



# Robust Review 2023 Progress Update

November 2023



# NEBRASKA

Good Life. Great Water.

DEPT. OF NATURAL RESOURCES



Jim Pillen, Governor

DATE: August 22, 2023  
TO: POAC Technical Committee  
FROM: Jennifer Schellpeper, Water Planning Division Head  
SUBJECT: COHYST Model Runs

## MEMORANDUM

A list of previously shared 2023 Robust Review planned model runs are indicated in the table. Please provide any feedback to the NeDNR within a week, preferably not later than August 30, 2023.

|   |
|---|
| Historical - Baseflow   |
| Historical - Total Flow   |
| 1997 GWO Irrigation - Baseflow - TPNRD                              |
| 1997 GWO Irrigation - Total Flow - TPNRD                            |
| 1997 GWO Irrigation - Baseflow - CPNRD                              |
| 1997 GWO Irrigation - Total Flow - CPNRD                            |
| 1997 GWO Irrigation - Baseflow - TBNRD                              |
| 1997 GWO Irrigation - Total Flow - TBNRD                            |
| 1997 GWO Irrigation - Baseflow - Outside NRDs                       |
| 1997 GWO Irrigation - Total Flow - Outside NRDs                     |
| 1997 GWO Irrigation and M&I - Baseflow or Total Flow - TPNRD        |
| 1997 GWO Irrigation and M&I - Baseflow or Total Flow - CPNRD        |
| 1997 GWO Irrigation and M&I - Baseflow or Total Flow - TBNRD        |
| 1997 GWO Irrigation and M&I - Baseflow or Total Flow - Outside NRDs |
| No Retirements - Baseflow or Total Flow - CPNRD                     |
| No Retirements - Baseflow or Total Flow - TBNRD                     |
| No North Dry Creek Augmentation                                     |
| No NCORPE Augmentation - TPNRD or North Pipeline                    |
| No NCORPE Augmentation - MRNRD or South Pipeline                    |
| 1997 Combined - Baseflow or Total Flow - TPNRD                      |
| 1997 Combined - Baseflow or Total Flow - CPNRD                      |
| 1997 Combined - Baseflow or Total Flow - TBNRD                      |
| No GWO Pumping - Baseflow or Total Flow - TPNRD                     |
| No GWO Pumping - Baseflow or Total Flow - CPNRD                     |
| No GWO Pumping - Baseflow or Total Flow - TBNRD                     |
| No GWO Pumping - Baseflow or Total Flow - Outside NRDs              |

Thomas C. Riley, P.E., Director

Department of Natural Resources  
245 Fallbrook Blvd., Suite 201 OFFICE 402-471-2363  
Lincoln, Nebraska 68521-6729 FAX 402-471-2900

[dnr.nebraska.gov](http://dnr.nebraska.gov)

| Robust Review Model Runs  |   | TFG Support Task   | Del Date | Ref Name         | Production Practices |     |  |  |
|---|---|--------------------|----------|------------------|----------------------|-----|--|--|
| Historical - Baseflow   | ➤ | Task 100           | 29-Nov   | Baseline2020_001 | 2020 SIM Files       |     |  |  |
| Historical - Total Flow   |   |                    |          | Baseline1998_001 | 1998 SIM Files       |     |  |  |
|   |   |                    |          |                  |                      |     |  |  |
| 1997 GWO Irrigation - Baseflow - TPNRD                              | ➤ | Task 200           | 29-Nov   | p1997_2020_001   | 2020 SIM Files       |     |  |  |
| 1997 GWO Irrigation - Total Flow - TPNRD                            |   |                    |          |                  |                      |     |  |  |
| 1997 GWO Irrigation - Baseflow - CPNRD                              |   |                    |          |                  |                      |     |  |  |
| 1997 GWO Irrigation - Total Flow - CPNRD                            |   |                    |          |                  |                      |     |  |  |
| 1997 GWO Irrigation - Baseflow - TBNRD                              |   |                    |          |                  |                      |     |  |  |
| 1997 GWO Irrigation - Total Flow - TBNRD                            |   |                    |          |                  |                      |     |  |  |
| 1997 GWO Irrigation - Baseflow - Outside NRDs                       |   |                    |          |                  |                      |     |  |  |
| 1997 GWO Irrigation - Total Flow - Outside NRDs                     |   |                    |          |                  |                      |     |  |  |
| 1997 GWO Irrigation and M&I - Baseflow or Total Flow - TPNRD        |   |                    |          | p1997_1998_001   | 1998 SIM Files       |     |  |  |
| 1997 GWO Irrigation and M&I - Baseflow or Total Flow - CPNRD        |   |                    |          |                  |                      |     |  |  |
| 1997 GWO Irrigation and M&I - Baseflow or Total Flow - TBNRD        |   |                    |          |                  |                      |     |  |  |
| 1997 GWO Irrigation and M&I - Baseflow or Total Flow - Outside NRDs |   |                    |          |                  |                      |     |  |  |
|   |   |                    |          |                  |                      |     |  |  |
| No Retirements - Baseflow or Total Flow - CPNRD                     |   |                    |          | ➤                | Task 400             | TBD |  |  |
| No Retirements - Baseflow or Total Flow - TBNRD                     |   |                    |          |                  |                      |     |  |  |
|   |   |                    |          |                  |                      |     |  |  |
| No North Dry Creek Augmentation                                     | ➤ | No TFG Involvement |          |                  |                      |     |  |  |
| No NCORPE Augmentation - TPNRD or North Pipeline                    |   |                    |          |                  |                      |     |  |  |
| No NCORPE Augmentation - MRNRD or South Pipeline                    |   |                    |          |                  |                      |     |  |  |
| 1997 Combined - Baseflow or Total Flow - TPNRD                      |   |                    |          |                  |                      |     |  |  |
| 1997 Combined - Baseflow or Total Flow - CPNRD                      |   |                    |          |                  |                      |     |  |  |
| 1997 Combined - Baseflow or Total Flow - TBNRD                      |   |                    |          |                  |                      |     |  |  |
|   |   |                    |          |                  |                      |     |  |  |
| No GWO Pumping - Baseflow or Total Flow - TPNRD                     | ➤ | Task 300           | 27-Nov   | nGWLands_001     | 2020 SIM Files       |     |  |  |
| No GWO Pumping - Baseflow or Total Flow - CPNRD                     |   |                    |          |                  |                      |     |  |  |
| No GWO Pumping - Baseflow or Total Flow - TBNRD                     |   |                    |          |                  |                      |     |  |  |
| No GWO Pumping - Baseflow or Total Flow - Outside NRDs              |   |                    |          |                  |                      |     |  |  |

| Robust Review Model Runs | TFG Support Task | Del Date | Ref Name | Tillage                                |
|--------------------------|------------------|----------|----------|--|
| Historical - Baseflow    | >                | Task 100 | 27-Nov   | <b>Baseline2020_001</b> 2020 SIM Files |
| Historical - Total Flow  |                  |          |          | Baseline1998_001 1998 SIM Files        |

### Average 1997 – 2020: All Acres

| Parameter                           | Baseline2020_001  |               |               |
|-------------------------------------|-------------------|---------------|---------------|
|                                     | AF                | in            | %             |
| <b>Acres</b>                        | 12,374,240        |               |               |
| Precipitation                       | 25,086,584        | 24.33         | 90.3%         |
| Groundwater Pumping                 | 2,496,808         | 2.42          | 9.0%          |
| Surface Water Deliveries            | 201,962           | 0.20          | 0.7%          |
| <b>Total Applied Water</b>          | <b>27,785,355</b> | <b>26.95</b>  | <b>100.0%</b> |
| Field Evapotranspiration            | 23,219,801        | 22.52         | 83.6%         |
| Field Deep Percolation              | 2,808,965         | 2.72          | 10.1%         |
| Field Runoff                        | 1,786,785         | 1.73          | 6.4%          |
| Irrigation Surface Losses           | 130,899           | 0.13          | 0.5%          |
| <b>Field Water Balance</b>          | <b>(161,096)</b>  | <b>(0.16)</b> | <b>-0.6%</b>  |
| Lateral Losses                      | 12,317            | 0.01          | 0.0%          |
| <b>Field Runoff</b>                 | <b>1,786,785</b>  | <b>1.73</b>   | <b>6.4%</b>   |
| Runoff Contributions to Streamflow  | 1,008,361         | 0.98          | 3.6%          |
| Runoff Losses to Recharge           | 389,212           | 0.38          | 1.4%          |
| Runoff Losses to Evapotranspiration | 389,212           | 0.38          | 1.4%          |
| <b>Net Recharge</b>                 | <b>713,686</b>    | <b>0.69</b>   |               |
| <b>Net Impact to Rivers</b>         | <b>1,722,047</b>  | <b>1.67</b>   |               |

### Average 1997 – 2020: GW Only Irr Acres

| Parameter                           | Baseline2020_001   |               |               |
|-------------------------------------|--------------------|---------------|---------------|
|                                     | AF                 | in            | %             |
| <b>Acres</b>                        | 3,500,915          |               |               |
| Precipitation                       | 7,593,238          | 26.03         | 75.9%         |
| Groundwater Pumping                 | 2,415,095          | 8.28          | 24.1%         |
| Surface Water Deliveries            | -                  | -             | 0.0%          |
| <b>Total Applied Water</b>          | <b>10,008,334</b>  | <b>34.31</b>  | <b>100.0%</b> |
| Field Evapotranspiration            | 7,866,776          | 26.96         | 78.6%         |
| Field Deep Percolation              | 1,026,688          | 3.52          | 10.3%         |
| Field Runoff                        | 1,038,831          | 3.56          | 10.4%         |
| Irrigation Surface Losses           | 120,755            | 0.41          | 1.2%          |
| <b>Field Water Balance</b>          | <b>(44,716)</b>    | <b>(0.15)</b> | <b>-0.4%</b>  |
| Lateral Losses                      | -                  | -             | 0.0%          |
| <b>Field Runoff</b>                 | <b>1,038,831</b>   | <b>3.56</b>   | <b>10.4%</b>  |
| Runoff Contributions to Streamflow  | 583,785            | 2.00          | 5.8%          |
| Runoff Losses to Recharge           | 227,523            | 0.78          | 2.3%          |
| Runoff Losses to Evapotranspiration | 227,523            | 0.78          | 2.3%          |
| <b>Net Recharge</b>                 | <b>(1,160,885)</b> | <b>(3.98)</b> |               |
| <b>Net Impact to Rivers</b>         | <b>(577,100)</b>   | <b>(1.98)</b> |               |

