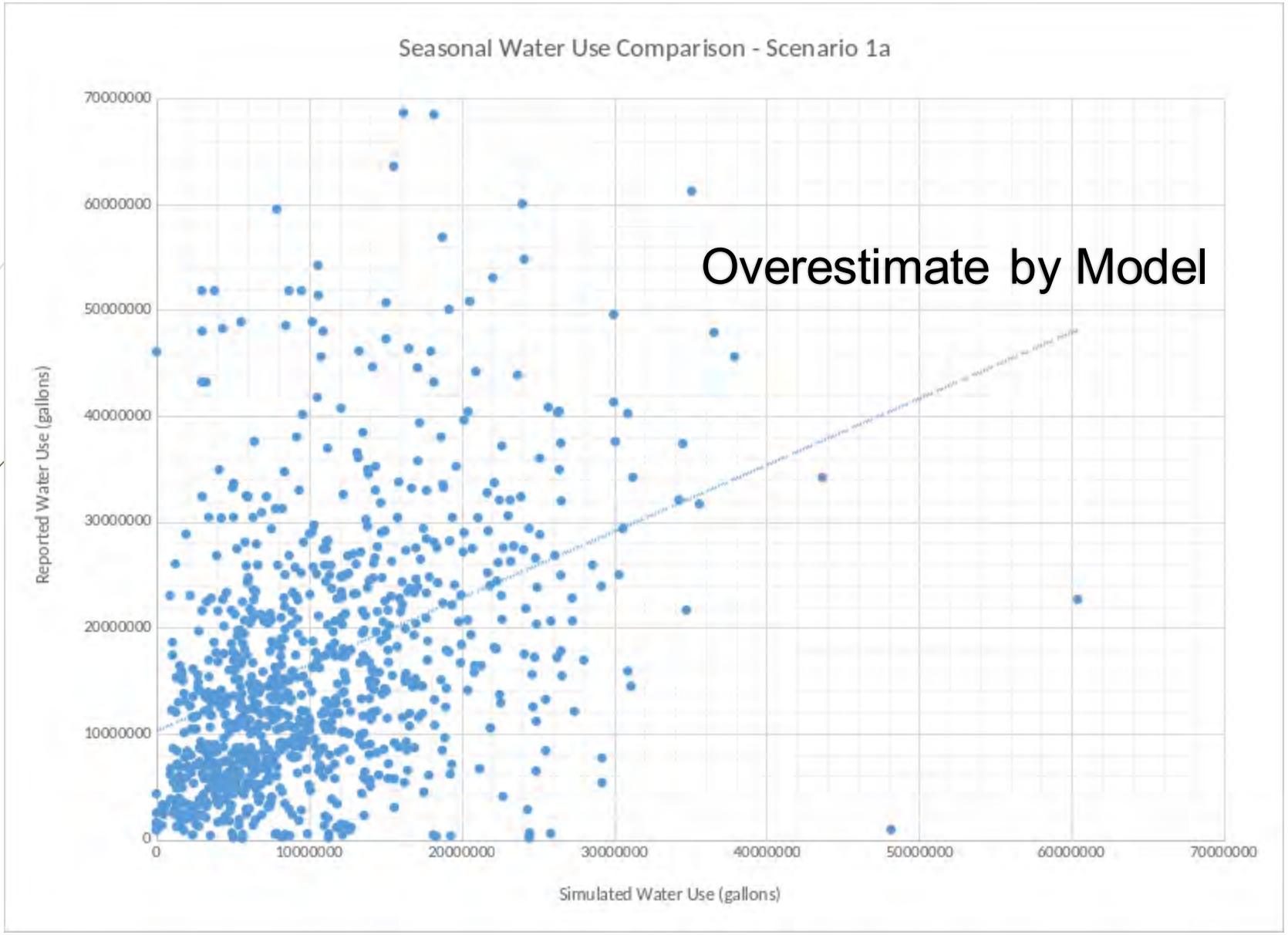

Delaware Estimated Agricultural Irrigated Water Use (2010-2019)
Scenario #1b: ET-based method; Precise Irrigation Amount
Billions of Gallons of Irrigated Water Use
40
30
20
10
0
06-01
07-01
08-01
09-01
10-01
Date
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019

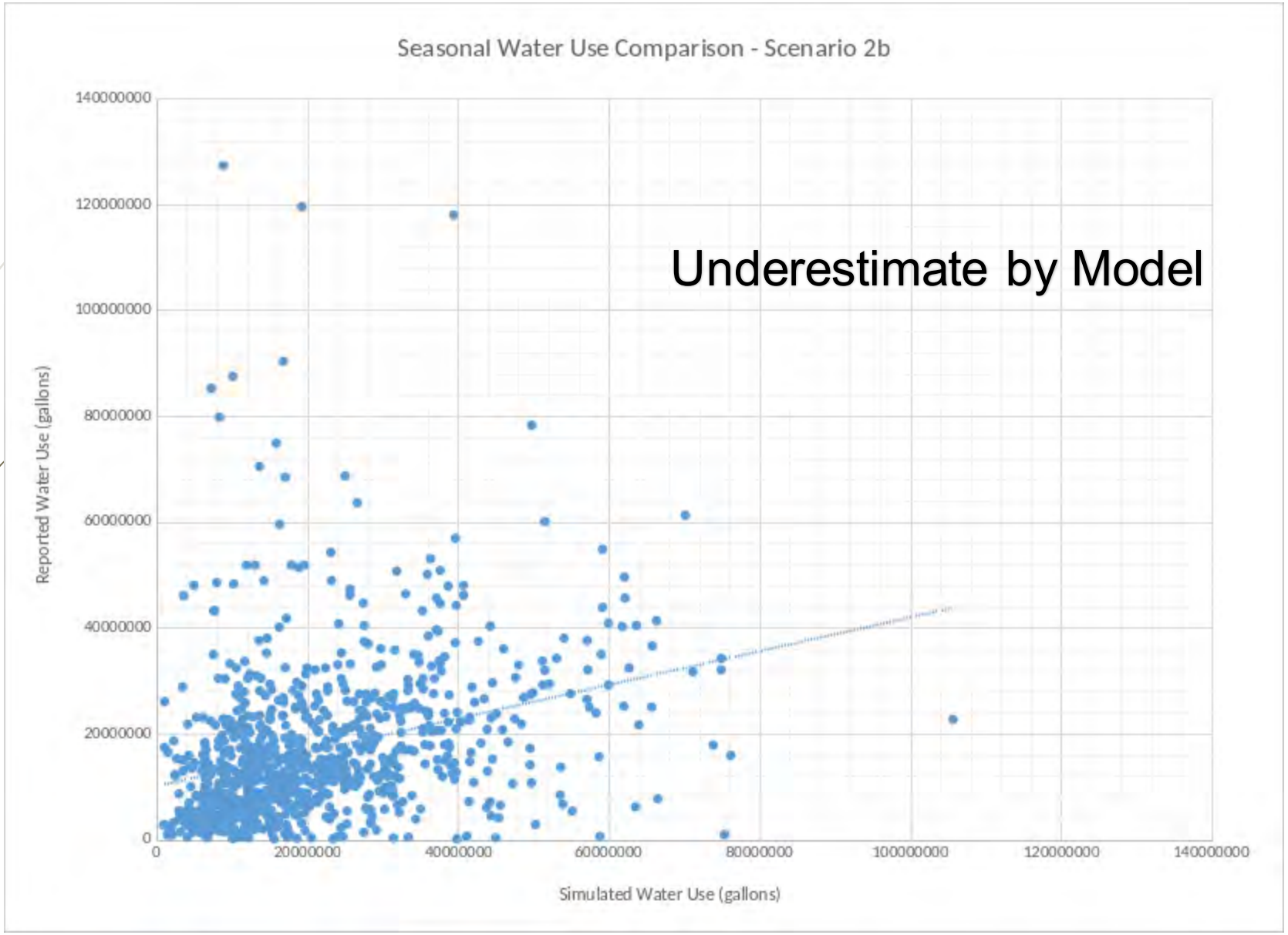

Delaware Estimated Agricultural Irrigated Water Use (2010-2019)
Scenario #2a: Calendar based method; Same irrigation amount everytime the calendar calls for it
Billions of Gallons of Irrigated Water Use
80
60
40
20
0
06-01
07-01
08-01
09-01
10-01
Date
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019


Delaware Estimated Agricultural Irrigated Water Use (2010-2019)
Scenario #2b: Calendar based method with a rain gauge; Same irrigation amount everytime the
Billions of Gallons of Irrigated Water Use
60
40
20
0
06-01
07-01
08-01
09-01
10-01
Date
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019

