Flow Routing Tool and Channel Width Model

Program Context: Program efforts to contribute to the survival of WC during migration have focused on providing WC roosting and foraging habitat along the central Platte River. Suitable WC on-channel roosting habitat has been defined as river channels with ≥650 ft wide channels unobstructed by vegetation. The flow routing tool and channel width model address two important whooping crane Extension Big Questions (EBQs) regarding Program flow management and whooping crane habitat response.

1) EBQ #1 – How effective is it to use Program water to maintain suitable whooping crane roosting habitat?
2) EBQ #2 – How effective is Program management of *Phragmites* for maintaining suitable whooping crane roosting habitat?

Looking Back: To answer these EBQs, the Program developed two complimentary tools to understand how future flows and management practices would change unobstructed channel width conditions for whooping crane roosting throughout the Associated Habitat Reach (AHR). First, an EDO flow routing tool provides realistic flow release scenarios from the Lake McConaughy Environmental Account (EA) to benefit Program's target species and their habitat in the AHR. Second, a channel width model using a random forest structure was initiated to predict annual change in unobstructed channel width and its response to flow and management activities.

Looking Forward: In preparation for the 2022 Science Reporting Session, several updates have increased the applicability and flexibility of the flow routing tool and the comprehensiveness of the channel width model to answer EBQ #1 and #2 and other emerging issues.

- Flow routing tool:
  - Updated North Platte chokepoint capacity to 1,775 cfs (at minor flood stage of 6.0 ft) based on recent flow measurements and shift adjustments.
  - Updated EA future water availability based on current and potential future leasing agreements.
  - Incorporated a North Platte Chokepoint bypass canal (up 1,500 cfs capacity) option to test benefits of additional flow capacity
- Channel width model:
  - Past peak flow explanatory variables were included without decayed effects
  - Random Forest model optimization (number of trees in forest/number of variables to consider at each model turn decision point) using 10-fold cross validation.

The refinements and updates to the flow routing tool and channel width model allowed the EDO to evaluate flows and channel width changes during a possible period of drought for the remainder of the First Increment Extension. We evaluated annual germination suppression target flow achievement and changes to maximum unobstructed channel width with and without flow releases including an option for bypass flow capacity.

Preliminary Results

Days target flows during the germination suppression period were reached increased slightly with flow releases but increased dramatically with flow releases with a bypass (Figure 1). Although germination suppression target flows were achieved more often with a bypass, MUCW-maintenance benefits were similar with or without a bypass canal (Figure 2). Lack of additional benefit from a bypass canal appears to be a function of current flat/wide channel geometry. Hydraulic modeling indicates average wetted width currently exceeds 650 ft at approximately 700 cfs. This is in contrast to the 2009 model, where achieving a wetted width of 650 ft required > 2,500 cfs. We anticipate that a bypass canal would become increasingly important during drought periods when thalweg incision and bar accretion would increase the flow magnitude necessary to inundate the channel during the germination period.

Future Development

1) Refine approach to incorporating climatic variability and its impact on flows and EA water availability
2) Run germination suppression experiment for two more years, then determine if the system "hack" of germination suppression flows have a similar channel maintenance ability as natural flows of similar magnitude.
3) Integrate the channel width model and annual predictions into the Reach Wide Monitoring report

Discussion Questions:

1) Did we choose an appropriate way to project channel width prediction uncertainty through the First Increment Extension (2021-2032) to communicate future channel width conditions under different scenarios? If not, what constitutes a more appropriate method to project into the future?
2) What performance indicators are most important to understand the effects of germination suppression flows and other management actions (e.g., river channel disking, in-channel herbicide application) on channel width conditions? What visual representations would be most effective to communication the costs (EA water and money) and benefits of actions to a broad audience?
3) How do we incorporate channel width modeling to make the decision whether to continue germination suppression flow releases at periodic check points during the First Increment Extension (See Figure 5 – Extension Science Plan Attachment #3) and what other information do we need to make those decisions?