Robust Review Model Runs

Historical - Baseflow

Historical - Total Flow



TFG Support Task

Task 100

Del Date

27-Nov

Ref Name

Baseline2020\_001

Baseline1998\_001

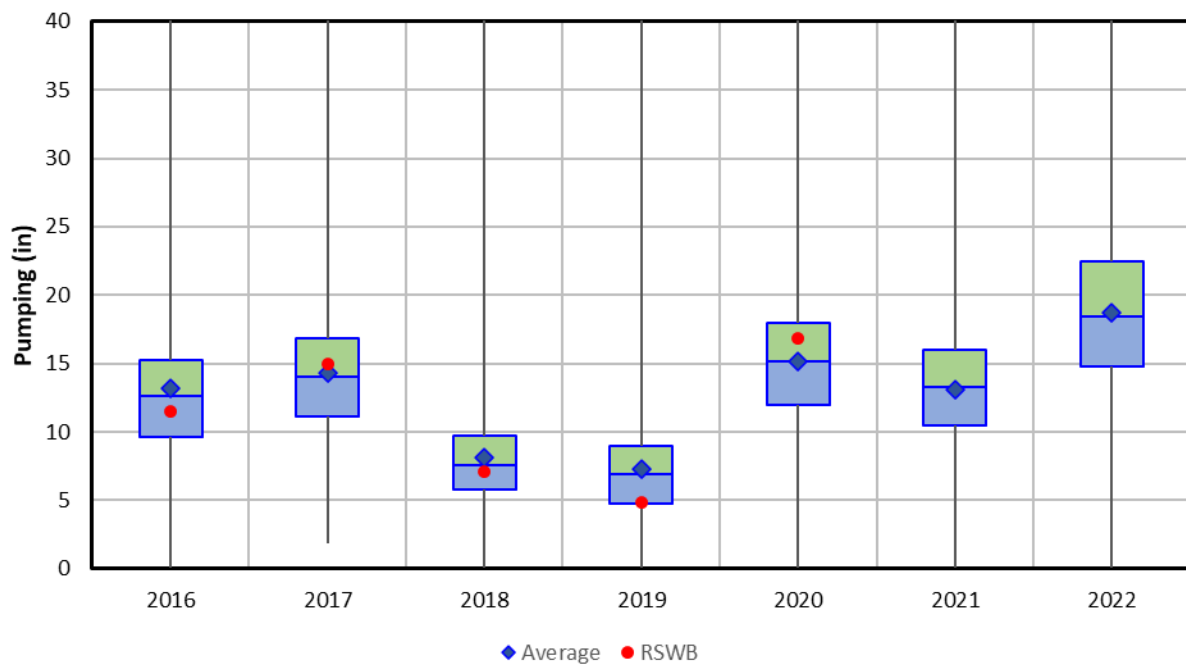
Tillage

2020 SIM Files

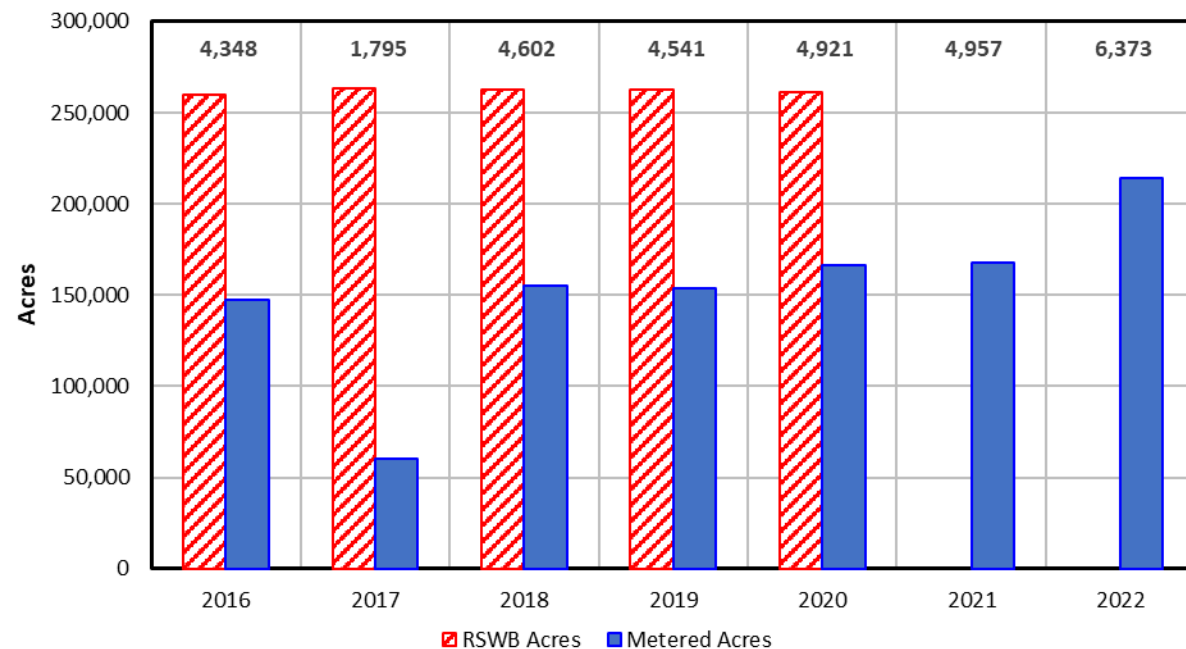
1998 SIM Files

# TPNRD – Pumping Comparison

TPNRD - Metered Pumping



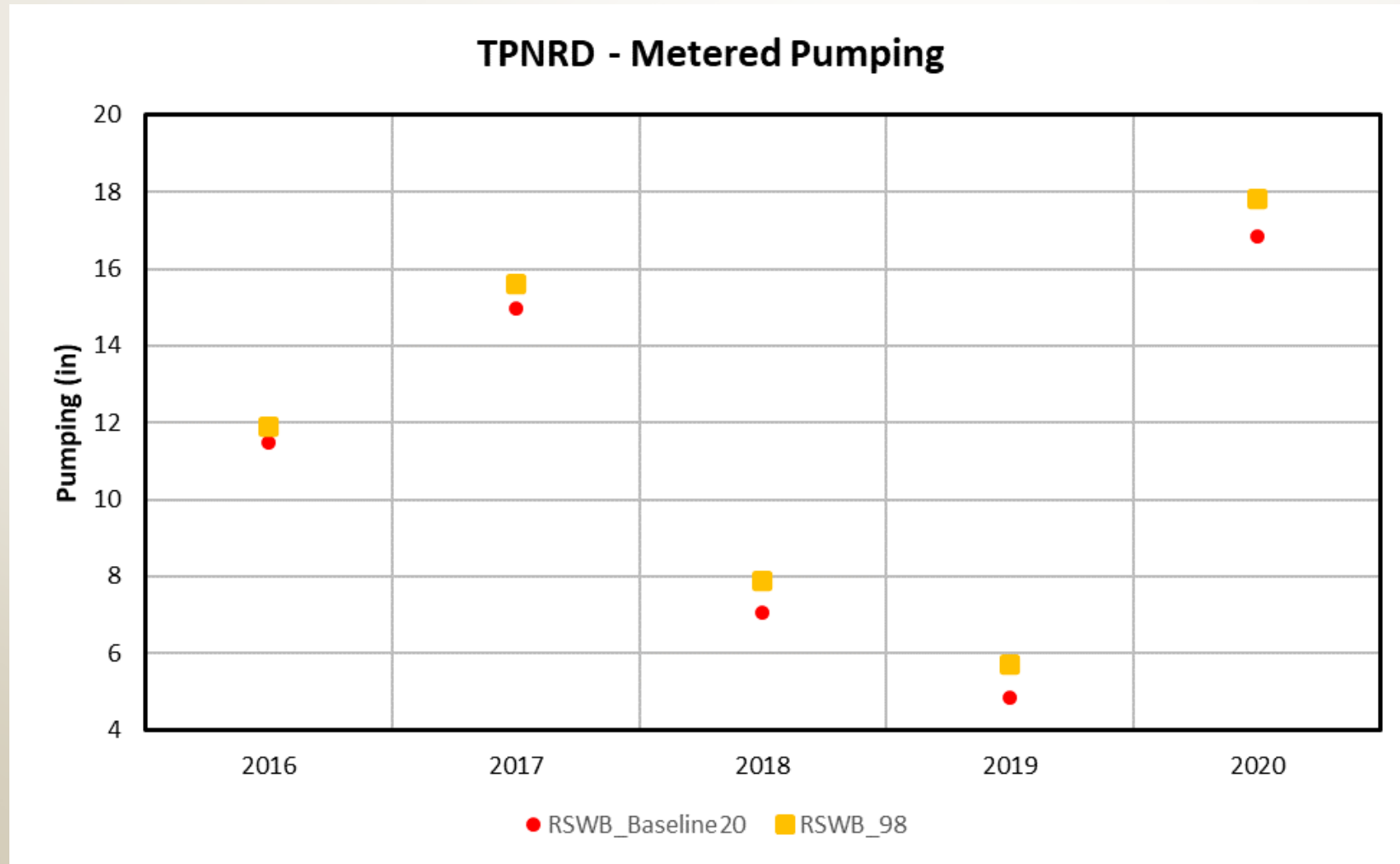
TPNRD - GW Irrigated Acres



Note: Number values above bars indicate number of metered pumping entries available.

| Robust Review Model Runs | TFG Support Task | Del Date | Ref Name | Production Practices |
|--------------------------|------------------|----------|----------|----------------------|
| Historical - Baseflow    | >                | Task 100 | 29-Nov   | Baseline2020_001     |
| Historical - Total Flow  |                  |          |          | Baseline1998_001     |

