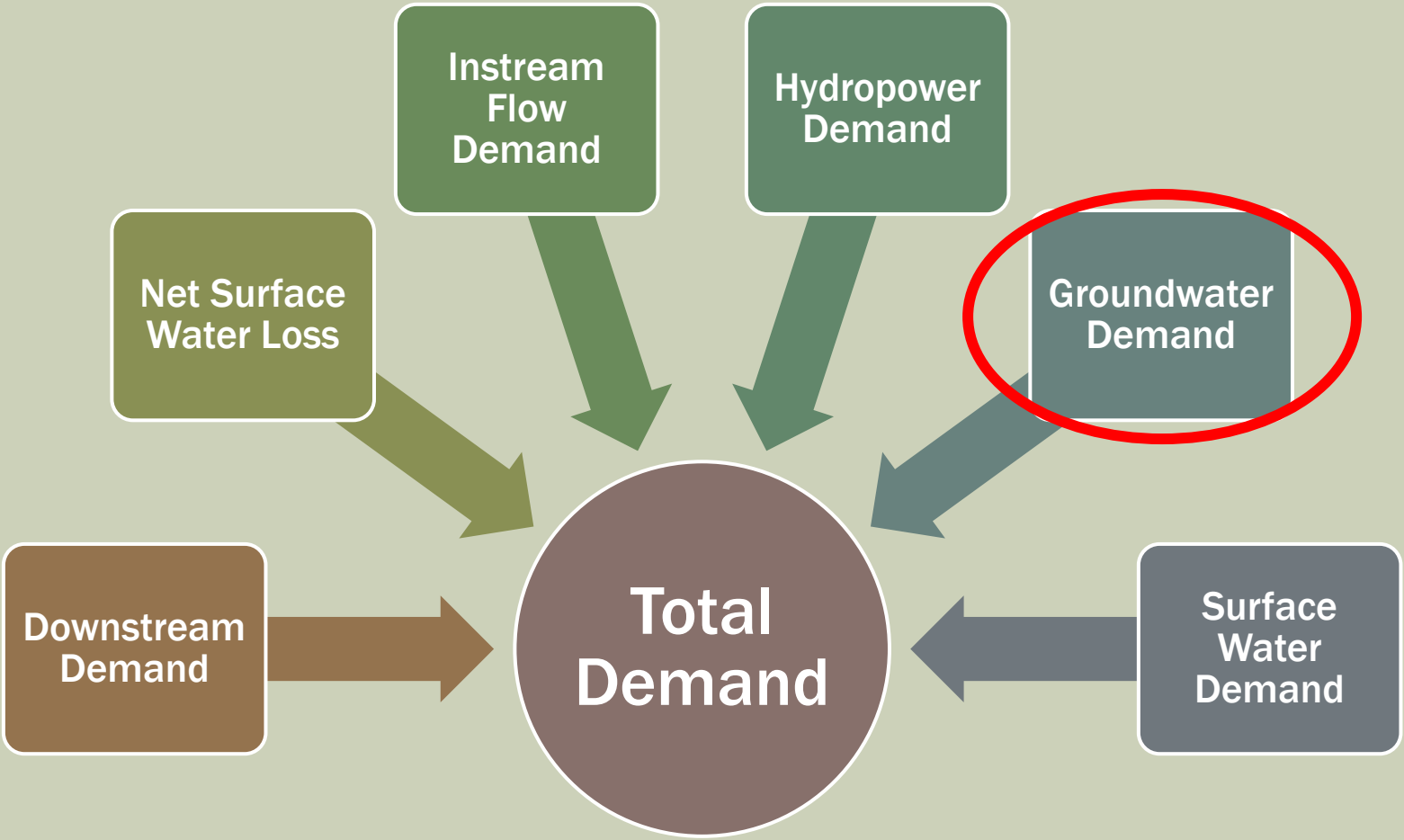
GROUNDWATER DEMAND

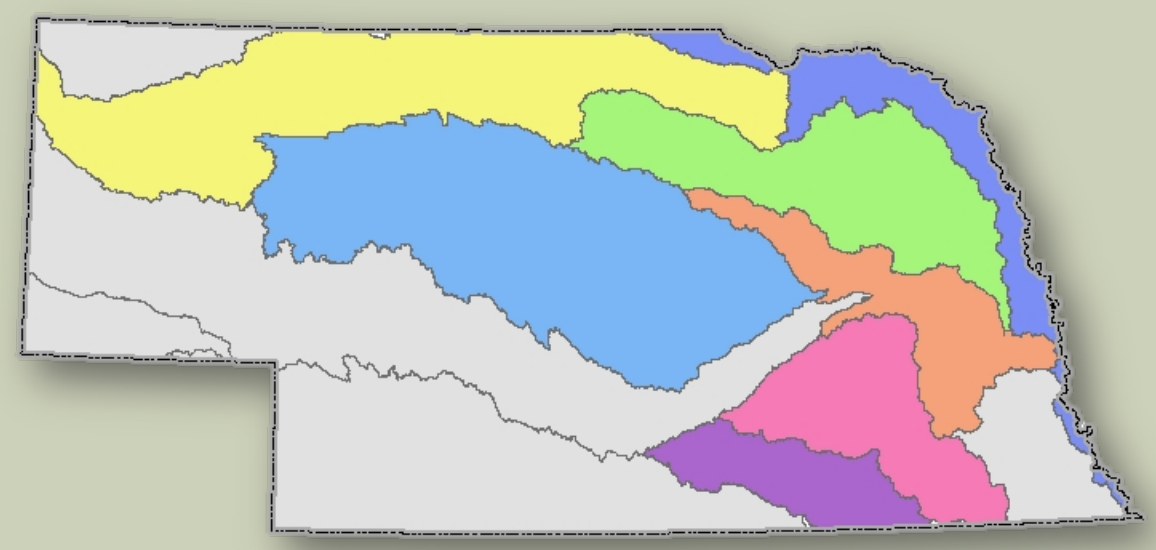
A Component of Total Demand as Calculated for INSIGHT

TOTAL DEMAND



GROUNDWATER DEMAND COMPONENTS

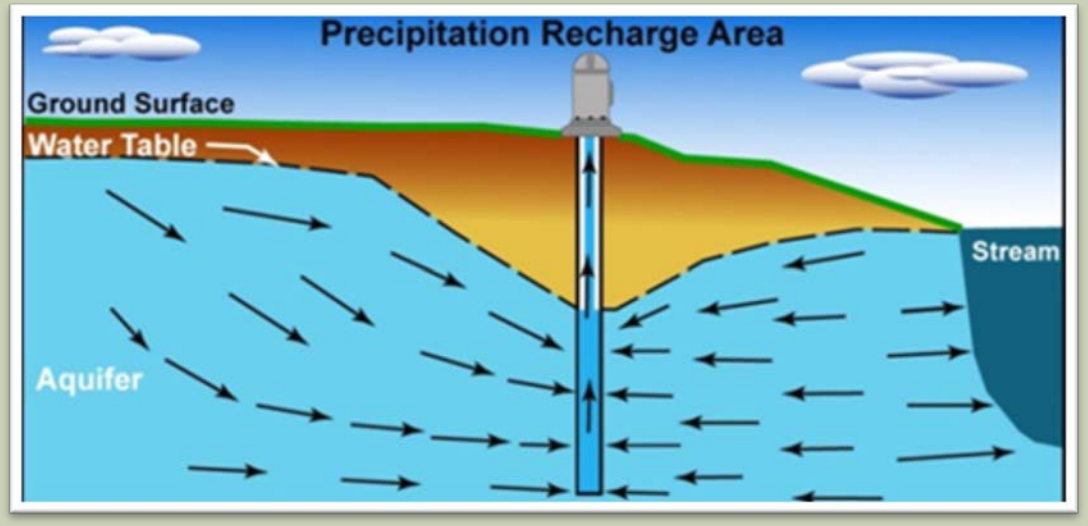
- Near-term Demand: GW Depletions used in calculation
- Long-term Demand: GW Consumptive Use used in calculation
- Projected Long-term Demand: Long-term demand times 1.05, assumes 5% increase in use
- Three components of groundwater demand:
  - Irrigation
  - Municipal
  - Industrial