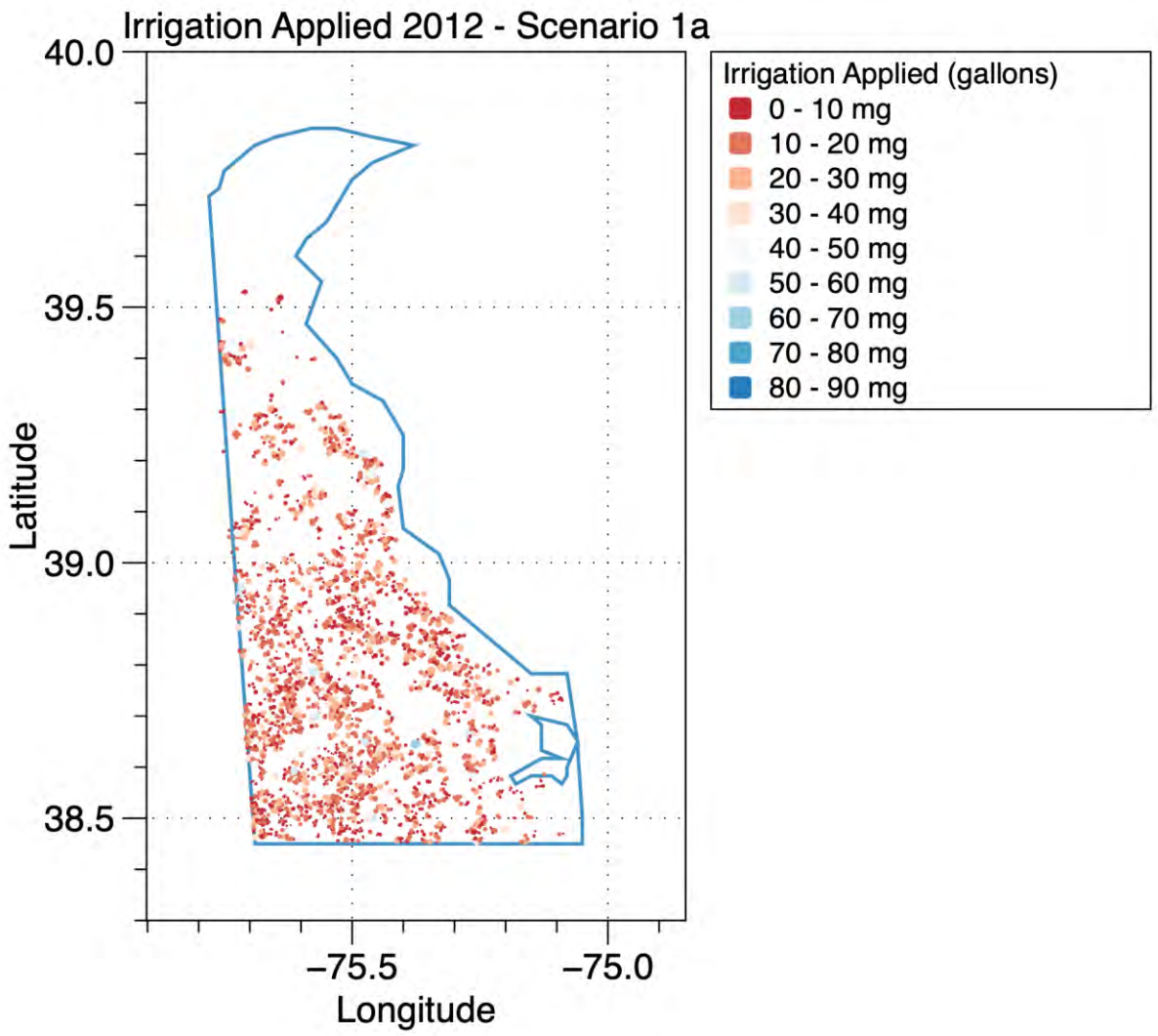

Growing Season Rainfall - Statewide Average at Irrigated Farm Fields (2010-2019)
25.00
20.00
15.00
10.00
5.00
0.00
Rainfall (Inches)
06-01
07-01
08-01
09-01
10-01
Date
2010_Sum
2011_Sum
2012_Sum
2013_Sum
2014_Sum
2015_Sum
2016_Sum
2017_Sum
2018_Sum
2019_Sum

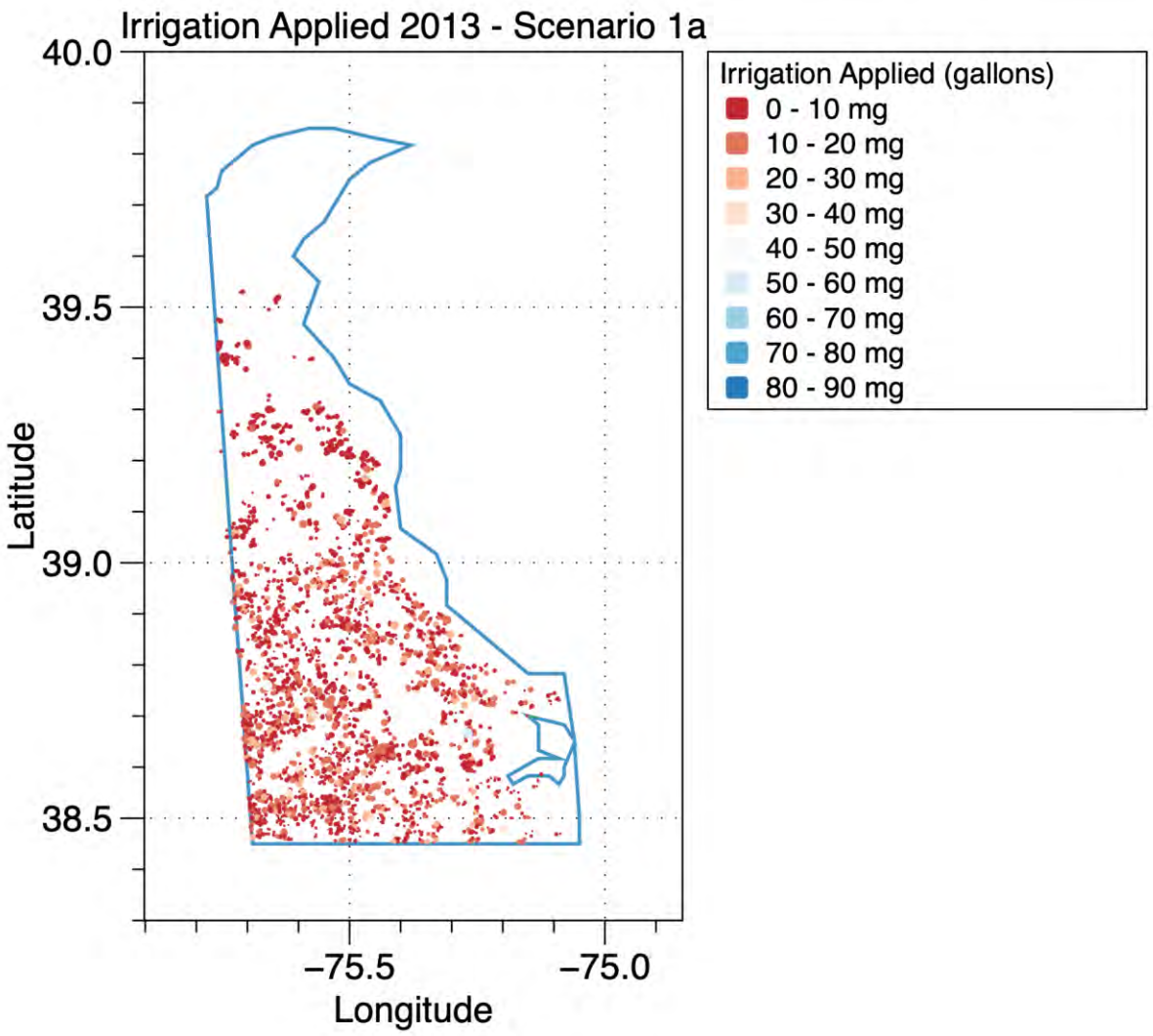
Seasonal Water Use Comaprison


Seasonal Water Use Comparison - Scenario 1a
Overestimate by Model
Reported Water Use (gallons)
Simulated Water Use (gallons)
0
10000000
20000000
30000000
40000000
50000000
60000000
70000000


Seasonal Water Use Comparison - Scenario 2b
Underestimate by Model
Reported Water Use (gallons)
Simulated Water Use (gallons)
0
20000000
40000000
60000000
80000000
100000000
120000000
140000000

Seasonal Irrigation Maps


Irrigation Applied 2012 - Scenario 1a
Irrigation Applied (gallons)
0 - 10 mg
10 - 20 mg
20 - 30 mg
30 - 40 mg
40 - 50 mg
50 - 60 mg
60 - 70 mg
70 - 80 mg
80 - 90 mg
40.0
39.5
39.0
38.5
Latitude
−75.5
−75.0
Longitude


Irrigation Applied 2013 - Scenario 1a
Irrigation Applied (gallons)
0 - 10 mg
10 - 20 mg
20 - 30 mg
30 - 40 mg
40 - 50 mg
50 - 60 mg
60 - 70 mg
70 - 80 mg
80 - 90 mg
40.0
39.5
39.0
38.5
Latitude
−75.5
−75.0
Longitude

Main Takeaways

- How much water is used to irrigate agricultural fields each year depending on the availability of rain during the growing season?
  - Low-end: 17-35.5 billion gallons
  - High-end: 43-55 billion gallons
  - Results still needs to be compared to reported water use data, but preliminary comparison suggests model scenario captures "reality" somewhere in between the two main irrigation scenarios.
- Model output available for all fields defined for each day, monthly, year for the last 10 years.
- Method can be replicated and improved for future growing seasons.
- To Do List:
  - Validate model results with best available reported water use data
  - Create crop water demand "climatology" from daily/monthly model data
  - Model sensitivity testing

Questions?

