

# DRAFT GROUNDWATER LEVEL TRENDS ON THE EASTERN SHORE OF VIRGINIA

June 2020



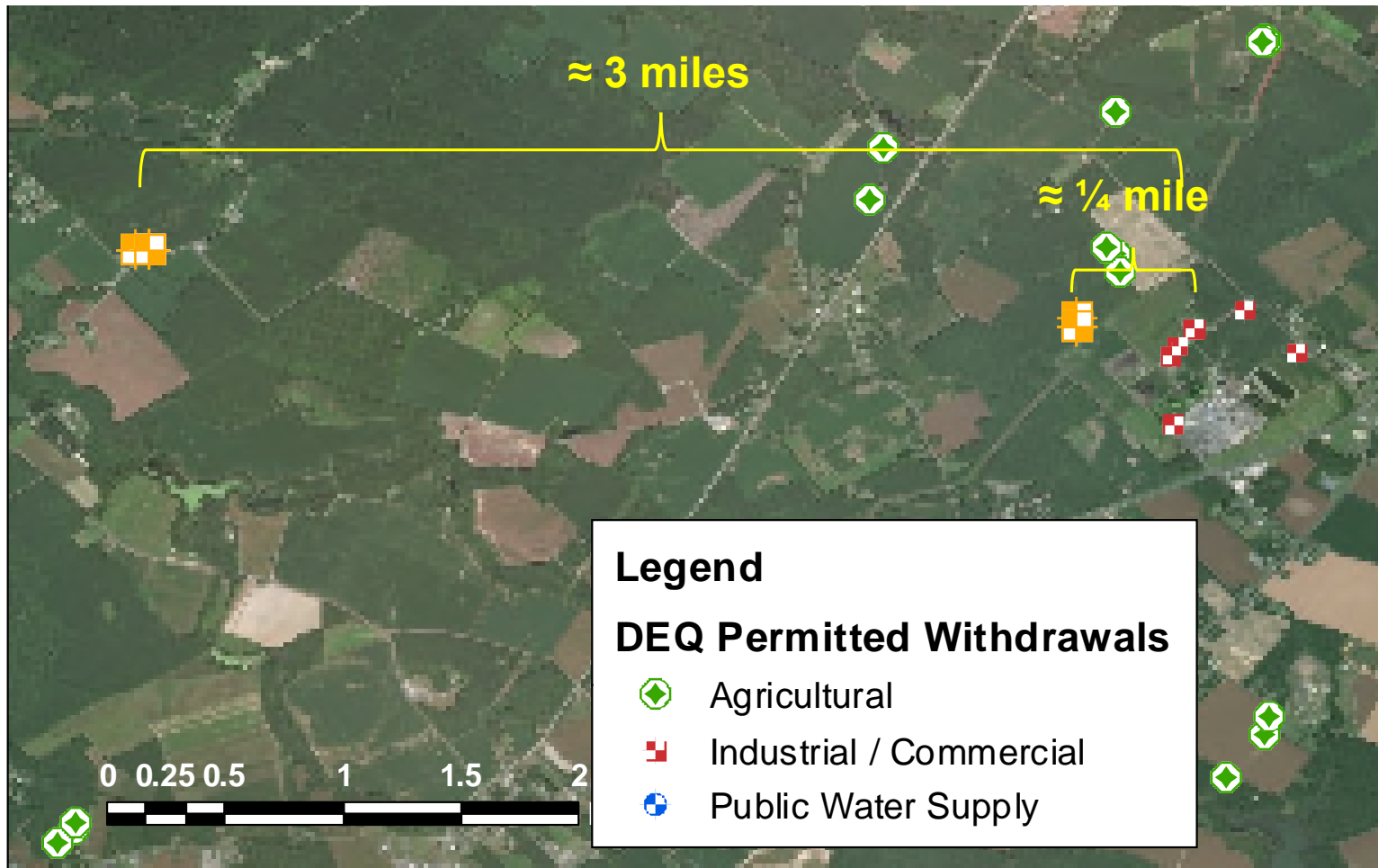
# Groundwater Level Trends

- Observation wells allow for measurement of the aquifer response to withdrawals and droughts through long term water level measurements.
  - These water levels trends are a critical component in assessing current state and stability of the groundwater resource.
  - The water level trends can also identify unexpected or unexplained changes that require further research / investigation. This can include large unpermitted withdrawals that are close to the observation well.
- The magnitude of the water level change in any one well is a function of:
  - Distance from the withdrawal well, with water level declines decreasing approximately 10-fold with distance.
  - Amount of groundwater withdrawn (with water level declines decreasing approximately 1x).

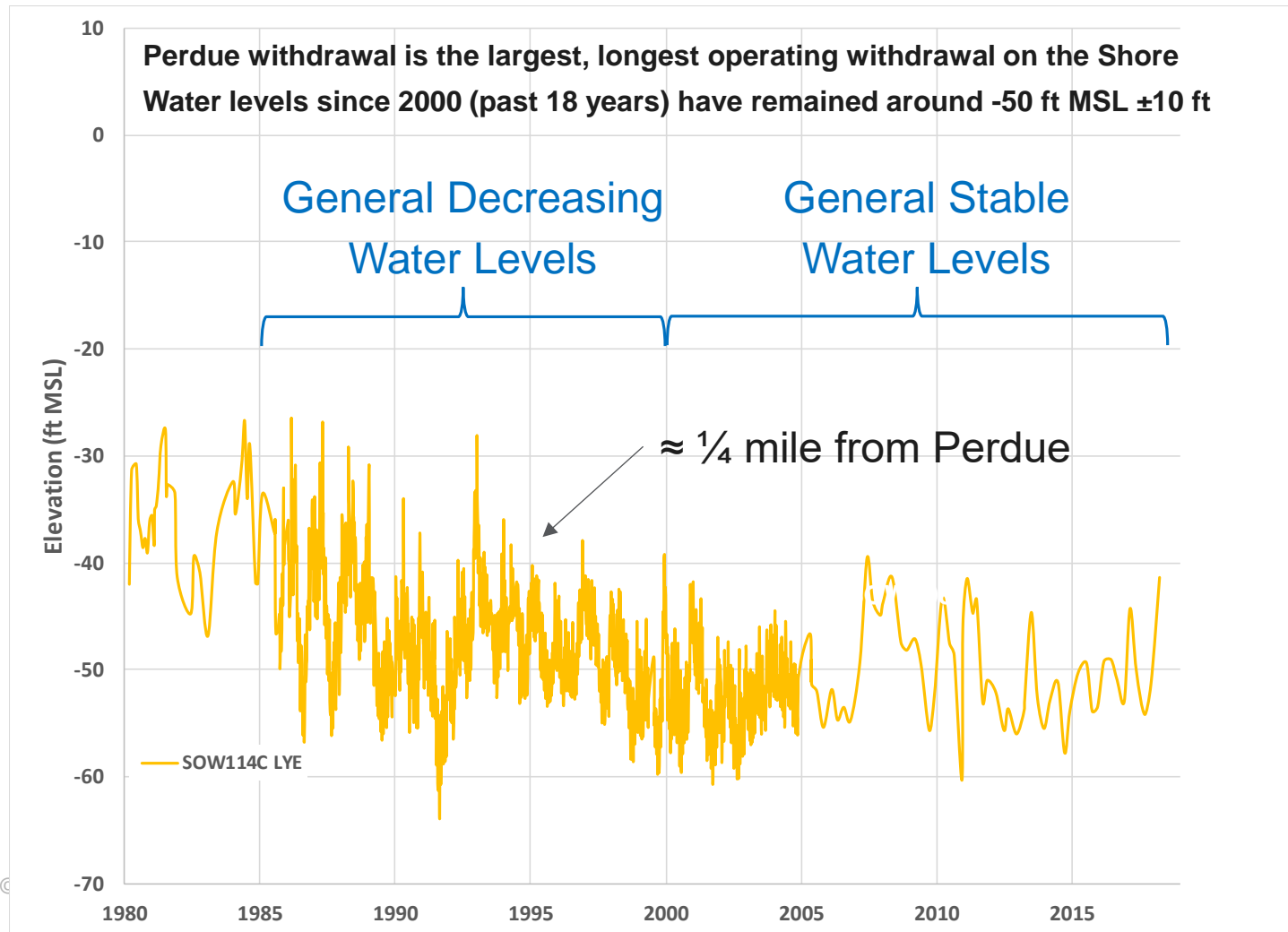
VDEQ and USGS have established a number of State Observation Wells on the Eastern Shore of Virginia that are routinely monitored.

- Most locations consist of multiple clustered wells, with the individual wells screened at different depths to measure water level response in the separate aquifers at the same location.
- Many of the locations have almost 40-years of water level measurements.