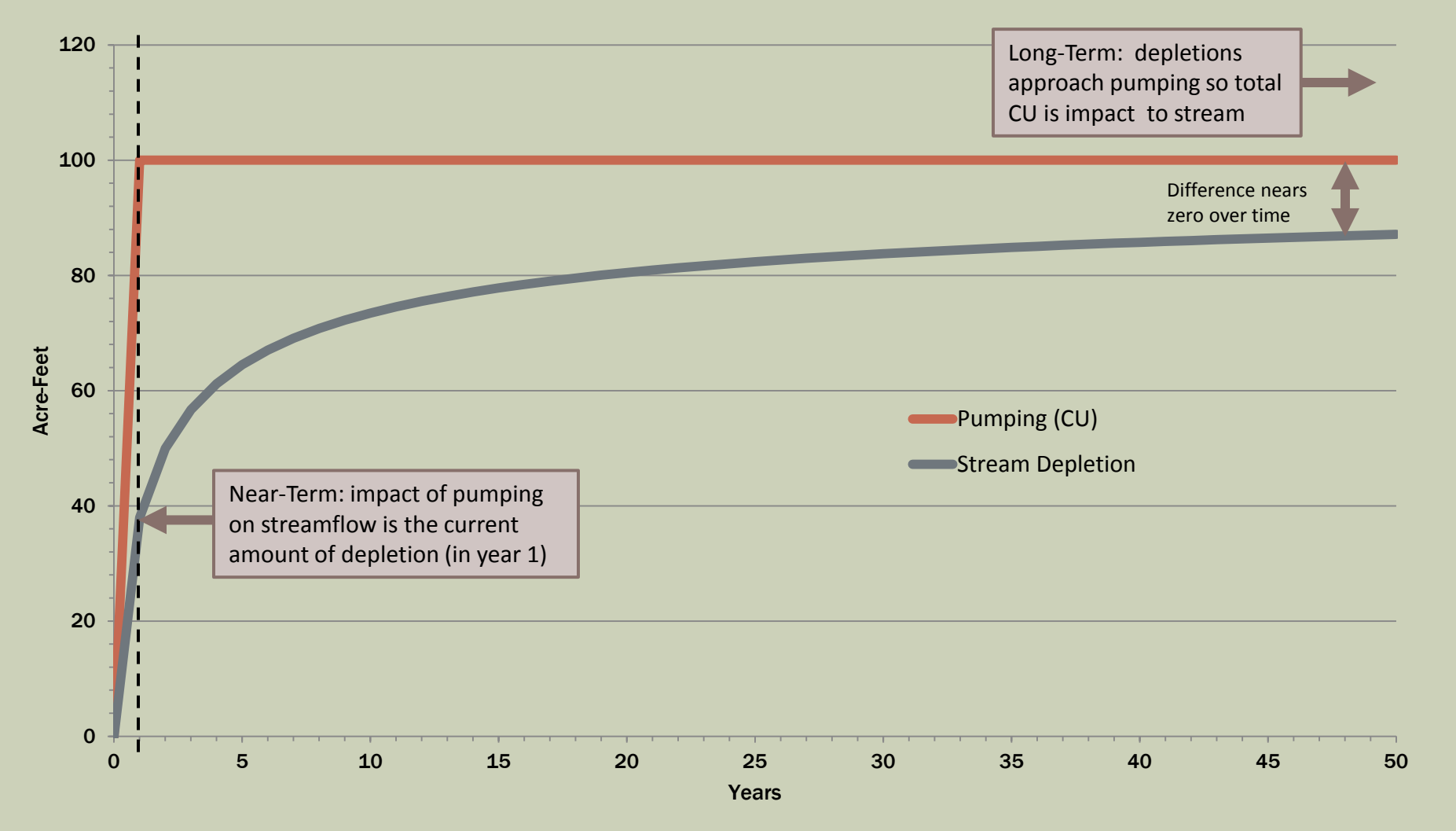
NEAR-TERM VERSUS LONG-TERM

- Near-term: GW Depletions. Current amount of impact to stream.
- Long-term: GW Consumptive Use. Full impact of well on stream

As time goes on (and we look to the "long term"), the impact to stream (or depletions) from pumping in a given year approach the total volume pumped during that year. In the near term, the impacts to the stream will only be the depletions occurring in that given year. This is depicted in the graph on the next slide.