GROUNDWATER AND SALINE WATER INTRUSION MONITORING NETWORK INFRASTRUCTURE IMPROVEMENTS: KENT COUNTY, DELAWARE

For: Water Supply Coordinating Council
Sept. 24, 2020
Delaware Geological Survey

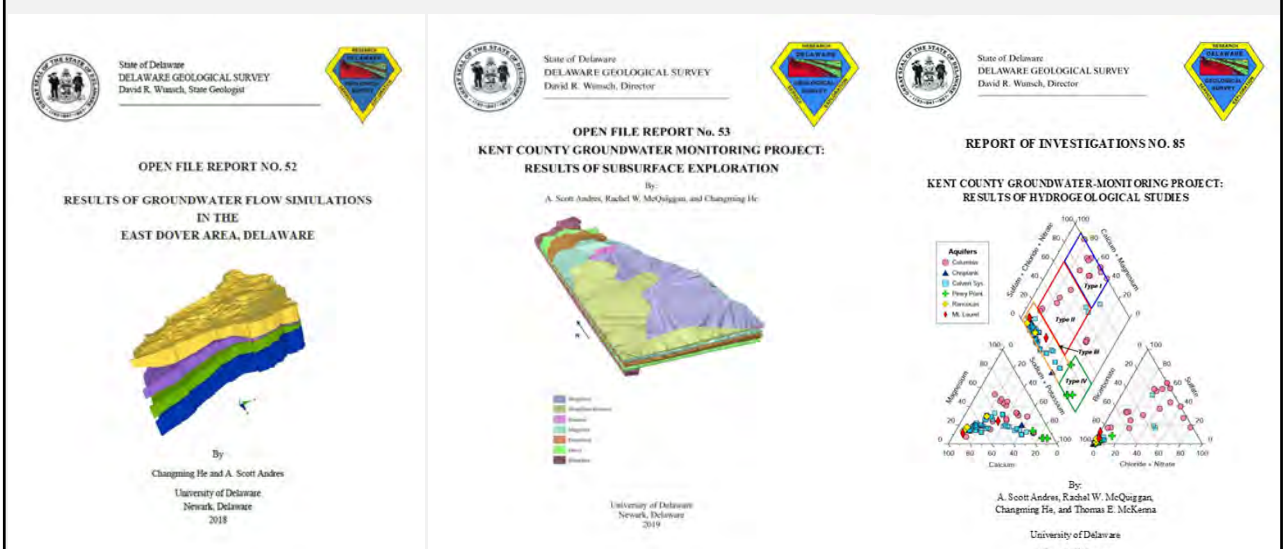
PROJECT BACKGROUND

- Purpose
  - Modernize and fill gaps in water monitoring infrastructure in Kent Co
  - Project collects data needed for water management and policy planning and decisions
  - Focus on currently used aquifers throughout Kent Co and east Dover area around City wellfield
- Capital funding approved FY 2017 – ends FY 2021 (~$710K)
  - No administrative costs in budget
  - Federally funded NEWERNet, WiCCED, + NGWMN overlap and leveraging (~ $1.2 M)

INFRASTRUCTURE COMPLETED

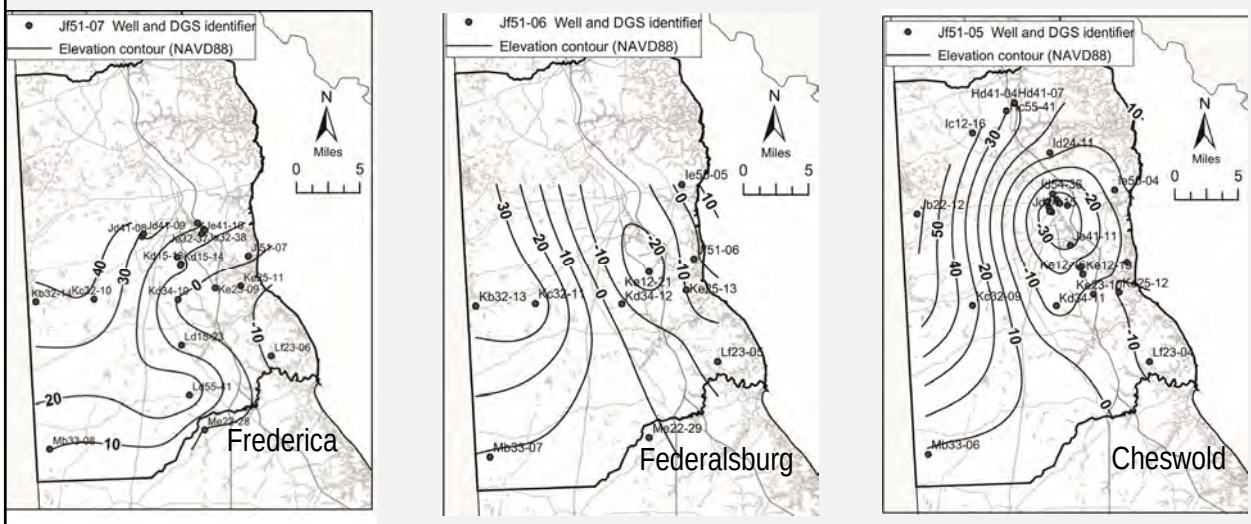
- Test borings, logs and wells completed at 10 of 10 proposed sites – plus 2 of 3 additional sites in Dover. More than 8700 feet of wells
- 2 USGS stream gages re-activated, data analyzed
- Monitoring stations and wells installed at multiple irrigation systems in east Dover focus area
- Instrumentation installed and operating in new wells and east Dover
- Groundwater quality testing completed
- 3 partial record tide height/salinity gages operated

PROJECT RESULTS OVERVIEW

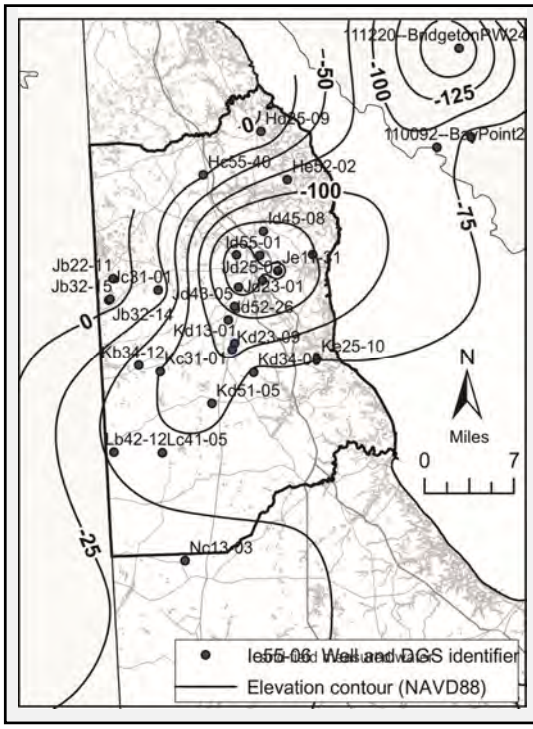


7.1 M gw level, 1.1 M gw salinity, ~90 gw samples

FREDERICA, FEDERALSBURG, CHESWOLD AQUIFERS



3 aquifers behave as a leaky system, indicate need for new management strategy
Regional and local pumping impacts demonstrate need for continued monitoring



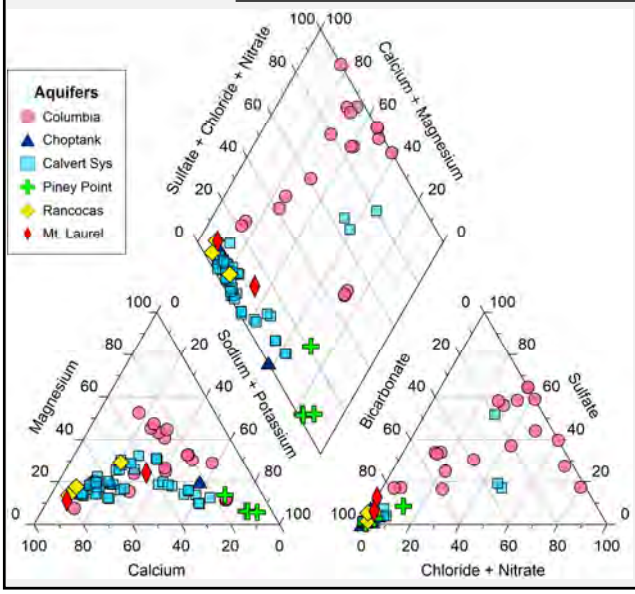
PINEY POINT AQUIFER

Drawdown extends MD – DE – NJ

Maximum drawdown centered on Dover and Bridgeton pumping centers

Long term sustainability of resource not possible at current pumping and annual drawdown rates

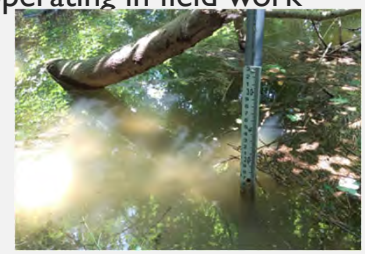
GROUNDWATER QUALITY AT 10 SITES



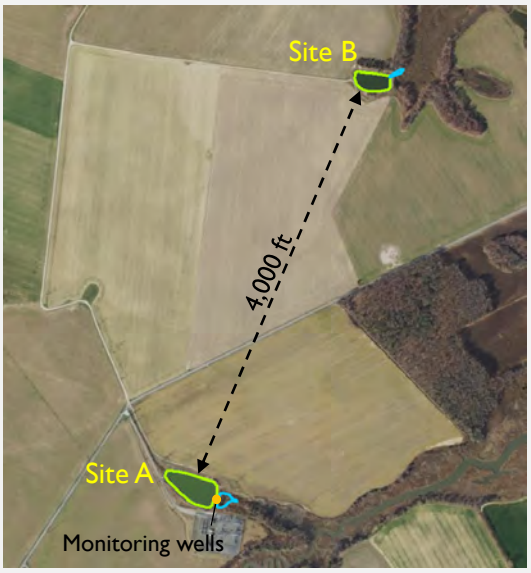
- Mixed story about water quality in confined aquifers. Cautious optimism
- Nitrate present in Columbia aquifer and shallowest wells in Calvert aquifers.
- Naturally occurring arsenic in Rancocas aquifer.
- Chemical evidence for interaquifer transfer of water between Frederica, Federalsbug, and Cheswold
- Continuous salinity monitoring found elevated values in Milford aquifer east of Milford and Piney Point at Woodland Beach

