22 July 2005

MASTER MANUAL SPRING-RISE ALTERNATIVE:

1. **Description of the Proposal:**
   a. **Number of Rises**:
      One/Two Rises
   b. **Flood Control Targets/constraints**:
      Spring Rise Preclude below 31 MAF system storage.
      Single rise only at 31 MAF to 54.5 MAF system storage and flood control + 6,000 cfs. Single rise can occur at any time during the spring rise period.
      Both first and second rise at system storage greater than 54.5 MAF. Minimal increase in flood control targets. (Flood control targets and system storage tiggers could be adjusted minimally if needed to ensure an acceptable number of spring rises.) Based on the restraints above a single rise would have occurred 38 year out of 100years , two rises would have occurred 58 years out of a 100 years and no spring rise of any type during extreme drought would have occurred four times.
   c. Timing, duration, magnitude, rise and fall rates of Single Rise:
      Timing: First rise would likely coincide with the start of the navigation season (23 March) at system storage between 31 MAF and 54.5 MAF. First rise on 16 March if system storage greater than 54.5 MAF.
      Duration: Six days
      Magnitude: Target plus 6,000 cfs above service level for the peak.
      Rise and Fall: Rising limb of two days at 3,000 cfs per day above service level. Falling limb of four days at 1,500 cfs per day to service level.

   d. **Timing, duration, magnitude, rise and fall rates of Second Rise:**
      Timing: Start second rise June 1. (This start date can be adjusted to reflect the actual antecedent temperature conditions.)
      Duration: Six days
      Magnitude: Flow Service Level Target plus 6,000 cfs. Flood controls not increased or minimal if essential. (Magnitude in the future can be increased or decreased based on best science.)
      Rise and Fall: Rising limb for two days at 3,000 cfs per day. Falling limb for four days at 1,500 cfs per day to service level as per system storage on March 15. (Rise and fall criteria can be decreased or increased base on best science.)

      How does this address water availability? Variation for wet, normal or dry years (including Stop Protocols or precludes): The existing Master Manual flow controls are designed to for dry, average and wet years.

No spring rise if system storage level is below 31 MAF. Flow exceeding flood control targets are the stop protocols. The natural change of water availability will result in corresponding variability.
Water availability is addressed by the 15 March system storage, which dictates the service level. System storage is largely a function of antecedent years plus precipitation up to March 15. Dry

e. Volume of water used: Volume is 0.36 MAF for a single mode rise and 0.71 MAF for a dual mode rise.

f. Level of and purposes for flexibility in its annual application (What is the intended flexibility given to USACE in its application of this proposal?):

USACE would have the flexibility in utilizing tributary flows to reach service level targets. USACE would have the flexibility to increase discharges for the purpose of evacuating water from the system to develop potential reservoir storage to prepare flood storage in the reservoirs. USACE would have the flexibility to use short term flood forecasts, which include antecedent conditions, to modify discharges to reduce likelihood of potential flooding. USACE would have the flexibility to address unforeseen emergency flow conditions.

2. **Hydrograph chart (with sideboards visually noted):** See Figure 1 for a typical Single Mode Spring Rise. See Figure 2 for a typical Dual Mode Spring Rise.

3. **Science: What is the scientific principle or hypothesis?** The Amended Biological Opinion has assumed that a hydrograph that better mimics the "natural" hydrograph is needed to recover the pallid sturgeon, the least tern, and the piping plover. The Amended Biological Opinion expanded the spring rise to include the historic March rise as well as the June rise. To apply the "natural" hydrograph paradigm to the mainstem of the Missouri River from Gavins Point to the Platte River and expect positive results generally requires the following assumptions:
* The hydrologic elements, including volume of water, biology, water chemistry, sediment, and turbidity of the tributaries are not the essential or controlling factors in the ecosystem of the Missouri River for the pallid sturgeon, which is unproven.
* That pallid sturgeon, which are ready and capable to spawn, will be available in the reach at the correct time. (This is unproven.)
* Magnitude of flow is the controlling factor for spawning of pallid sturgeon. (This is unproven.)
* Nutrients, food, turbidity, and suitable spawning substrate are available in adequate quantities in the reach at the correct time. (this is , which is unproven.
* That successful spawning in the mainstem will result in recruitment of the pallid sturgeon. (This is unproven.)

Finally, if the above assumptions can all be met, one must consider if the assumption that the "Natural" hydrograph was a good hydrograph for the pallid sturgeon. (This is unproven.)

Not withstanding the above, an alternative is presented herein. The alternative, if adequately monitored would test if one or both of the modes of the spring rise could cue the spawning of the pallid sturgeon. After each spring rise, all information will be analyzed completely, after which the adequacy of the completed spring rise as well as the need for additional spring rises will be evaluated. All additional spring rises proposed will be justified by independent science.

4. Anticipated effects

a. Proposal's anticipated effects on, or benefits to, Pallid Sturgeon (how does it assist in flow, timing, temperature, photoperiod, compare with historic hydrograph, comparison with historic flow percentiles, etc):

First rise corresponds well with the historic March rise at Sioux City, which typically started March 15 with a standard deviation of 13 days. Temperature on March 15 can be expected to be about 8 deg. C, well below the seemingly optimal temperature of 18 deg. C and also well below the typical reported spawning temperature range of 15 to 25 deg. C. However, it has been speculated that the first rise is important in cleaning the spawning substrate and or triggering adult pallid sturgeon to aggregate at spawning sites. Based on historical observations of spawning runs of sturgeon in the Missouri River Basin, it is estimated that minimum photoperiod is about 13 hours, which occurs about the first week in April at Sioux City. Thus, the first spring rise is likely outside of both the temperature and photoperiod spawning ranges at Sioux City. However new information for the Lower Yellowstone River a March rise with a generally declining hydrograph resulted in shovelnose sturgeon spawning. Thus, a single March rise below Gavins Point could be tested.

Second Rise: The June rise typically started about May 15 at Sioux City with a standard deviation of 13 days. The typical date of 18 deg. C for three consecutive days at Sioux City is about May 26 with a standard deviation of 18 days. Thus, the start date of June 1 would, in general, occur after the temperature reached 18 degrees. Recent information suggests that spawning of sturgeon may at least sometimes occur before the second rise. Based on historical observations of the photoperiod of spawning sturgeon in the Missouri River Basin it is estimated that minimum photoperiod is about 13 hours, which occurs about the first week in April at Sioux City. Thus, the second rise starting on June 1 would generally meet the minimum photoperiod criteria. However, the actual starting date can be adjusted to reflect the actual antecedent water temperature conditions

b. List the anticipated negative environmental effects (for example, terns and plovers, native fish, flood plain lakes and wetlands,)

The second rise in June could result in a large take of terns and plovers. However, if the Corps uses fluctuating water levels prior to June 1 to discourage nesting, the take may be reduced. All flood pulses aggravate streambed degradation. Streambed degradation results in a more incised river and loss of

sandbar areas in the "unchannelized" reach between Ponca and Gavins Point Dam. Streambed degradation results not only in loss of connection to chutes and backwaters but also dewatering of alluvial floodplain lakes and wetlands. However, the magnitudes of the pulses in this proposal are not large and are for short durations. Thus, this proposal would tend to minimize the additional negative environmental and economic effects of streambed degradation resulting from any spring rise.

c. **Proposal's anticipated effects on, or benefits to, socio-economic factors (how does this Proposal appear to affect water used in the basin, how do flows attenuate, effect on reservoir levels, navigation impacts, what modeling helps understand the effects):** The relatively small spring pulses proposed should typically have minimal flooding potential and or negative interior drainage potential. In addition, the "low peak-type pulses from Gavins Point Dam should attenuate to at least some degree as they proceed downstream. The total volume needed to create the pulses is small (0.071 MAF). However, both rises are at in opportune times as related to efforts to increase or at least stabilize water levels in the reservoirs during the reservoir fish spawning season. However, in non-drought years, the effect of the small pulses would be expected not to cause any problem. In general, the pulses will not have a negative effect on navigation except on years when the navigation season is shortened. No modeling has been done on the alternative proposed herein.

d. **Proposal's anticipated effects on, or benefits to, historic, cultural and burial sites (how does this Proposal appear to affect historic, cultural and burial sites in the basin, what modeling helps understand the effects):** The alternatives are not expected to have any significant additional affect on burial sites along the reservoirs as compared to present water control plan.. In general, the alternative proposed herein would not likely result in significant increases of negative or positive effects that exist with the present water control plan. The cultural resources should be evaluated at this time.

3. Brief description of monitoring methods and indicators:

a. What are the key indicators to be monitored?

b. Pending creation of MRRIC, what interim processes should be used to monitor this proposal?

Population assessment including collection of sturgeon larvae should continue. Sturgeon larvae should be described in detail and identified as to species. Monitoring of activities of "ripe" surrogate shovelnose sturgeon should continue.
Fixed station monitoring should minimally include, flow, stage, temperature, dissolved oxygen, turbidity, sediment, chlorophyll, endocrine disrupters, total trace elements, dissolved and particulate organic carbon. Productivity indicators should also be monitored, especially condition of substrate in relation to periphyton and diatoms. An additional NASQAN station just downstream of Gavins Point Dam, such as at Yankton, should be added. Other new NASQAN stations should be initiated at St. Joseph, Waverly, and Boonville. Monitoring of water from the

tributaries is likely more important than mainstem monitoring and must be initiated. This information will help evaluate a basic assumption in the Biological Opinion that the changes of population of the pallid sturgeons are due to changes to the mainstem by the USACE. This assumption has not been evaluated and its resolution may be crucial to the recovery of the pallid sturgeon. Monitoring of stream bed degradation and planform changes in the Gavins Point to Platte River reach are needed. Conversely monitoring of streambed aggradation resulting form the spring rises, in general below the Platte River mouth, is needed.