NEAR-TERM VERSUS LONG-TERM



LONG-TERM GW IRRIGATION DEMAND

- Groundwater irrigated acres
  - Obtained from land use dataset
  - Alfalfa, corn, edible beans, small grains, soybeans, sugar beets
  - Number of acres per NE grid cell (1 mile by 1 mile)
  - Transient dataset, yearly for 1950 to 2012

LONG-TERM GW IRRIGATION DEMAND

- Net Irrigation Requirement (NIR) data
  - From The Flatwater Group
    - CROPSIM
  - NIR in inches by TFG grid cell
  - Alfalfa, corn, small grains, soybeans
  - Monthly for 1985 to 2012
  - Adjust for FAB year
    - Advance Sep, Oct, Nov, and Dec to next year
  - Sum for peak and non-peak season
  - Combine into one dataset with the four crop types
  - Join with NE grid dataset to get NE grid cell ID

- Join NIR with Irrigated acres using NE grid cell ID as key
  - “Merge1”

LONG-TERM GW IRRIGATION DEMAND

- Join Merge1 with the 10/50 area dataset
  - Indicates if cell is in the 10/50 area with yes or no
  - Joined dataset is called “Merge2”

- So now we have one dataset with the number of acres of each crop, NIR data for each crop by season, 10/50 area info, and INSIGHT info for each cell

LONG-TERM GW IRRIGATION DEMAND

- Calculate volume of consumptive use (CU) by cell
  - Acres of crop times NIR for that crop

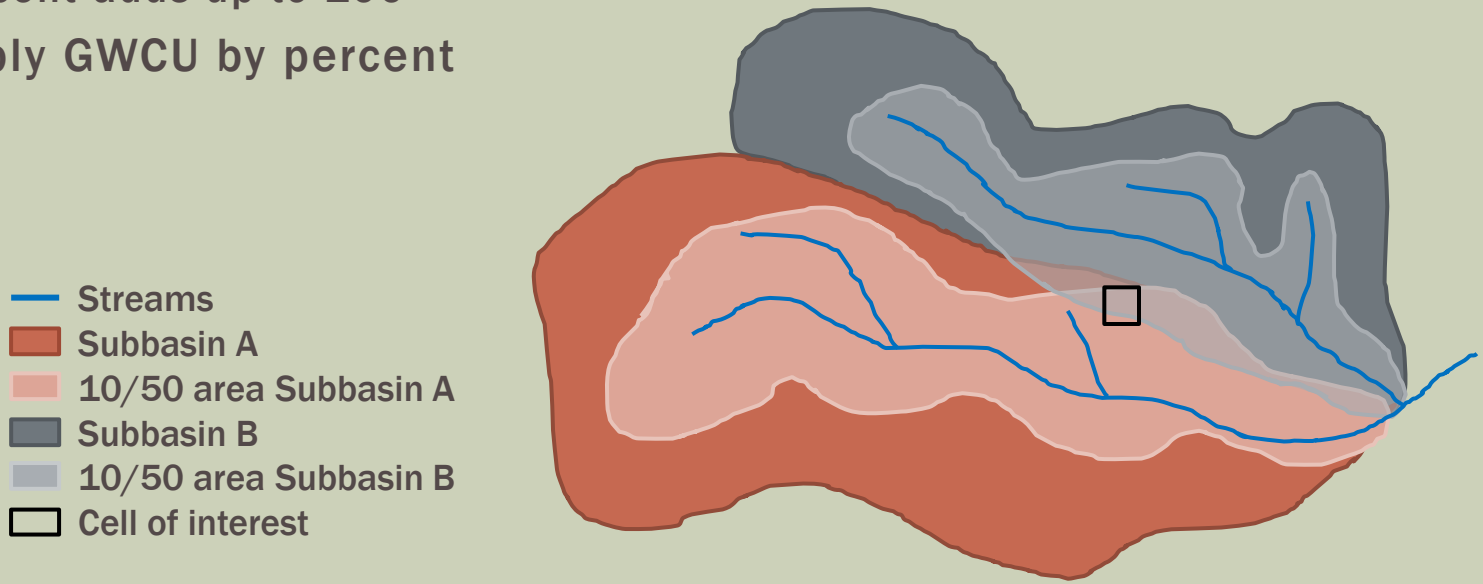
$$\mathrm{GWCU}_{Peak}=(\mathrm{GWacres}_{corn}\times\mathrm{NIR}_{CornPeak})+(\mathrm{GWacres}_{alf}\times\mathrm{NIR}_{AlfalfaPeak})+(\mathrm{GWacres}_{soy}\times\mathrm{NIR}_{SoybeansPeak})+(\mathrm{GWacres}_{smGrn}\times\mathrm{NIR}_{SmGrPeak})+((\mathrm{GWacres}_{sugBeets}+\mathrm{GWacres}_{edBeans})\times\mathrm{NIR}_{CornPeak})$$