EAST DOVER FOCUS AREA

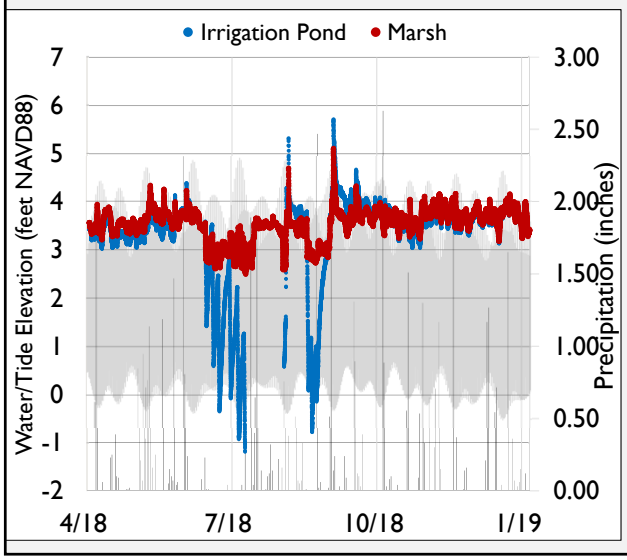
- Working with 3 farmers and Dover Water where previous work predicted greatest risk for salinity issues
- Leveraged existing wells and added new wells and surface water stations
- EPSCoR WiCCED constructing density dependent groundwater model and cooperating in field work

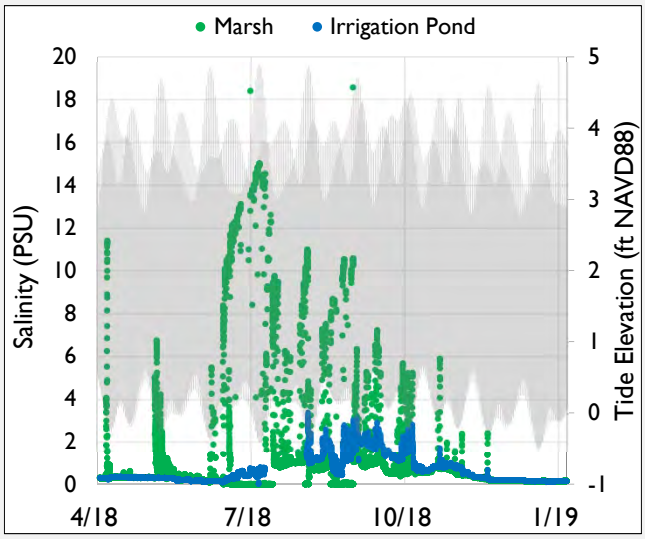


Level gage and logger housing at Site A marsh

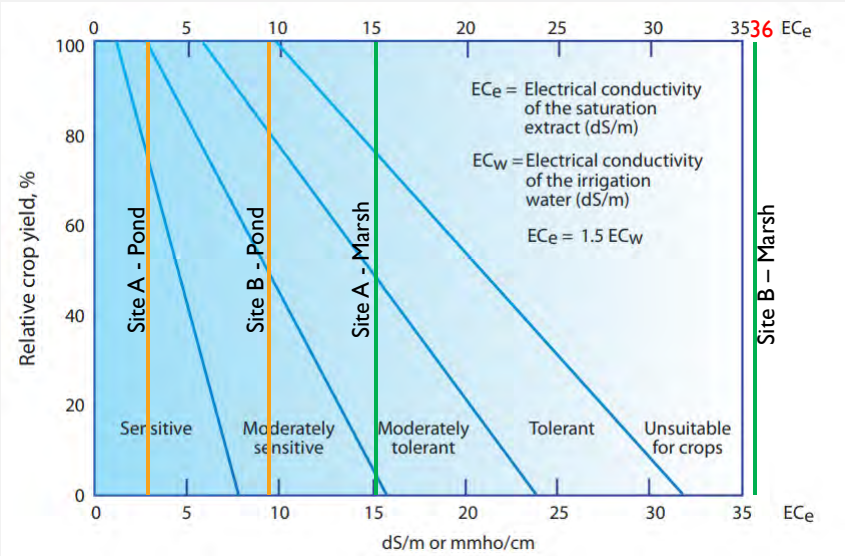


SALINITY RISK - EAST DOVER SITE B





DATA AND SALINITY RISK TO CROPS



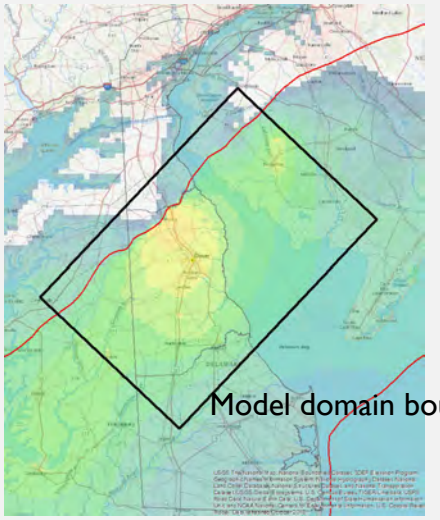
- Soybeans are "moderately tolerant"
- Corn is "moderately sensitive"
- Lines represent salinity/conductivity PEAKS during summer irrigation season

UCANR, 2016, adapted from Maas and Grattan, 1999; Grieve et al., 2012).

CONTINUING WORK

- EPSCoR WiCCED project adding to the east Dover study. Additional NSF funded sealevel rise and salinization project just underway
- Regional groundwater model of confined aquifers being developed with design input from DNREC and Dover. Updates work completed 1980.
- East Dover report in preparation

OBJECTIVES OF FLOW MODEL



Modeling goals:

- Developed with input from Dover and DNREC
- Quantitatively define the relation between water use and groundwater drawdown in the Piney Point, Cheswold, Federalsburg, and Frederica aquifers, past and future.
- Characterize water movement between aquifers
- What if scenario simulations
- Columbia aquifer modeled directly but not at high resolution.