Figures

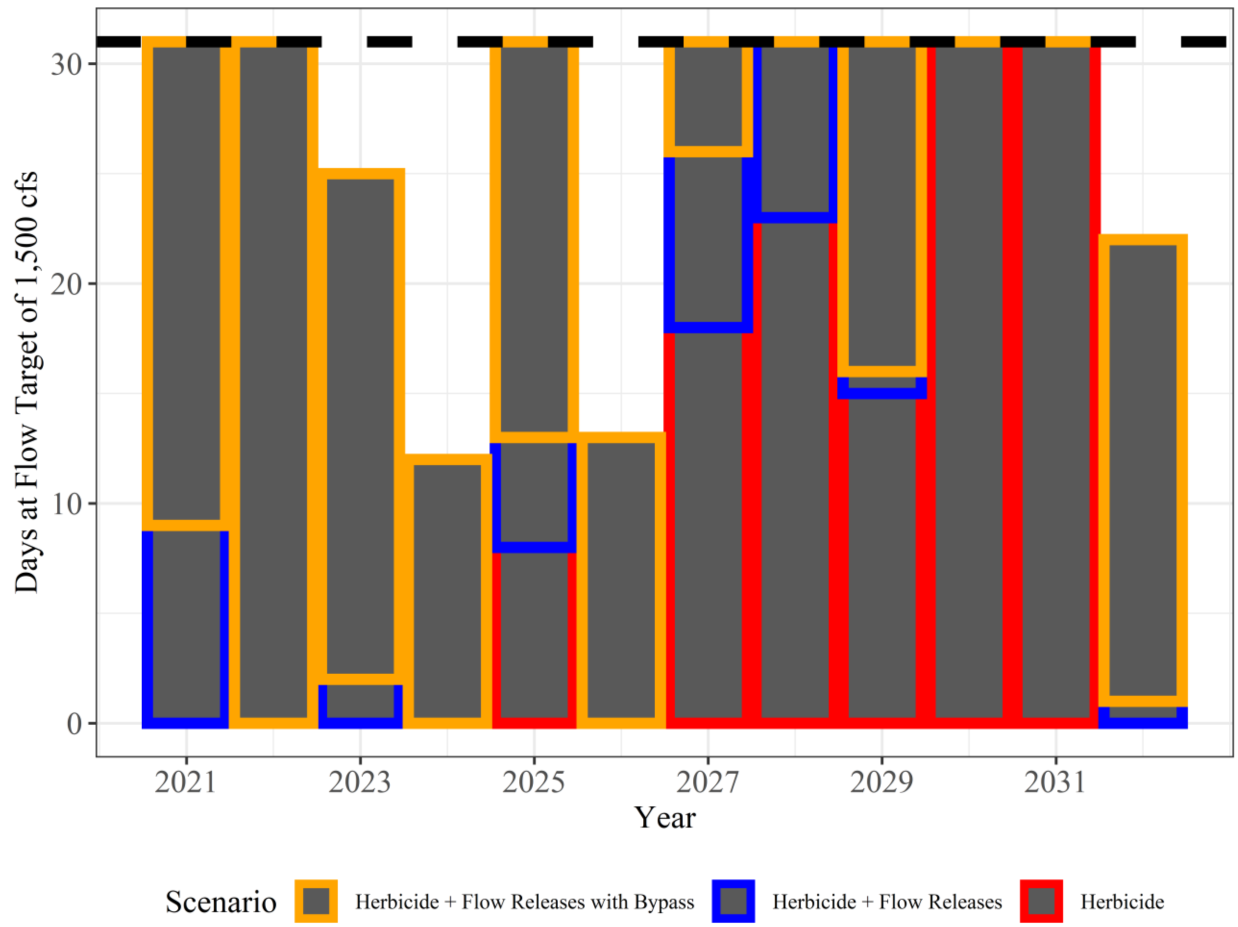

Figure 1. Annual days at flow target (1,500 cfs at Grand Island) within 31-day window for germination suppression (Dashed line) for 2021-2032 with drought conditions in early years transitioning to wet/normal hydrology later years with base flows (red) and the addition of flow releases (blue) and flow releases with a 1,500 cfs North Plate chokepoint bypass canal (orange).