4. Advantages of this alternative.

***The Master Manual flow control considers dry, average and wet conditions in relation to system storage. Additionally other Master Manual guides control flooding, reservoir operation and other factors that are related to the Congressionally authorized uses as well as the Endangered Species are already in place. Spring rises can be built upon these Master Manual controls with minimal modification.**

*** The alternative can be used with adaptive management to obtain experimental information. This alternative is very flexible and allows for modification based on science as justified by independent science process.**

*** The plan requires minimal water use.**

*** Plan offers quick rises and falls to minimize flood pulses.**

*** The plan minimizes streambed degradation and the numerous negative economic and environmental impacts.**

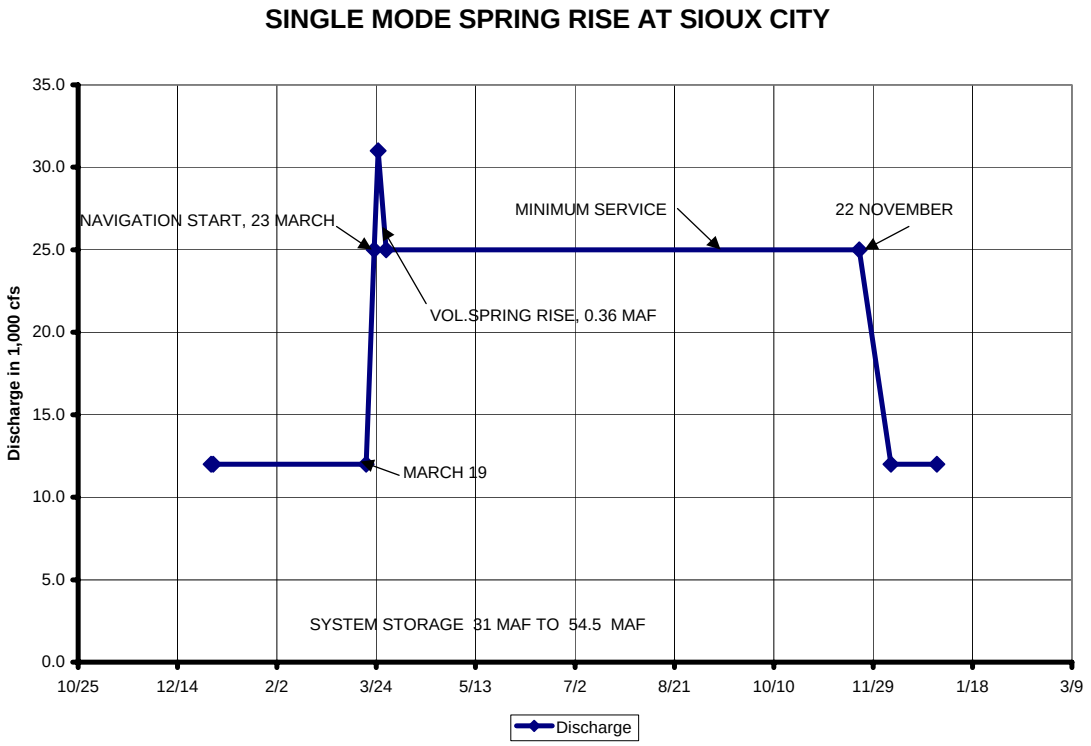


Figure 1. Single Mode Spring Rise for the Missouri River at Sioux City, Iowa. Minimum service is provided if the March 15 system storage equals or exceeds 31.0 maf and is less 49.0 maf. (Prorated service level is provided if system storage is between 49.0 and 54.5 maf.) An eight month navigation season is provided if a 1 July system storage check value equals or exceeds 51.5 maf.

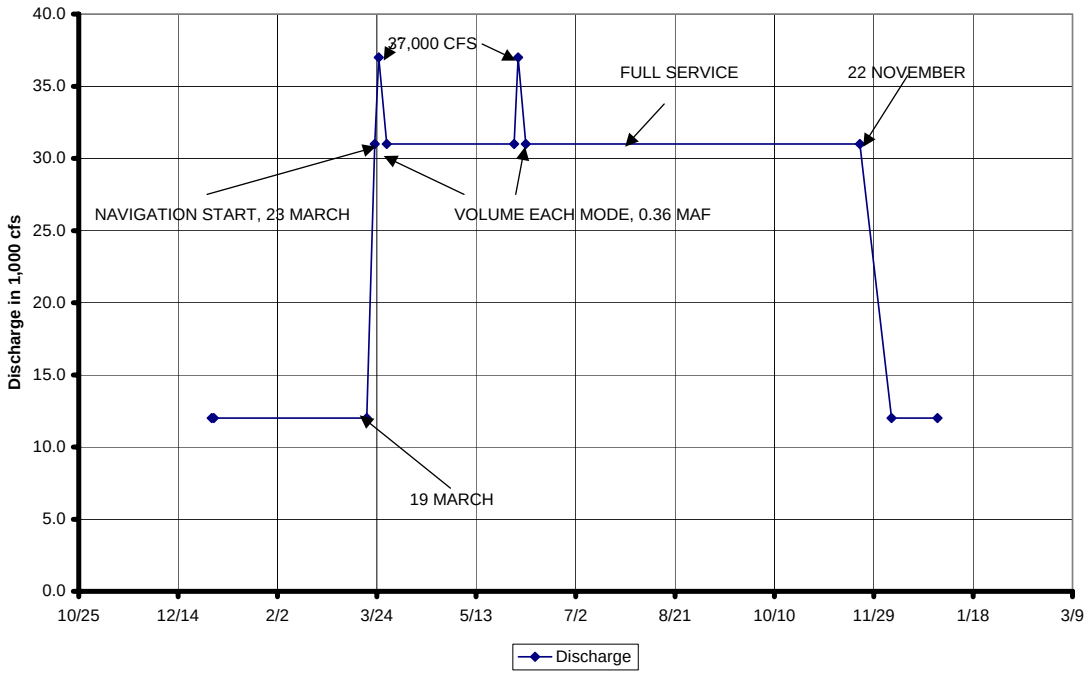


Figure 2. Dual Mode Spring Rise for the Missouri River at Sioux City, Iowa. Full service level is provided if the March 15 system storage is equal or greater than 54.5 maf, (Prorated service is provided between 54.5 49.0 maf.) An eight month navigation season is provided if the 1 July system storage equal or greater than 57..0 maf.

Multiple Use Alternative

1. Description of the Proposal:
    a. Number of Rises:
        i. One/Two depending on storage conditions. Have no spring rises when system storage is below 31.0 MAF, a single rise from 31.0 to 34.0 MAF, and two rises between 34 and 58.5 MAF. Above 58.5 MAF evacuation will be occurring and no spring rise should occur.
    b. Flood Control Targets/constraints:
        i. Minimal modification of the flood control constraints during the Spring Rise timing.
    c. Timing, duration, magnitude, rise and fall rates of First Rise:
        i. Timing
            1. Begin first rise to coincide with start of navigation support releases from Gavins Point.
        ii. Duration and rise and fall rates
            1. Rise up to 6,000 cfs/day.
            2. 2 day peak.
            3. Fall 4,000 cfs first day, then prorate the drop of the remainder of the descending limb so the total length of the rise from initiation to end is approximately 16 days
        iii. Magnitude
            1. Prorate between the +22,000 cfs and the minimum rise.
            2. Have an absolute flow cap of 35,000 cfs at Gavins Point.
    d. Timing, duration, magnitude of Flow Between Rises:
        i. Guided by the master manual
            1. Release plan (may only be necessary under certain plans when the second rise occurs after late May)
                a. Flat release only during evacuation
                b. Flow to target other times
    e. Timing, duration, magnitude, rise and fall rates of Second Rise:
        - Below 31.0 MAF storage, no rise. Between 31.0 and 54.5 MAF the rise is prorated. Between 54.5 and 58.5 there will be a full rise. Above 58.5 there will not be specific releases for a spring rise because system will be evacuating water.
        i. Timing
            1. As late as possible - must consider the bird species and avoid unacceptable levels of take.
        ii. Duration and rise and fall rates
            1. Rise up to 6,000 cfs per day.
            2. 2 day peak.
            3. Drop first two days at 4,000 cfs/day, then prorate the drop of the remainder of the descending limb so the total length of the rise from initiation to end is between 21 to 28 days.
        iii. Magnitude
            1. Prorate between 20,000 cfs and the minimum rise.

2. Have an absolute cap of 48,000 cfs.

f. How does this address water availability? Variation for wet, normal or dry years (including Stop Protocols or precludes):
    - March 15th storage check will set the number of peaks and their magnitude.
    - This alternative is based upon navigation support and drought conservation listed in the current water control master manual (NWCP00).

g. Volume of water used:
    - The volume will range from the minimum peak to 0.5 MAF (estimated)

h. Level of and purposes for flexibility in its annual application (What is the intended flexibility given to USACE in its application of this proposal?):
    - The Corps should use all forecasting abilities to reduce flooding.
    - The Corps should have the ability to react to unexpected events during the spring rise period.
    - As more tern and plover habitat is created, the spring rise may be shifted later into June.
    - Proposed flow rates could be targeted immediately below the James River confluence. This would require a new gaging site to be established at this site. Monitoring at this site could include flow rate and water temperature.