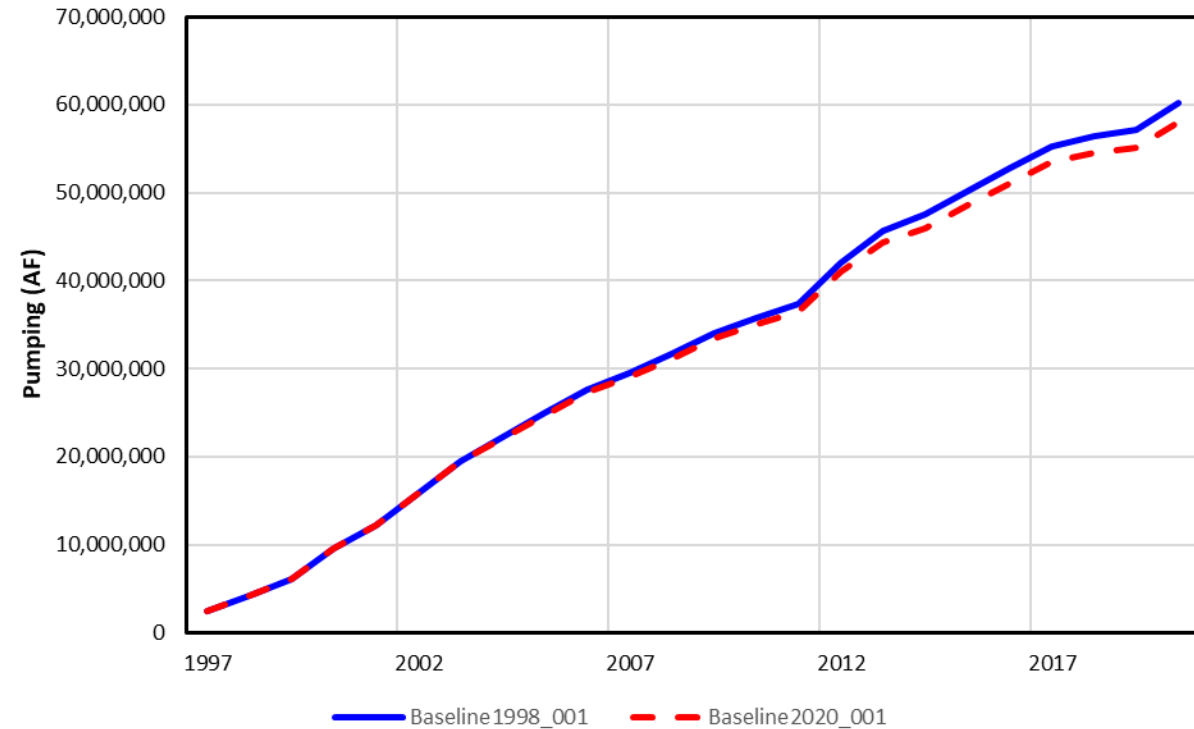
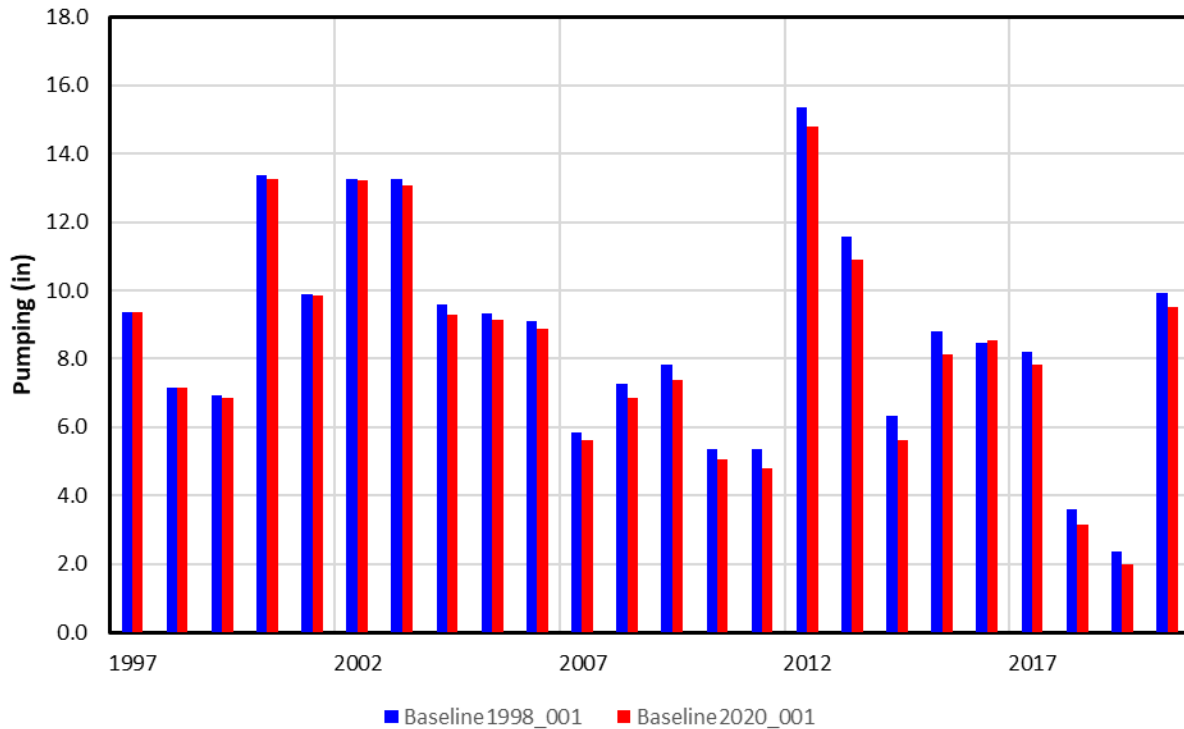
## Production Practice Update Impacts on Pumping Estimates



| Robust Review Model Runs | TFG Support Task | Del Date | Ref Name         | Tillage        |
|--------------------------|------------------|----------|------------------|----------------|
| Historical - Baseflow    | Task 100         | 27-Nov   | Baseline2020_001 | 2020 SIM Files |
| Historical - Total Flow  |                  |          | Baseline1998_001 | 1998 SIM Files |

# Pumping Comparison – Production Practice Impacts

GW Only Irrigated Acres



| Robust Review Model Runs  | TFG Support Task | Del Date | Ref Name         | Production Practices |                |                |
|---|------------------|----------|------------------|----------------------|----------------|----------------|
| Historical - Baseflow   | Task 100         | 29-Nov   | Baseline2020_001 | 2020 SIM Files       |                |                |
| Historical - Total Flow   |                  |          | Baseline1998_001 | 1998 SIM Files       |                |                |
| 1997 GWO Irrigation - Baseflow - TPNRD                              | Task 200         | 29-Nov   |                  |                      |                |                |
| 1997 GWO Irrigation - Total Flow - TPNRD                            |                  |          |                  |                      |                |                |
| 1997 GWO Irrigation - Baseflow - CPNRD                              |                  |          |                  |                      |                |                |
| 1997 GWO Irrigation - Total Flow - CPNRD                            |                  |          |                  | p1997_2020_001       | 2020 SIM Files |                |
| 1997 GWO Irrigation - Baseflow - TBNRD                              |                  |          |                  |                      |                |                |
| 1997 GWO Irrigation - Total Flow - TBNRD                            |                  |          |                  |                      |                |                |
| 1997 GWO Irrigation - Baseflow - Outside NRDs                       |                  |          |                  |                      |                |                |
| 1997 GWO Irrigation - Total Flow - Outside NRDs                     |                  |          |                  |                      |                |                |
| 1997 GWO Irrigation and M&I - Baseflow or Total Flow - TPNRD        |                  |          |                  |                      | p1997_1998_001 | 1998 SIM Files |
| 1997 GWO Irrigation and M&I - Baseflow or Total Flow - CPNRD        |                  |          |                  |                      |                |                |
| 1997 GWO Irrigation and M&I - Baseflow or Total Flow - TBNRD        |                  |          |                  |                      |                |                |
| 1997 GWO Irrigation and M&I - Baseflow or Total Flow - Outside NRDs |                  |          |                  |                      |                |                |

Dry Historic LU, 2020 SIM  
 + CO Historic LU, 2020 SIM  
 + GW Historic LU, 2020 SIM  
 + SW Historic LU, 2020 SIM

Dry p1997 LU, 2020 SIM  
 + CO Historic LU, 2020 SIM  
 + GW p1997 LU, 1998 SIM  
 + SW Historic LU, 2020 SIM

=====

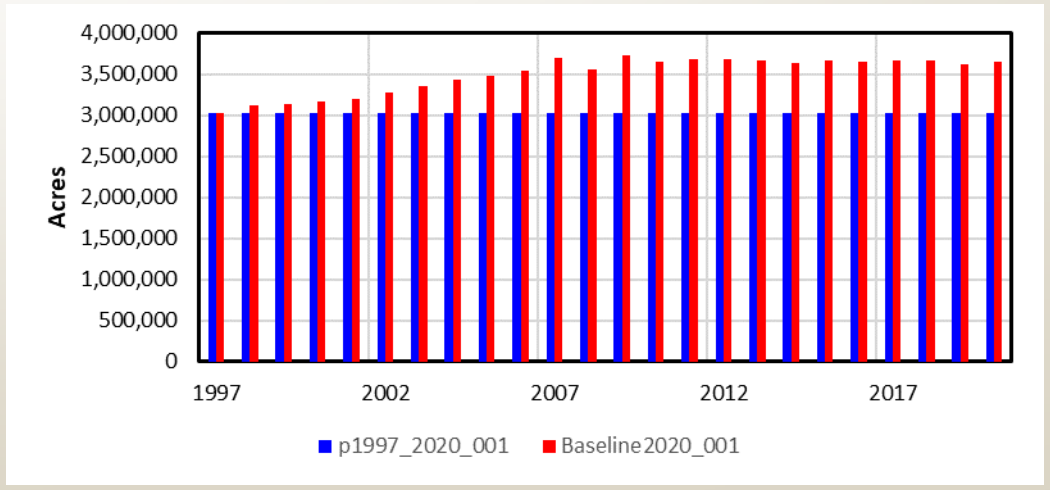
=====

$\alpha$ =Current Condition

$\beta$ =1997 Condition

$Impact = \alpha - \beta$

GW Only Irrigated Acres



GW Only acreage in excess of 1997 levels re-classified as "dryland" equivalent of the previous irrigated crop mix for Task 200

| Robust Review Model Runs  | TFG Support Task | Del Date | Ref Name         | Production Practices |
|---|------------------|----------|------------------|----------------------|
| Historical - Baseflow   | Task 100         | 29-Nov   | Baseline2020_001 | 2020 SIM Files       |
| Historical - Total Flow   |                  |          | Baseline1998_001 | 1998 SIM Files       |
| 1997 GWO Irrigation - Baseflow - TPNRD                              | Task 200         | 29-Nov   | p1997_2020_001   | 2020 SIM Files       |
| 1997 GWO Irrigation - Total Flow - TPNRD                            |                  |          |                  |                      |
| 1997 GWO Irrigation - Baseflow - CPNRD                              |                  |          |                  |                      |
| 1997 GWO Irrigation - Total Flow - CPNRD                            |                  |          |                  |                      |
| 1997 GWO Irrigation - Baseflow - TBNRD                              |                  |          |                  |                      |
| 1997 GWO Irrigation - Total Flow - TBNRD                            |                  |          |                  |                      |
| 1997 GWO Irrigation - Baseflow - Outside NRDs                       |                  |          |                  |                      |
| 1997 GWO Irrigation - Total Flow - Outside NRDs                     |                  |          |                  |                      |
| 1997 GWO Irrigation and M&I - Baseflow or Total Flow - TPNRD        |                  |          |                  |                      |
| 1997 GWO Irrigation and M&I - Baseflow or Total Flow - CPNRD        |                  |          |                  |                      |
| 1997 GWO Irrigation and M&I - Baseflow or Total Flow - TBNRD        |                  |          |                  |                      |
| 1997 GWO Irrigation and M&I - Baseflow or Total Flow - Outside NRDs |                  |          |                  |                      |

**Dry** Historic LU, 2020 SIM  
+ CO Historic LU, 2020 SIM  
+ GW Historic LU, 2020 SIM  
+ SW Historic LU, 2020 SIM

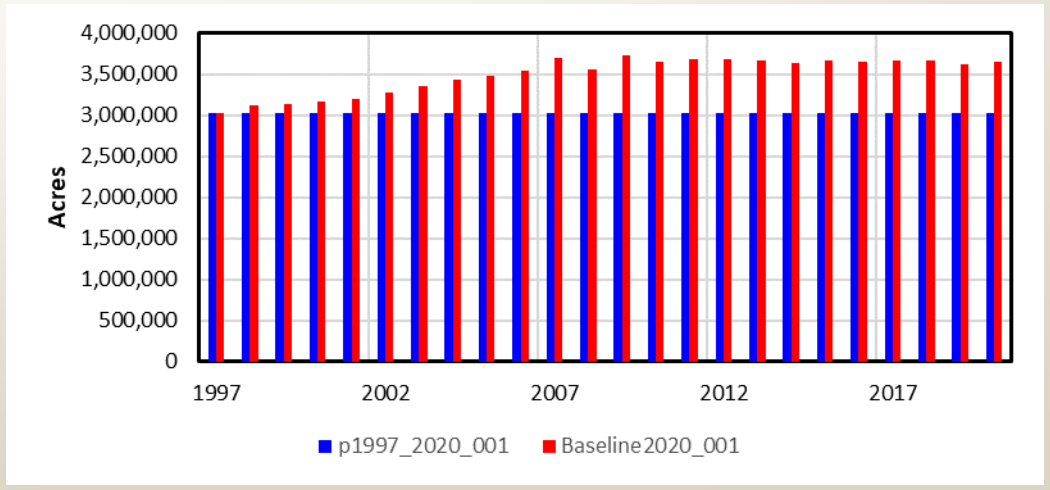
**Dry** p1997 LU, 2020 SIM  
+ CO Historic LU, 2020 SIM  
+ GW p1997 LU, 1998 SIM  
+ SW Historic LU, 2020 SIM