QUESTIONS

Drought Indicators Update

Water Supply Coordinating Council Meeting

September 24, 2020

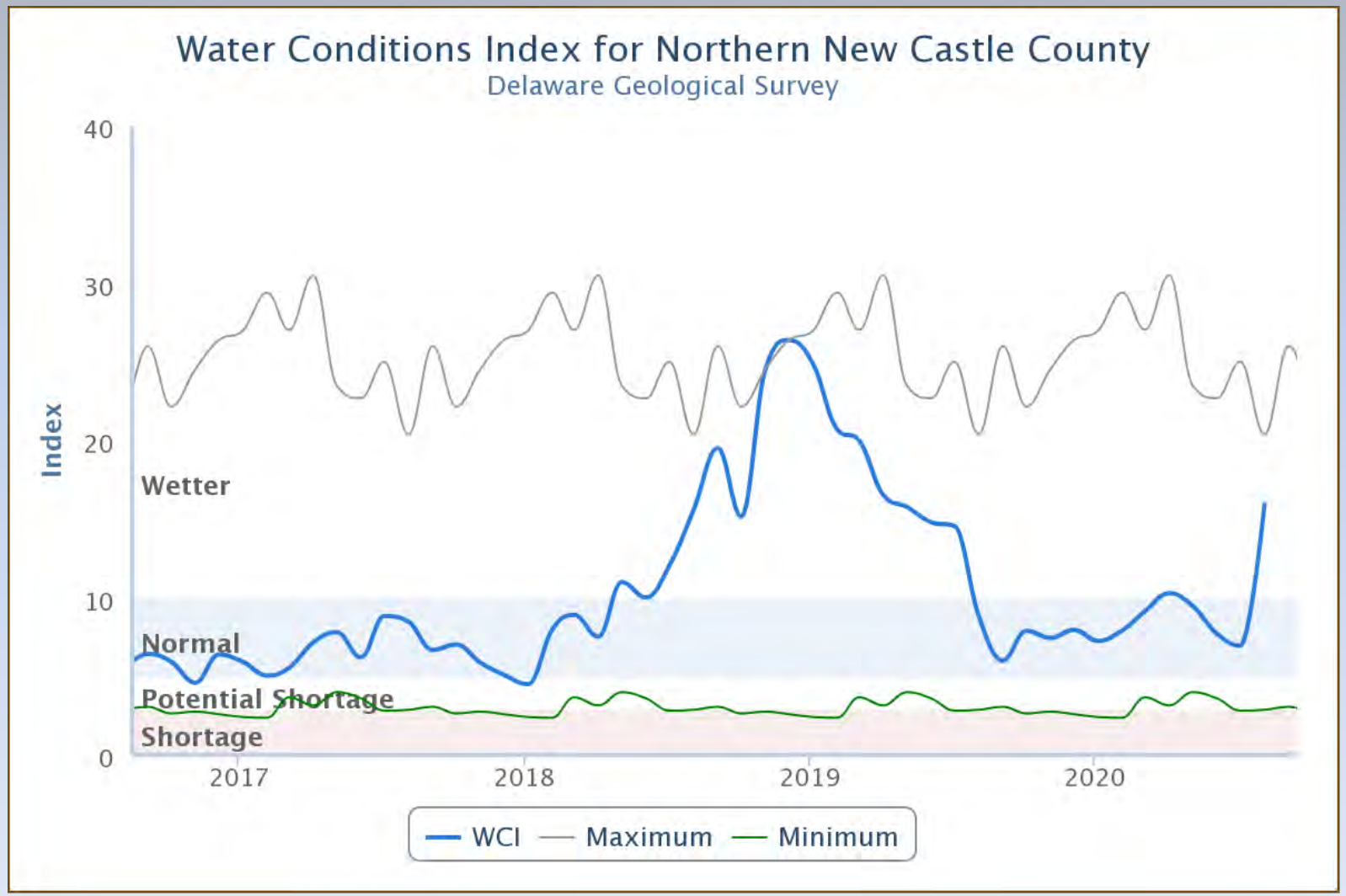
CEMA

College of Earth, Ocean, and Environment

www.deos.udel.edu

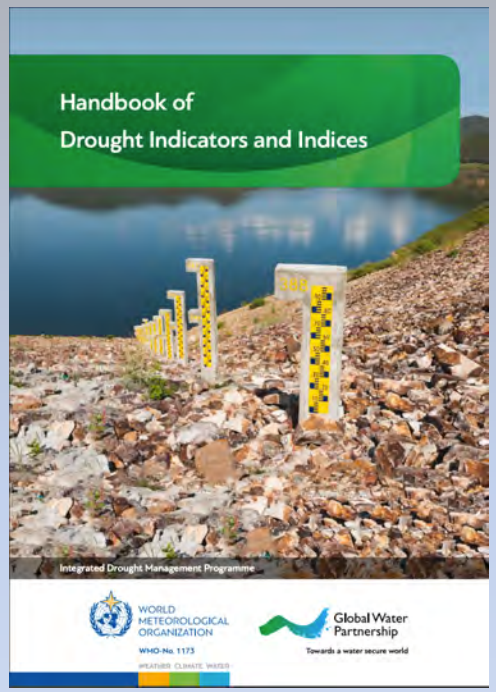
DEOS

The ***"Water Conditions Index"*** has been an affective indicator of water supply across northern New Castle County for several decades. However, is there a way to better monitor diverse water resource variables across the entire state?



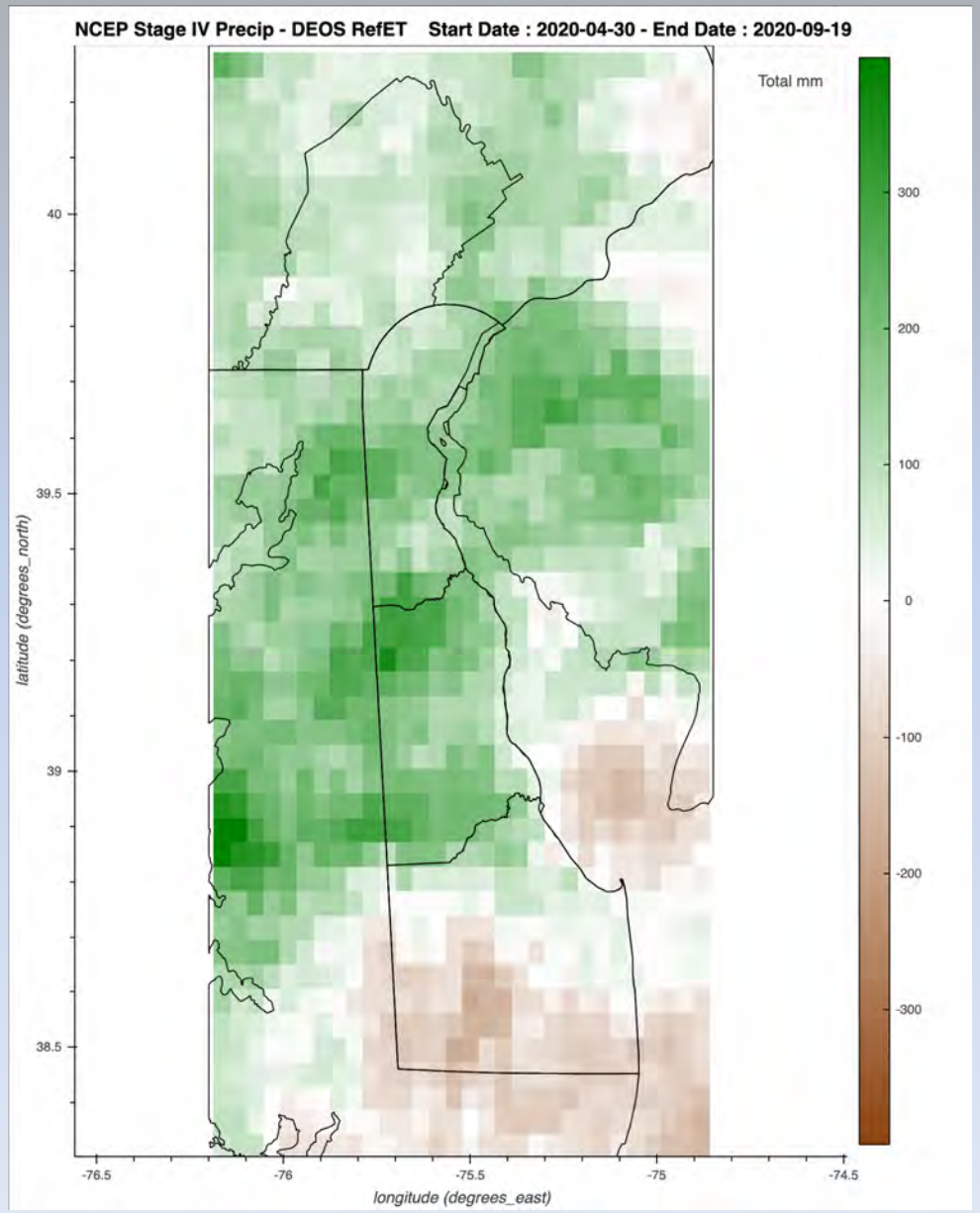
We have looked at relationships between Delaware water resources (streamflow, well levels, soil moisture, etc.) and numerous drought indices at diverse time periods. These variables include:

Palmer Drought Severity Index (PDSI)
Palmer Hydrologic Drought Index (PHDI)
Palmer Modified Drought Index (PMDI)
Palmer Z-Index
Precipitation – Evapotranspiration ($P - E_t$)
Standardized Precipitation Index (SPI)
Standardized Precipitation Evapotranspiration Index (SPEI)
Evaporative Demand Drought Index (EDDI)
Quick Drought Response Index (QuickDRI)
Vegetation Drought Response Index (VegDRI)
Evaporative Stress Index (ESI)
Water Conditions Index (WCI)



3-month	PDSI03	ZNDX03	SP03	WCI03	DAGF03	DDFS03	DGES03	Brandy03_avg	Nanticoke03_avg	RedClay03_avg	StJones03_avg	WhiteClay03_avg	Well_Kent03	Wells_NCC03	Wells_Sussex03	DHOC_soil03	DGES_soil03	DDFS_soil03
PDSI03	1	.803**	.673**	.475**	.290**	.359**	.324**	.339**	.474**	.428**	.499**	.379**	-.240*	-0.124	0.042	0.076	0.061	0.194
ZNDX03	.803**	1	.931**	.277*	0.129	.227*	0.195	0.179	.284*	.289**	.465**	.229*	-0.12	0.029	0.111	-0.051	-0.046	0.019
SP03	.673**	.931**	1	0.197	0.018	0.099	0.088	0.164	0.169	.254*	.419**	0.202	0.005	-0.013	0.077	-0.105	-0.114	-0.065
WCI03	.475**	.277*	0.197	1	.442**	.344**	0.108	.863**	.440**	.857**	.538**	.836**	-.278*	-.541**	-.363**	0.211	0.138	.316**
DAGF03	.290**	0.129	0.018	.442**	1	.838**	.645**	.469**	.415**	.531**	.518**	.527**	-.498**	0.095	-0.16	.714**	.655**	.637**
DDFS03	.359**	.227*	0.099	.344**	.838**	1	.844**	.412**	.584**	.457**	.644**	.455**	-.644**	.268*	-0.005	.748**	.757**	.799**
DGES03	.324**	0.195	0.088	0.108	.645**	.844**	1	0.194	.634**	.223*	.491**	.258*	-.584**	.266*	0.041	.595**	.683**	.663**
Brandy03_avg	.339**	0.179	0.164	.863**	.469**	.412**	0.194	1	.605**	.964**	.747**	.958**	-.470**	-.395**	-.385**	.452**	.352**	.479**
Nanticoke03_avg	.474**	.284*	0.169	.440**	.415**	.584**	.634**	.605**	1	.612**	.790**	.620**	-.764**	-0.078	-0.065	.529**	.547**	.676**
RedClay03_avg	.428**	.289**	.254*	.857**	.531**	.457**	.223*	.964**	.612**	1	.784**	.976**	-.479**	-.395**	-.424**	.478**	.393**	.508**
StJones03_avg	.499**	.465**	.419**	.538**	.518**	.644**	.491**	.747**	.790**	.784**	1	.762**	-.699**	-0.039	-0.088	.604**	.556**	.660**
WhiteClay03_avg	.379**	.229*	0.202	.836**	.527**	.455**	.258*	.958**	.620**	.976**	.762**	1	-.493**	-.444**	-.485**	.477**	.411**	.519**
Well_Kent03	-.240*	-0.12	0.005	-.278*	-.498**	-.644**	-.584**	-.470**	-.764**	-.479**	-.699**	-.493**	1	-0.049	-0.14	-.568**	-.549**	-.748**
Wells_NCC03	-0.124	0.029	-0.013	-.541**	0.095	.268*	.266*	-.395**	-0.078	-.395**	-0.039	-.444**	-0.049	1	.406**	.345**	.351**	0.183
Wells_Sussex03	0.042	0.111	0.077	-.363**	-0.16	-0.005	0.041	-.385**	-0.065	-.424**	-0.088	-.485**	-0.14	.406**	1	-0.076	-0.135	-0.007
DHOC_soil03	0.076	-0.051	-0.105	0.211	.714**	.748**	.595**	.452**	.529**	.478**	.604**	.477**	-.568**	.345**	-0.076	1	.936**	.865**
DGES_soil03	0.061	-0.046	-0.114	0.138	.655**	.757**	.683**	.352**	.547**	.393**	.556**	.411**	-.549**	.351**	-0.135	.936**	1	.866**
DDFS_soil03	0.194	0.019	-0.065	.316**	.637**	.799**	.663**	.479**	.676**	.508**	.660**	.519**	-.748**	0.183	-0.007	.865**	.866**	1

Precipitation – Evapotranspiration ($P - E_t$)



Growing Season $P - E_t$

5/1/20 – 9/19/20

What is the correct "time scale" for water resources applications?