2. Hydrograph charts (with sideboards visually noted): Figures 1, 2, & 3.

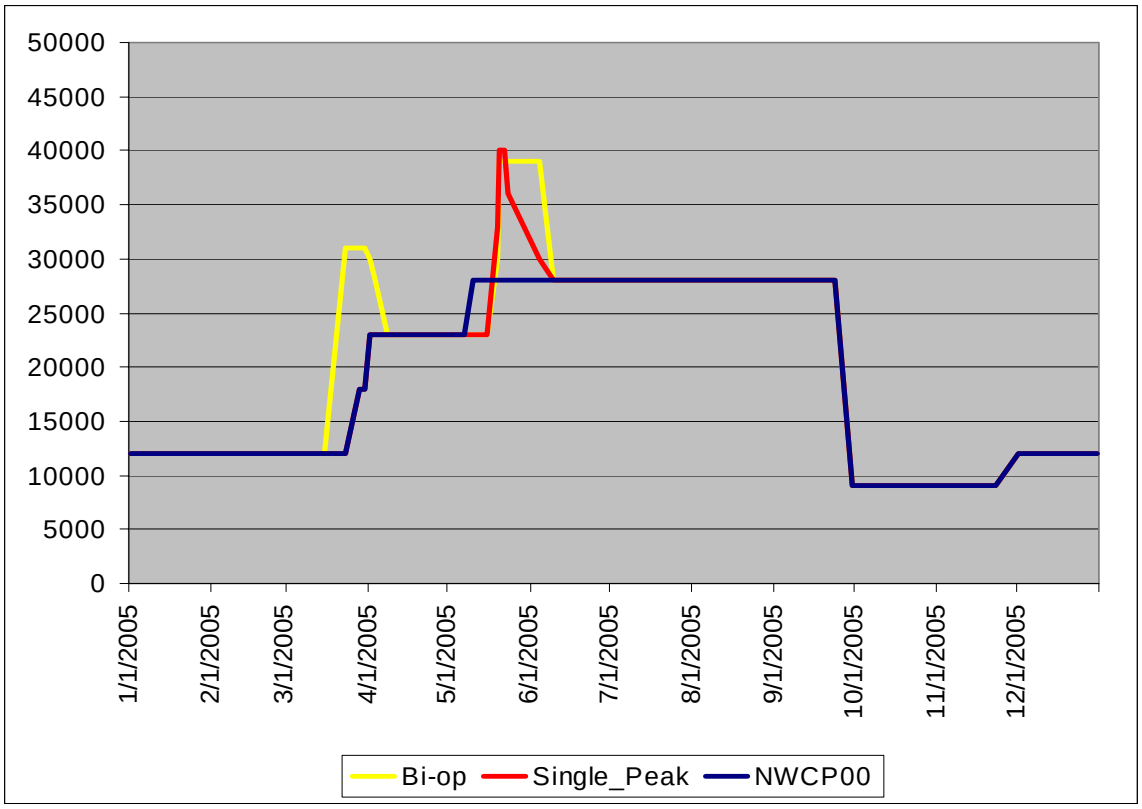


Figure 1. Single modal rise under extreme low system storage conditions, navigation support and drought conservation utilize current water control master manual guidelines.

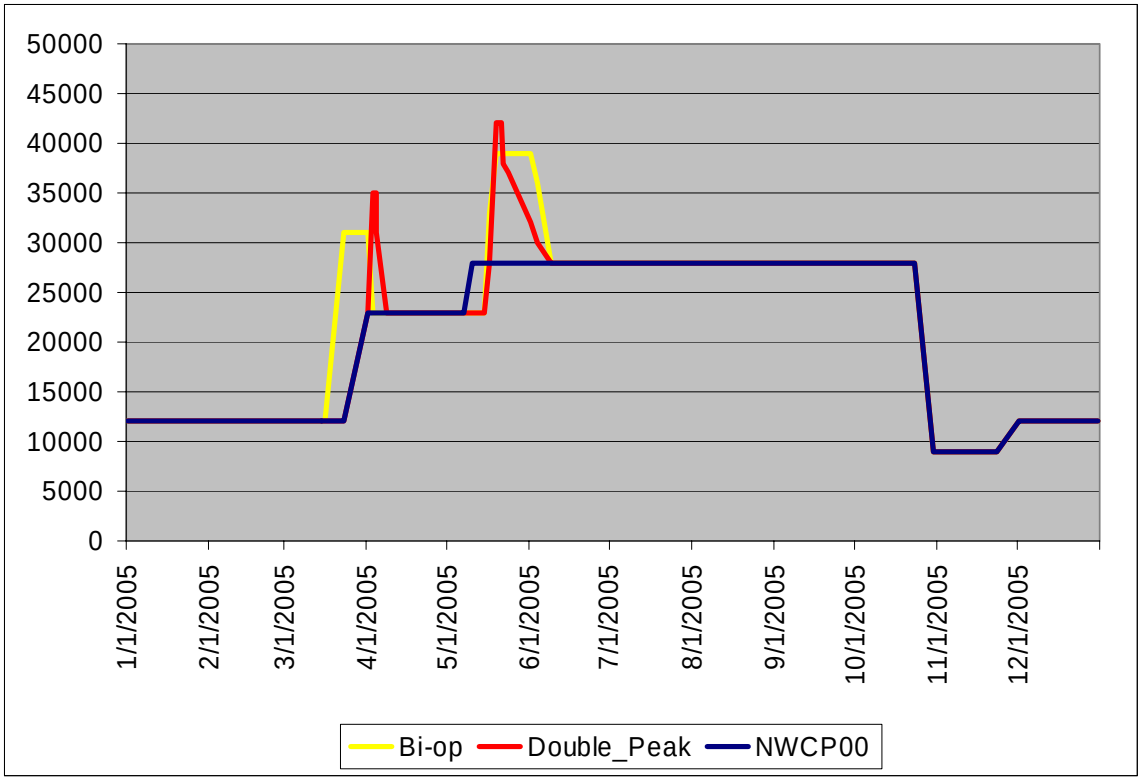


Figure 2. Double modal rise under low system storage conditions navigation support and drought conservation utilize current water control master manual guidelines.

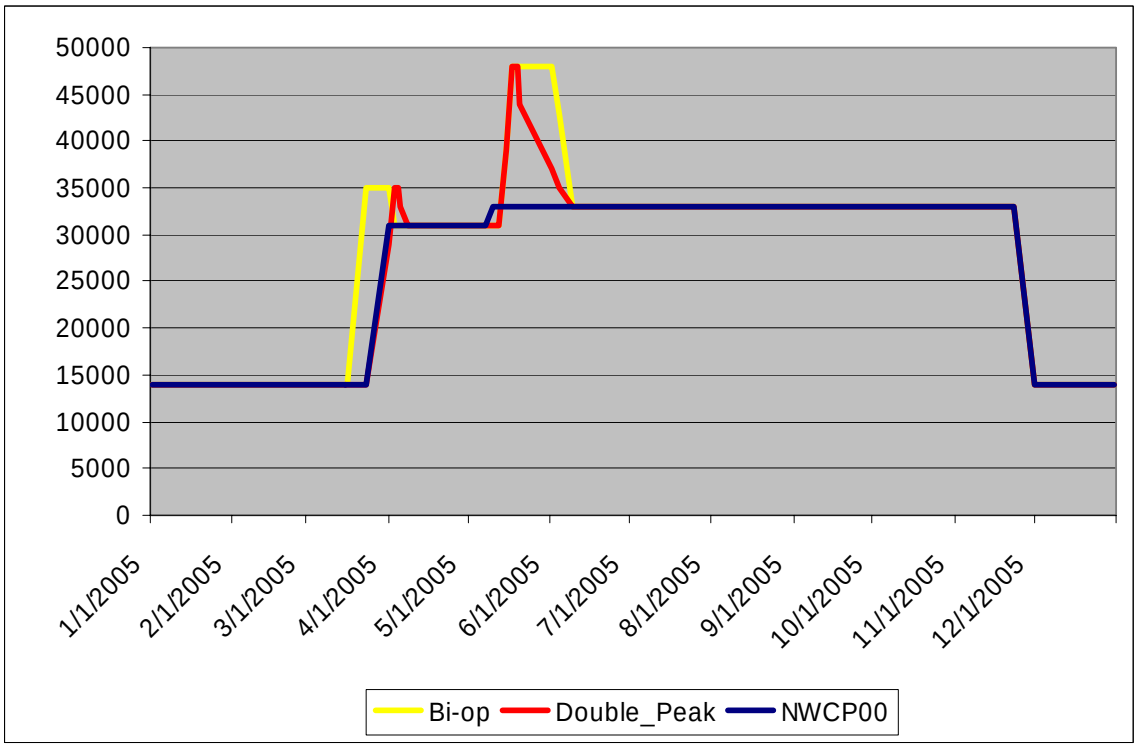


Figure 3. Double modal rise under normal system storage conditions navigation support and drought conservation utilize current water control master manual guidelines.

3. Rationale for the proposal:
    a. Biological: This alternative mimics the timing of the natural hydrograph based upon the lower third of the historic runoff data. Factored into this alternative is consideration for the nesting requirement of the least terns and piping plovers.
    b. Socio-economic: This plan utilizes peak rather than plateau shaped rises. Some advantages over the default plan are utilization of less water for the rises during periods of low system storage. This alternative also uses peaks to lessen the potential downstream flooding effects for flood plain farmers. The foundation for this alternative is based upon the current master manual relative to navigation support and drought conservation.
    c. Other: This plan attempts to balance the need for creating a more positive natural environment for the pallid sturgeon while considering nesting habitat and timing for the least tern and piping plover, with the other authorized project purposes
4. Anticipated effects (positive or negative)
    a. Proposal's anticipated effects on, or benefits to, Pallid Sturgeon (how does it assist in flow, timing, temperature, photoperiod, compare with historic hydrograph, comparison with historic flow percentiles, etc): This alternative suggested timing for the spring rise pulses are based upon historic natural flow data taking into account water temperature and the photoperiod conditions hypothesized to be needed to create a positive environment to induce spawning in pallid sturgeon.
    b. Proposal's anticipated effects on, or benefits to, socio-economic factors (how does this Proposal appear to affect water used in the basin, how to flows attenuate, effect on reservoir levels, navigation impacts, what modeling helps understand the effects): This alternative as compared to the default spring rise plan utilizes peak shaped rises with a fairly steep ascending limb, short duration top and initial sharp descending limb for a short time period followed by a protracted decline for the remainder of the descent period. This plan relative to the default plan should reduce the potential for negative effects for flood effect downstream flood plain farming. Also compared default plan, this alternative reduces the total amount of water required to provide for the spring rise(s) benefiting total system storage in the mainstem which provides benefits to reservoir water supply intakes, inundated cultural resource sites along the reservoirs, reservoir recreation and reservoir habitat for fish production.
    c. Proposal's anticipated effects on, or benefits to, historic, cultural and burial sites (how does this Proposal appear to affect historic, cultural and burial sites in the basin, what modeling helps understand the effects): By reducing the amount of water drafted from the reservoirs, cultural resource sites originally flooded when the reservoirs filled stand a better chance of remaining flooded which protects them from being uncovered by wave action and potential bank sloughing. Keeping these site flooded also reduces the likelihood of possible looting.