=====  
 $\alpha$ =Current Condition

=====  
 $\beta$ =1997 Condition

**Impact =  $\alpha - \beta$**

GW Only Irrigated Acres



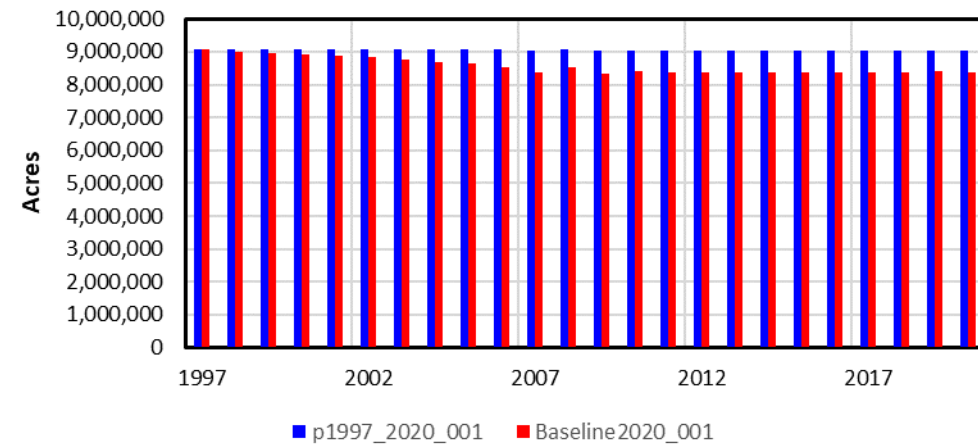
GW Only acreage in excess of 1997 levels re-classified as "dryland" equivalent of the previous irrigated crop mix for Task 200

| Robust Review Model Runs  | TFG Support Task | Del Date | Ref Name         | Production Practices |
|---|------------------|----------|------------------|----------------------|
| Historical - Baseflow   | Task 100         | 29-Nov   | Baseline2020_001 | 2020 SIM Files       |
| Historical - Total Flow   |                  |          | Baseline1998_001 | 1998 SIM Files       |
| 1997 GWO Irrigation - Baseflow - TPNRD                              | Task 200         | 29-Nov   | p1997_2020_001   | 2020 SIM Files       |
| 1997 GWO Irrigation - Total Flow - TPNRD                            |                  |          |                  |                      |
| 1997 GWO Irrigation - Baseflow - CPNRD                              |                  |          |                  |                      |
| 1997 GWO Irrigation - Total Flow - CPNRD                            |                  |          |                  |                      |
| 1997 GWO Irrigation - Baseflow - TBNRD                              |                  |          |                  |                      |
| 1997 GWO Irrigation - Total Flow - TBNRD                            |                  |          |                  |                      |
| 1997 GWO Irrigation - Baseflow - Outside NRDs                       |                  |          |                  |                      |
| 1997 GWO Irrigation - Total Flow - Outside NRDs                     |                  |          |                  |                      |
| 1997 GWO Irrigation and M&I - Baseflow or Total Flow - TPNRD        |                  |          |                  |                      |
| 1997 GWO Irrigation and M&I - Baseflow or Total Flow - CPNRD        |                  |          |                  |                      |
| 1997 GWO Irrigation and M&I - Baseflow or Total Flow - TBNRD        |                  |          |                  |                      |
| 1997 GWO Irrigation and M&I - Baseflow or Total Flow - Outside NRDs |                  |          |                  |                      |
|   |                  |          | p1997_1998_001   | 1998 SIM Files       |

### Dryland Acres: 1997-2020 Average

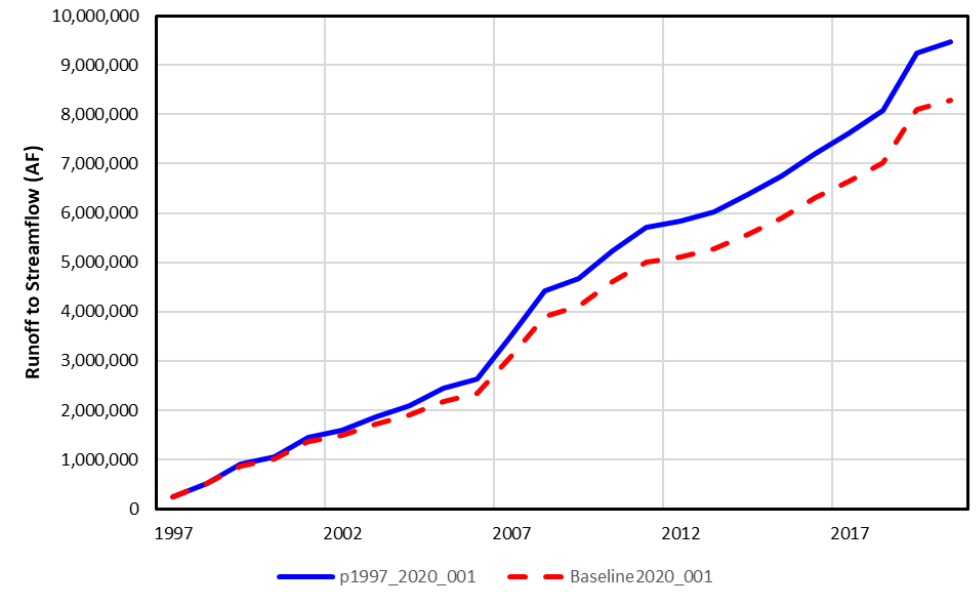
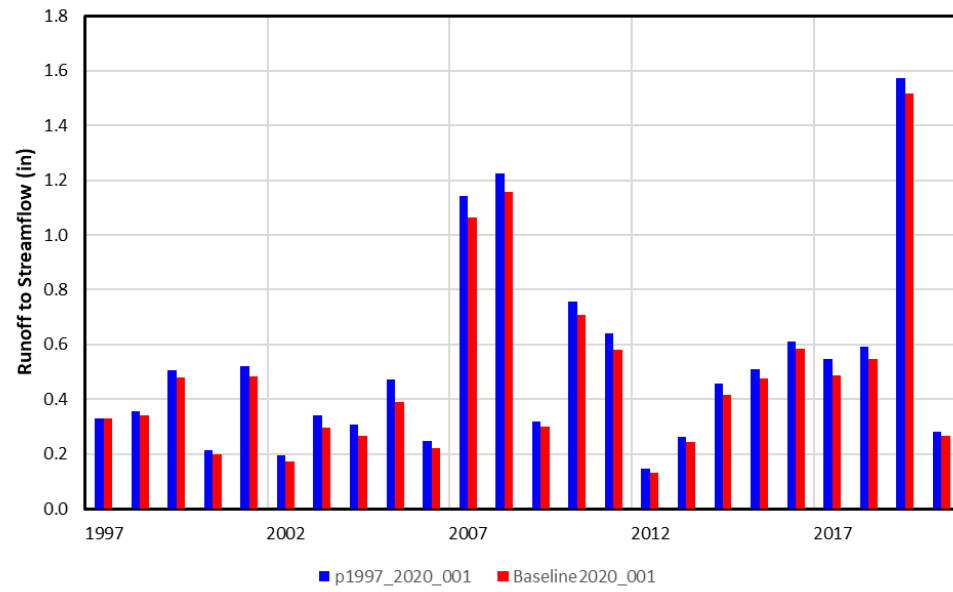
| Parameter                           | p1997_2020_001 |        |        | Baseline2020_001 |        |        |
|-------------------------------------|----------------|--------|--------|------------------|--------|--------|
|                                     | AF             | in     | %      | AF               | in     | %      |
| <b>Acres</b>                        | 9,050,428      |        |        | 8,572,150        |        |        |
| Precipitation                       | 17,927,506     | 23.77  | 100.0% | 16,875,997       | 23.62  | 100.0% |
| Groundwater Pumping                 | -              | -      | 0.0%   | -                | -      | 0.0%   |
| Surface Water Deliveries            | -              | -      | 0.0%   | -                | -      | 0.0%   |
| <b>Total Applied Water</b>          | 17,927,506     | 23.77  | 100.0% | 16,875,997       | 23.62  | 100.0% |
| Field Evapotranspiration            | 15,500,933     | 20.55  | 86.5%  | 14,657,169       | 20.52  | 86.9%  |
| Field Deep Percolation              | 1,817,530      | 2.41   | 10.1%  | 1,701,764        | 2.38   | 10.1%  |
| Field Runoff                        | 722,674        | 0.96   | 4.0%   | 626,706          | 0.88   | 3.7%   |
| Irrigation Surface Losses           | -              | -      | 0.0%   | -                | -      | 0.0%   |
| <b>Field Water Balance</b>          | (113,631)      | (0.15) | -0.6%  | (109,642)        | (0.15) | -0.6%  |
| Lateral Losses                      | -              | -      | 0.0%   | -                | -      | 0.0%   |
| <b>Field Runoff</b>                 | 722,674        | 0.96   | 4.0%   | 626,706          | 0.88   | 3.7%   |
| Runoff Contributions to Streamflow  | 394,401        | 0.52   | 2.2%   | 344,980          | 0.48   | 2.0%   |
| Runoff Losses to Recharge           | 164,137        | 0.22   | 0.9%   | 140,863          | 0.20   | 0.8%   |
| Runoff Losses to Evapotranspiration | 164,137        | 0.22   | 0.9%   | 140,863          | 0.20   | 0.8%   |
| <b>Net Recharge</b>                 | 1,981,667      | 2.63   |        | 1,842,627        | 2.58   |        |
| <b>Net Impact to Rivers</b>         | 2,376,067      | 3.15   |        | 2,187,608        | 3.06   |        |