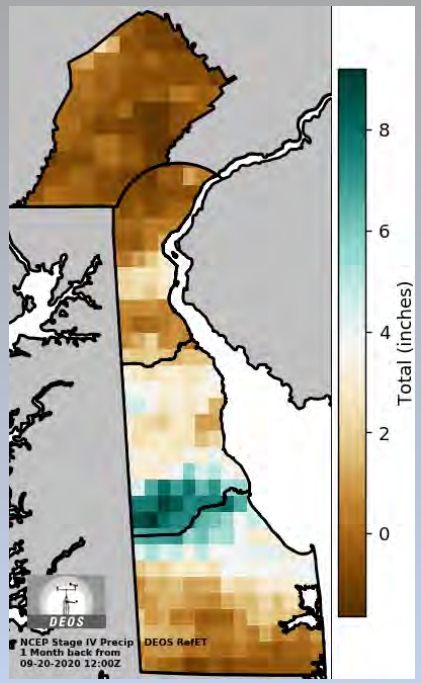
One-month – Agriculture?

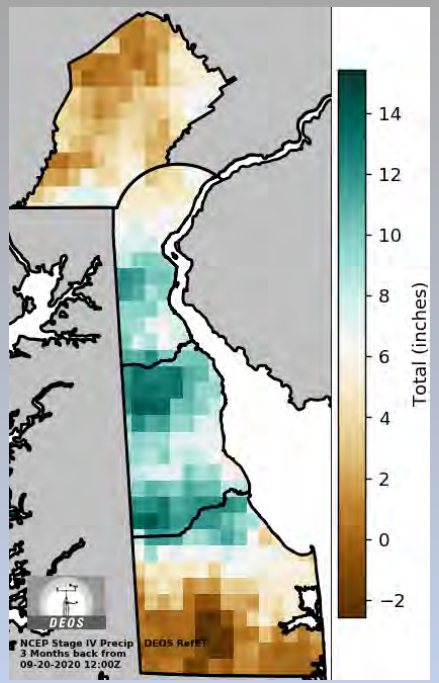
Three-months – Streamflow?

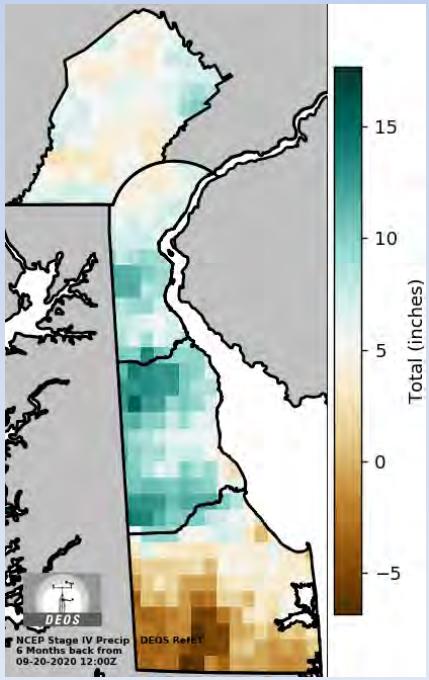
Six-months – Well levels?

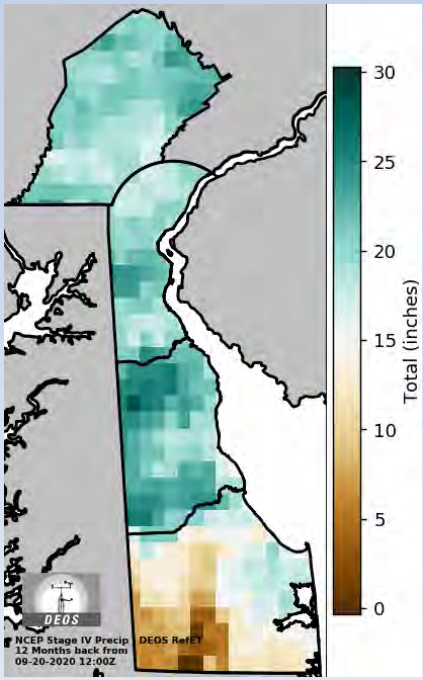
12 or 18-months – Societal drought?

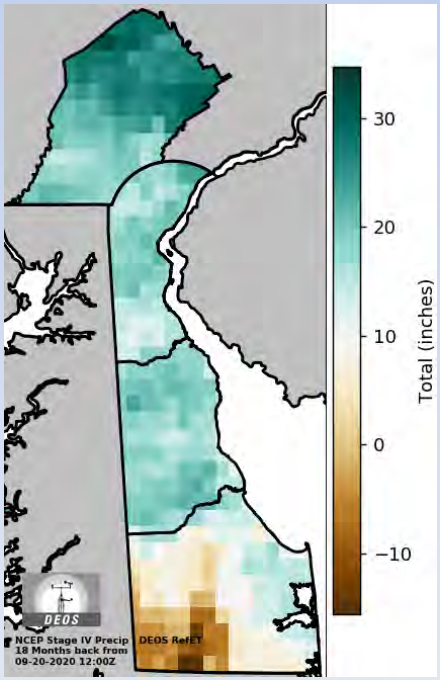
This is currently being investigated!











CEMA Agriculture Dashboard

Select a dataset, set your parameters, and click plot

- Heating Degree Days
- Cooling Degree Days
- DEOS Precip
- Energy Density
- Reference Evapotranspiration
- Growing Degree Days
- Mean Temperature
- Max Temperature
- Min Temperature
- Mean Wind Speed
- Mean Dew Point
- Mean Relative Humidity
- Max Relative Humidity
- Min Relative Humidity
- Mean Soil Temperature
- Max Soil Temperature
- Min Soil Temperature
- Mean Volumetric Water Content
- Max Volumetric Water Content
- Min Volumetric Water Content
- Mean Solar
- Mean Wind Direction
- Wind Gust
- Min Wind Chill
- NCEP Stage IV Precip
- ✓ NCEP Stage IV Precip - DEOS RefET

Data Available
2010 - Present

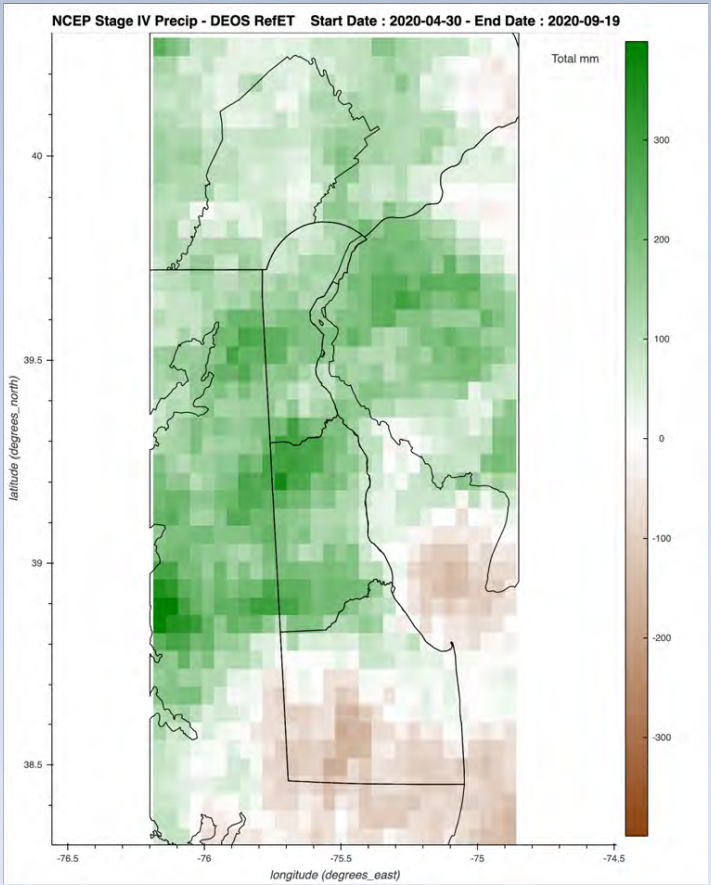
Dataset
NCEP Stage IV Precip - DEOS RefET