5. Brief description of monitoring methods and indicators:
    a. What key indicators (whether positive or negative) are to be monitored?

Intense monitoring of the pallid sturgeon population should be performed to determine if the proposed alternative is providing the need queues to induce spawning. Monitoring of the effects, both positive an negative, to the authorized project purposes.

b. Pending creation of MRRIC, what interim processes should be used to monitor this proposal? Continue the several existing biological monitoring programs, the Corps should collect this information then distribute the data to the various stake holders including the individuals who participated in both the technical and plenary portions of this process.

Socio-Economic Technical Working Group Spring Rise Proposal

Draft of July 22, 2005

Title of Option: Modified Pallid Sturgeon Fish & Wildlife Proposal 1 7-21 (PAFW PROP 1 7-21)

Note: Excluding fish and wildlife resource interests (an authorized use which would continue to be significantly compromised/impacted) and certain recreational users, the members of the Socio-Economic Technical Working Group (SETWG) expressed unanimous support for the recommendations contained in this report. (The strongest divergence of opinion centered on the desirability of a single or bimodal rise.)

1. Description of the Proposal:

Tables 1A and1B provide general rationale for the following:

a. Number of Rises:

Strong preference for 1 mode; however, the SETWG has noted its preferences regarding a second rise should it be required below.

b. Flood Control Targets/constraints:

Minimal to no adjustment.

c. Timing, duration, magnitude, rise and fall rates of First Rise:

- **Timing:** Start of the First Rise should begin soon enough so release levels coincide with minimum navigation service release levels from Gavins Point by March 23rd (rise should begin March 21- 22 and decline to flow-to-target minimum navigation service levels by April 7th)
- **Magnitude:** < 35 kcfs. James River flows should count toward flow levels throughout the Spring Rise.
- **Rise:** As steep as possible
- **Fall:** As steep as possible

d. Timing, duration, magnitude of Flow Between Rises:

Minimum navigation service levels flow-to-target

e. Timing, duration, magnitude, rise and fall rates of Second Rise:

- **Timing:** Timing should be such that the initial 30% decline from the peak of the Second Rise should be completed as close as possible to May 21st.
- **Magnitude:** $\leq$52 kcfs. The critical component of magnitude is the length of time the peak is above the critical floodgate gate gage level (CFGGL, yet to be determined). Specifically, the peak above the CFGGL should be as short as possible, 1-3 days. Magnitude should be prorated based upon storage and the most up-to-date runoff predictions for areas above and below Sioux City. James River flows should count toward flow levels throughout the Spring Rise.
- **Rise:** As steep as possible
- **Fall:** As steep as possible down to the CFGGL. Duration and rate of fall are less critical once levels are below the CFGGL.

f. How does this address water availability? Variation for wet, normal or dry years (including Stop Protocols or precludes):

This rise is designed for dry conditions with regard to low mainstem storage levels and low runoff levels. By starting the rise later in May, storage is saved in upper basin reservoirs. Flow-to-target during May benefits system storage relative to the CWCP. Starting the second rise at flow-to-target levels will lessen the magnitude while still maintaining the delta (stage change). Mountain snowpack generally begins entering the system later in May allowing for timely replacement of storage in mainstem reservoirs. At the same time, by May 21, possibly earlier, agricultural interests down river face the inability to replant if the peak results in interior drainage problems.

Group should discuss stop protocols.

Flooding and/or a spring rise resulting in mainstem storage dropping to a level that threatens water intakes in the reservoirs (38 MAF)

g. Volume of water used:

Design incorporates socioeconomic recommendations into the Pallid Sturgeon Fish & Wildlife Proposal 1 7-21 (PAFW PROP 1 7-21). The SETWG will attempt to provide this calculation for presentation to the Plenary Group.

2. Hydrograph chart (with sideboards visually noted):

SETWG will attempt to have a hydrograph completed for presentation to the Plenary Group.

3. Anticipated effects

a. Proposal's anticipated effects on, or benefits to, Pallid Sturgeon (how does it assist in flow, timing, temperature, photoperiod, compare with historic hydrograph, comparison with historic flow percentiles, etc):

This proposal works off of recommendations from the Pallid Sturgeon Technical Working Group.

b. Proposal's anticipated effects on, or benefits to, socio-economic factors (how does this Proposal appear to affect water used in the basin, how to flows attenuate, effect on reservoir levels, navigation impacts, what modeling helps understand the effects):

The group provides general observations regarding impacts in Table 2. A thorough accounting of impacts is necessary and will require formal study.

c. Proposal's anticipated effects on, or benefits to, historic, cultural and burial sites (how does this Proposal appear to affect historic, cultural and burial sites in the basin, what modeling helps understand the effects):

This proposal will minimize losses to mainstem system storage. In fact because the May peak will now more closely coincide with mountain snowpack runoff, mainstem system storage from the start to finish of the spring rise may realize little relative change.

4. Brief description of monitoring methods and indicators:

A monitoring regime that measures impacts of the Spring Rise to all socio-economic interests/uses should be in place prior to implementation. The SETWG lacked expertise to develop a list of indicators and strategies and therefore recommends that an expert and impartial third party is identified to develop a monitoring regime. An ad-hoc committee should be appointed to select this group. The SETWG believes that mitigation and/or compensation strategies that are closely tied to the results of monitoring efforts should be evaluated.

Table 1A, Socio-Economic Interests Regarding Certain Characteristics of a ***First*** 2006 Spring Rise										
	DURATION	**TIMING**	**QUANTITY**	**MODES**	**RATE OF RISE**	**RATE OF FALL**	**PRE-RISE DISCHARGE**[1]	**PRECLUDE**[2]	**PRORATE**[3]	**FLOOD**[4] **CONTROL CONSTRAINT**
USE	S/L Short/Long	E/L Early/Late	1/2/3 Sm/Med/Large	1/2 Single/Bi	1/2/3 Slow/Med/Fast	1/2/3 Slow/Med/Fast	1/2/3 11-18/18-25/25-35	1/2/3/4/5 ≤31/≤35/≤40/≤45/≤57	1/2/3/4 ≤31/≤35/≤40/≤45	=/</0 (0=no change)
FC	S	E	1	1	3	3		4	4	0
Hydro	S	L	1	1	3	3		4	4	0
Therm	S	L[5]	1	1	3	3		4	4	0
Nav	S	E	1	1	3	3		5	5	0
W Supp	S	L	1	1	3	3		4	4	NA
W Qual	S/L[6]	L	1/2/3[7]	1	3	3		3	4	NA
Irr	S	E	1	1	3	3		3	4	NA
Rec	S	L[8]	1	1	3	3		3	4	NA
Ag	S	E[9]	1	1	3	3		5	5	0
Riparian	S	E	1	1	3	1		3	3	0
Fish/Wild	S/L	Mimic natur	3 or mimic	2	2	1		1	1	=

[1] Since system releases are at CWCP winter release levels prior to the first rise, pre-rise discharge is not an issue.
[2] These two terms are often intertwined with storage levels. Many of the concerns with fluctuations in storage levels and a spring rise are intimately tied with runoff in a given year. Concerns about fish production in reservoirs may be completely eliminated if runoff is sufficient to provide both a spring rise and rising elevations in mainstem reservoirs. Conversely, during a low runoff year, the harms to fish production will be exacerbated with the addition of a spring rise. This has very little to do with mainstem storage levels (other than surface area of water) and everything to do with the amount of water (runoff), coming into the system.
[3] Spring Rise may be prorated based on system storage or runoff.
[4] Flood control constraint is raised to a level equal to the Spring Rise (=), is raised to a level less than the Spring Rise (<), or is not raised at all.
[5] July or August.
[6] Increased storage improves water quality in reservoirs. Water quality in riverine stretches is maintained with sufficient flows.
[7] Ibid.
[8] Gamefish interests would prefer that a Spring Rise occur outside of the April 7 – May 31 spawning period.
[9] By May 21. The rise must be done early enough so that is does not compound the natural rise occurring during this period.

Table 1B, Socio-Economic Interests Regarding Certain Characteristics of a ***Second*** 2006 Spring Rise										
	DURATION	**TIMING**	**QUANTITY**	**MODES**	**RATE OF RISE**	**RATE OF FALL**	**PRE-RISE DISCHARGE**	**PRECLUDE** [10] [11] [12]	**PRORATE** [13]	**FLOOD CONTROL CONSTRAINT** [14]
USE	S/L Short/Long	E/L Early/Late	1/2/3 Sm/Med/Large	1/2 Single/Bi	1/2/3 Slow/Med/Fast	1/2/3 Slow/Med/Fast	1/2/3 11-18/18-25/25-35	1/2/3/4/5 ≤31/≤35/≤40/≤45/≤57	1/2/3/4 ≤31/≤35/≤40/≤45	=/</0 (0=no change)
FC	S	E	1	1	3	3	1	4	4	0
Hydro	S	L	1	1	3	3	1/2[15]	4	4	0
Therm	S	L[16]	1	1	3	3	1/2/3[17]	4	4	0
Nav	S	E	1	1	3	3	3[18]	5	5	0
W Supp	S	L	1	1	3	3	1/2[19]	4	4	NA
W Qual	S/L[20]	L	1/2/3[21]	1	3	3	1/2[22]	3	4	NA
Irr	S	E	1	1	3	3	1	3	4	NA
Rec	S	L[23]	1	1	3	3	1	3	4	NA
Ag	S	E[24]	1	1	3	3	1/2/3[25]	5	5	0
Riparian	S	E	1	1	3	1		3	3	0
Fish/Wild	S/L	Mimic natur	3 or mimic	2	2	1	1	1	1	=

[10] Spring Rise may be precluded based on system storage or runoff. Responses were made on the basis of a water consumptive spring rise. If the spring rise added water to storage in mainstem reservoirs through the flexibility afforded by a low (i.e. winter release level) pre-rise discharge, then a preclude would not be requested.