# West of Perdue Withdrawal



# Lower Yorktown-Eastover Water Levels near Perdue Withdrawal

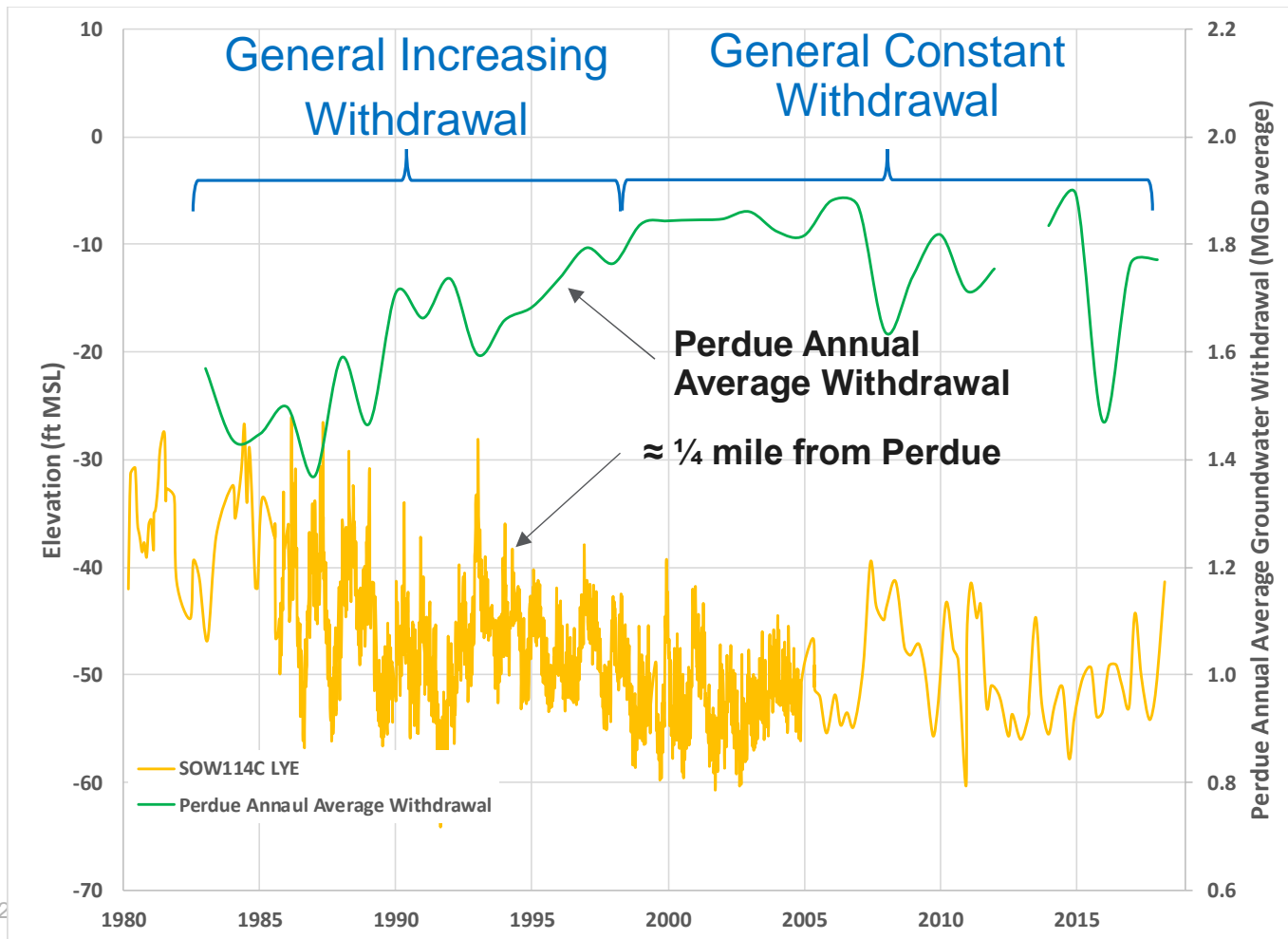


# Groundwater Level Response to Withdrawals

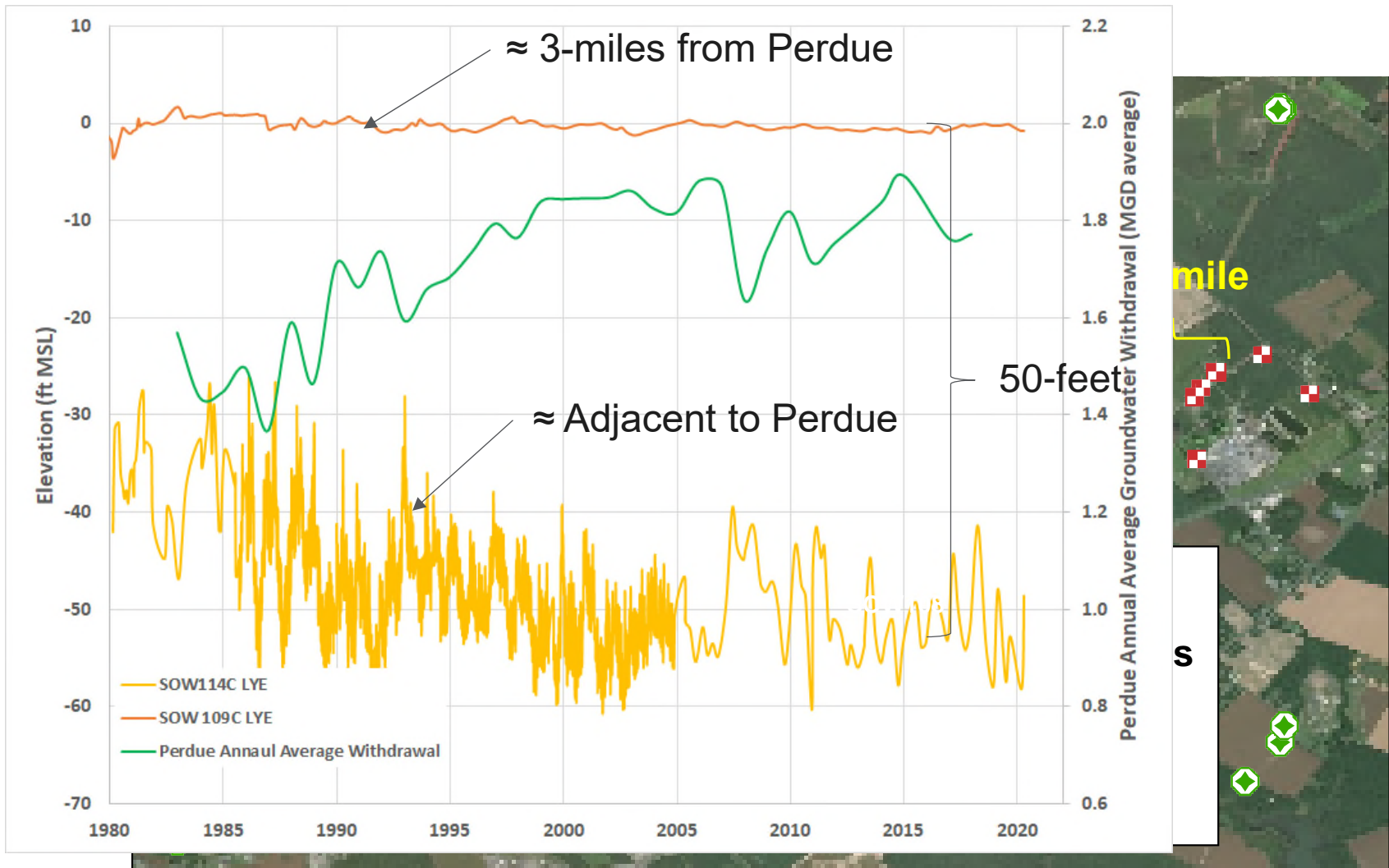
Perdue use increased from around 1.5 MGD average in the 1980's through 1990's to around 1.8 MGD ( $\pm 0.2$  MGD) since 2000.

The general use increase in the 1980's through 1990's correspond to water level declines in the Yorktown-Eastover aquifer.

The general constant withdrawal since 2000 corresponds to stable water levels over the same period.