Start Date
2020-05-01

End Date
2020-09-20

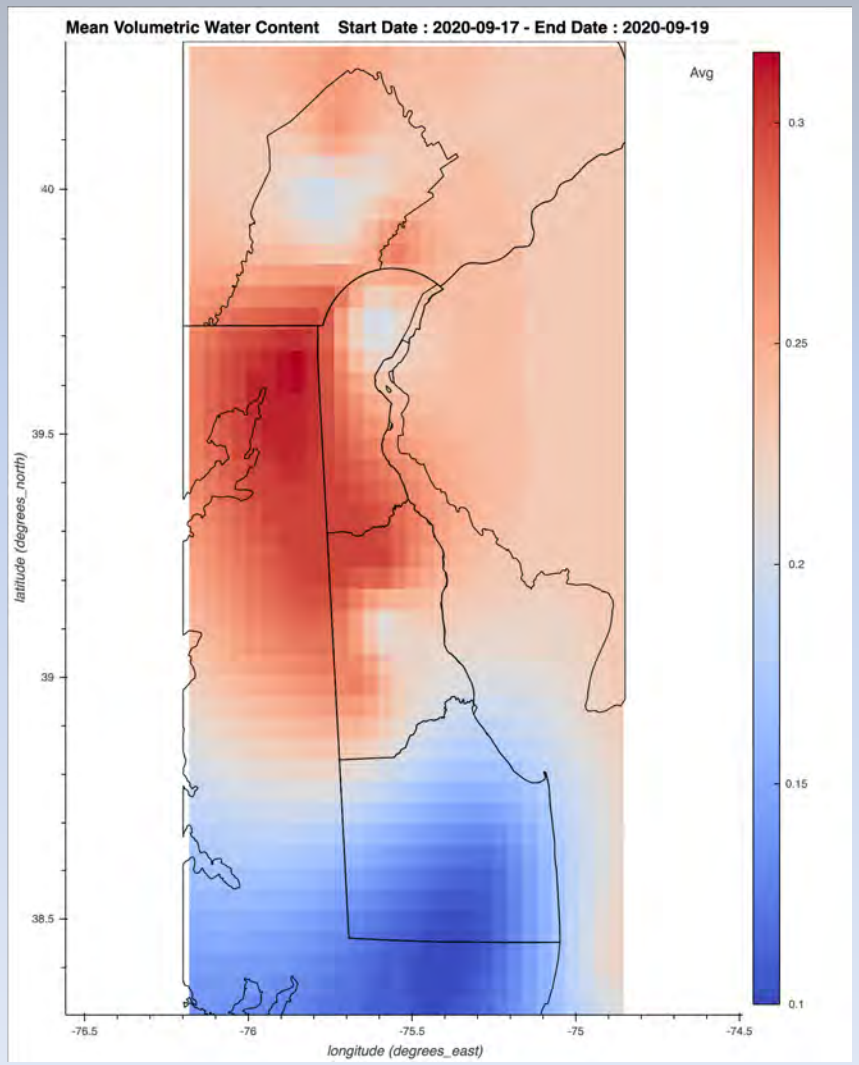
Color Ramp
Drought

Plot

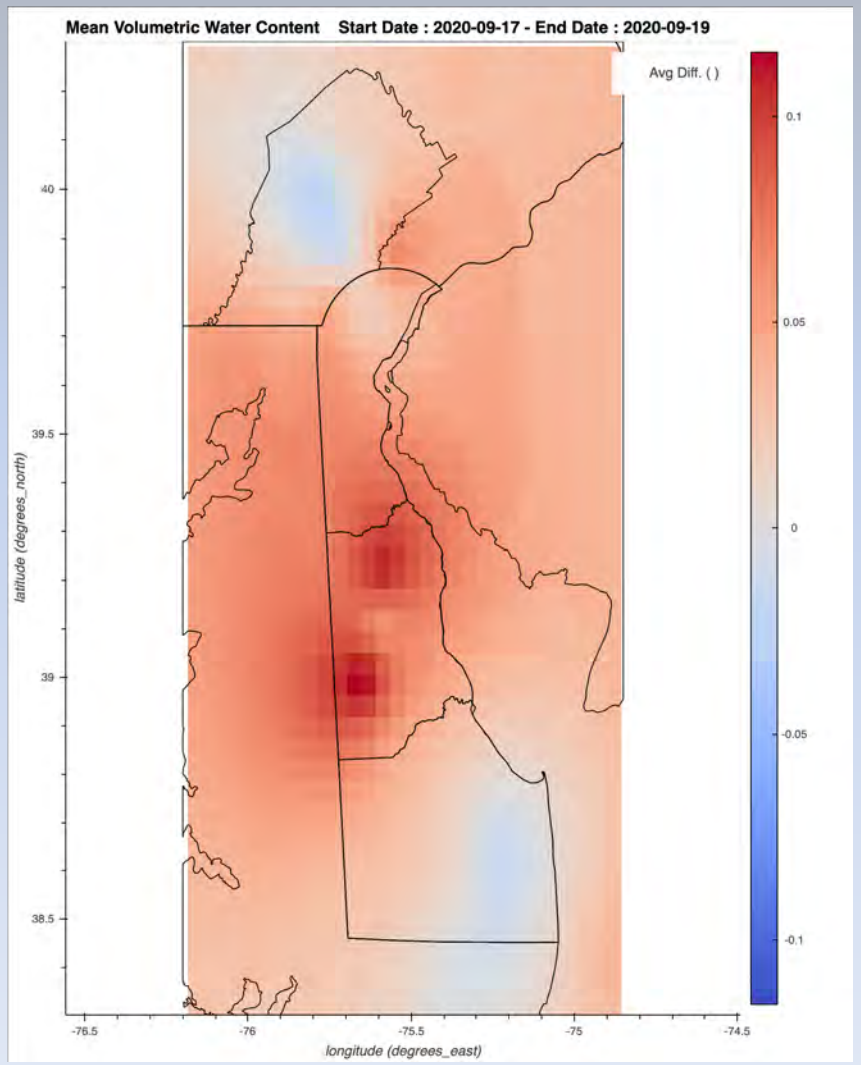


Also Realtime Variables
Soil Moisture

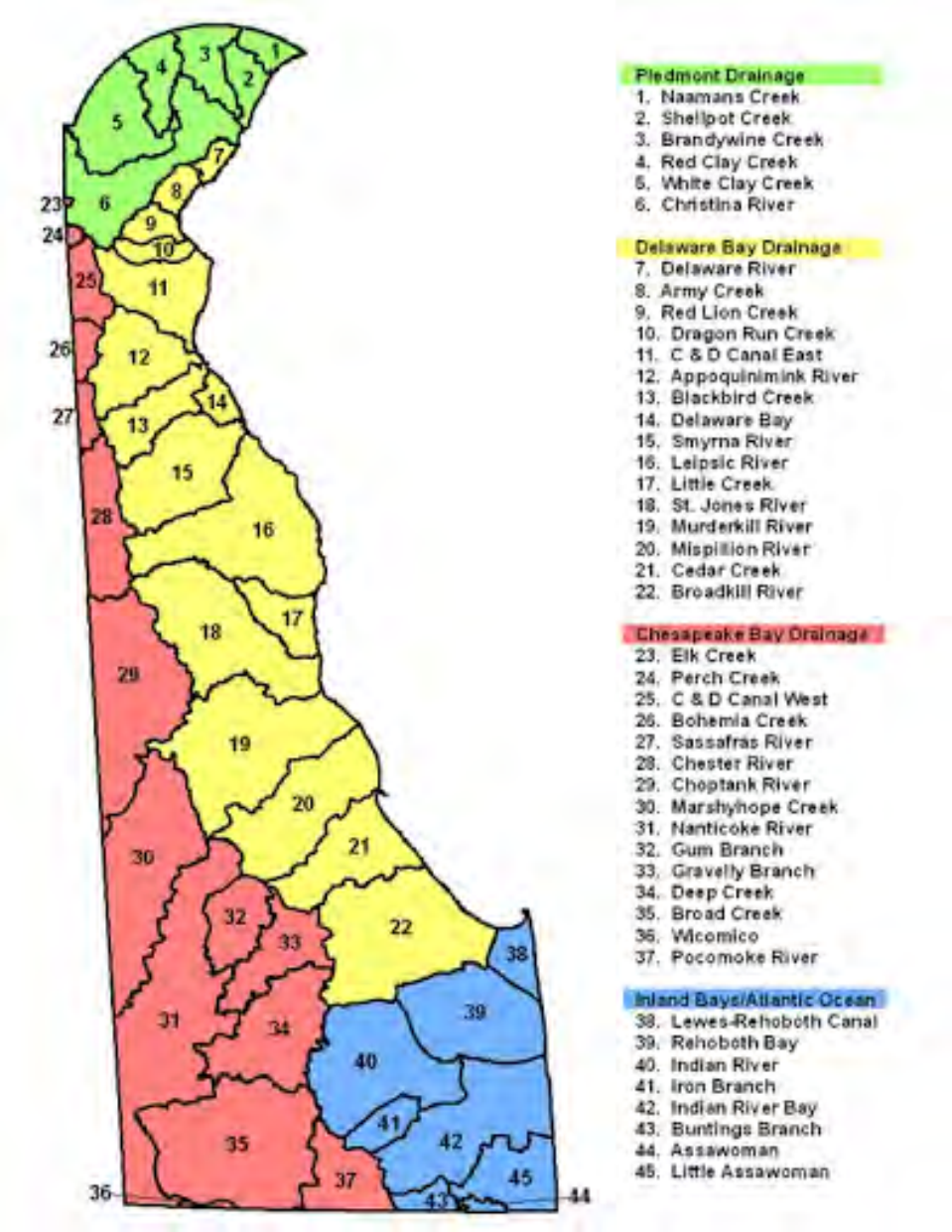
Volumetric Water Content 9/19/20

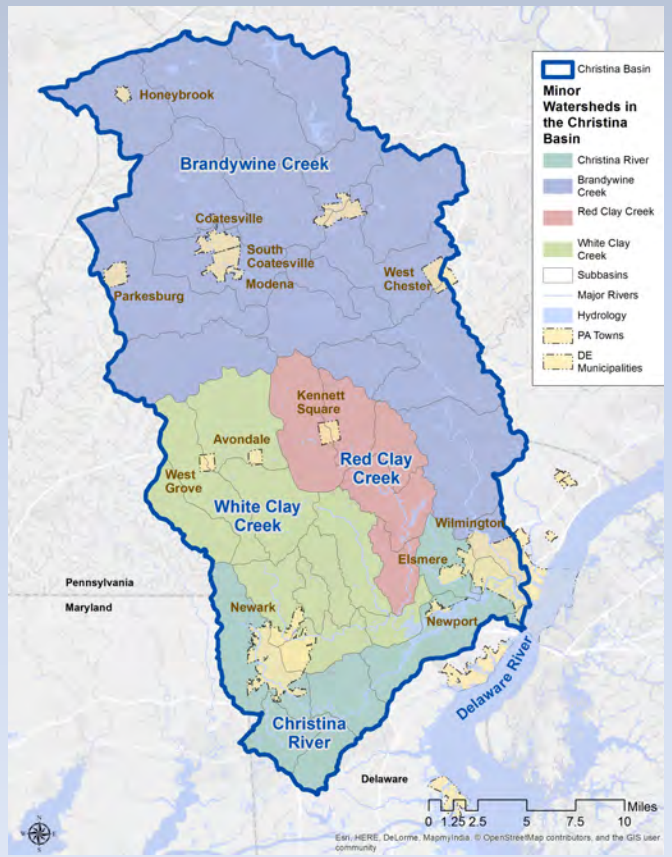


Volumetric Water Content 9/19/20
Departure



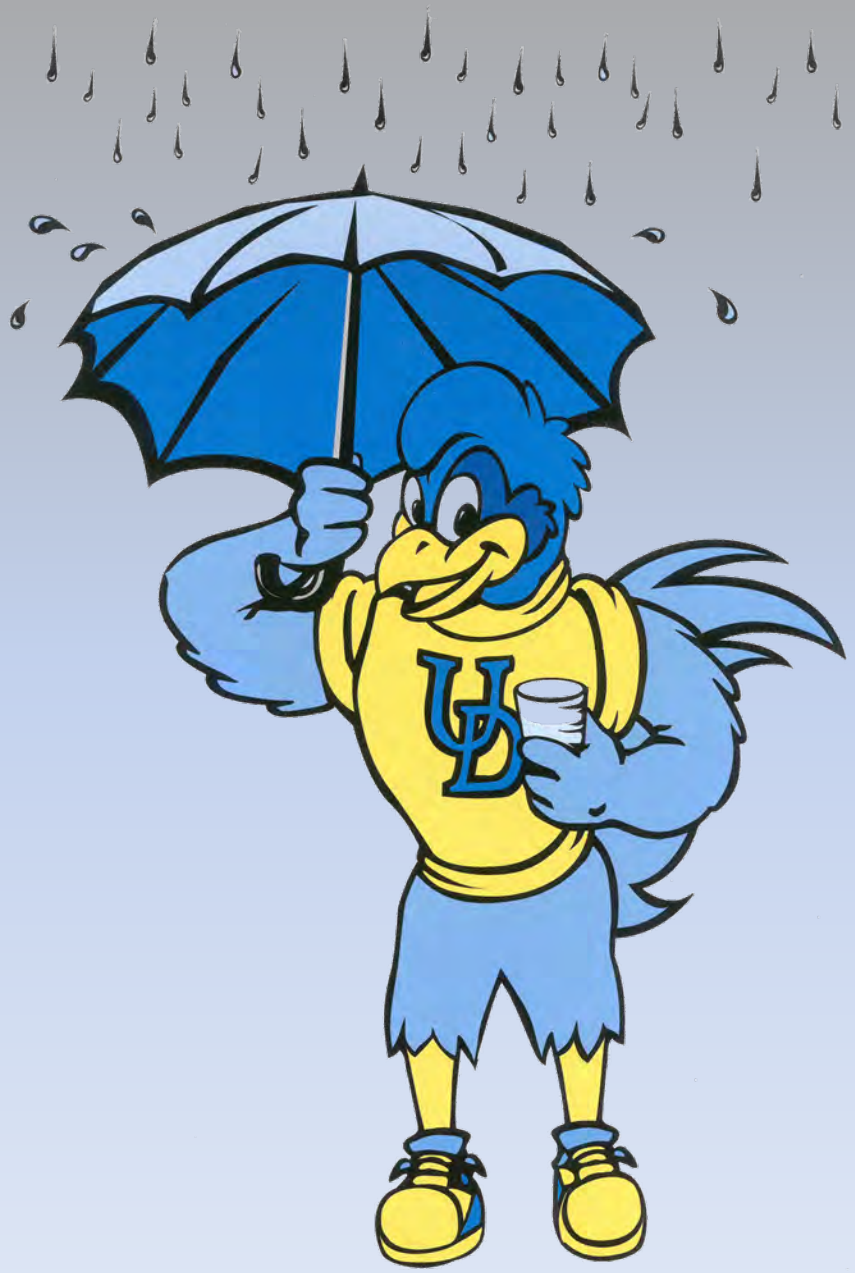
This information can be aggregated over specific watersheds across the State.





Future Work:

- Continue to investigate the relationships between P– E_t and water resource variables including streamflow, well levels, soil moisture, and general water quantity and quality over diverse time periods
- Continue to investigate other possible drought indices and their efficacy for use in monitoring water resources.
- Develop a “Delaware Water Quantity” decision support tool for decision makers across the State. Test this tool and its usefulness with diverse user groups.



Questions?

EIGHTH REPORT TO GOVERNOR AND GENERAL ASSEMBLY Regarding the Progress of DELAWARE WATER SUPPLY COORDINATING COUNCIL, Estimates of Water Supply/Demand in Southern New Castle County through 2030, Nov. 8, 2005

	Watershed	2005 Availability (mgd)	2005 Supply (mgd)	2005 Public Demand (mgd)	2030 Availability (mgd)	2030 Supply (mgd)	2030 Public Demand (mgd)
Q	C&D Canal	2.6	3.6	0.7	2.6	3.6	2.3
R	Augustine Creek			0.3			0.8
S	Drawyer Creek	5.7	4.7	1.4	5.7	4.7	4.4
T	Appoquinimink			1.5			4.6
U	Blackbird Creek	3.9	0.2	0.2	3.9	0.2	0.5
V	Cedar Swamp	0.3	0	0.0	0.3	0	0.1
W	Smyrna River	2.8	1.1	0.2	2.8	1.1	0.7
X	Cypress Branch	1.5	0	0.1	1.5	0	0.3
Y	Sassafras River	1.4	0	0.1	1.4	0	0.2
Z	Sandy Branch	1.2	0.4	0.2	1.2	0.4	0.6
AA	Back Creek	0.6	3.4	0.5	0.6	3.4	1.7
	Total	20.0	13.4	5.2	20.0	13.4	16.2

TWELFTH REPORT TO GOVERNOR AND GENERAL ASSEMBLY *Regarding the Progress of* DELAWARE WATER SUPPLY COORDINATING COUNCIL, Estimates of Water Supply & Demand for Kent and Sussex County through 2030, June 20, 2014