[11] If the annual spring rise in Oahe reservoir falls below 1578' feet MSL elevation on March 15, 2006 and/or if projections show at any time an MSL elevation for Oahe at or below 1567' we recommend a preclude to a 'spring rise' release. Maintaining these elevations is absolutely critical in maintaining an adequate water supply for at least 14,000 people living on or near the Cheyenne River Sioux Tribe Indian Reservation in central South Dakota.

[12] Preclude and proration are often intertwined with storage levels. Many of the concerns with fluctuations in storage levels and a spring rise are intimately tied with runoff in a given year. Concerns about fish production in reservoirs may be completely eliminated if runoff is sufficient to provide both a spring rise and rising elevations in mainstem reservoirs. Conversely, during a low runoff year, the harms to fish production will be exacerbated with the addition of a spring rise. This has very little to do with mainstem storage levels (other than surface area of water) and everything to do with the amount of water (runoff), coming into the system.

[13] Spring Rise may be prorated based on system storage or runoff.

[14] Flood control constraint is raised to a level equal to the Spring Rise (=), is raised to a level less than the Spring Rise (<), or is not raised at all.

[15] Releases should be sufficient to meet normal hydropower demands. Winter releases, a period of high power demand, are around generally about 11 kcfs. Pre-rise discharge would be at a time of lower power demand, April-May. Therefore a 1 is likely warranted. Moreover, by increasing storage, head is increased above the turbines and more water is available for release during the summer, another period of high hydropower demand.

[16] July or August.

[17] Low releases during April-May would not impact thermal power production. It may be a positive as more water would be available during the summer when greater quantities are needed for cooling. If the Spring Rise is later than April, a 2 would be more appropriate. If the second rise is later than May, a 3 may be more appropriate.

[18] See xxvi

[19] Releases should be sufficient to meet water supply needs. Water supply needs are met at winter release levels for riverine intakes. Early season (April/May) releases could be similar to winter releases and still meet riverine water intake/supply needs. Additionally, increased storage would benefit reservoir based water intakes. Therefore a 1 is likely warranted.

[20] Increased storage improves water quality in reservoirs. Water quality in riverine stretches is maintained with sufficient flows.

[21] Ibid.

[22] Ibid.

[23] Gamefish interests would prefer that a Spring Rise occur outside of the April 7 – May 31 spawning period.

[24] By May 21. The rise must be done early enough so that is does not compound the natural rise occurring during this period. *Dave Sieck will further clarify as necessary.*

[25] A lower pre-rise discharge would increase flood protection to flood plain agriculture.– Spring rise releases which decrease reservoir levels potentially decrease navigation days/service levels, or worse case scenario, precluding navigation (1" of service level = 17 tons/barge). The decreased flows would directly impact efficiency of the middle Mississippi River. (Note: Total economic impact to upper MS/IL River $2.3 billion/yr). If flow is reduced below navigation service levels in April, navigation would be severely crippled, since historically 40% of ag business is in April/early May. 1 barge = 58 trucks/increases to air pollution. Terminal access could be limited/lost by flooding during "rise." Declining reservoir levels would long-term negatively impact water available for navigation. Man-made flooding degrades navigation channel.

	Potential Impact	Measure	Monitoring Mechanism	Mitigation
Flood Control	FEMA Flood Insurance Program	Ruling from FEMA	National Weather Service/USACE	Policy Change / Pay no matter what
Flood Control	Internal Drainage	Pumping and/or Flood Insurance	Levee Board/USACE	Pay pumping costs and all crop loss
Flood Control	Bank Erosion above revetment	Rip-rap/rock is too low. It needs to be higher up the revetment	Levee Board/USACE	Replace revetment to project authorization
Flood Control	Levee overtop	Raise Levees	Levee Board/USACE	Policy change – pay for all floods including small floods. (or) Raise/Move levees (USACE pay)

	Potential Impact	Measure	Monitoring Mechanism	Mitigation
Hydropower	Flow regime changes from Gavins Point Dam required to support a Spring Rise may result in a shift in Mainstem hydropower generation from periods of peak electrical demand to off-peak periods. Such shifts could result in increased costs to the Western Area Power Administration (WAPA) to supply their firm commitments, thereby increasing the costs to their customers.	Additional costs ($) associated with hydropower capacity and energy marketed by WAPA.		
Hydropower	Flow regime changes from Gavins Point Dam required to support a SR will result in a shift in mainstem hydropower generation from seasonal periods of high demand to seasonal periods of low demand. Shifting generation to low demand periods has two impacts. Generation surpluses to Western's contractual commitments is sold at very low prices. To the extent that less water is available to meet contractual commitments, Western will have to purchase power at high prices and have no surplus power to sell at these high prices. Long term shifts in generation that results in Western increasing purchases and lost surplus sales could price Western's firm power out of the market and jeopardize repayment of the federal investment or force Western to reduce allocations and prompt construction of base load power plants (typically coal fired). Flows out of Gavin's Point of over 35,000 cfs requires spilling water resulting in no generation.		Generation amounts by month and compare to similar storage level at March 15th for current Master Manual. Quantity of power purchased and sold by month and compare to similar March 15 level storage for current Master Manual. Dollar amounts for purchased power and power sold, and compare to similar year for March 15 storage for current Master Manual. Track power prices, compare to normal (average?) year. Note any anomalies that might have affected prices. Footnote: The continuing drought could adversely impact the availability of supplemental or replacement power, perhaps causing a domino effect	Later peaks. Faster ramp up and downs to 35,000 cfs. Deem adverse impacts due to SR (not drought, not flood) non-reimbursable and be funded by Congressional appropriations

	Potential Impact	Measure	Monitoring Mechanism	Mitigation
Thermal				
Water quality effects of the Spring Rise alternatives on the river segments of the Missouri River	Flow regime changes from Gavins Point Dam associated with a Spring Rise, when combined with high summer air temperatures, may affect the ability of downstream water users to meet NPDES permits for thermal discharges. Depending upon the frequency of occurrence, power plants may need to reduce generation levels, or consider alternatives such as cooling ponds or cooling towers in order to maintain compliance with NPDES permits.[1]	1) Additional costs ($) associated with replacement capacity and energy. 2) Additional costs ($) associated with supplemental or alternative cooling systems.		States will enforce NPDES permit conditions for thermal discharges. Renewed NPDES permits may need to be changed due to the change in flow regimes from Gavins Point Dam. Including appropriate preclude or proration constraints for providing a Spring Rise could also help to mitigate potential impacts.
Navigation				

	Potential Impact	Measure	Monitoring Mechanism	Mitigation
Water Supply				
Water Supply effects of the Spring Rise alternatives on the river segments of the Missouri River	Flow regime changes from Gavins Point Dam associated with a Spring Rise could result in increased maintenance costs related to additional amounts of sedimentation and trash being deposited in the intake structures of water supply facilities downstream from Gavins Point dam.[1]	1) Additional costs ($) associated with cleaning silt and other debris from water supply intake structures. 2) Additional costs ($) associated with modifications to intake structures to reduce sedimentation and trash build up.		Modifications to water supply intake structures may help to reduce the build up of sedimentation and trash. Including appropriate preclude or proration constraints for providing a Spring Rise could also help to mitigate potential impacts.
Water Supply reservoirs	Loss of municipal water supply begins at the following elevations **Garrison** 1801.5 – Shutdown of Parshall **Oahe** 1564 – Shutdown Wakpala **Fort Peck ???**	Individual reservoir elevation vs. individual intake elevation	USACE database	Minimize reservoir declines, Extend intakes, alternative water supplies (expensive)

	Potential Impact	Measure	Monitoring Mechanism	Mitigation
Water Quality				
Water quality effects of the alternatives on the Missouri River mainstem lakes.	Severe fluctuations in lake elevations in Fort Peck Lake, Lake Sakakawea, and Lake Oahe may affect the size and quality of coldwater fish habitat. Coldwater Garrison 800,000 acre ft impacts 200,000 acre ft likelihood of fish kill increases.	Acre feet	State Agencies Hydroacoustic Survey	As part of the Missouri River adaptive management process, the Corps, Tribes, States, and EPA should evaluate the relationship between coldwater habitat and water quality to lake elevations based upon reliable water quality monitoring data.
Irrigation	Start losing irrigation intakes at system storage levels of ~43 MAF	Develop database on irrigation intakes	Check data	Extend / Relocate Intakes. Not always feasible

	Potential Impact	Measure	Monitoring Mechanism	Mitigation
Recreation	The CWCP does not allow for water levels to be maintained during the critical period for fish production (April-June) in mainstem reservoirs under certain runoff scenarios. Spring rise proposals which increase the loss of water from mainstem reservoirs would exacerbate the impacts to reservoir fish populations. With regard to the spring rise and fluctuating reservoir levels -the first peak should end prior to April 7 and the second peak should begin late as possible, i.e. late May, June or even July. The interphase release levels should be kept as low as possible	Under runoff scenarios which would cause reservoirs to fall during the period April – May, adopt a spring rise plan which adds water to reservoirs during the pre-rise phase and/or the interphase between rises	State fish & game agencies monitor fisheries in mainstem reservoirs.	Balance harms
Recreation	Loss of use & boat ramp access loss becomes an issue ~45 to 40 MAF	Maintain database	Check data	Extend / Relocate to the extent possible. Not possible in all instances.
Recreation	Oahe mid 90's $25 million/river Recent years $8-9 year. Similar losses to Lake Sakakawea and Fort Peck fishing industries	Under runoff scenarios which would cause reservoirs to fall during the period April – May, adopt a spring rise plan which adds water to reservoirs during the pre-rise phase and/or the interphase between rises	State agencies monitor usage	???