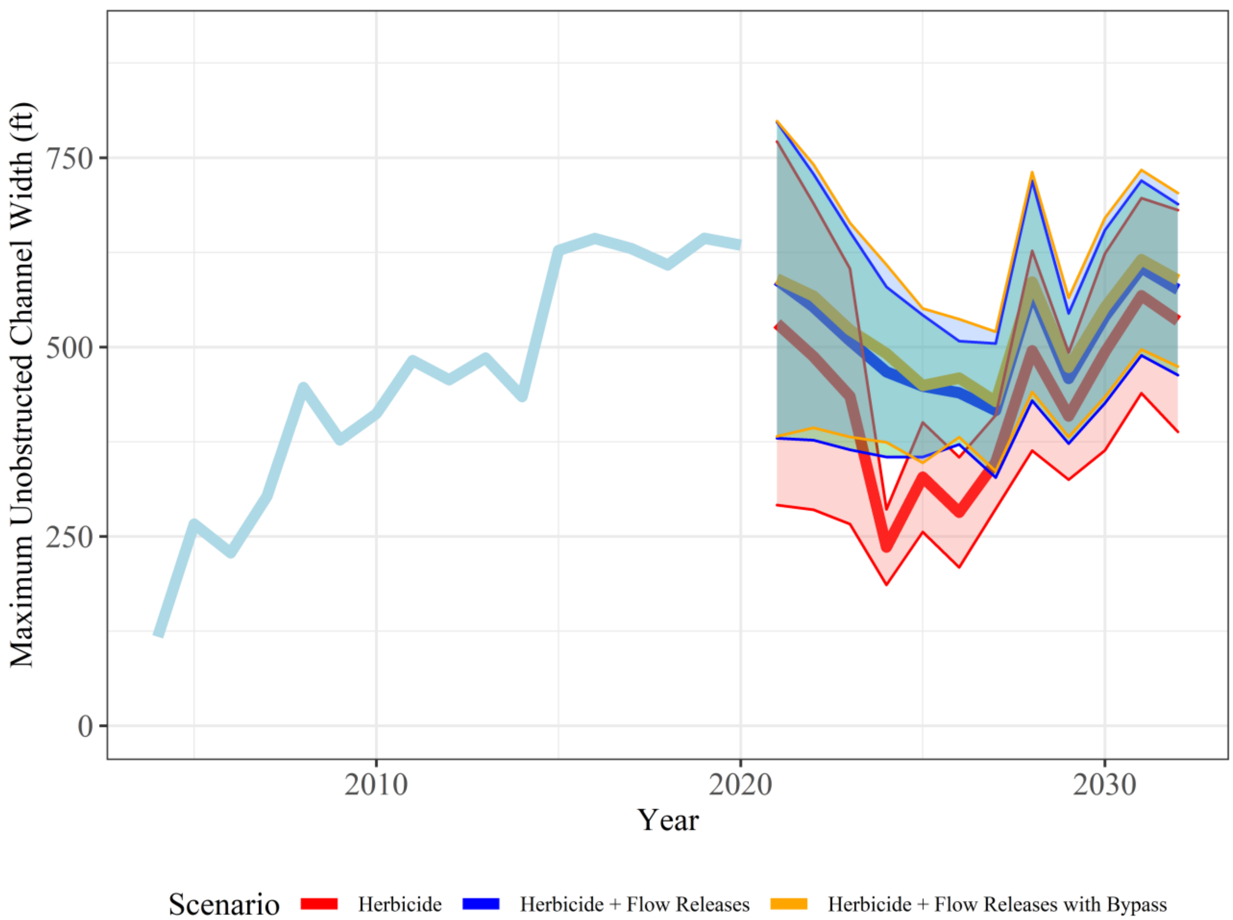

Figure 2. Mean annual maximum unobstructed channel width (MUCW) in the central Platte River from 2004 to 2020 (light blue line) and predicted mean MUCW for 2021-2032 based on drought conditions in early years transitioning to wet/normal hydrology later years with only herbicide application and base flows (red), the addition of flow releases (blue) and flow releases with a 1,500 cfs North Plate chokepoint bypass canal (orange). Channel widths from 2020 were used as a known starting point and predicted 2021 MUCWs were derived from 2020 channel widths plus predicted 2021 ΔMUCW. After 2021, predicted previous year's MUCW plus annual ΔMUCW calculated annual MUCW. Shaded regions represent 95% bootstrapped confidence intervals.