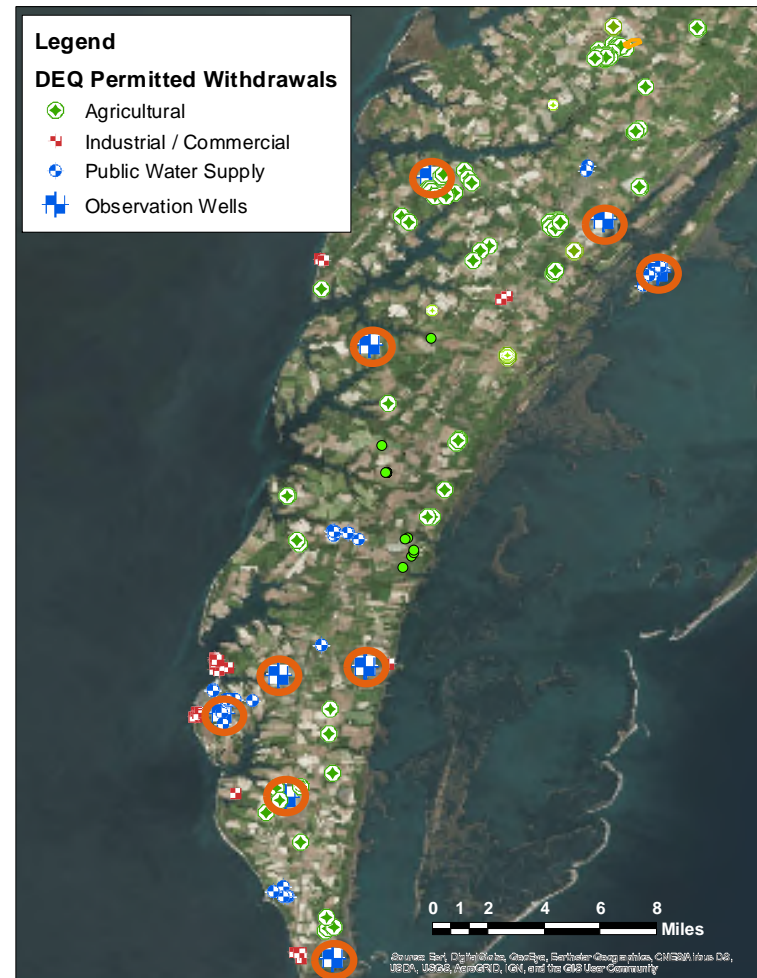
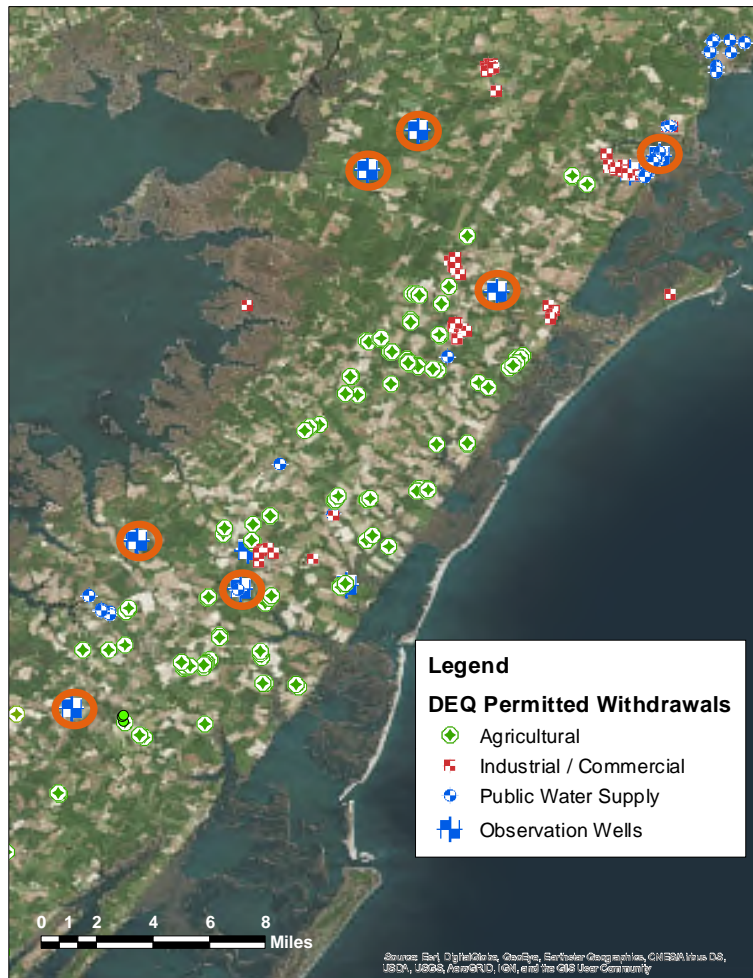
# West of Perdue Withdrawal







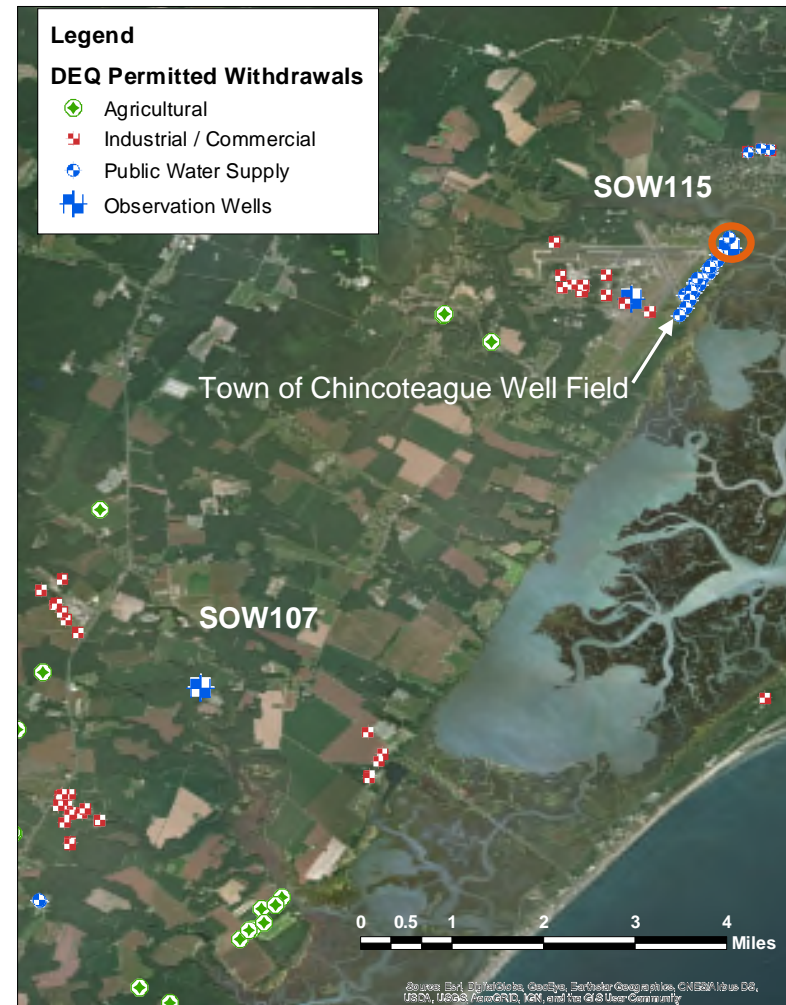
# Locations of State Observation Wells in Relation to Permitted Groundwater Withdrawals



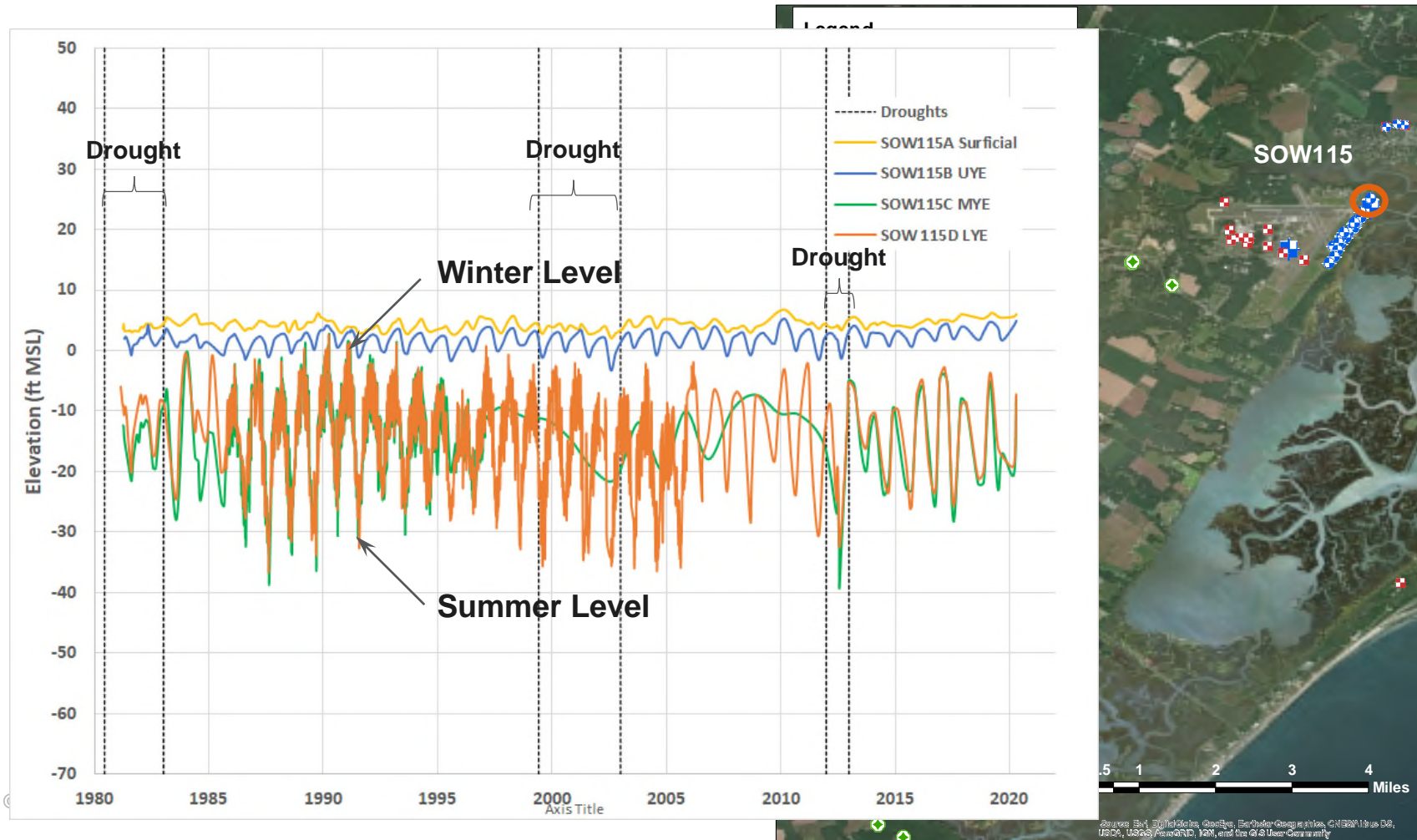
# Groundwater Trends near the Town of Chincoteague Water Supply