	Potential Impact	Measure	Monitoring Mechanism	Mitigation
Agriculture	Lost Land, lost real estate/value	1.4 million acres in the Missouri River flood plain	Historical land value/affected land vs. non-affected land	Taxpayers pay
Agriculture	Crop damage/loss of income	Dollars/acre	Farm Service Agency	$/acre x total lost acres
Agriculture	Shipping costs barge vs. rail	Shipping Rate difference - Basis in winter (no barge traffic) vs basis during navigation season	Check prices during the year. Pro Exporter, FAPRI	???
Agriculture	Loss of Market/ Disruption to barge service resulting in less places to sell grain	Water compelled rates	New or historic studies	???
Agriculture	Land Loss / erosion	Count acres	Farm Service Agency	Taxpayers pay
Agriculture	Crop Insurance	Lower average yield/base for crop insurance due to more frequent flooding	FSA	New type of insurance to cover man-made floods

	Potential Impact	**Measure**	**Monitoring Mechanism**	**Mitigation**
Riparian	Bank Degradation/loss of land	Value/acres x lost acres	USDA, real estate values	Taxpayers pay
	A. For riparian landowners on the Ponca, NE-Yankton, SD reach of the Missouri, the principal (and much dreaded) impact would be the inevitable increase in the already severe erosion. Land lost is never restored as usable land. Exacerbating the prospect of increased losses is the fact that the "spring-rise" proposal is <u>intended</u> to erode the river's shorelines. USACE <u>stated aim</u> of the "spring-rise" proposal is to put more nutrients in the water for fish. B. Bottom-degradation is lowering the river bed and also the water table. Cottonwood forests, e.g., are not replacing themselves; head-cutting on the tributaries increases, intake structures etc., have to be lowered and bridges are endangered.	A. Do not increase the flows B. Bank stabilization (would not defeat one aim of the "spring-rise." C. Compensation ($$$) for the riparian owners for land losses, etc.	Land records. USDA has aerial photos/maps via which the exact amount of the loss can be determined	COMPENSATION (see measures)

	Potential Impact	Measure	Monitoring Mechanism	Mitigation
Fish Wildlife / Ecosystem	**1st Order Social/Economic Impacts (Positives**			
Fish Wildlife / Ecosystem	• Increase in fisheries • Increase in waterfowl, raptors, birds • Increase in riparian fauna • Habitat for pollinators and biocontrol agents • Preservation of genetic diversity	• Population viability • Age structure • Reproductive success • Indicator species • Habitat index for quality • Biodiversity from baseline	State, tribal and federal agencies develop monitoring plans for various biotic and abiotic parameters	None needed---overall tremendous realization of cost savings in the long-term to numerous natural resources and other service flows
Fish Wildlife / Ecosystem	• Wildlife viewing opportunities and other recreational amenities	• State/local parks etc. visitor with satisfaction survey		None needed---overall tremendous realization of cost savings in the long-term to numerous natural resources and other service flows
Fish Wildlife / Ecosystem	• Overall cost-saving to the taxpayer less restoration efforts, T/E recovery efforts. • Reduced need for NRCS floodplain programs, wetland loss programs, and other mitigation requirements • Less $ for stocking restoration efforts	Data from state and federal agencies		None needed---overall tremendous realization of cost savings in the long-term to numerous natural resources and other service flows
Fish Wildlife / Ecosystem	• More habitat available in and adjacent to the floodplain • Improved contaminant sinks • Bio-transformation of excess nutrients	• Habitat surveys and/or indices • State/Federal agencies		None needed---overall tremendous realization of cost savings in the long-term to numerous natural resources and other service flows.

	Potential Impact	Measure	Monitoring Mechanism	Mitigation
Fish Wildlife / Ecosystem	• Production clean water (more sustainable, natural system). • Protection of recharge areas and watersheds • Detention of potential floodwaters • Reduction of erosion and sedimentation shoreline stability—Les $ for stabilization • Production of topsoil • Improved resilience to external perturbation, therefore less need to perform follow-up maintenance	• Water Quality – turbidity, metals • Physical chemical parameters • Floodplain assessment in structure and function from over-time (improvement)		None needed---overall tremendous realization of cost savings in the long-term to numerous natural resources and other service flows
	2nd Order Social/Economic Impacts: (Positives)			
Fish Wildlife / Ecosystem	• Increased tourism • Increased $ from Recreational goods/services • More $ to communities • More opportunities to capture medicinal benefits of plant/animal populations • Less cost to taxpayer for restoration, maintenance, programs • Increased fish & game based recreation • Natural groundwater recharge	Sandbars used by hunters Fishing licenses (in-state/out-of-state) Chamber of Commerce data See NAP report 2002	Need an economic model or economist	

Pallid Sturgeon Fish & Wildlife Proposal 1

Draft of July 22, 2005

Title of Option: PS/FWG 50/50 Proposal 1

1. Description of the Proposal:

a. **Number of Rises**: 2

b. **Flood Control Targets/constraints**: Must be adjustable. Constraints should be reaised as necessary to prevent them from stopping the rise.

c. **Timing, duration, magnitude, rise and fall rates of First Rise**: This bi-modal spring rise is represented by the 50%tile of the 100 years of discharge record at Gavins Point Dam. Proposed TOTAL magnitude for the first rise is ~64 Kcfs.. Timing needs to occur before initiation of spawning window (e.g.16 degrees) and should occur on the rising limb of the thermograph. Beginning date should be about March 14 (Julian day 74), peaking (2 days) on March 30 (Julian day 90), with a rise of 16 days. The descending limb would fall over 20 days for a total duration for first pulse of 38 days. For the first pulse, magnitude is more important than duration. First pulse will condition spawning habitat.

Start of rise	March 14 (Julian date 74)
Peak of rise	March 30 (Julian date 90)
End date	April 21 (Julian date 111)
Relative rising peak (Kcfs)	40.7 (~63.5Kcfs total peak)
Total pulse duration	38 days

d. **Timing, duration, magnitude of Flow Between Rises**: Dependent on model output and the specifications of **c**. above and **e.** below.

Timing/duration between pulses	April 22 – May 27 (Julian dates 112-148)
Magnitude of flow	~23 Kcfs stable with slight increase

e. **Timing, duration, magnitude, rise and fall rates of Second Rise**: The second rise should start when water temperature (at Sioux City) reaches ~16 ° C (for second time on ascending limb of thermograph). Rise should start on May 27, rise for 19 days to the peak and then descend for 26 days. Duration of the second pulse is important for physical and biological reasons (i.e., habitat creation, egg hatch…)

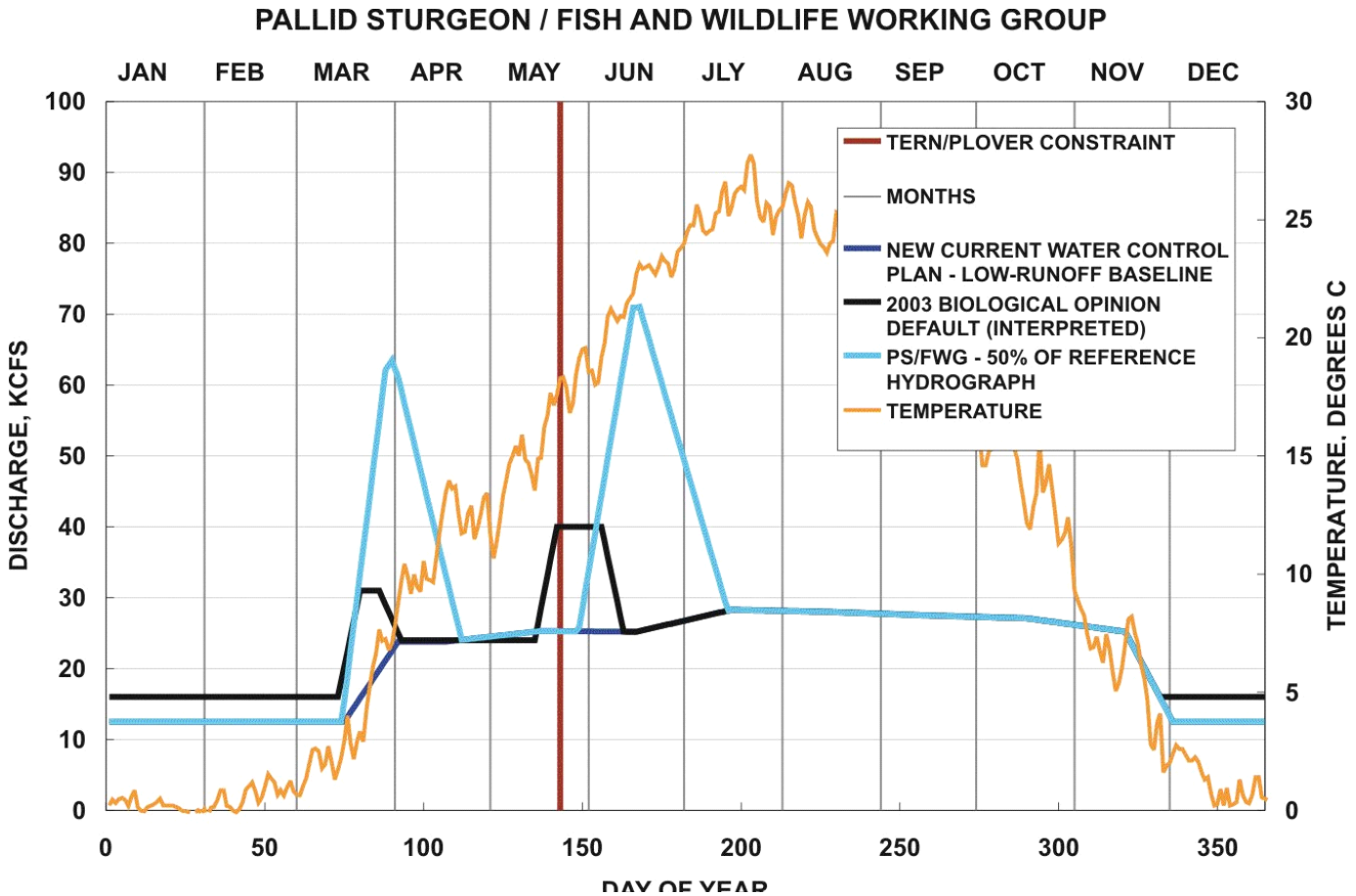
Start of rise	May 27 (Julian date 148)
Peak of rise	June 16 (Julian date 168)
End date	July 13 (Julian date 195)
Relative rising peak (Kcfs)	45.8 Kcfs (~71 Kcfs total peak)
Total pulse duration	47 days

f. How does this address water availability? Variation for wet, normal or dry years (including Stop Protocols or precludes): This proposal uses the 50th percentile of the long term flow record. This proposal uses a peak pulse to address the physical component of the natural hydrograph. This proposal would require that this occur under wetter scenarios than currently exist.