$$\mathrm{GWCU}_{Nonpeak}=(\mathrm{GWacres}_{corn}\times\mathrm{NIR}_{CornNonpeak})+(\mathrm{GWacres}_{alf}\times\mathrm{NIR}_{AlfalfaNonpeak})+(\mathrm{GWacres}_{soy}\times\mathrm{NIR}_{SoybeansNonpeak})+(\mathrm{GWacres}_{smGrn}\times\mathrm{NIR}_{SmGrNonpeak})+((\mathrm{GWacres}_{sugBeets}+\mathrm{GWacres}_{edBeans})\times\mathrm{NIR}_{CornNonpeak})$$

- Divide 12 inches/foot to convert to acre-feet

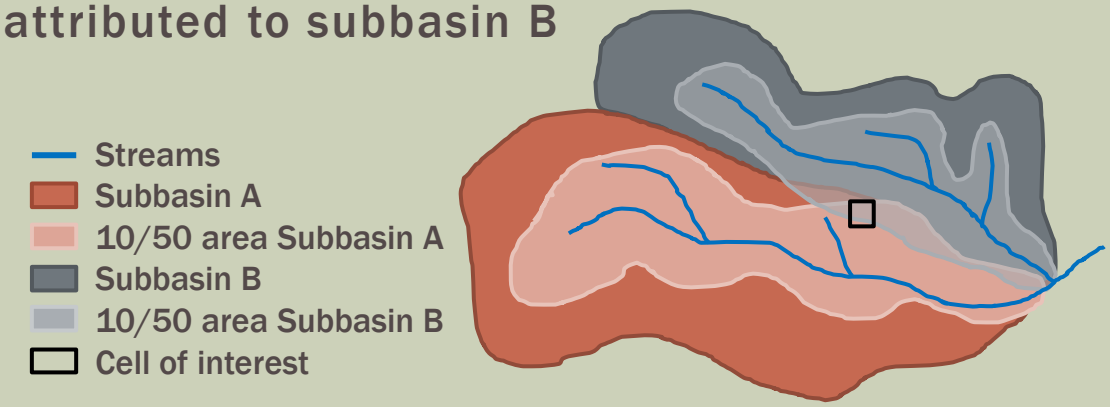
LONG-TERM GW IRRIGATION DEMAND

- Proportion to appropriate subbasin
  - Wherever overlap occurs between 10/50 areas
    - i.e., pumping in one cell will deplete more than one stream
  - Dataset of all cells in 10/50 area with percent to assign to subbasin
    - Percent based on amount of depletion to stream (stream depletion factor)
    - Cells in overlap areas occur more than once in the dataset, but total percent adds up to 100
  - Multiply GWCU by percent