- Observation wells very close to withdrawal and drawdown from pumping will be greater.
- Withdrawal amounts vary seasonally:
  - Summer is higher withdrawals and lower water levels
  - Winter lower withdrawals with water levels recovering.
- Overall, water level trends appear stable (no long term declines).
- Statistical increase / recovering over past 10-years

Water is withdrawn all year



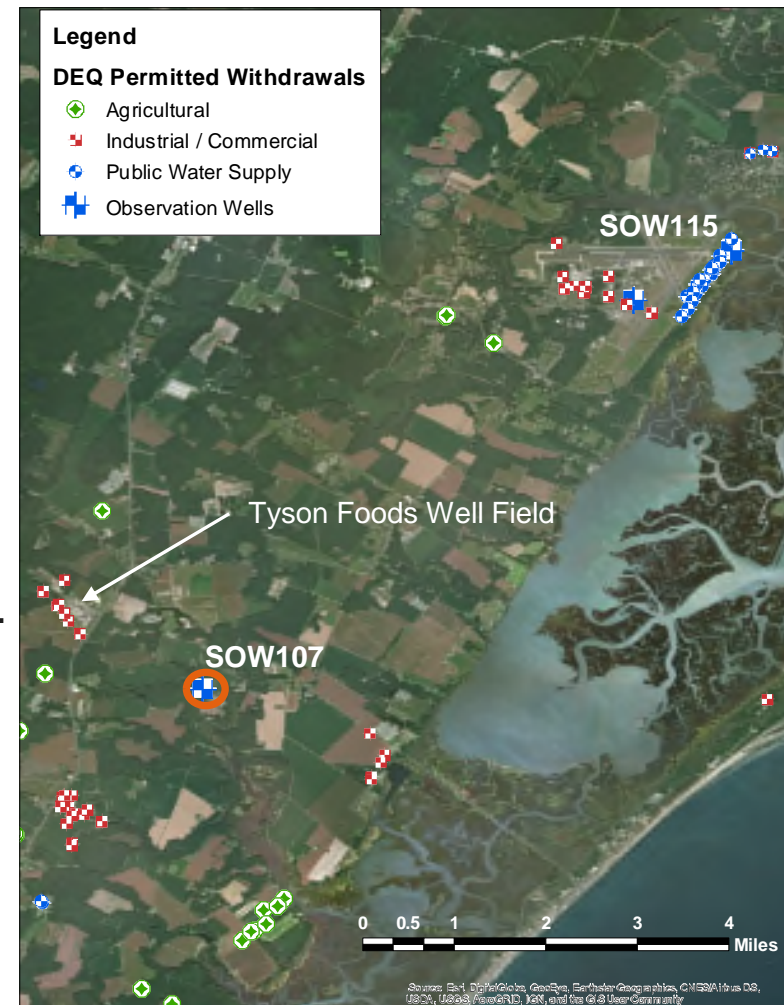
# Groundwater Trends near the Town of Chincoteague Water Supply



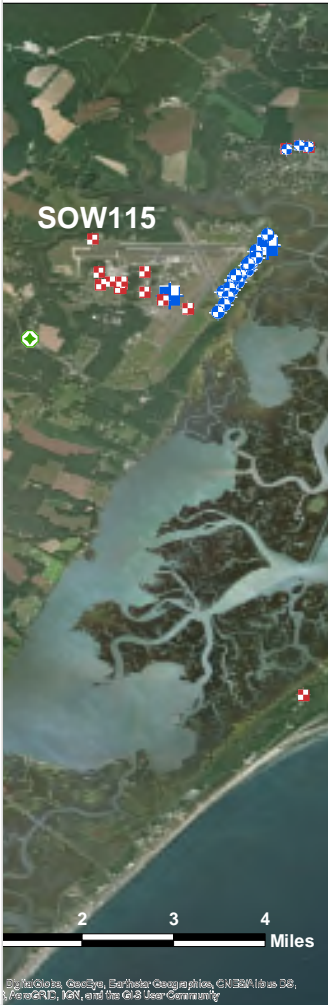
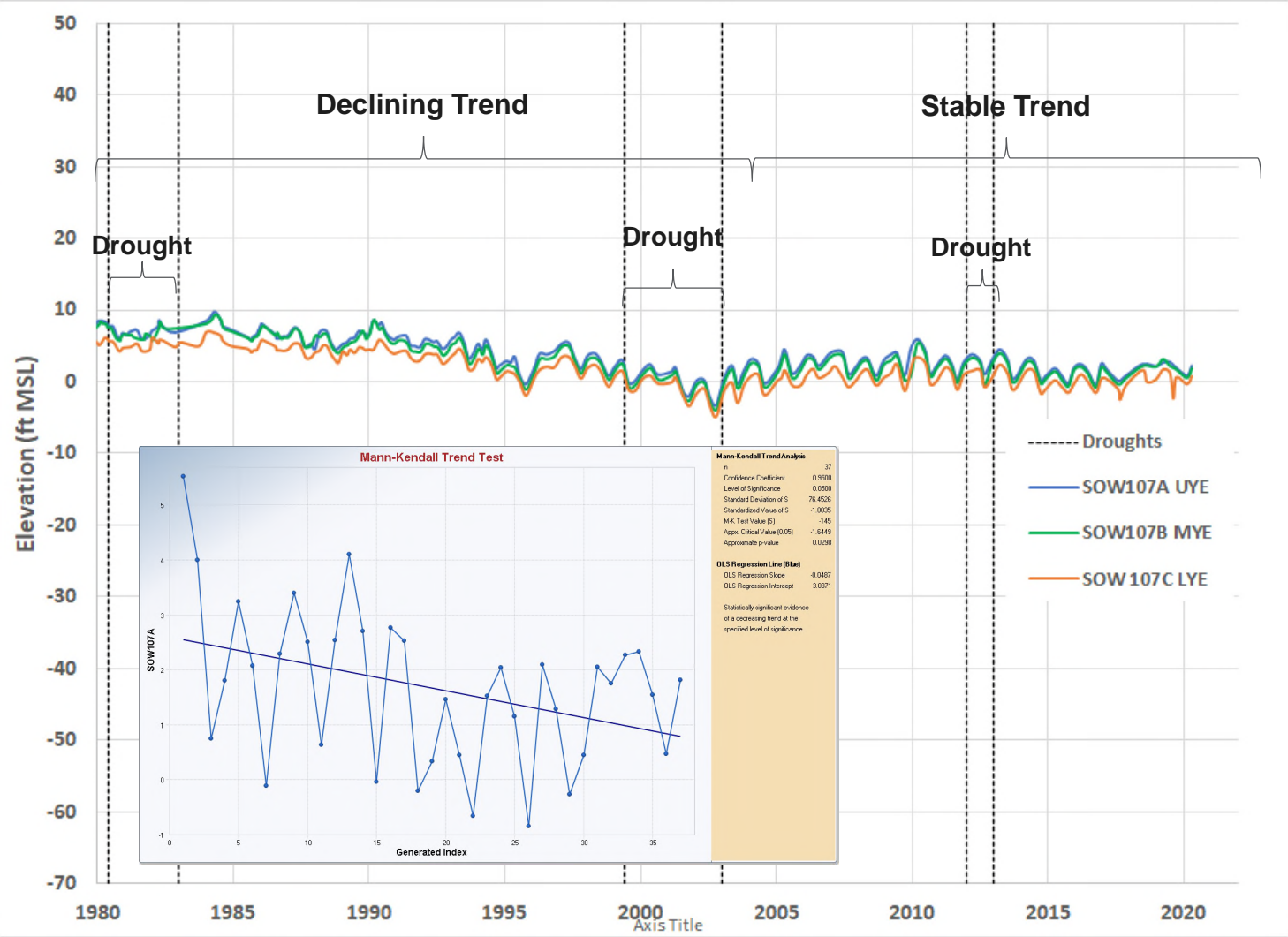


# East of Tyson Foods Withdrawal

- Observation wells > 1 mile from withdrawal. Drawdown will be less at the larger distance from pumping.
- Overall decreasing trend from 1980 through 2002.
- From 2002 through 2020 water levels have been relatively stable.
  - Water levels recovered slightly from 2002 to 2010.
  - Water levels from 2010 to 2020 show a slight decreasing trend for Upper YT. All other wells show no trends.
  - Levels at the end of 2020 are about the same as 2002.