f. **Volume of water used**: This proposal will utilize 3.86 MAF more than the current water control plan.

g. **Level of and purposes for flexibility in its annual application (What is the intended flexibility given to USACE in its application of this proposal?)**: Flexibility exists within magnitude, timing and duration on both rises. Actual amount of water needed for habitat forming flows is uncertain and some flexibility is warranted. As experiment matures and water availability changes different flow scenarios are expected. The specifics of this flexibility will be influenced by what we learn with each new run and the changes that occur within the basin over time.

2. **Hydrograph chart (with sideboards visually noted)**: This proposal is indicated by the dark blue line: PS/FWG - 50% of Reference



3. **Rationale for proposal**:

Biological – The rationale for this proposal is based on the natural hydrograph and our current understanding of *Scaphirhynchus* sturgeon (shovelnose and pallid sturgeons) biology. Timing of the two peaks is based on best available evidence of *Scaphirhynchus* reproductive biology.

The rises in the natural hydrograph are responsible for forming and maintaining spawning habitats. They also historically inundated the floodplain which contributed organic material back to the river. The annual spring rises provided ecological cues for fish spawning and generally maintained the dynamic character of the Missouri River ecosystem. Based on the National Research Council 2000 report and the U.S. Fish and Wildlife Service Biological Opinion, some semblance of these functions needs to be restored to promote recovery of the pallid sturgeon. With that said, there are additional biological benefits spring rises provide. Our spring rise should seek to address/accomplish both the physical and biological functions. Based on current water year constraints, addressing the physical aspects of the rise are not possible this year, but it is what is felt is needed for the species and habitat. Species have adapted to the natural hydrograph and receive biological cues from those flows. These smaller pulses are designed to facilitate reproductive success of the pallid sturgeon. The 1st peak is timed to provide a stimulus for migration and condition spawning habitats (clean spawning substrate). If the 1st peak is high enough and long enough it should stimulate adult sturgeon to begin to migrate and stage (i.e., congregate in spawning aggregations). As we progress towards the second peak, based on flow stimulus and increasing temperature the fish are physiologically and behaviorally getting ready to spawn. The second peak is designed to generate habitat benefits and to coincide with a temperature window conducive to spawning (~18 °C). After the peak, the descending limb will take advantage of the greatest flexibility within the temperature window, providing what we think are beneficial spawning environments. The slowly declining limb promotes spawning, facilitates egg incubation, and dispersal of newly hatched larval sturgeon. There are other community benefits that this flow pattern will facilitate that will provide forage base and general diversity that will be beneficial to the sturgeon.

4. Anticipated effects

a. **Proposal's anticipated effects on, or benefits to, Pallid Sturgeon (how does it assist in flow, timing, temperature, photoperiod, compare with historic hydrograph, comparison with historic flow percentiles, etc):** Our proposal is based on the timing, magnitude, duration, and rate of change of the historical hydrograph within the area of concern, ambient photoperiod, and river temperatures. These factors are universally accepted as critical to reproductive development and successful spawning of riverine fishes, including sturgeons. As we are lacking specific, detailed biological information on exactly what factors affect successful *Scaphirhynchus* spawning this is the most rational approach and

is supported by the scientific literature. The natural hydrograph justifies two rises: the 1st rise is expected to inundate and condition spawning substrate and provide migration cues; the second rise is expected to also inundate and condition spawning substrate, elicit a spawning cue, provide for egg incubation, hatch and larval dispersal. The timing of the proposed second rise is based on our knowledge/understanding of pallid and shovelnose sturgeon reproductive biology in the lower Missouri River and elsewhere. Expected benefits to pallid sturgeon may include: *1st rise* – (1) movement of reproductively mature adults on the first pulse; (2) cleaning of potential spawning substrates; *interval between rises* – (3) movement, staging, and spawning of adults; (4) successful deposition of eggs; (4) incubation of eggs to hatch: *2nd rise* - (5) further cleaning of spawning substrates; (6) movement, staging, and spawning of adults; (7) successful deposition of eggs; (8) incubation of eggs to hatch, and (9) dispersal of newly hatched larvae.

b. **Proposal's anticipated effects on, or benefits to, socio-economic factors (how does this Proposal appear to affect water used in the basin, how to flows attenuate, effect on reservoir levels, navigation impacts, what modeling helps understand the effects)**:

This proposal would have some affects. Modeling is required to clearly identify those impacts.

c. Proposal's anticipated effects on, or benefits to, historic, cultural and burial sites (how does this Proposal appear to affect historic, cultural and burial sites in the basin, what modeling helps understand the effects):

5. Brief description of monitoring methods and indicators:

a. What are the key indicators to be monitored?

Documenting each of the nine expected benefits outlined under 4.a. will be required to evaluate if the proposed spring rise contributes to their reproductive success of shovelnose and pallid sturgeon throughout the lower Missouri River. Ongoing programs that will contribute to this include:

Movement of tagged pallid sturgeon, spawning, congregations of fishes; response of sexually mature shovelnose, are being monitored through the USGS telemetry study. Supporting physiological data are also being collected within this effort. Population monitoring is currently underway throughout the entire reach below Gavins Point Dam and will provide monitoring support for adult and juvenile fish. This effort provides trend information for the population over time. There is also fish and habitat monitoring underway which will provide data on what habitats are used by fishes.

Additional research and evaluation will be required and will be designed as outlined in the next section.

b. **Pending creation of MRRIC, what interim processes should be used to monitor this proposal?** Following this process a group of technical experts should be convened (coordinated by the Corps) to determine the specific monitoring and research objectives that need to be developed, and expanded into study plans. The group should determine the technical skills required to accomplish objectives and acquire the resources necessary to carry out these actions. This needs to be done within the time frame necessary to evaluate the spring rises and provide information back into the process. The success of the spring rise process is dependent on synthesis of the information collected and using that information in an adaptive management frame work to modify this proposal.

   The PS/FWG is currently ranking hypotheses related to evaluating the spring rise and the Middle Basin Working Group has finished the ranking process for recovery of the pallid. The efforts within the Spring Rise need to be closely coordinated with the on going activities within the basin to ensure comprehensive, coordinated management of our actions and the species.

c. **Take the hypothesis developed by this group and provide them to the Middle Basin Pallid Sturgeon Work Group for consideration (e.g., review and comment)**
d. **Develop a priority of these hypothesis**
e. Evaluate the number that are or could be tested under current programs
f. Make recommendations on additional research and funding of the top priorities

Pallid Sturgeon Fish & Wildlife Proposals

Draft of July 22, 2005

Title of Option: PS/FWG Proposal 2

1. Description of the Proposal:

a. **Number of Rises**: 2

b. **Flood Control Targets/constraints**: Yes, they must be adjustable. Raise them as much as is necessary to deter them from stopping the rise in most years.

c. **Timing, duration, magnitude, rise and fall rates of First Rise**: This bi-modal spring rise is represented by the 25%tile of the 100 years of discharge record at Gavins Point Dam . Proposed TOTAL magnitude of the first rise is ~41 Kcfs. Timing of this first pulse needs to occur *before* initiation of spawning window (e.g., ~16 ° C) and on the rising limb of the thermograph.