Water Use	Daily Max. Allocation (mgd)	2010 Peak Day Demand (mgd)	2010 Surplus Deficit (mgd)	2030 Peak Day Demand (mgd)	2030 Surplus/ Deficit (mgd)
Kent County					
Public Water Supply	37.9	14.3	23.6	16.1	21.8
Non-Community	1.3	0.5	0.8	0.6	0.7
Domestic Wells	4.2	3.9	0.3	4.5	-0.3
Farm Irrigation	157.3	18.9	138.4	22.9	134.4
Golf Course	2.2	2.2	0	2.2	0
Industrial	5.7	1.3	4.4	2.6	3.1
Sussex County					
Public Water Supply	56.9	30.5	26.4	48.8	8.1
Non-Community	5	1.5	3.5	2.4	2.6
Domestic Wells	7.4	7.4	0	8.2	-0.8
Farm Irrigation	619.4	71.7	547.7	87.0	532.4
Golf Course	12.2	12.2	0	12.2	0
Industrial	30.0	5.6	24.4	11.2	18.8

THIRTEENTH REPORT TO GOVERNOR AND GENERAL ASSEMBLY Regarding Progress of DELAWARE WATER SUPPLY COORDINATING COUNCIL, Water Supply/Demand Projections for Northern New Castle County through 2030, June 2018

Purveyor	2015			2020			2030		
	Supply	Max Month Demand	Surplus/ Deficit +/-	Supply	Max Month Demand	Surplus/ Deficit +/-	Supply	Max Month Demand	Surplus/ Deficit +/-
Wilmington	**38.3**	**21.3**	**17.0**	**38.3**	**21.6**	**16.7**	**38.3**	**22.0**	**16.3**
Brandywine Creek	15.0			15.0			15.0		
Hoopes Reservoir	21.3			21.3			21.3		
Raise Hoopes Res.	2.0								
Artesian Water	**29.0**	**19.8**	**9.2**	**29.0**	**20.1**	**8.9**	**29.0**	**20.4**	**8.6**
Groundwater	24.3			24.3			24.3		
CWA Interconn.	3.0			3.0			3.0		
ASR	1.7			1.7			1.7		
SUEZ Delaware	**26.8**	**20.4**	**6.4**	**26.8**	**20.7**	**6.1**	**26.8**	**21.1**	**5.7**
Stanton WTP	19.3			19.3			19.3		
Hoopes Contract	2.7			2.7			2.7		
Christiana WTP	3.0			3.0			3.0		
ASR	1.0			1.0			1.0		
CWA Interconn.	0.8			0.8			0.8		
Newark	**6.9**	**3.9**	**3.0**	**7.8**	**4.0**	**3.8**	**7.8**	**4.0**	**3.8**
White Clay WTP	0.0			0.0			0.0		
Newark Reservoir	4.0			4.0			4.0		
Groundwater	2.9			3.8			3.8		
New Castle MSC	**1.6**	**0.6**	**1.0**	**1.6**	**0.6**	**1.0**	**1.6**	**0.6**	**1.0**
Subtotal	**102.6**	**66.0**	**36.6**	**103.5**	**67.0**	**36.5**	**103.5**	**68.1**	**35.4**