# East of Tyson Foods Withdrawal



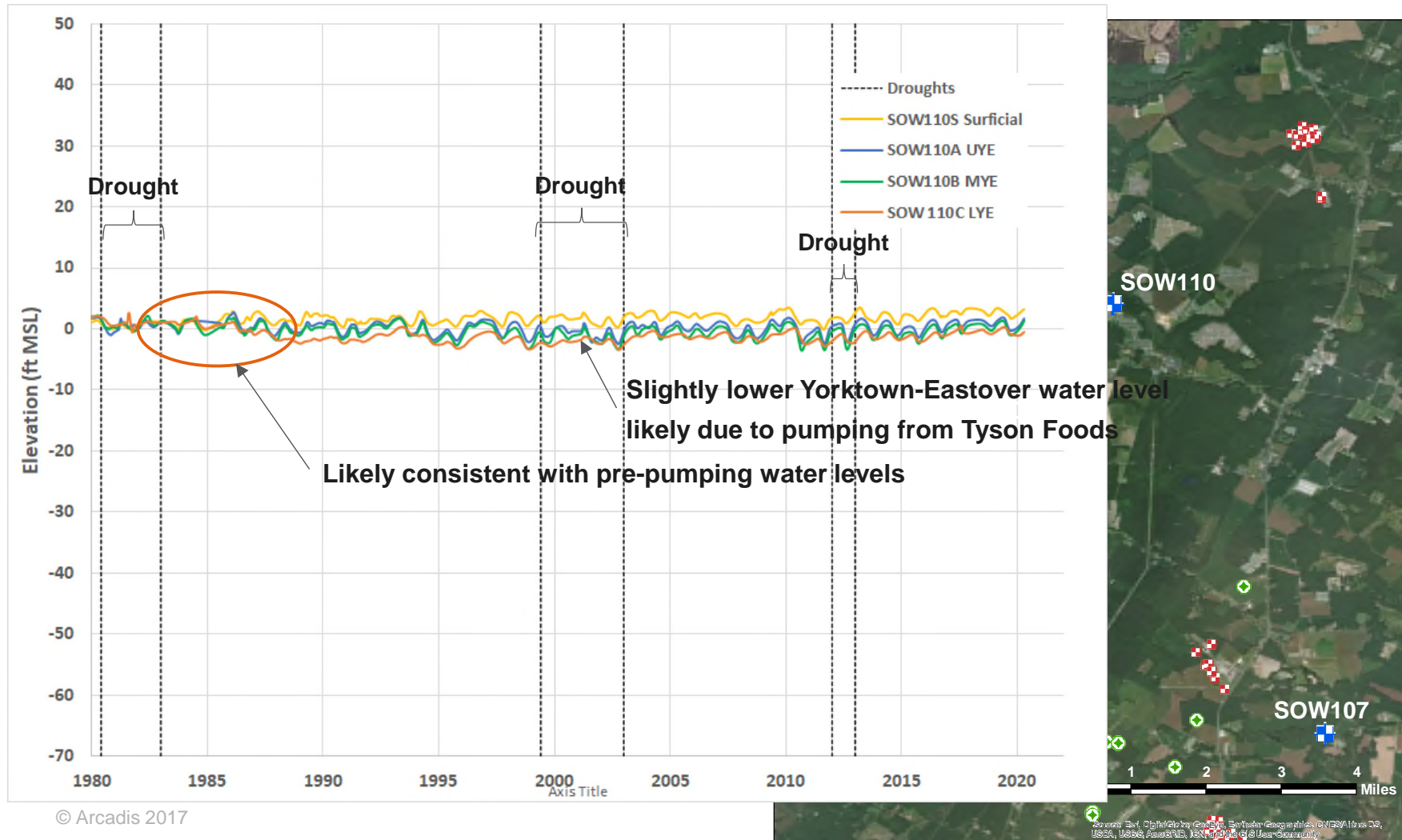
# West of Tyson Foods Withdrawal

- Observation wells > 2 mile from a permitted withdrawal.
- Very little influence from groundwater withdrawals observed in this observation well.
- 1980-1985 levels likely closely approximates non-pumping conditions.
- Very slight decrease for the Yorktown-Eastover aquifers (less than 2-feet) from 1985 through 2002 likely from Tyson Foods withdrawal.
- More recent (2010 through 2020) water levels appear to show a stronger seasonal fluctuation:
  - Lower water levels in late summer to fall.
  - Higher water levels in winter to spring.
- These fluctuations are consistent with seasonal irrigation withdrawals.
- Overall there are rising (recovering) trends from 2010 to 2020.