### Dryland Acres

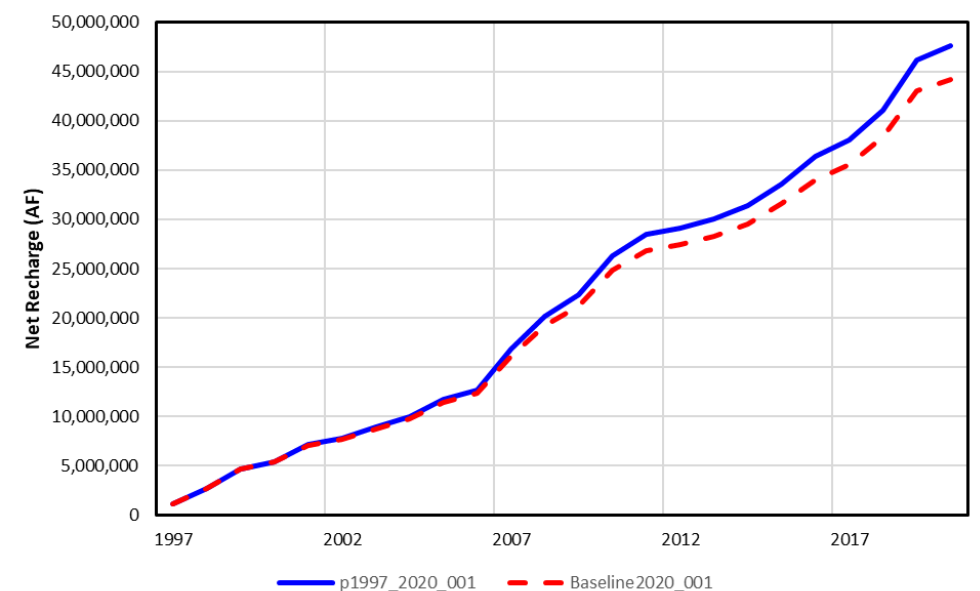
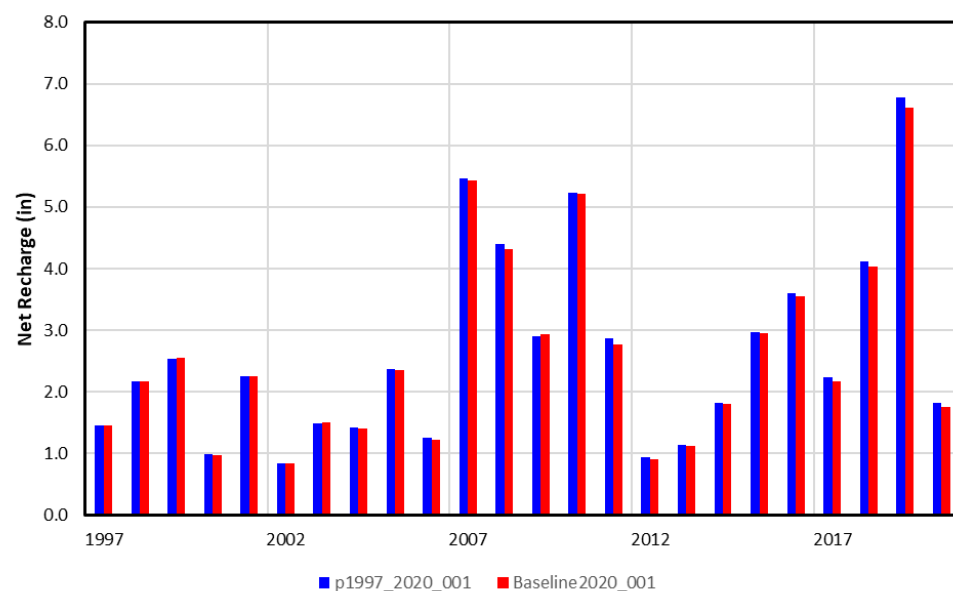


GW Only acreage in excess of 1997 levels re-classified as "dryland" equivalent of the previous irrigated crop mix for Task 200

## SF: Dryland Acres: Baseline (2020 SIM) [ $\alpha$ ] vs Dryland Acres: Post 1997 (2020 SIM) [ $\beta$ ]



## NR: Dryland Acres: Baseline (2020 SIM) [ $\alpha$ ] vs Dryland Acres: Post 1997 (2020 SIM) [ $\beta$ ]

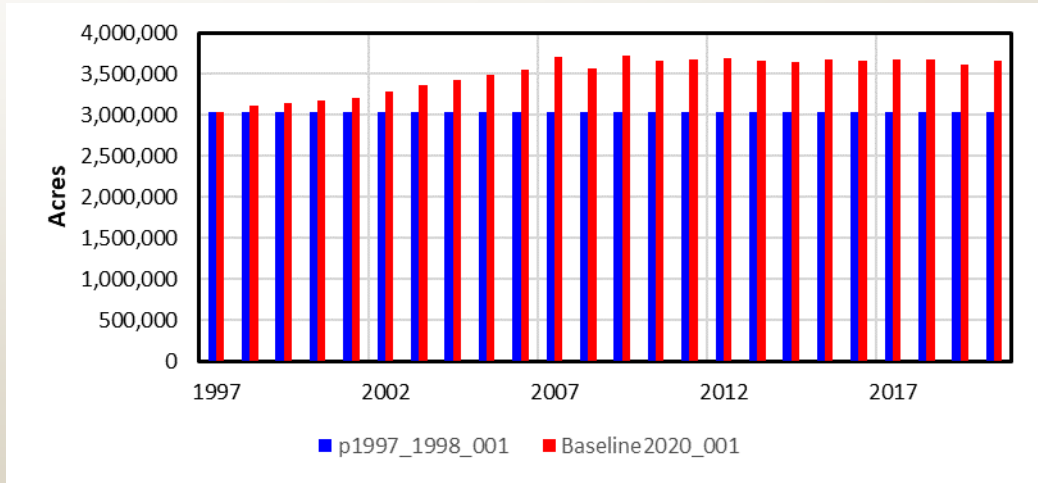


| Robust Review Model Runs  | TFG Support Task | Del Date | Ref Name         | Production Practices |                |                |
|---|------------------|----------|------------------|----------------------|----------------|----------------|
| Historical - Baseflow   | Task 100         | 29-Nov   | Baseline2020_001 | 2020 SIM Files       |                |                |
| Historical - Total Flow   |                  |          | Baseline1998_001 | 1998 SIM Files       |                |                |
| 1997 GWO Irrigation - Baseflow - TPNRD                              | Task 200         | 29-Nov   |                  |                      |                |                |
| 1997 GWO Irrigation - Total Flow - TPNRD                            |                  |          |                  |                      |                |                |
| 1997 GWO Irrigation - Baseflow - CPNRD                              |                  |          |                  |                      |                |                |
| 1997 GWO Irrigation - Total Flow - CPNRD                            |                  |          |                  | p1997_2020_001       | 2020 SIM Files |                |
| 1997 GWO Irrigation - Baseflow - TBNRD                              |                  |          |                  |                      |                |                |
| 1997 GWO Irrigation - Total Flow - TBNRD                            |                  |          |                  |                      |                |                |
| 1997 GWO Irrigation - Baseflow - Outside NRDs                       |                  |          |                  |                      |                |                |
| 1997 GWO Irrigation - Total Flow - Outside NRDs                     |                  |          |                  |                      |                |                |
| 1997 GWO Irrigation and M&I - Baseflow or Total Flow - TPNRD        |                  |          |                  |                      | p1997_1998_001 | 1998 SIM Files |
| 1997 GWO Irrigation and M&I - Baseflow or Total Flow - CPNRD        |                  |          |                  |                      |                |                |
| 1997 GWO Irrigation and M&I - Baseflow or Total Flow - TBNRD        |                  |          |                  |                      |                |                |
| 1997 GWO Irrigation and M&I - Baseflow or Total Flow - Outside NRDs |                  |          |                  |                      |                |                |

|                              |                            |
|------------------------------|----------------------------|
| Dry Historic LU, 2020 SIM    | Dry p1997 LU, 2020 SIM     |
| + CO Historic LU, 2020 SIM   | + CO Historic LU, 2020 SIM |
| + GW Historic LU, 2020 SIM   | + GW p1997 LU, 1998 SIM    |
| + SW Historic LU, 2020 SIM   | + SW Historic LU, 2020 SIM |
| =====                        | =====                      |
| $\alpha$ = Current Condition | $\beta$ = 1997 Condition   |

Impact =  $\alpha - \beta$

GW Only Irrigated Acres



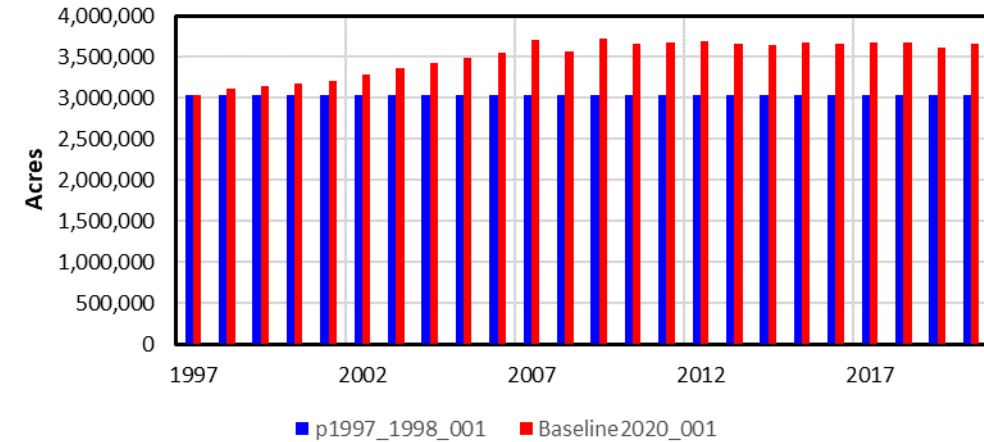
GW Only acreage in excess of 1997 levels re-classified as "dryland" equivalent of the previous irrigated crop mix for Task 200

| Robust Review Model Runs  | TFG Support Task | Del Date | Ref Name         | Production Practices |                |                |
|---|------------------|----------|------------------|----------------------|----------------|----------------|
| Historical - Baseflow   | Task 100         | 29-Nov   | Baseline2020_001 | 2020 SIM Files       |                |                |
| Historical - Total Flow   |                  |          | Baseline1998_001 | 1998 SIM Files       |                |                |
| 1997 GWO Irrigation - Baseflow - TPNRD                              | Task 200         | 29-Nov   |                  |                      |                |                |
| 1997 GWO Irrigation - Total Flow - TPNRD                            |                  |          |                  |                      |                |                |
| 1997 GWO Irrigation - Baseflow - CPNRD                              |                  |          |                  |                      |                |                |
| 1997 GWO Irrigation - Total Flow - CPNRD                            |                  |          |                  | p1997_2020_001       | 2020 SIM Files |                |
| 1997 GWO Irrigation - Baseflow - TBNRD                              |                  |          |                  |                      |                |                |
| 1997 GWO Irrigation - Total Flow - TBNRD                            |                  |          |                  |                      |                |                |
| 1997 GWO Irrigation - Baseflow - Outside NRDs                       |                  |          |                  |                      |                |                |
| 1997 GWO Irrigation - Total Flow - Outside NRDs                     |                  |          |                  |                      |                |                |
| 1997 GWO Irrigation and M&I - Baseflow or Total Flow - TPNRD        |                  |          |                  |                      | p1997_1998_001 | 1998 SIM Files |
| 1997 GWO Irrigation and M&I - Baseflow or Total Flow - CPNRD        |                  |          |                  |                      |                |                |
| 1997 GWO Irrigation and M&I - Baseflow or Total Flow - TBNRD        |                  |          |                  |                      |                |                |
| 1997 GWO Irrigation and M&I - Baseflow or Total Flow - Outside NRDs |                  |          |                  |                      |                |                |

