Model Objectives and Scenarios - DRAFT

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General Concerns

- Observed water level declines
- 'Rising waters' are less reliable
- Localized heavy pumping
- Surface water not making it to users because of losses in Big Lost (river 'breaks' at Darlington sinks)
- Canals are being lined
- 'Rule 50' boundary
- Mackay sedimentation and integrity
- Changing of climatic "norms"

General model objectives

- Simulated interactions between surface water and groundwater
- More accurate discharge across the southern boundary
- Water rights administration
- Pumping impacts
- Ability to simulate the impacts of pumping and consumptive use in the northern half of the valley on the availability of water to Mackay reservoir
- Ability to do uncertainty and sensitivity analysis across the southern boundary
- Potential effectiveness of managed aquifer recharge on the Big Lost River aquifer system

Possible Model Scenarios (we will run two)

The following scenario ideas were introduced during the November MTAC meeting. The first three generated more discussion. Details of these three scenarios are outlined on the following pages.

1. **Reduced pumping**
2. **Canal lining**
3. **Reduced (or increased) storage capacity in Mackay reservoir**
4. Climatic change – earlier and larger spring runoff, and higher summer ET
5. Multi-year drought

Scenario Option 1: Reduced Pumping

This scenario would provide a general assessment of the impacts of pumping on groundwater levels and flows in the Big Lost River.

Action

Pumping is reduced in all wells (or only in a broad region, like below Mackay) by some percent.

Outcome

Simulate the flows in the Big Lost River at specific diversion locations. How do flows increase?

Model Features Needed

- Surface water features in areas with shallow groundwater are represented as head-dependent boundary conditions. For example, rather than specifying in advance the quantity of leakage that occurs in the Big Lost River, the model will calculate it based upon the physics that we include in the model.
- [*Probably*] The model should calculate the flow in The Big Lost River at different locations, not just the seepage between the river and groundwater.
- [*Maybe*] Individual wells will be included in the model rather than 'synthetic wells' (these are sometimes used to capture the net effect of pumping from an area).

Notable Data Needs

- Well locations
- Diversion locations at which to track streamflow for judging the impact of pumping reductions
- Well open intervals in relation to low permeability layers that may mute or enhance the impact of pumping (or pumping reductions) on nearby surface water
- Location of low permeability layers that may mute or enhance the impact of pumping (or pumping reductions) on nearby surface water

Scenario Option 2: Canal Lining

Canals are being lined throughout the valley in order to reduce seepage losses. Seepage is a source of recharge so lining will cause a reduction in recharge that will likely impact groundwater levels and potentially river flows. Other water use changes may also occur.

Action

Represent the recharge in a specific canal or section of canal with and without lining. Probably only larger canals.

Outcome

Simulated groundwater levels and surface water seepage at specific locations.

Model Features Needed

- Surface water features in areas with shallow groundwater are represented as head-dependent boundary conditions. For example, rather than specifying in advance the quantity of leakage that occurs in the Big Lost River, the model will calculate it based upon the physics that we include in the model.
- The model can represent how seepage changes after lining occurs
    - We could do this with specified fluxes or varying the conductance of a head-dependent boundary that is used to represent the canal.
- [*maybe]* Some way to predict where and by how much pumping will be reduced in the lands that will receive more surface water deliveries after the canals are lined.
    - An external calculation procedure?
    - Calculated by the model with an explicit representation of the supplies and demands of irrigation water?

Notable Data Needs

- Which canals have already been lined? When?
- Information allowing us to estimate leakage before and after lining
- Full canal network in shapefile or map form
- Monitored returns or anecdotal returns information
- [*maybe*] Data necessary to model supply and demand decisions at the scale of fields and canals

Scenario Option 3: Change in Mackay reservoir capacity

The basis of this scenario is a future in which the capacity of Mackay reservoir is reduced (sedimentation) or increased (dredging; higher dam). Such a changed could result in a number of changes in how water is used and managed. This could include: less surface water delivery and increased pumping if capacity shrinks, more surface water delivery and decreased pumping if it grows, more or less water flowing out of the basin through the river channel, and more or less managed aquifer recharge.

Action

Change the amount of water that is released from Mackay reservoir during the irrigation season (and captured in the spring).

Outcome

Simulate the change in groundwater and streamflow; potentially as simulated changes in the flow in the Big Lost River at diversion locations, supplemental use of groundwater where surface water is insufficient, and canal leakage from changing canal flow.

Features

- [*Probably*] The model should calculate the flow in The Big Lost River at different locations, not just the seepage between the river and groundwater.
- Surface water features in areas with shallow groundwater are represented as head-dependent boundary conditions. For example, rather than specifying in advance the quantity of leakage that occurs in the Big Lost River, the model will calculate it based upon the physics that we include in the model.
- Ability to change the shape of the release from Mackay to different degrees.
- [*probably*] Modeling of water demand and delivery system with the points of diversion, points of use, consumptive use, and infiltration. Also, the model would need to be able to adjust the canal leakage based upon how much water would be flowing into the canals.

Notable Data Needs

- Current + hypothetical bathymetry for simulating stage changes in Mackay
- [*probably*] Data necessary to model supply and demand decisions at the scale of fields and canals