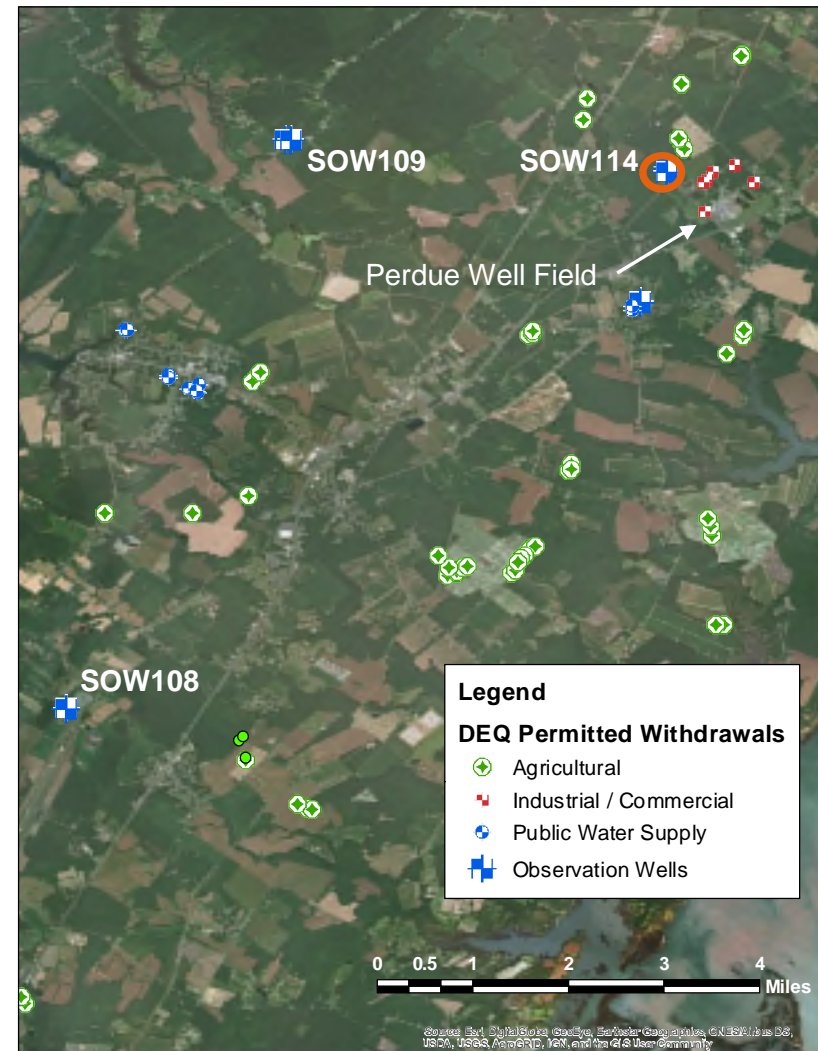


# West of Tyson Foods Withdrawal



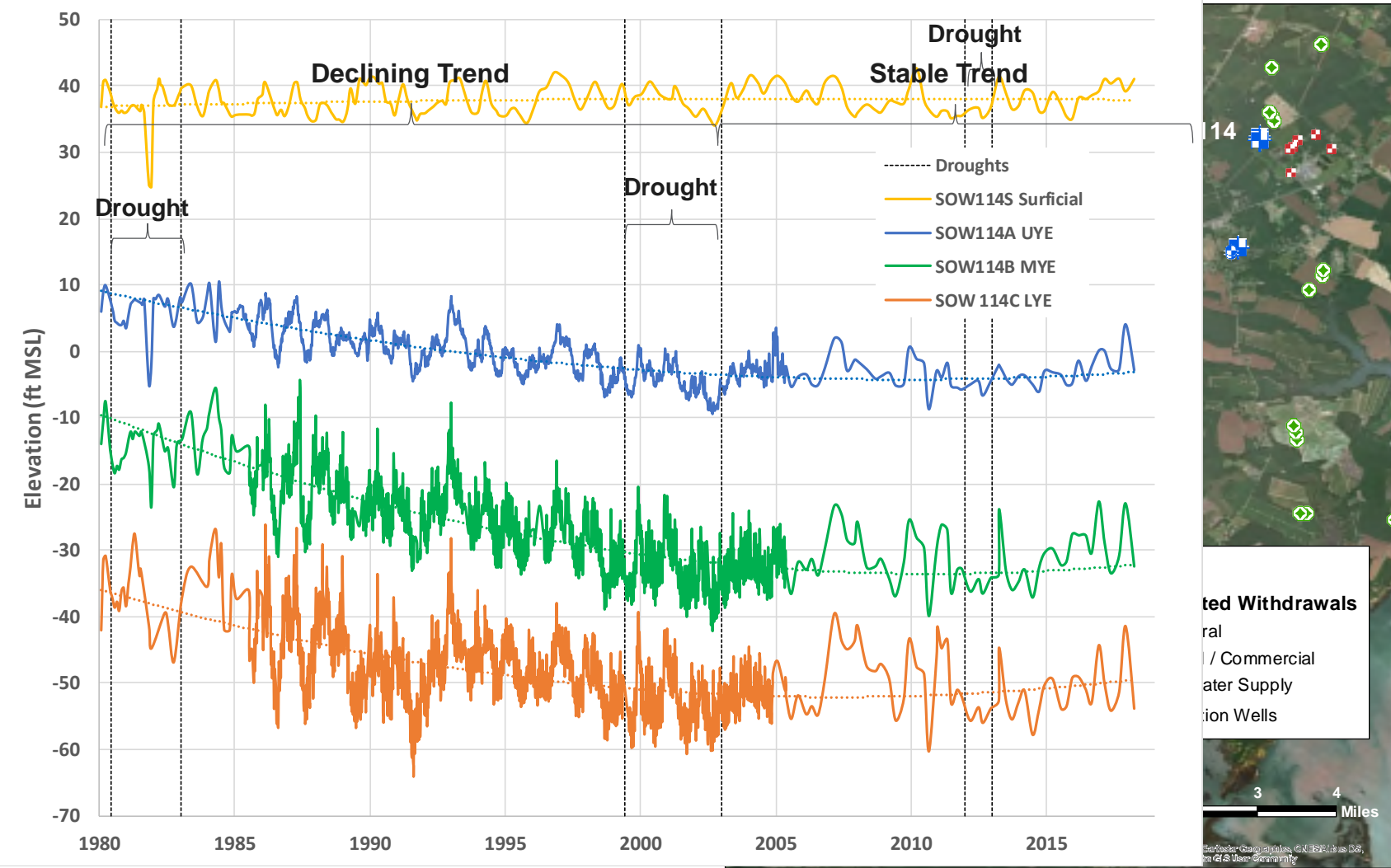
# Adjacent to Perdue Withdrawal

- Observation wells << 1 mile from Perdue withdrawal. Drawdown will reflect close distance from pumping well.
- Overall decreasing trend in Yorktown-Eastover aquifer through 2002.
- Since 2002 trends have generally stabilized.
- Statistically decreasing trend for Upper YT from 2010-2020
- No trend from Middle and Lower YT from 2010-2020
- Overall no significant trend for the surficial (Columbia) aquifer. Statistically increasing (recovering) trend from 2010 to 2020.



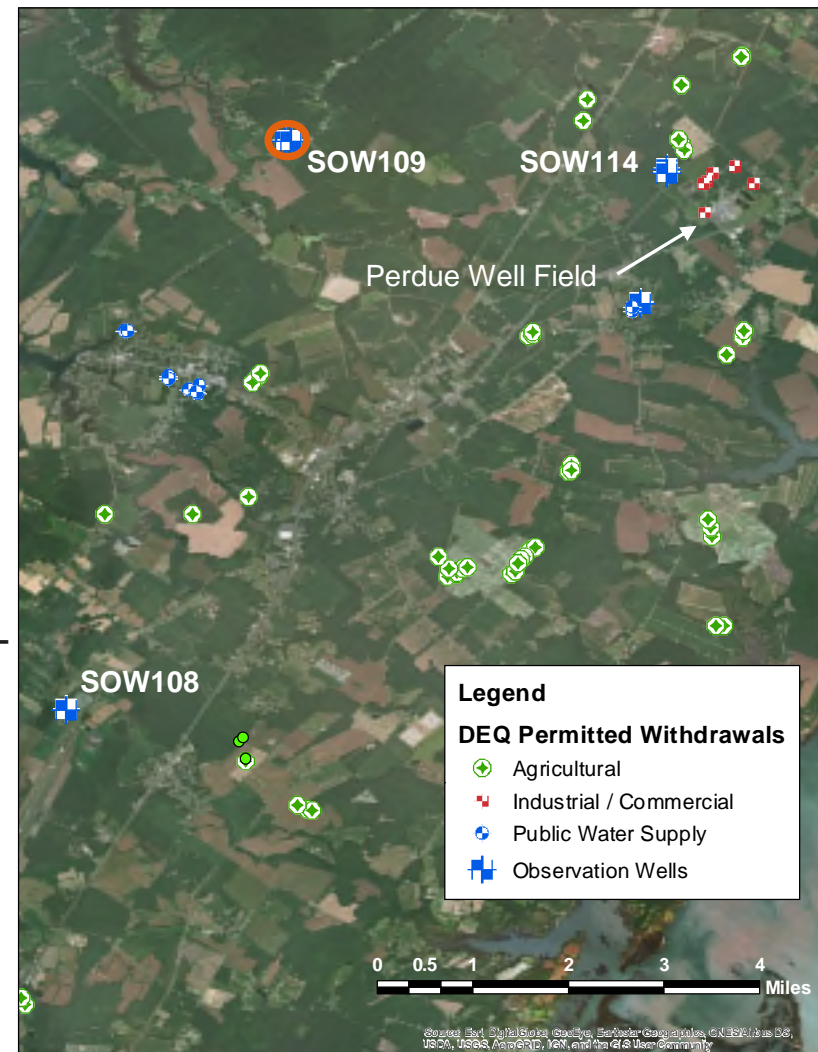


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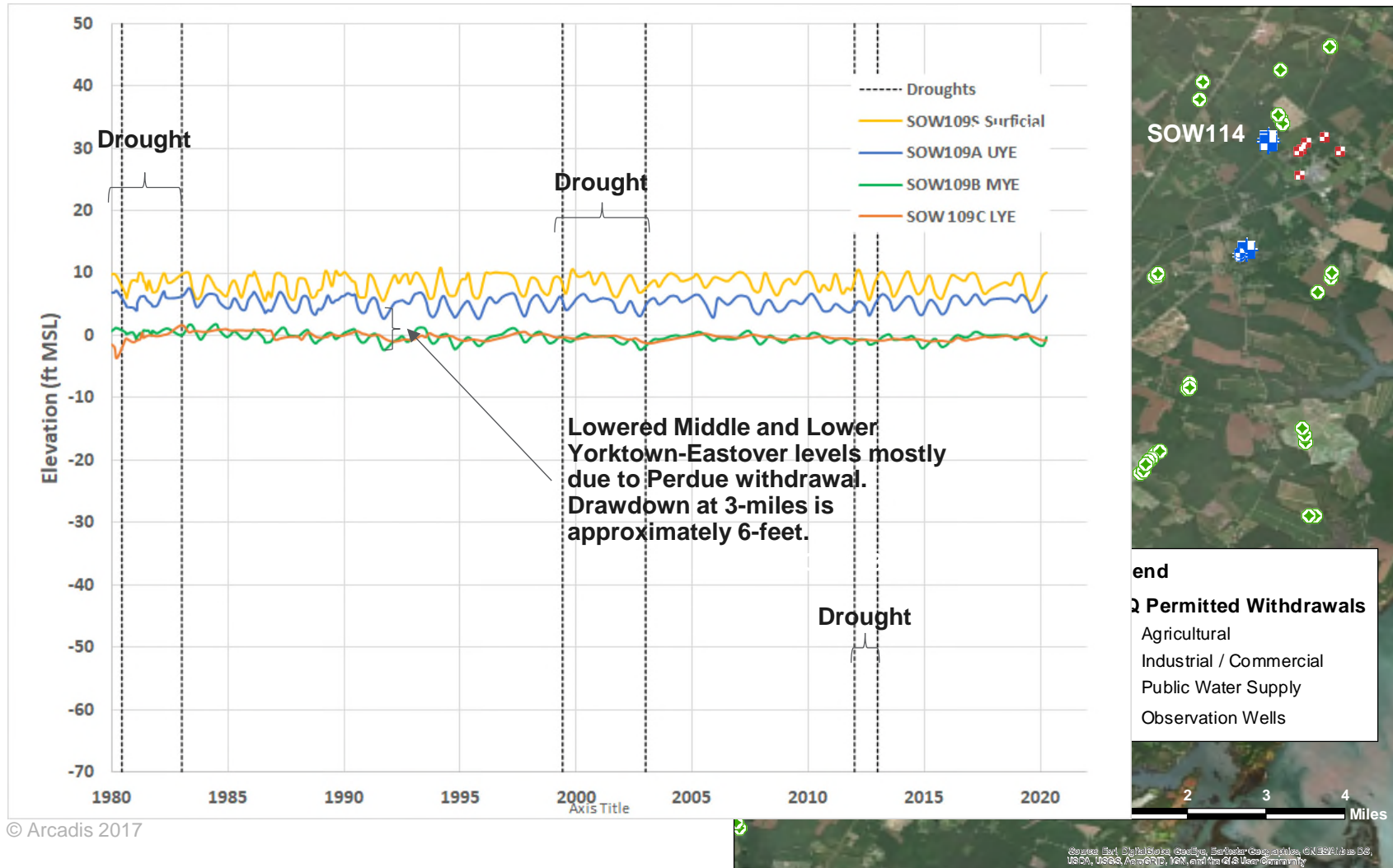