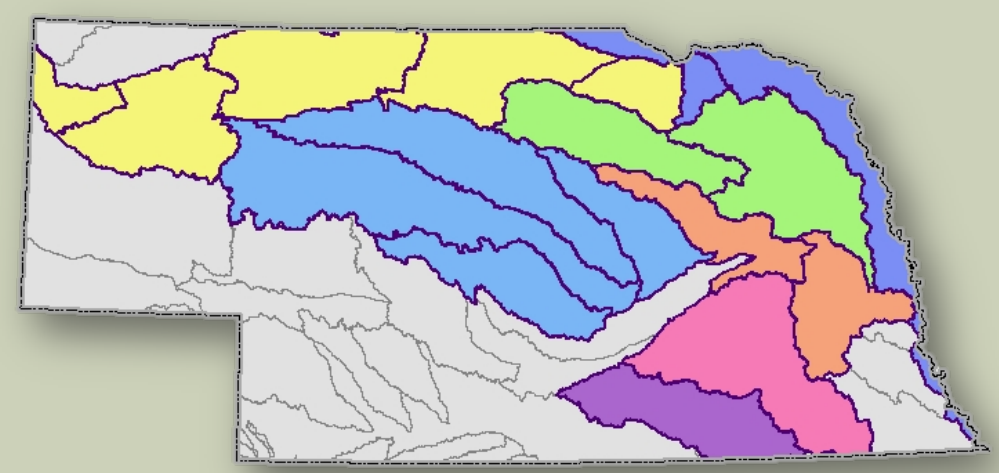
EXAMPLE OF PROPORTIONING

- A cell causes stream depletion to subbasin A of 20% and stream depletion to subbasin B of 30%, the total amount of stream depletion is 50%
  - The percent of consumptive use occurring in the cell to attribute to subbasin A would be 20% ÷ 50% = **40%**
  - The percent of consumptive use occurring in the cell to attribute to subbasin B would be 30% ÷ 50% = **60%**
- If GWCU in the cell was 80 acre-feet,
  - 80 x 0.4 = **32** acre-feet attributed to subbasin A
  - 80 x 0.6 = **64** acre-feet attributed to subbasin B



LONG-TERM GW IRRIGATION DEMAND

- Sum GWCU cell data by INSIGHT subbasin
  - Add up subbasins to get basin total
- Add up peak and non-peak irrigation GWCU to get annual and redistribute
  - $GWCIrrigation_Peak = 0.3 \times (GWCU_Peak + GWCU_NonPeak)$
  - $GWCIrrigation_{NonPeak} = 0.7 \times (GWCU_{Peak} + GWCU_{NonPeak})$
  - Based on observed seasonal pattern of groundwater depletions



LONG-TERM GW INDUSTRIAL DEMAND

- Dataset of industrial well pumping by NE grid cell
  - From TFG
  - Monthly for 1939 to 2012
- Adjust for FAB year
  - Advance Sep, Oct, Nov, and Dec to next year
- Sum by FAB year and season
- Join with 10/50 area dataset
- Sum cells in 10/50 area by subbasin

LONG-TERM GW MUNICIPAL DEMAND

- Dataset of municipal well pumping by NE grid cell
  - From TFG
  - Monthly for 1939 to 2012
- Adjust for FAB year
  - Advance Sep, Oct, Nov, and Dec to next year
- Sum by FAB year and season
- Join with 10/50 area dataset
- Sum cells in 10/50 area by subbasin

- Add consumptive use for Lincoln and MUD wellfields to Lower Platte River North Bend to Louisville subbasin total
  - Permitted amount

TOTAL LONG-TERM GW DEMAND

- Long-term groundwater demand for peak and non-peak seasons:

$$GWCTotal_{NonPeak} = GWCIrrigation_{NonPeak} + GWCIndustrial_{NonPeak} + GWCMunicipal_{NonPeak}$$