### GW Only Irrigated Acres: 1997-2020 Average

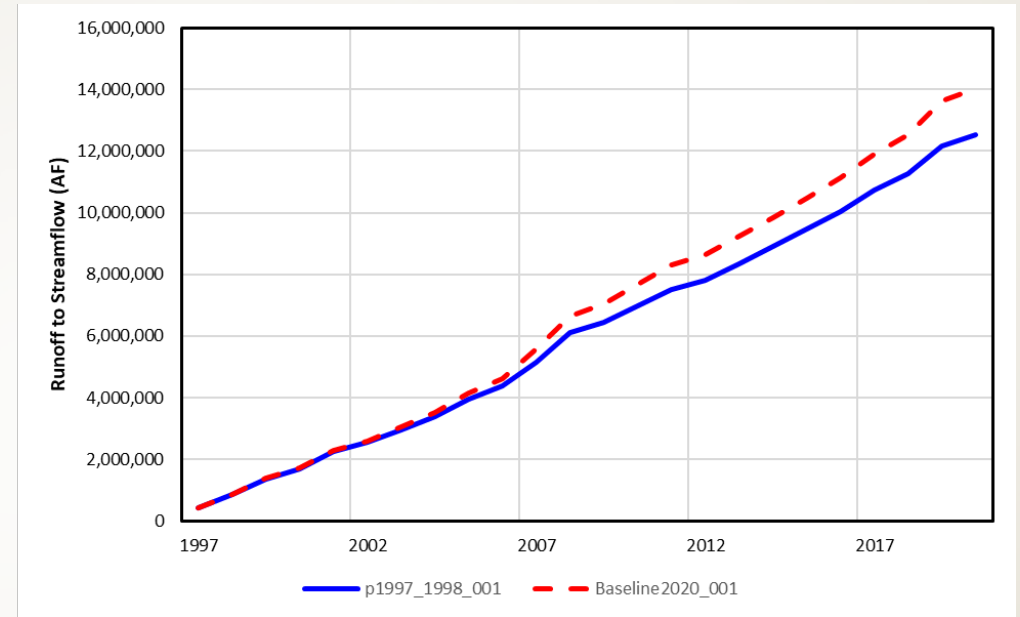
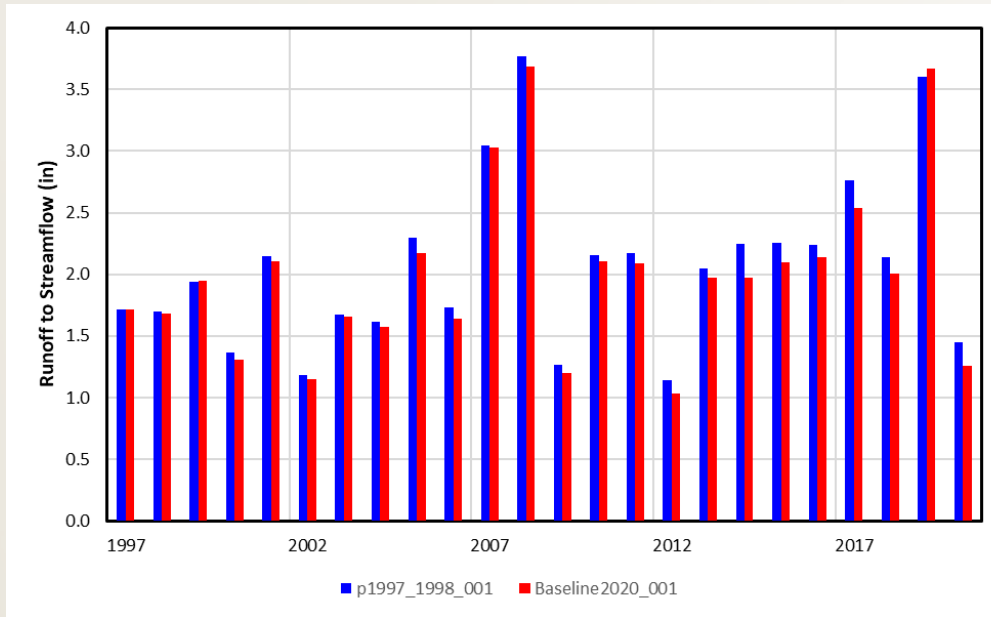
| Parameter                           | p1997_1998_001 |        |        | Baseline2020_001 |        |        |
|-------------------------------------|----------------|--------|--------|------------------|--------|--------|
|                                     | AF             | in     | %      | AF               | in     | %      |
| <b>Acres</b>                        | 3,030,435      |        |        | 3,500,915        |        |        |
| Precipitation                       | 6,559,743      | 25.98  | 74.7%  | 7,593,238        | 26.03  | 75.9%  |
| Groundwater Pumping                 | 2,223,510      | 8.80   | 25.3%  | 2,415,095        | 8.28   | 24.1%  |
| Surface Water Deliveries            | -              | -      | 0.0%   | -                | -      | 0.0%   |
| <b>Total Applied Water</b>          | 8,783,253      | 34.78  | 100.0% | 10,008,334       | 34.31  | 100.0% |
| Field Evapotranspiration            | 7,065,076      | 27.98  | 80.4%  | 7,866,776        | 26.96  | 78.6%  |
| Field Deep Percolation              | 719,077        | 2.85   | 8.2%   | 1,026,688        | 3.52   | 10.3%  |
| Field Runoff                        | 925,936        | 3.67   | 10.5%  | 1,038,831        | 3.56   | 10.4%  |
| Irrigation Surface Losses           | 111,176        | 0.44   | 1.3%   | 120,755          | 0.41   | 1.2%   |
| <b>Field Water Balance</b>          | (38,012)       | (0.15) | -0.4%  | (44,716)         | (0.15) | -0.4%  |
| Lateral Losses                      | -              | -      | 0.0%   | -                | -      | 0.0%   |
| <b>Field Runoff</b>                 | 925,936        | 3.67   | 10.5%  | 1,038,831        | 3.56   | 10.4%  |
| Runoff Contributions to Streamflow  | 522,654        | 2.07   | 6.0%   | 583,785          | 2.00   | 5.8%   |
| Runoff Losses to Recharge           | 201,641        | 0.80   | 2.3%   | 227,523          | 0.78   | 2.3%   |
| Runoff Losses to Evapotranspiration | 201,641        | 0.80   | 2.3%   | 227,523          | 0.78   | 2.3%   |
| <b>Net Recharge</b>                 | (1,302,792)    | (5.16) |        | (1,160,885)      | (3.98) |        |
| <b>Net Impact to Rivers</b>         | (780,138)      | (3.09) |        | (577,100)        | (1.98) |        |

### GW Only Irrigated Acres

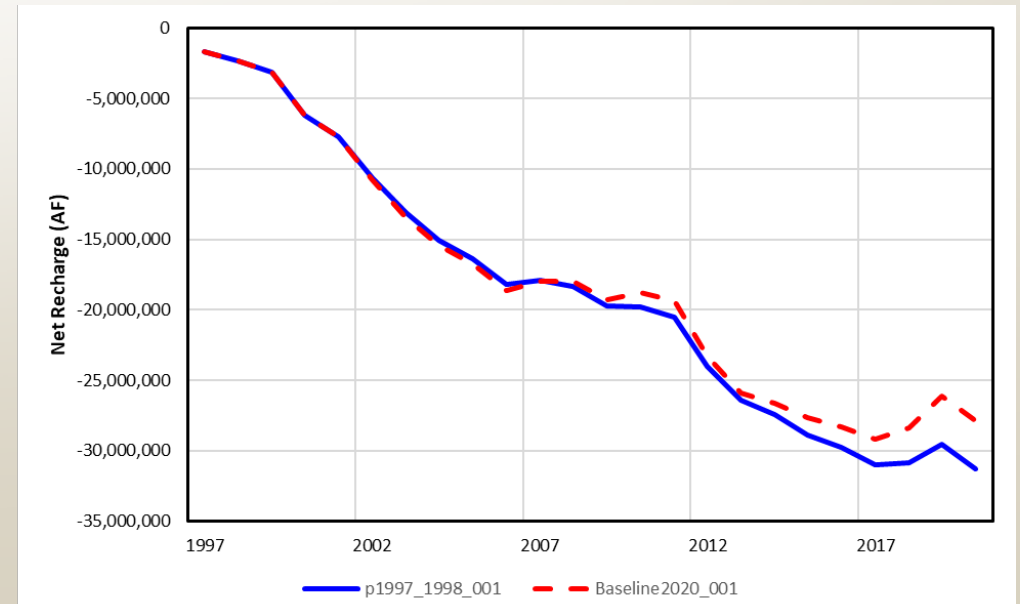
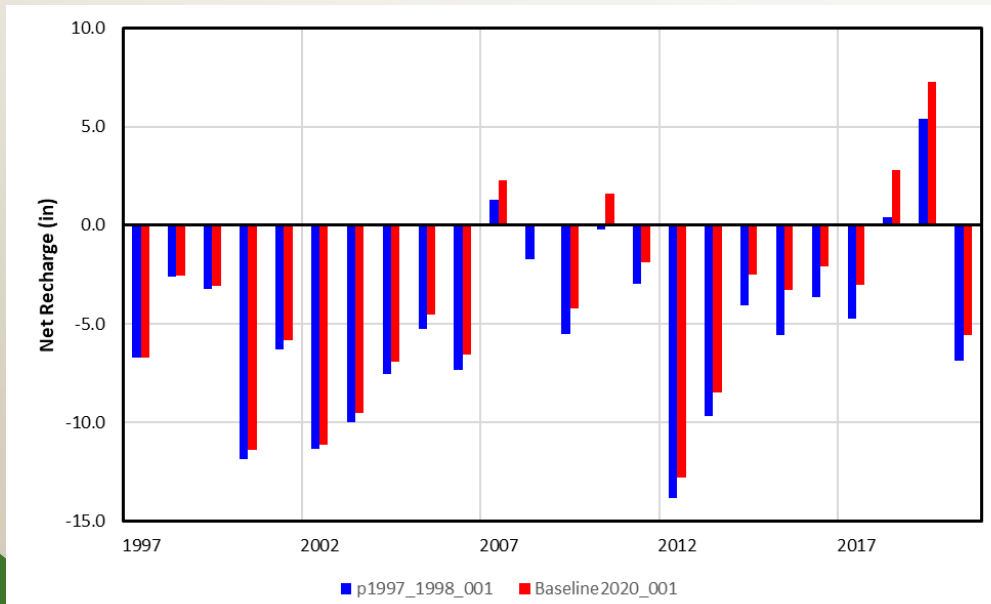


GW Only acreage in excess of 1997 levels re-classified as "dryland" equivalent of the previous irrigated crop mix for Task 200

SF: GW Only Irrigated Acres: Baseline (2020 SIM) [ $\alpha$ ] vs GW Only Irrigated Acres: Post 1997 (1998 SIM) [ $\beta$ ]



NR: GW Only Irrigated Acres: Baseline (2020 SIM) [ $\alpha$ ] vs GW Only Irrigated Acres: Post 1997 (1998 SIM) [ $\beta$ ]