# West of Perdue Withdrawal

- Observation wells > 3 miles from Perdue withdrawal. Drawdown from Perdue withdrawal will be much less at this distance.
- Very slight decreasing trends through 2002.
- Since 2002 trends have stabilized.
- No statistical trends for all wells from 2010-2020.
- Lower water levels for the middle and lower Yorktown-Eastover aquifer are predominately influenced from Perdue withdrawal.
- Drawdown near Perdue for lower Yorktown-Eastover is  $\approx$  55 to 60 feet.
- Drawdown approximately 3-miles from Perdue is  $\approx$  5 feet (around 10x less).



# West of Perdue Withdrawal



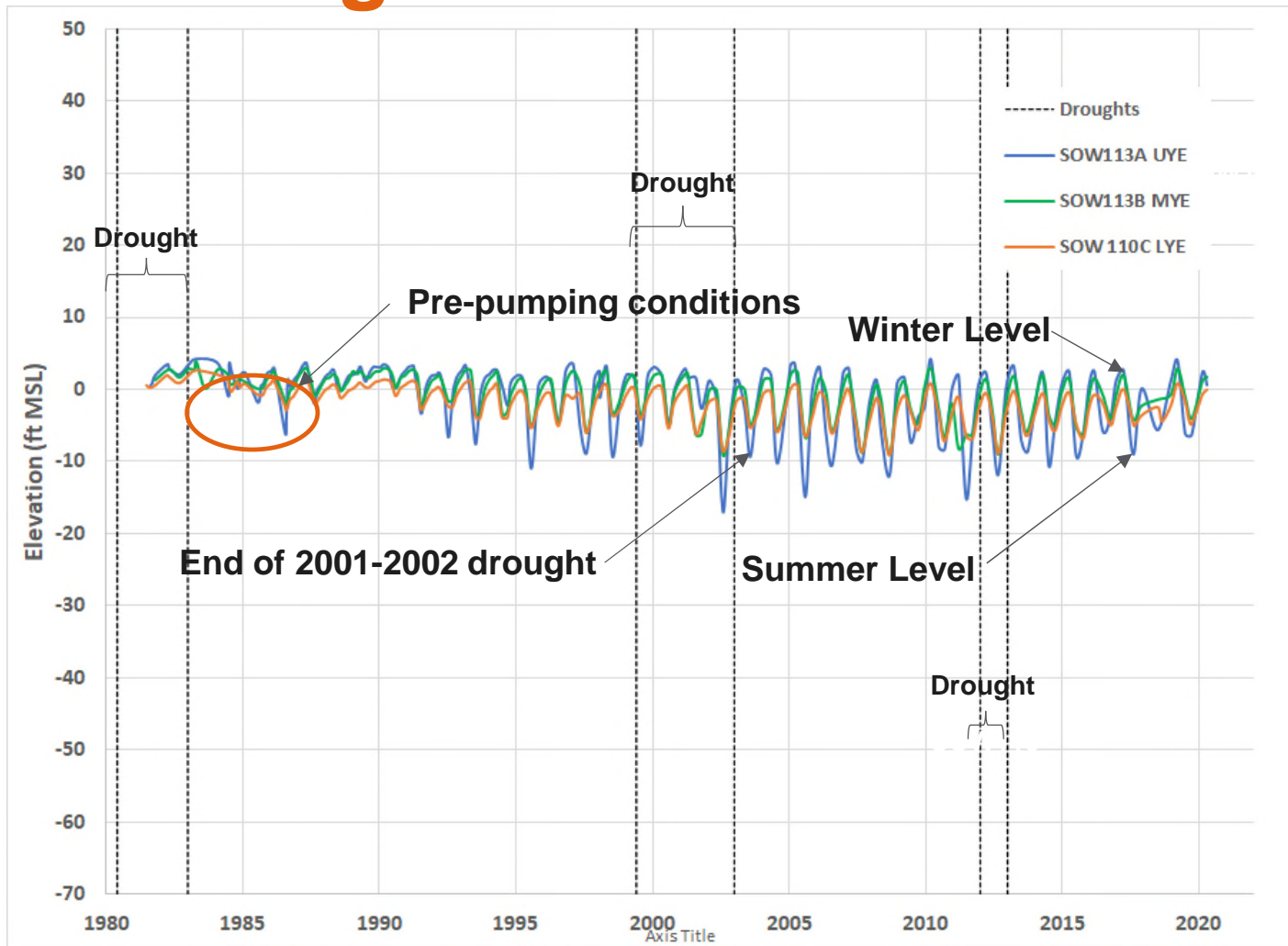
# Near Agricultural Withdrawals

- Near several agricultural withdrawals.
- Use is highly seasonal:
  - Very little to no use in the winter.
  - High use in summer.
- Use varies based on crop and weather conditions.
- Agricultural use increasing gradually from 1980's to 2000.
- Peak drawdown corresponds to the end of the 2001-2002 drought.
- Water levels appear generally stable from 2002 through 2020.
- Statistically decreasing trend for middle YT from 2010-2020
- No trends for upper YT and lower YT from 2010-2020