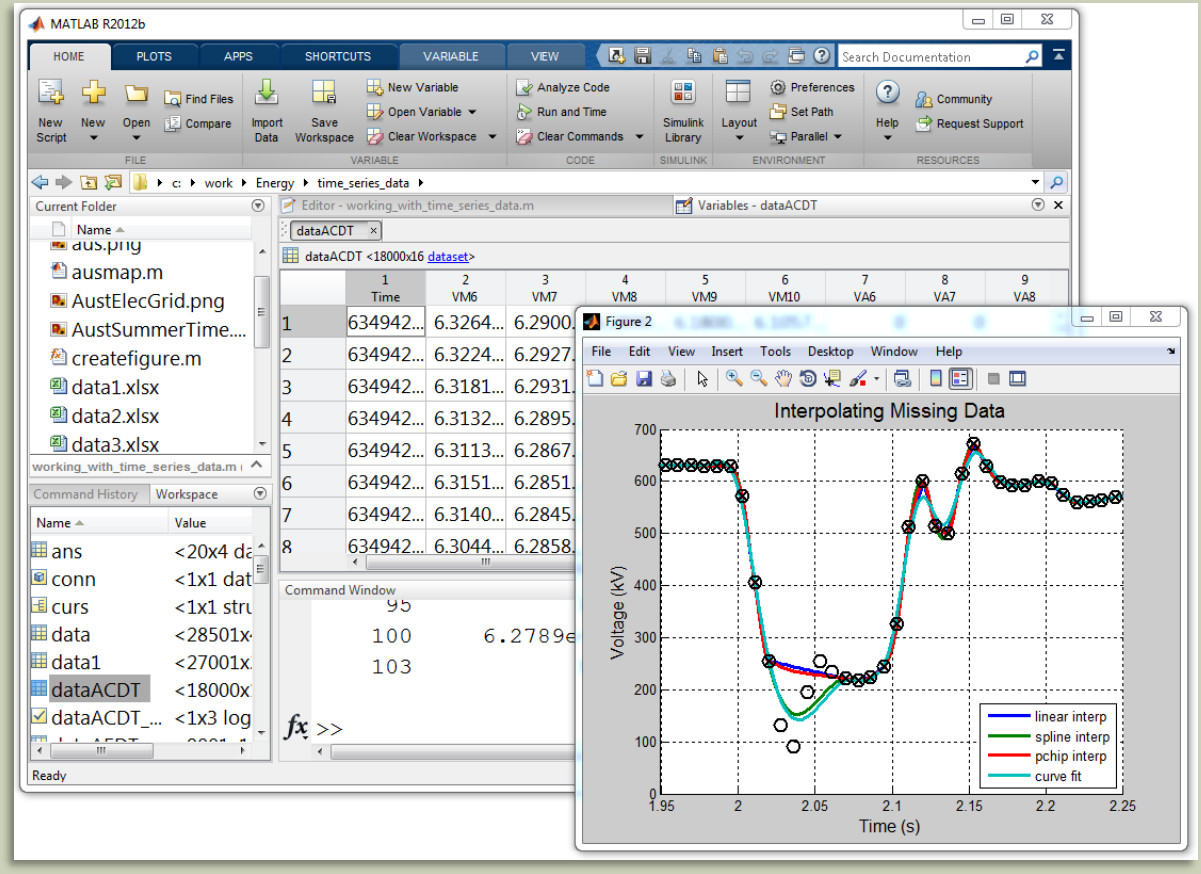
$$GWCTotal_{Peak} = GWCIrrigation_{Peak} + GWCIndustrial_{Peak} + GWCMunicipal_{Peak}$$

NEAR-TERM GROUNDWATER DEMAND

- As stated earlier, the near-term demand utilizes groundwater depletions
  - Current impact pumping has on the stream
  - Groundwater models
    - Wells over 50 gpm
    - Irrigation, municipal, and industrial
  - Plus Lincoln and Omaha wellfield depletions
    - Since these particular wells impact the stream very rapidly, the total amount pumped was considered as depletions

GROUNDWATER DEMAND PROCESSING

- Utilized MATLAB to work with and do calculations on large datasets



OTHER DEMAND COMPONENTS

- Downstream Demand
  - Amount of water typically received by downstream basin
- Instream Flows
  - Permitted flow requirements for fish, wildlife, or recreation
  - Non-consumptive use
- Surface Water Demand
  - Surface water demand for irrigation, municipal, or industrial uses
- Hydropower
  - Non-consumptive use
- Net Surface Water Loss
  - Water necessary to convey surface water for consumptive uses

- These components are explained in more detail in other presentations