Start date	March 20 (Julian day 80)
Peak date	March 28 (Julian date 88)
End date	April 9 (Julian date 100)
Relative rising peak, Kcfs	18.0 (~40.5 Kcfs total peak)
Total pulse duration	20 days

For the first pulse, magnitude is more important than duration to condition spawning areas. The ascending limb should occur over 8 days and descending limb should occur over 12 days.

d. **Timing, duration, magnitude of Flow Between Rises**: Dependent on model output and the specifications of **c**. above and **e.** below. General description would be similar to the following:

Timing/duration between pulses	April 10 – May 14 (Julian dates 101-135)
Magnitude of flow	~23 Kcfs, stable to slightly rising

e. **Timing, duration, magnitude, rise and fall rates of Second Rise**: The second rise should start when water temperature (at Sioux City) reaches ~16 ° C (for second time on ascending limb of thermograph). Ramp up for 11 days with a two day peak. The descending limb will ramp out to end when river temperature reaches ~24 ° C for the second time. Proposed magnitude of this scenario is ~50Kcfs. Duration with the second pulse is important for biological reasons (i.e., egg hatch, see biological rationale)

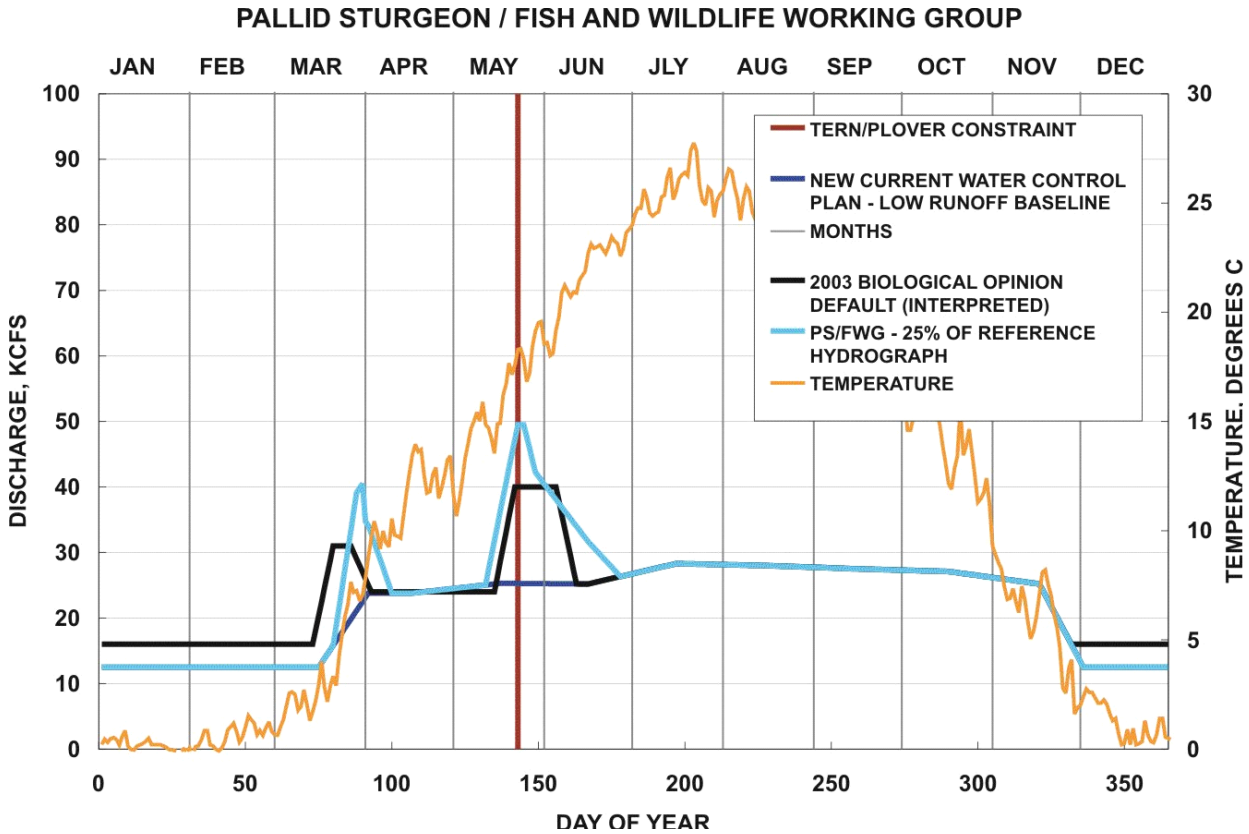
Start date	May 11 (Julian date 132)
Peak date	May 22 (Julian date 143)
End date	June 27 (Julian date 179**)**
Relative rising peak, Kcfs	24.2 (~49.5 Kcfs total peak)
Total pulse duration	47 days

How does this address water availability? Variation for wet, normal or dry years (including Stop Protocols or precludes): This proposal uses the 25 percentile of the long term flow record, an appropriate percentile based on water availability and species needs. This proposal uses a peak pulse rather than a plateau flow, and includes water conservation measures at most points.

f. **Volume of water used**: 1.286 MAF above the current water control plan..

Level of and purposes for flexibility in its annual application (What is the intended flexibility given to USACE in its application of this proposal?): The 25th percentile option provides a considerable reduction in water releases over the preferred 50 percentile option

2. **Hydrograph chart (with sideboards visually noted)**: This proposal is indicated by the green line: PS/FWG - 25% of Reference



3. **Rationale for proposal**:

Biological – The rationale for this proposal is based on the natural hydrograph and our current understanding of *Scaphirhynchus* sturgeon (shovelnose and pallid sturgeons) biology. Timing of the two peaks is based on best available evidence of *Scaphirhynchus* reproductive biology.

The rises in the natural hydrograph are responsible for forming and maintaining spawning habitats. They also historically inundated the floodplain which contributed organic material back to the river. The annual spring rises provided ecological cues for fish spawning and generally maintained the dynamic character of the Missouri River ecosystem. Based on the National Research Council's 2000 report and the U.S. Fish and Wildlife Service's Biological Opinion, some semblance of these functions needs to be restored to promote recovery of the pallid sturgeon. With that said, there are additional biological benefits spring rises provide. This proposed spring rise seeks to address/accomplish both physical and biological functions. Based on current water year constraints, addressing the physical aspects of the rise is not possible this year, but it is possible to address the biological components of the rise. Species have adapted to the natural hydrograph and receive biological cues from those flows. These smaller pulses are designed to facilitate reproductive success of the pallid sturgeon. The 1st peak is timed to provide a stimulus for migration and condition spawning habitats (i.e., clean spawning substrate). If the 1st peak is high enough and long enough it should stimulate adult sturgeon to begin to migrate and stage (i.e., congregate in spawning aggregations). As we progress towards the second peak, based on flow stimulus and increasing temperature the fish are physiologically and behaviorally getting ready to spawn. The second peak is designed to coincide with a temperature window conducive to spawning (~18 °C). After the peak, the descending limb will take advantage of the greatest flexibility within the temperature window, providing what we think are beneficial spawning environments. The slowly declining limb promotes spawning, facilitates egg incubation, and dispersal of newly hatched larval sturgeon. There are other community benefits that this flow pattern will facilitate that will provide forage base and general diversity that will be beneficial to the sturgeon.

4. Anticipated effects

a. **Proposal's anticipated effects on, or benefits to, Pallid Sturgeon (how does it assist in flow, timing, temperature, photoperiod, compare with historic hydrograph, comparison with historic flow percentiles, etc):** Our proposal is based on the timing, magnitude, duration, and rate of change of the historical hydrograph within the area of concern, ambient photoperiod, and river temperatures. These factors are universally accepted as critical to reproductive development and successful spawning of riverine fishes, including sturgeons. As we are lacking specific, detailed biological information on exactly what factors affect successful *Scaphirhynchus* spawning this is the most rational approach and is supported by the scientific literature. The natural hydrograph justifies two rises: the 1st rise is expected to inundate and condition spawning substrate and provide migration cues; the second rise is expected to also inundate and

condition spawning substrate, elicit a spawning cue, provide for egg incubation, hatch and larval dispersal. The timing of the proposed second rise is based on our knowledge/understanding of pallid and shovelnose sturgeon reproductive biology in the lower Missouri River and elsewhere. Expected benefits to pallid sturgeon may include: *1st rise* – (1) movement of reproductively mature adults on the first pulse; (2) cleaning of potential spawning substrates; *interval between rises* – (3) movement, staging, and spawning of adults; (4) successful deposition of eggs; (4) incubation of eggs to hatch: *2nd rise* - (5) further cleaning of spawning substrates; (6) movement, staging, and spawning of adults; (7) successful deposition of eggs; (8) incubation of eggs to hatch, and (9) dispersal of newly hatched larvae.

b. **Proposal's anticipated effects on, or benefits to, socio-economic factors (how does this Proposal appear to affect water used in the basin, how to flows attenuate, effect on reservoir levels, navigation impacts, what modeling helps understand the effects)**:

There will be impacts to various entities based on this scenario. In crafting this proposal we considered navigation, interior drainage and terns and plovers, and reservoir storage and worked to minimize those impacts as much as possible.

c. **Proposal's anticipated effects on, or benefits to, historic, cultural and burial sites (how does this Proposal appear to affect historic, cultural and burial sites in the basin, what modeling helps understand the effects):**

5. Brief description of monitoring methods and indicators:

a. What are the key indicators to be monitored?

Documenting each of the nine expected benefits outlined under 4.a. will be required to evaluate if the proposed spring rise contributes to their reproductive success of shovelnose and pallid sturgeon throughout the lower Missouri River. Ongoing programs that will contribute to this include:

Movement of tagged pallid sturgeon, spawning, congregations of fishes; response of sexually mature shovelnose, are being monitored through the USGS telemetry study. Supporting physiological data are also being collected within this effort. Population monitoring is currently underway throughout the entire reach below Gavins Point Dam and will provide monitoring support for adult and juvenile fish. This effort provides trend information for the population over time. There is also fish and habitat monitoring underway which will provide data on what habitats are used by fishes.

Additional research and evaluation will be required and will be designed as outlined in the next section.

b. **Pending creation of MRRIC, what interim processes should be used to monitor this proposal?** Following this process a group of technical experts should be convened (coordinated by the Corps) to determine the specific monitoring and research objectives that need to be developed, and expanded into study plans. The group should determine the technical skills required to accomplish objectives and acquire the resources necessary to carry out these actions. This needs to be done within the time frame necessary to evaluate the spring rises and provide information back into the process. The success of the spring rise process is dependent upon synthesis of the information collected and using that information in an adaptive management frame work to modify this proposal.

The PS/FWG is currently ranking hypotheses related to evaluating the spring rise and the Middle Basin Working Group has finished the ranking process for recovery of the pallid. The efforts within the Spring Rise need to be closely coordinated with the on going activities within the basin to ensure comprehensive, coordinated management of our actions and the species. Our approach will entail:

Take the hypotheses developed by this group and provide them to the Middle Basin Pallid Sturgeon Work Group for consideration (e.g., review and comment)

Prioritize revised hypotheses

Evaluate those hypotheses that are or could be tested under current programs

Make recommendations on additional research and funding of the top priorities