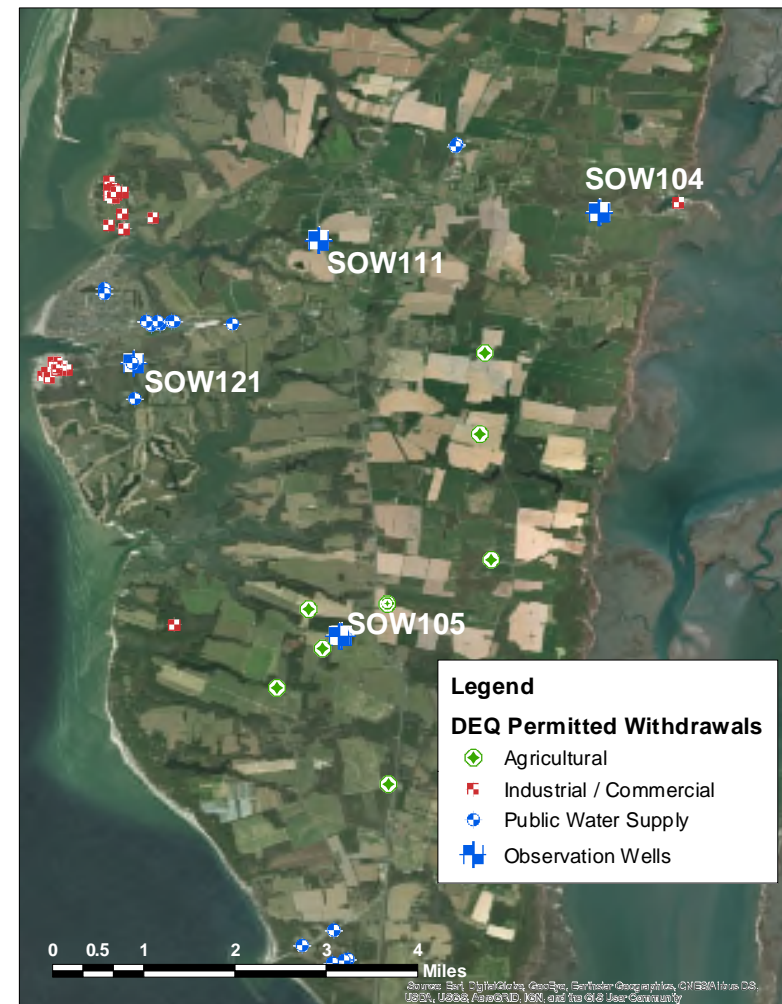


# Near Agricultural Withdrawals

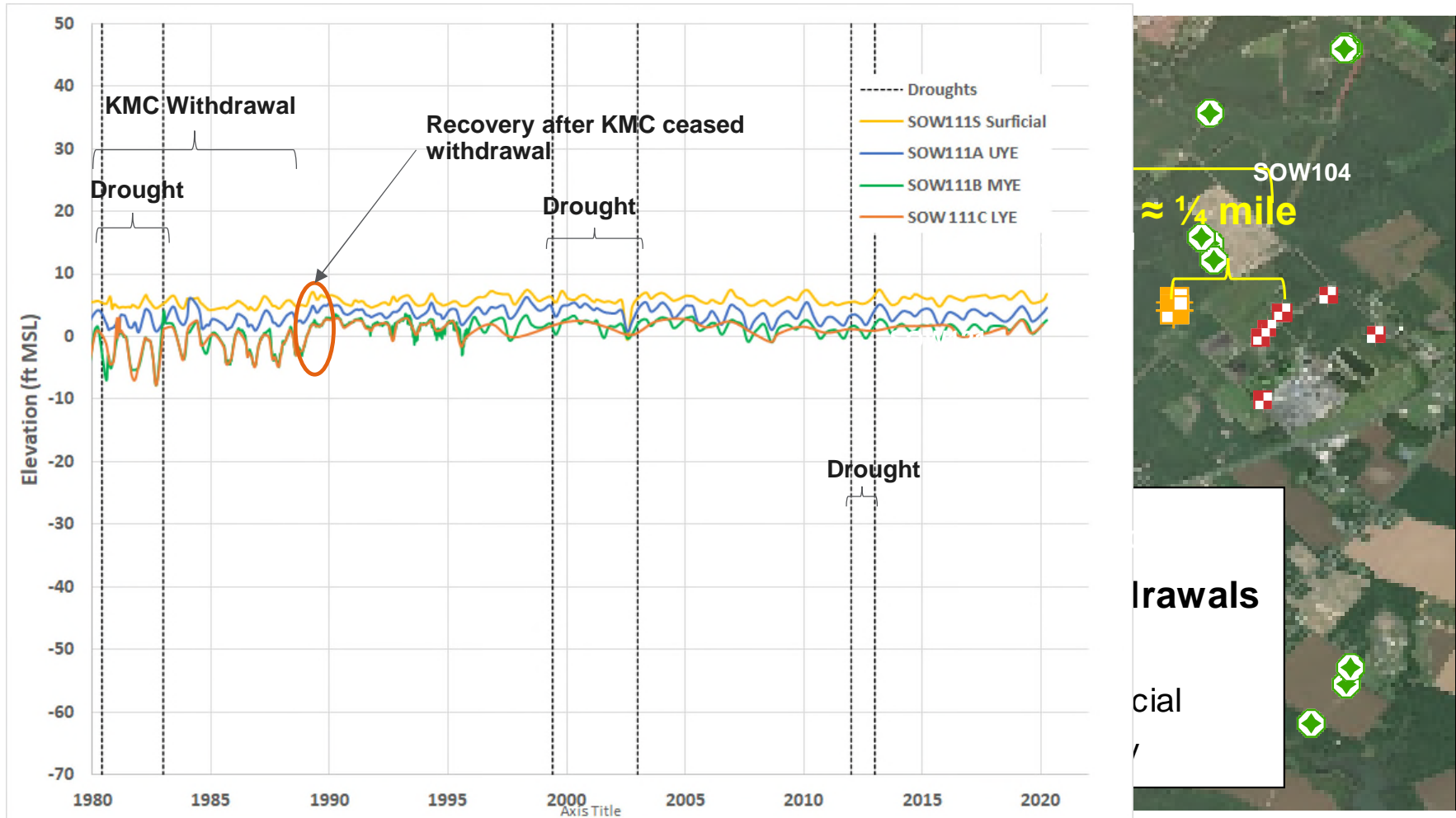


# Water Levels Near Former KMC Foods

- Withdrawals by KMC Foods from the middle and lower Yorktown-Eastover aquifers through 1988.
- Use was seasonal with highest use in late summer and fall.
- KMC ceased operations around 1988.
- Water levels in the Yorktown-Eastover aquifer have recovered levels within 6-feet of the surficial (Columbia) aquifer.

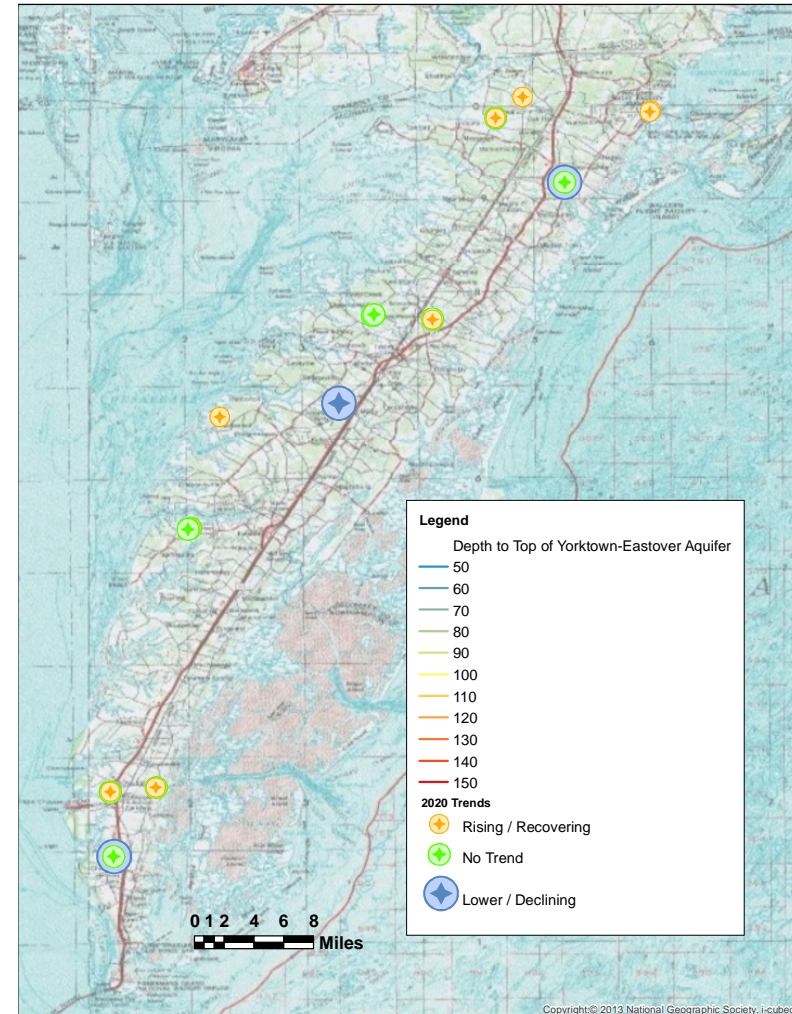


# Water Levels Near Former KMC Foods



# Recent Water Level Trends (2010-2020)

- Statistical Test: Mann-Kendall
- Water levels from 2010 to 2020
- Majority of wells (56%) have statistically significant increasing trends (water levels rising / recovering)
- 38% have no statistically significant trend
- 7% (three wells) have significant decreasing trends (declining):
  - SOW105A (Near several agricultural withdrawals)
  - SOW107A (Near Tyson Foods)
  - SOW108C (Near large agricultural withdrawals)





# Summary

- Measured groundwater levels record aquifer response to groundwater withdrawals.
  - These levels are important tools in tracking status of the groundwater resource.
  - If there were on-going significant declining trends it would indicate conditions have not stabilized and additional impacts could occur (lowered water levels, reduced well yields, and possible salt water intrusion).
  - Stable or recovering trends are consistent with sustainable conditions.
- Groundwater levels in many of the observation wells showed declining trends from the 1980's through 2002.
- Majority of trends from 2002 through 2020 are stable to recovering.
- Based on the available groundwater level trends, current groundwater use from the Columbia and Yorktown-Eastover aquifers is sustainable.
- It is important to routinely re-evaluate water level trends to verify aquifer conditions have not changed.
- Because distance from the withdrawal is important, additional observation well clusters may be necessary if there are new large withdrawals in previously un-monitored areas.