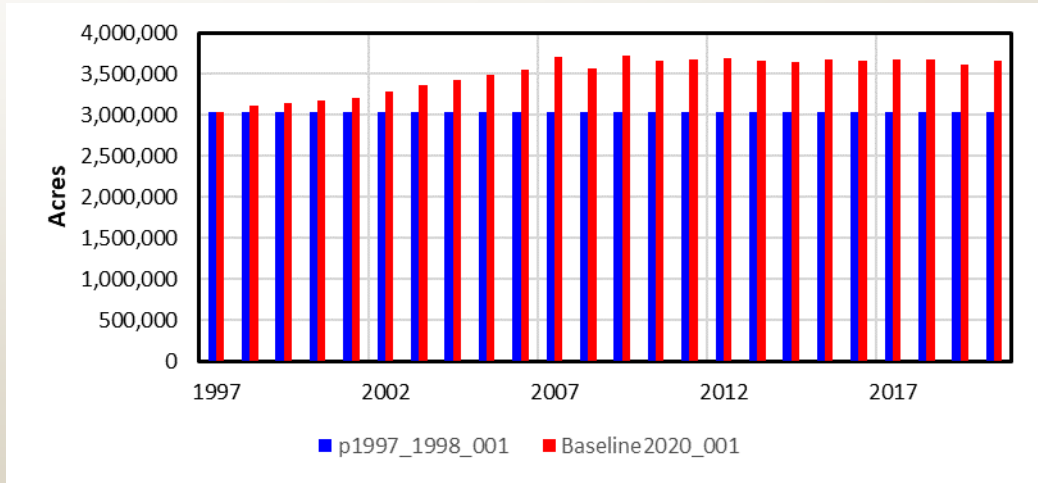


| Robust Review Model Runs  | TFG Support Task | Del Date | Ref Name         | Production Practices |                |                |
|---|------------------|----------|------------------|----------------------|----------------|----------------|
| Historical - Baseflow   | Task 100         | 29-Nov   | Baseline2020_001 | 2020 SIM Files       |                |                |
| Historical - Total Flow   |                  |          | Baseline1998_001 | 1998 SIM Files       |                |                |
| 1997 GWO Irrigation - Baseflow - TPNRD                              | Task 200         | 29-Nov   |                  |                      |                |                |
| 1997 GWO Irrigation - Total Flow - TPNRD                            |                  |          |                  |                      |                |                |
| 1997 GWO Irrigation - Baseflow - CPNRD                              |                  |          |                  |                      |                |                |
| 1997 GWO Irrigation - Total Flow - CPNRD                            |                  |          |                  | p1997_2020_001       | 2020 SIM Files |                |
| 1997 GWO Irrigation - Baseflow - TBNRD                              |                  |          |                  |                      |                |                |
| 1997 GWO Irrigation - Total Flow - TBNRD                            |                  |          |                  |                      |                |                |
| 1997 GWO Irrigation - Baseflow - Outside NRDs                       |                  |          |                  |                      |                |                |
| 1997 GWO Irrigation - Total Flow - Outside NRDs                     |                  |          |                  |                      |                |                |
| 1997 GWO Irrigation and M&I - Baseflow or Total Flow - TPNRD        |                  |          |                  |                      | p1997_1998_001 | 1998 SIM Files |
| 1997 GWO Irrigation and M&I - Baseflow or Total Flow - CPNRD        |                  |          |                  |                      |                |                |
| 1997 GWO Irrigation and M&I - Baseflow or Total Flow - TBNRD        |                  |          |                  |                      |                |                |
| 1997 GWO Irrigation and M&I - Baseflow or Total Flow - Outside NRDs |                  |          |                  |                      |                |                |

|          |                       |         |                       |
|----------|-----------------------|---------|-----------------------|
| Dry      | Historic LU, 2020 SIM | Dry     | p1997 LU, 2020 SIM    |
| + CO     | Historic LU, 2020 SIM | + CO    | Historic LU, 2020 SIM |
| + GW     | Historic LU, 2020 SIM | + GW    | p1997 LU, 1998 SIM    |
| + SW     | Historic LU, 2020 SIM | + SW    | Historic LU, 2020 SIM |
| =====    |                       | =====   |                       |
| $\alpha$ | Current Condition     | $\beta$ | 1997 Condition        |

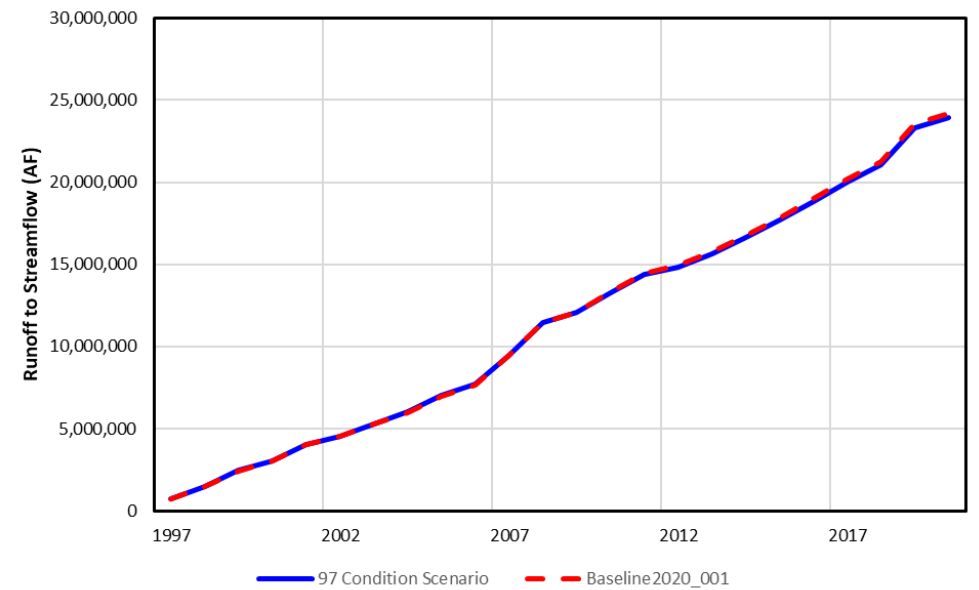
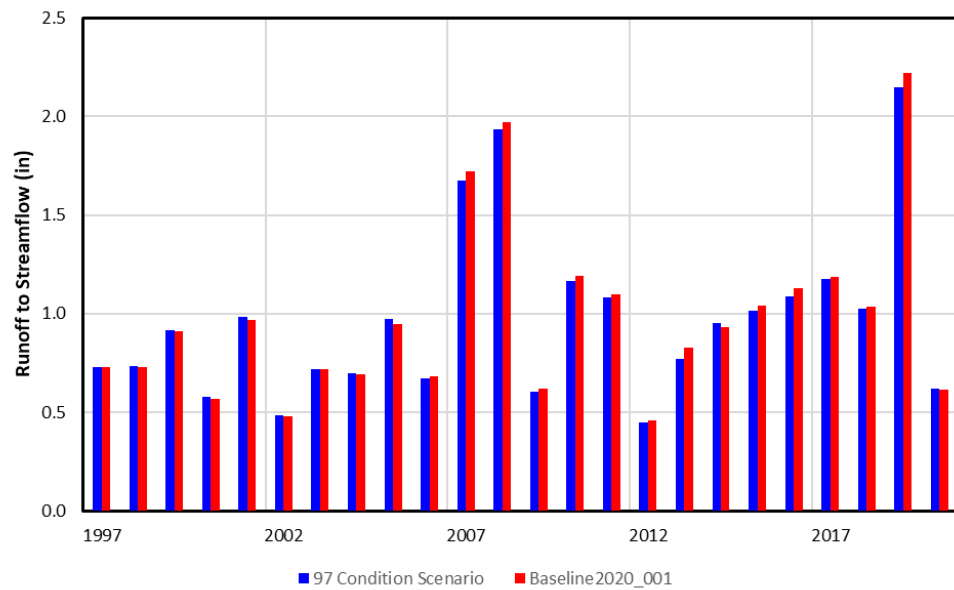
**Impact =  $\alpha - \beta$**

GW Only Irrigated Acres

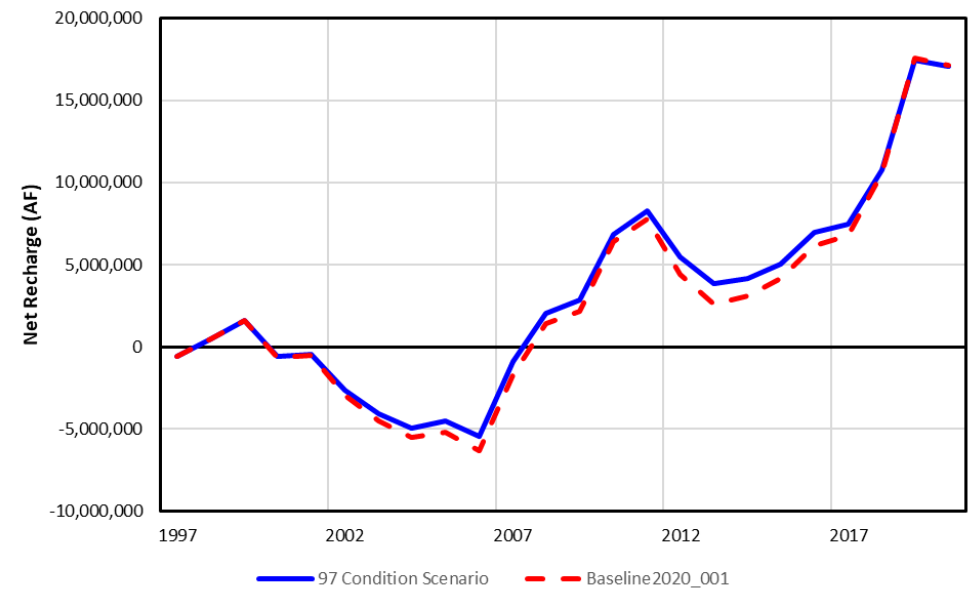
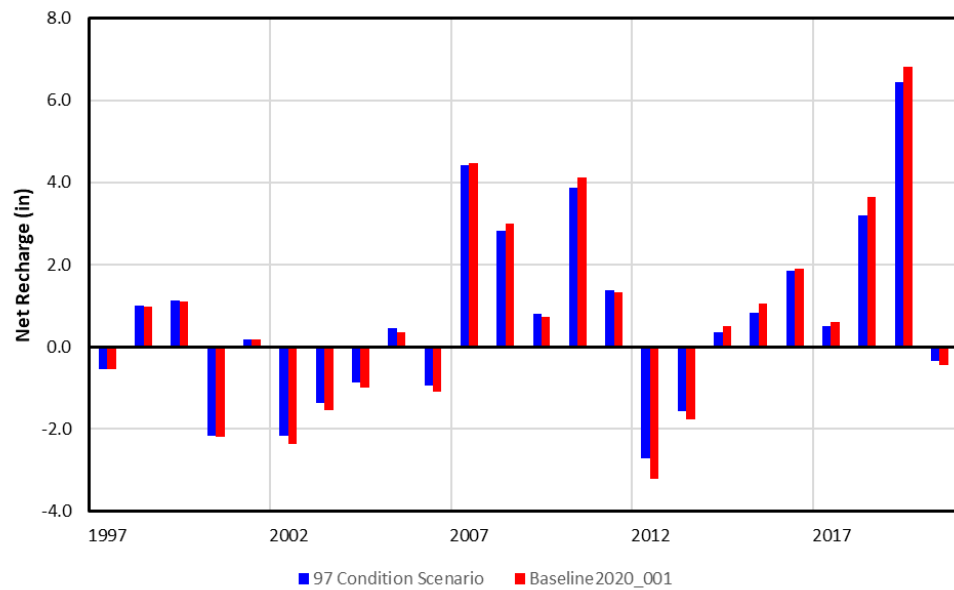


GW Only acreage in excess of 1997 levels re-classified as "dryland" equivalent of the previous irrigated crop mix for Task 200

## Impact $\alpha - \beta$ : Runoff To Streamflow



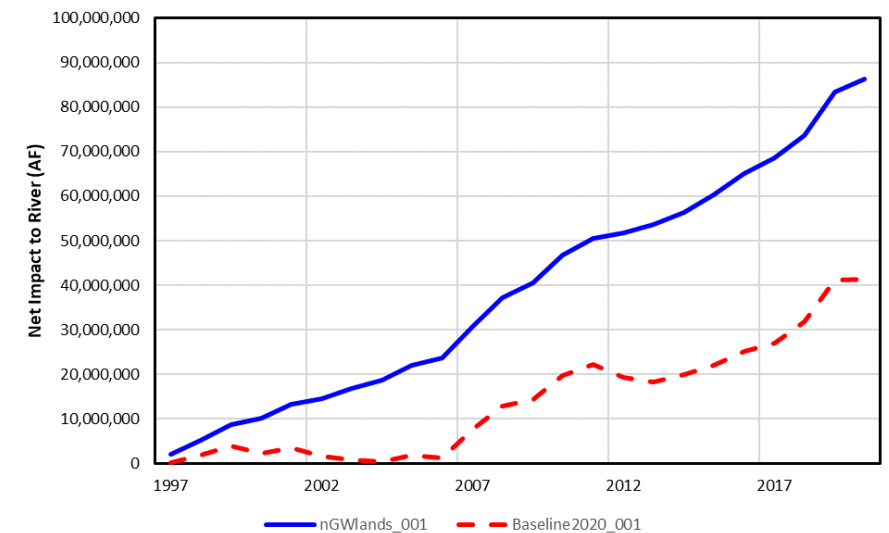
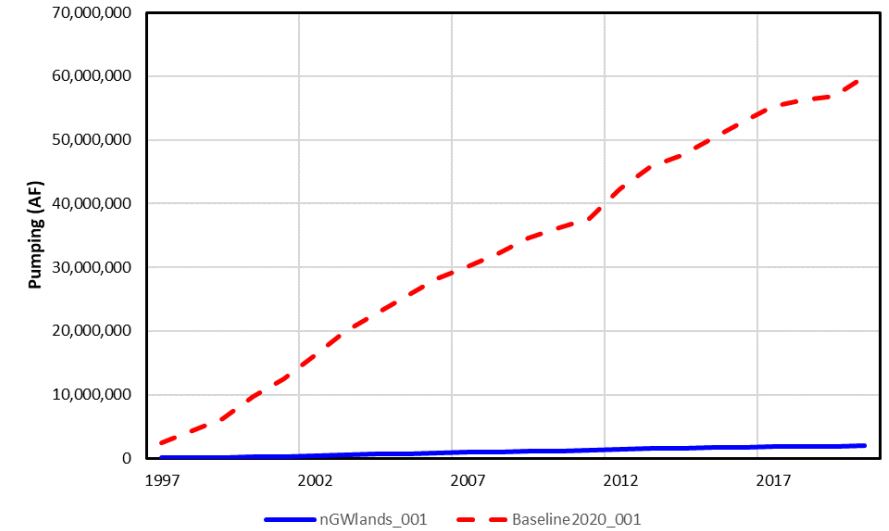
## Impact $\alpha - \beta$ : Net Recharge



| Robust Review Model Runs                               | TFG Support Task | Del Date | Ref Name         | Tillage        |
|--|------------------|----------|------------------|----------------|
| Historical - Baseflow                                  | Task 100         | 27-Nov   | Baseline2020_001 | 2020 SIM Files |
| Historical - Total Flow                                |                  |          | Baseline1998_001 | 1998 SIM Files |
| No GWO Pumping - Baseflow or Total Flow - TPNRD        | Task 300         | 27-Nov   | nGWLands_001     | 2020 SIM Files |
| No GWO Pumping - Baseflow or Total Flow - CPNRD        |                  |          |                  |                |
| No GWO Pumping - Baseflow or Total Flow - TBNRD        |                  |          |                  |                |
| No GWO Pumping - Baseflow or Total Flow - Outside NRDs |                  |          |                  |                |

### Average 1997 – 2020: All Acres

| Parameter                           | nGWLands_001 |        |        | Baseline2020_001 |        |        |
|-------------------------------------|--------------|--------|--------|------------------|--------|--------|
|                                     | AF           | in     | %      | AF               | in     | %      |
| Acres                               | 12,374,240   |        |        | 12,374,240       |        |        |
| Precipitation                       | 25,086,584   | 24.33  | 98.9%  | 25,086,584       | 24.33  | 90.3%  |
| Groundwater Pumping                 | 81,713       | 0.08   | 0.3%   | 2,496,808        | 2.42   | 9.0%   |
| Surface Water Deliveries            | 201,962      | 0.20   | 0.8%   | 201,962          | 0.20   | 0.7%   |
| Total Applied Water                 | 25,370,259   | 24.60  | 100.0% | 27,785,355       | 26.95  | 100.0% |
| Field Evapotranspiration            | 21,514,691   | 20.86  | 84.8%  | 23,219,801       | 22.52  | 83.6%  |
| Field Deep Percolation              | 2,497,401    | 2.42   | 9.8%   | 2,808,965        | 2.72   | 10.1%  |
| Field Runoff                        | 1,493,011    | 1.45   | 5.9%   | 1,786,785        | 1.73   | 6.4%   |
| Irrigation Surface Losses           | 10,145       | 0.01   | 0.0%   | 130,899          | 0.13   | 0.5%   |
| Field Water Balance                 | (144,988)    | (0.14) | -0.6%  | (161,096)        | (0.16) | -0.6%  |
| Lateral Losses                      | 12,317       | 0.01   | 0.0%   | 12,317           | 0.01   | 0.0%   |
| Field Runoff                        | 1,493,011    | 1.45   | 5.9%   | 1,786,785        | 1.73   | 6.4%   |
| Runoff Contributions to Streamflow  | 837,140      | 0.81   | 3.3%   | 1,008,361        | 0.98   | 3.6%   |
| Runoff Losses to Recharge           | 327,935      | 0.32   | 1.3%   | 389,212          | 0.38   | 1.4%   |
| Runoff Losses to Evapotranspiration | 327,935      | 0.32   | 1.3%   | 389,212          | 0.38   | 1.4%   |
| Net Recharge                        | 2,755,940    | 2.67   |        | 713,686          | 0.69   |        |
| Net Impact to Rivers                | 3,593,081    | 3.48   |        | 1,722,047        | 1.67   |        |



| Robust Review Model Runs  |   | TFG Support Task   | Del Date | Ref Name         | Production Practices |     |  |  |
|---|---|--------------------|----------|------------------|----------------------|-----|--|--|
| Historical - Baseflow   | ➤ | Task 100           | 29-Nov   | Baseline2020_001 | 2020 SIM Files       |     |  |  |
| Historical - Total Flow   |   |                    |          | Baseline1998_001 | 1998 SIM Files       |     |  |  |
|   |   |                    |          |                  |                      |     |  |  |
| 1997 GWO Irrigation - Baseflow - TPNRD                              | ➤ | Task 200           | 29-Nov   | p1997_2020_001   | 2020 SIM Files       |     |  |  |
| 1997 GWO Irrigation - Total Flow - TPNRD                            |   |                    |          |                  |                      |     |  |  |
| 1997 GWO Irrigation - Baseflow - CPNRD                              |   |                    |          |                  |                      |     |  |  |
| 1997 GWO Irrigation - Total Flow - CPNRD                            |   |                    |          |                  |                      |     |  |  |
| 1997 GWO Irrigation - Baseflow - TBNRD                              |   |                    |          |                  |                      |     |  |  |
| 1997 GWO Irrigation - Total Flow - TBNRD                            |   |                    |          |                  |                      |     |  |  |
| 1997 GWO Irrigation - Baseflow - Outside NRDs                       |   |                    |          |                  |                      |     |  |  |
| 1997 GWO Irrigation - Total Flow - Outside NRDs                     |   |                    |          |                  |                      |     |  |  |
| 1997 GWO Irrigation and M&I - Baseflow or Total Flow - TPNRD        |   |                    |          | p1997_1998_001   | 1998 SIM Files       |     |  |  |
| 1997 GWO Irrigation and M&I - Baseflow or Total Flow - CPNRD        |   |                    |          |                  |                      |     |  |  |
| 1997 GWO Irrigation and M&I - Baseflow or Total Flow - TBNRD        |   |                    |          |                  |                      |     |  |  |
| 1997 GWO Irrigation and M&I - Baseflow or Total Flow - Outside NRDs |   |                    |          |                  |                      |     |  |  |
|   |   |                    |          |                  |                      |     |  |  |
| No Retirements - Baseflow or Total Flow - CPNRD                     |   |                    |          | ➤                | Task 400             | TBD |  |  |
| No Retirements - Baseflow or Total Flow - TBNRD                     |   |                    |          |                  |                      |     |  |  |
|   |   |                    |          |                  |                      |     |  |  |
| No North Dry Creek Augmentation                                     | ➤ | No TFG Involvement |          |                  |                      |     |  |  |
| No NCORPE Augmentation - TPNRD or North Pipeline                    |   |                    |          |                  |                      |     |  |  |
| No NCORPE Augmentation - MRNRD or South Pipeline                    |   |                    |          |                  |                      |     |  |  |
| 1997 Combined - Baseflow or Total Flow - TPNRD                      |   |                    |          |                  |                      |     |  |  |
| 1997 Combined - Baseflow or Total Flow - CPNRD                      |   |                    |          |                  |                      |     |  |  |
| 1997 Combined - Baseflow or Total Flow - TBNRD                      |   |                    |          |                  |                      |     |  |  |
|   |   |                    |          |                  |                      |     |  |  |
| No GWO Pumping - Baseflow or Total Flow - TPNRD                     | ➤ | Task 300           | 27-Nov   | nGWLands_001     | 2020 SIM Files       |     |  |  |
| No GWO Pumping - Baseflow or Total Flow - CPNRD                     |   |                    |          |                  |                      |     |  |  |
| No GWO Pumping - Baseflow or Total Flow - TBNRD                     |   |                    |          |                  |                      |     |  |  |
| No GWO Pumping - Baseflow or Total Flow - Outside NRDs              |   |                    |          |                  |                      |     |  |  |